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U P L A N D L A N D U S E

A DESK STUDY

INTERIM REPORT ON CUMBRIA SECTION

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CONTENTS

UPLAND LAND USE AT A REGIONAL LEVEL

The previous chapters have described uplands and their use in general terms and at a National level, but land use planning occurs mainly at Regional and Local levels, and landscape is perceived in the range of 1-10 km, occasionally 50 km. Therefore we require techniques to survey, characterise and plan on a unit of about 1 km^2. Many regional studies describe plans for development and there are a multitude of local studies of farms, valleys or parishes. We have not attempted to digest and compare these but have concentrated on an examination of the potential of a multivariate method of land classification (Bunce, Morrell and Stel, 1975) based on readily available information from maps. The land classes derived from map attributes show major environmental divisions within an area which can then be used to stratify subsampling for particular features which are required, e.g. vegetation or current land use.

The map attributes used do not include information on soils and it was therefore questioned whether or not the resulting classes could be used as a basis for agricultural or forestry land capability assessment. There are few soil maps for the uplands and it was decided to examine the application of the approach in two areas: 1. Cumbria where soil data were few; 2. Snowdonia where, for a particular area, soil as well as vegetation and other map details were available, thus allowing a comparison of the classes derived from map attributes with detailed ground survey obtained by more traditional methods.

The classification in Cumbria is used as a basis for examining a number of land use and landscape features, to compare areas, and to indicate areas where change in land use might be expected. The study is exploratory and not definitive, many further questions may be asked of the information.

<u>The multivariate classification is being used by Cumbria County Council as a basis for part of their Structure Plan. The results of the study, carried out in conjunction with ITE, must be treated in STRICT CONFIDENCE until the publication of the Structure Plan.</u>

1. LAND CLASSIFICATION

Introduction

One of the earliest activities of ecologists was to observe and map the distribution of species and aggregates of species usually termed "vegetation types". Indeed many early papers, such as those by the Smith brothers, are concerned solely with the description of regions and their associated vegetation.

Until recently the principles of direct observation and interpretation in the field laid down by those early ecologists have basically remained unaltered, although superficially more sophisticated. Modern adherents of the continental phytosociological schools likewise lay great stress upon the ability of the observer in the field to simplify the observed complexity. Data collection is only carried out within the strata subjectively defined in the field, i.e. interpretation first; data collection second. Parallel lines of developments have been followed in many other disciplines involved in the reduction of the complexity of biological systems in the field - e.g. in soil surveys, agricultural surveys and forest inventories.

These activities produce readily interpretable results since the initial field observations are directly related to visual patterns. In most scientific disciplines however, it is usual to first collect data without a subjective sampling structure and then proceed with analyses and interpretation as a second phase activity i.e. data collection first; interpretation second. It is only recently with the development of suitable analytical procedures and computers, that the large data sets generated by broad ecological surveys can be analysed using a similar method.

The conflict between numerical and traditional methods is unnecessary because in many cases they have different objectives. In particular, pure vegetation survey sets out to define vegetation units and cannot be used for resource evaluation as defined by the present project. In some respects the approach advocated is complementary to traditional phytosociology but it is certainly not in rivalry.

The issue has been further confused by difficulties in communication between some of the advocates of numerical approaches and those primarily interested in their application. Also initially numerical studies took longer than the traditional approach, although now the programmes and data handling facilities are more readily available, this is no longer the case.

Certain specific areas of environmental surveys have proved intractable by traditional methods - in particular that problem of a land classification. Here there are no readily observed associations between a dependent and independent group of variables, as between plants and soil; and moreover there are no readily discernible units on the ground. Rather there is a complex underlying series of factors resulting in an overall expression of their interactions without a simple mode of definition. As a result, whilst gross features, such as glacial valleys, may be interpreted it has rarely been possible to classify whole landscapes by a generally accepted system.

It was during the application of multivariate methods to such data that the present study evolved. The basic principle is that the underlying features of land are reflected in observable characteristics recordable from maps. Analyses of these data can then provide a structure on which to base ground surveys of particular biological aspects, such as vegetation or land use. Because the overall relationships within the study area are known, a limited representative sample may be taken which can then be referred to the whole population. In this way a small sample can be used for intensive surveys which may then be used to predict what will be present elsewhere.

Previous surveys

Three surveys have been carried out based on the analysis of data derived from maps and involving similar principles to the Cumbria project. The approaches adopted are summarised below.

Grizedale Forest: 12 variables were recorded from 0.5 x 0.5 km grid squares. Analysis of the data by principal component and cluster analyses produced eight types that were shown to be highly correlated with field data. However the variables were restricted and henoe the second study was undertaken to expand the range covered.

Lake District: 152 attributes were recorded from 2,842, 1 km squares in the Lake District. The classification, obtained by indicator species analysis, was again shown to be highly correlated with field data. It was, therefore, concluded that map data can be used to provide a stratification for field sampling and to provide a useful basis for land classification.

Shetland Survey: as a consequence of the satisfactory results from the Lake District survey, when it came to producing a vegetation survey of Shetland, it was decided to use a similar system - the important principle being that a method of stratification was required that would enable detailed samples to be drawn from a defined population. Map attributes were therefore, used to classify 1 km squares and the classification used to stratify the subsequent intensively sampled squares. In the Shetland survey features associated with human use, such as roads and human habitations were omitted, in order to simplify the classification. Instead, more variables were included, although for analytical purposes these were divided into categories. The classification appeared to be overweighted towards attributes related to the sea, but later the predictions of vegetation composition from the map types proved to be acceptably accurate and corresponded well to an independent assessment from aerial photographs. The main conclusion from the Shetland study was that the approach had been successful, and that, on a larger scale with wider contrasts and a more balanced data set, a clear cut picture would emerge.

The Cumbria Survey

Methods

The approach eventually adopted was selected after a consideration of the following alternatives:-

1. Aerial photography. A uniform cover was not available for the whole area at a suitable scale.
2. Altitude. The original Lake District study showed the importance of altitude, but it was considered that altitude alone did not incorporate a sufficiently wide range of correlations for an entire regional study - a conclusion since supported in the analytical separation of the Pennines and Central Lakes, despite similar altitudinal ranges.
3. Natural divisions. Another possibility was to divide the county into regions which appear subjectively to have common features, but such an approach would result in non-standardized units.

4. In the Cumbria survey a 1km grid square was adopted as these provided a convenient and useful scale at which to examine units of land. The advantages and disadvantages of this system are summarised below:-

Advantages	Disadvantages
Good scale for ground sampling and for mapping on a county basis.	Square boundaries may give artificial combinations of attributes.
Previous experience suggested that the scale was suitable.	Complete cover not possible at primary analysis stage.
Detailed surveys of units such as valleys possible.	
A reference system is provided that fits into a national grid.	

5. The 1 km squares should be considered as abstracts in the same way that quadrats are used in vegetation surveys and are not necessarily recognisable finite units in themselves.

6. Since all squares could not be recorded the analysis was based on the centre square of groups of nine squares, giving an approximately 11 per cent sample. The data recorded from these squares were 152 attributes described by Bunce (1975) and also 30 geological series records taken from the $\frac{1}{4}$" geological map. These data were analysed by indicator species analysis to give 16 types.

7. Indicator species analysis (Hill et al 1975) is a divisive, polythetic numerical procedure that incorporates a key that enables new data to be assigned to the classificatory framework. First, a one dimensional reciprocal averaging ordination is computed. The samples are then divided into two groups according to whether they fall on one side or other of the centre of gravity of the ordination. Five indicator attributes are then identified which discriminate as well as possible between the two groups of samples. The balance between the indicator attributes provides a key for the identification of further samples. In the present case the residual 89% of squares were assigned to their appropriate positions in the classification by the use of the key given in the hierarchy of Fig. 1.

Results.

The classification of the map data may be interpreted in two main ways:

a) Direct interpretation of the indicator attributes in ecological terms.

b) An examination of features, both environmental and other habitat attributes, common to the classes of squares.

The second approach is considered at the end of the section but one brief comment on the first, will be useful at this stage to set the scene.

The first division is related directly to features relating primarily to lowland as opposed to upland, with attributes relating to habitation and human development on the one hand, as opposed to altitudinal features on the other. Within the lowland division, the next separation is between higher land on the margins of the fells as opposed to features relating to the coastal plain. The upland division is separated into the intermediate fells as opposed to the high fells of the central Lakes and Pennines. At the third level final divisions are made between these major groups with, for example, the coastal squares (type 7 and 8) being separated and the central Lakes fells (types 15 and 16) from the Pennines (types 13 and 14).

The distribution of the types of square in Cumbria is shown in Figs. 2, 3 and in the figures they have been grouped together to emphasize the major divisions. The patterns of distribution are readily interpretable and Cumbric CC and LDPB (1976) have regrouped these map types into seven landscape zones (Fig. 4). The frequency of the 16 types in Cumbria is given in Table 1.

The classification is a basic framework on which a range of environmental ecological parameters can be sampled. Evidence from experience with the classification suggests that it is strongly related to underlying patterns in land forms and show quite subtle differentiation between different types of land. Some types are more heterogeneous than others in terms of the degree of contrast present but this feature is not a drawback in that some landscape types are inherently more variable than others. Because of the interpretation of basic information the classification types have many common features relating to agriculture, land use and visual appearance, which provide the basis for the sub-sampling mentioned above. A range of such sampling is included in this report.

Within the Cumbria project the emphasis to date has been largely upon the vegetation but it is important to stress that the species are being used primarily as an index to the environment and as a statement of the current potential of the land.

The system is capable of further development for monitoring and studies are at present taking place in this direction. To summarise, the main objective of the analysis of the map data is to provide a sound framework on a general scale for sampling on an intensive scale, that could not otherwise be carried out on a County scale without years of work.

Ground Survey

Initially it had been intended to survey 5, 1 km squares drawn at random from each of the 16 types, using a similar field technique to that used in Shetland. However sufficient resources were only available to complete 16 sample plots in each of 2, 1 km squares (i.e. 512 plots). 16 sample plots were used initially, as in the Shetland study and the squares were found to be very heterogeneous and hence it seemed more efficient to opt for intense coverage of single km squares. However, during the field work the majority of squares appeared to be more homogeneous than those in Shetland, due perhaps in part to less complex drainage patterns and in part to more uniform geology.

Accordingly a third series of squares was surveyed with 8 sample plots in each. A further examination of the Shetland data indicated that, although individual plot types continued to be picked up over the 16 plots, the majority were already recorded within an 8 plot sample.

During the survey of the third series of squares it was noted that, particularly in lowland areas, much of the variation was in linear features i.e. hedges, ditches, streams and roadsides. In due course therefore a fourth series of squares will be surveyed including recordings from linear features, and a start has been made to test this modified system.

Eventually the distribution of vegetation types can be predicted on a county basis, but to date only species cover has been carried out. These were obtained by calculating the mean cover for the species observed at the sample plots for each map type. The average values may then be used to estimate the probability of finding that cover of the particular species within a given map type. Two examples of predicted distribution are given in Figs. 5 and 6. Fig. 7 shows the average cover of several species in the map types.

In the summaries of the ecological features of the map types given below the majority of the categories are from summaries of the basic map data - only the species cover and pH are from field measurements. The objective of the summaries is to give an overall impression of the principal features of the map types. Further results will be available in further analysis of the survey data and in Landscape features later in this report.

EXPLANATION OF SUMMARY SHEETS

Cumbria Survey

Map type ( )

the brackets refer to the number of squares coming in that type in the original analysis 14-29 = low, 30-54 = medium, 55-89 = high (See table for relationship to % frequency in Cumbria)

Number of Attributes:

the number of original attributes recorded in the type: gives some measure of the range of variation present (34-55 = low, 56-76 = medium, 77-97 = high)

Constant Attributes:

attributes that occur in the types more than the appropriate percentages.

Selective Attributes:

the observed frequency of an attribute within a type is compared with the expected frequency (i.e. the frequency calculated on the basis that species are randomly distributed between types). Chi square is used to test the departure from expectation. Attributes are ranked in order of selectivity in two groups of chi square greater than 30 and 10-30. The figures in brackets are the observed and expected percentage frequencies, with attributes occurring less than 30% excluded.

Species Cover:

the average cover of species from the recorded field samples. Species ranked in two groups, over 5% and 1-8% scores below 1% were not rounded up to 1%.

pH:

the frequency, in classes, of the soils sampled in the plots recorded in the type.

Distribution:

the majority distributional patterns.

Comments:

all these comments are interpreted and not based upon numerical scores of frequencies, as they will be in due course when the field observations are summarised. The objective of this section was therefore to give a pen picture for temporary use until the complete summaries are available.

Cumbria Survey

Map type one (77, high)

No. of Attributes:

Constant Attributes:

80%	60-80%
Grey house	Aspect (w)
White road	Stream
Yellow road	250-499
Footpath	Aspect (w)
	Black house

Selective Attributes:

chi sq 30	chi sq 10-30
250-499' (69-20)	'A' road (36, 13)
0-249' (58, 20)	Copse (56, 29)
Grey house (91, 50)	Footpath (82, 58)
Yellow road (83, 46)	Black house (64, 43)
White road (86, 51)	

Species Cover:

over 5%	1-5%
Loliu peren (19)	Agros tenui (4)
Pteri aquil (8)	Cynos crist (2)
Poa trivi (5)	Holcu lanat (1)
	Festu ovine (1)
	Phleu prate (1)

pH:

3.1-3.5	3.6-4.0	4.1-4.5	4.6-5.0	5.1-5.5	5.6-6.0	6.1-6.5	6.6-7.0	7.1
6	4	4	12	8	12		1	

Distribution:

Solway Plain, Southern Lowlands, Coastal Plain

Comments:

Land form: gentle slopes, with a variety of detailed pattern reflecting a range of underlying geological formations.
Land use: varied, mainly cattle, with some sheep and cereals, good communications with even population density.
Vegetation: variable, with much improved pasture and permanent grass and with a varying amount of semi-natural cover.

Cumbria Survey

Map type two (89, high)

No. of Attributes:

94 (high)

Constant Attributes:

80%	60-80%
Grey house	Footpath
Yellow road	Aspect (N)
250-499'	Aspect (W)
White road	Black house
	Aspect (N)
	Aspect (E)

Selective Attributes:

chi sq 30	chi sq 10-30
250-499' (87, 16)	Sandstone (30, 15)
Penrith sandstone (40, 3)	Footpath (79, 58)
Yellow road (87, 45)	Copse (48, 30)
Grey house (88, 49)	
River (43, 17)	
White road (82, 51)	
Black house (72, 42)	

Species Cover:

over 5%	1-5%
Loliu peren (36)	Phleu prate (5)
Cereals (8)	Holou lanat (4)
Trifo repen (7)	Agros tenui (3)

pH:

3.1-3.5	3.6-4.0	4.1-4.5	4.6-5.0	5.1-5.5	5.6-6.0	6.1-6.5	6.6-7.0	7.1
	3	1	4	9	8	6	1	

Distribution:

Eden Valley and Solway Plain

Comments:

Land form: mainly level with low relief, with limited variation.
Land use: mainly beef and dairy cattle, with some arable and small areas of woodland. Uniformally settled with good communications.
Vegetation: uniform mainly, leys with a small amount of permanent grass, and diversity coming from hedgerows copses and riversides, mainly hedges but some walls. Little semi-natural vegetation.

Cumbria Survey

Map type three (86, high)

No. of Attributes:

96 (high)

Constant Attributes:

80%	60-80%	
white road	Yellow road	Aspect (E)
	Limestones	750-999'
	Footpath	Aspect (S)
	Grey house	Aspect (N)
	Black house	
	Unfenced road	

Selective Attributes:

chi sq 30	chi sq 10-30
Limestone (78, 24)	Yellow road (78, 46)
750-999' (65, 20)	500-749 (51, 24)
White road (85, 51)	Unfenced road (69, 40)
Black house (76, 42)	Grey house (77, 51)

Species Cover:

over 5%	1-5%
Loliu peren (19)	Agros tenui (4)
Poa trivi (7)	Holcu lanat (4)
Cynos crist (6)	Phleu orate (3)
Juncu effus (5)	Trifo repens (2)
	Cereals (2)

pH:

3.1-3.5	3.6-4.0	4.1-4.5	4.6-5.0	5.1-5.5	5.6-6.0	6.1-6.5	6.6-7.0	7.1
		1	5	24	7	10	2	

Distribution:

Eden Valley

Comments:

Land form: mainly level, with low relief and little variation.
Land use: less arable and more permanent grassland than type 2, more sheep as opposed to cattle. Uniformally settled with good communications.
Vegetation: uniform, often old grasslands, with diversity coming from hedgerows and road verges. More walls present than type 2. Little semi-natural vegetation.

Cumbria Survey

Map type four (83, high)

Number of Attributes:

97 (high)

Constant Attributes:

80%

Stream
500-749'
Yellow road
Grey house

60-80%

White road
Aspect (E)
Unfenced road
Bracken/heath
Aspect (N)
Footpath
Aspect (W)
Aspect (S)

Selective Attributes:

chi sq 30

500-749' (88, 20)
Bannisdale slates (48, 13)
Yellow road (82, 46)

chi sq 10-30

Unfenced road (72, 40)
Hamlet (35, 13)
Grey house (81, 51)
River (39, 18)
Bracken/heath (82, 49)
Copse (51, 30)
White road (74, 52)
Basin peat (37, 21)

Species Cover:

over 5%

Pteri aquil (19)
Loliu peren (10)
Agros tenui (5)
Poa trivi (5)

1-5%

Trifo repen (4)
Nardus stric (3)
Cereals (3)
Cyno cris
Desch flexu (2)
Holcu lanat (2)
Phleu prate (2)
Molin caeru (1)
Dacty glome (1)

pH:

3.1-3.5	3.6-4.0	4.1-4.5	4.6-5.0	5.1-5.5	5.6-6.0	6.1-6.5	6.6-7.0	7.1
1	9		8	19	13	12	2	

Distribution:

General

Comments:

Land form: very variable with many of the low lying fells presenting a wide variety of slopes and features such as small rock outcrops.
Land Use: very variable from arable, to leys, permanent pasture to neglected slopes and woodland. Mainly sheep but cattle also and some little used land. Sometimes afforested.
Vegetation: very variable from grassland, to bracken covered slopes and woodland. Mainly hedgerows but also walls, and diversity from marshly conditions, extensive semi-natural vegetation.

Cumbria Survey

Map type five (76, high)

Number of Attributes:

74 (medium)

Constant Attributes:

80%

0-249
White road

60-80%

Grey house
Aspect (S)
Sandstones
Basin peat
Black House
Yellow road
Footpath
Stream
Aspect (W)
Aspect (E)

Selective Attributes:

chi sq - 30

0-249 (92, 17)
Sandstone (72, 10)
Basin peat (70,18)
White road (87, 51)

chi sq 10-30

Grey house

Species Cover:

over 5%

Cereals (20)
Loliu peren (19)

1-5%

Trifo repen (4)
Pteri aqui (3)
Phleu prato (3)

pH:

3.1-3.5	3.6-4.0	4.1-4.5	4.6-5.0	5.1-5.5	5.6-6.0	6.1-6.5	6.6-7.0	7.1
	3		1	13	8	8	6	

Distribution:

Solway Plain, Coastal Plain, Southern Lowland

Comments:

Land form: alluvial lowlands, with little pronounced relief, except where outcrops emerge from the alluvium, mainly level.
Land use: much arable, and leys with beef and dairy cattle predominating, less densely populated than types 2 and 3.
Vegetation: uniform grassland and arable with diversity coming mainly from hedgerows, few walls, streams and some woodland. Little semi-natural vegetation present.

Cumbria Survey

Map type six (31, medium)

No. of Attributes:

73 (medium)

Constant Attributes:

80%

0-249'
Grey house
Yellow road
White road
Basin peat

60-80%

Aspect (S)
Aspect (W)
Aspect (E)
Sandstones
Aspect (N)
Black house
'A' road
Embankments
Aspect (E)

Selective Attributes:

chi sq 30

Embankment (61, 6)
Town (36, 2)
0-249' (100, 21)
Railway disused (42, 5)
Basin peat (81, 14)
Sandstone (68, 14)
'A' road (61, 13)
Church (36, 5)

chi sq 10-30

Bridleway (155, 18)
Grey House (87, 13)
Bridge (30, 9)
Steep hill (road (81, 49))

Species Cover:

over 5%

Loliu peren (38)
Trifo repen (10)

1-5%

Phleu prate (3)
Poa trivi (2)
Dacty glom
Agros tenuis (2)

pH:

3.1-3.5	3.6-4.0	4.1-4.5	4.6-5.0	5.1-5.5	5.6-6.0	6.1-6.5	6.6-7.0	7.1
		1	2	8	11	12	4	2

Distribution:

Solway Plain, Coastal Plain, Southern Lowlands

Comments:

Land form: alluvial lowlands with little pronounced relief.
Land use: mainly pasture with some arable, but particularly associated with built up land and communication routes.
Vegetation: mainly grassland, with some copse and with many disturbed habitats and with limited semi-natural vegetation.

Cumbria Survey

Map type seven (14, low)

No. of Attributes:

39 (low)

Constant Attributes:

80%	60-80%
0-249'	Basin peat
Sea	
Intertidal	
Sand and mud	

Selective Attributes:

chi sq 30	chi sq 10-30
Sand and mud (93, 1)	Basin peat (71, 22)
Sea (100, 3)	
Intertidal (9, 4)	
Marsh (42, 2)	
0-249' (100, 23)	

Species Cover:

over 5%	1-5%
+	-

pH:

3.1-3.5	3.6-4.0	4.1-4.5	4.6-5.0	5.1-5.5	5.6-6.0	6.1-6.5	6.6-7.0	7.1
						5	14	1

Distribution:

Coastal

Comments:

Land form: mainly estuarine or where there is very little land present.
Land use: grazing by sheep on salt marshes or bare ground.
Vegetation: salt marsh or none.

Cumbria Survey

Map type eight (24, low)

No of Attributes:

70 (medium)

Constant Attributes:

80%	60-80%
Intertidal	White road
0-249'	Grey house
Sea	Footpath

Selective Attributes:

chi sq 30	chi sq 10-30
Intertidal (100, 2)	Railway (in use) (38, 7)
Sea (88, 2)	Sandstone (50, 15)
Sand and shingle (58, 1)	
Sand and Mud (38, 2)	
0-249' (100, 22)	

Species Cover:

over 5%	1-5%
Loliu peren (11)	Holcu lanat (3)
Trifo repen (7)	Agrost tenui (3)
Cereals (5)	

pH:

3.1-3.5	3.6-4.0	4.1-4.5	4.6-5.0	5.1-5.5	5.6-6.0	6.1-6.5	6.6-7.0	7.1
			2	3	10	9	11	3

Distribution:

Coastal

Comments:

Land form: coastal varying from dunes to cliffs and low eroded moraines.
Land use: pasture mainly for dairy and beef, but with some arable.
Vegetation: variable, depending upon the amount of cliff, dune or salt marsh present. Mainly hedgerows but many fences and banked fields. Variable amounts of semi-natural vegetation.

Cumbria Survey

Map type nine (64, high)

No. of Attributes:

72 (medium)

Constant Attributes:

80%	60-80%
1000-1249'	Aspect (W)
Bracken/heath	Aspect (N)
Stream	Aspect (S)
1250-1499	Aspect (E)

Selective Attributes:

chi sq 30	chi sq 10-30
1000-1249' (92, 14)	750-999' (48, 23)
1250-1499' (81, 14)	1700-1749' (33, 14)
Bracken/heath (92, 47)	Borrowdale Volc. (33, 15)

Species Cover:

over 5%	1-5%
Callu vulga (26)	Festu ovina (4)
Nardu stric (9)	Desch flexu (4)
Juncu squar (7)	Juncu effu (3)
Pteri aquil (6)	Agros tenui (3)
	Vacci myrt (2)
	Eriop an/va (2)

pH:

3.1-3.5	3.6-4.0	4.1-4.5	4.6-5.0	5.1-5.5	5.6-6.0	6.1-6.5	6.6-7.0	7.1
9	22	7	1	1				

Distribution:

Eastern Fells, Western Fells, Southern Fells, and Pennines

Comments:

Land form: lower fells on the fringe of the principal mountains, with usually rolling relief, often broken by small rocky outcrops and small streams.
Land use: mainly sheep grazing but contains much marginal land.
Vegetation: variable within narrow limits with diversity limited to small areas such as streams. Walls very common, with few hedges and little woodland. Extensive semi-natural vegetation.

Cumbria Survey

Map type ten (37, medium)

No. of Attributes:

67 (medium)

Constant Attributes:

80%

Stream
1000-1249'
Bracken/heath
1250-1499'

60-80%

Unfenced road
Aspect (S)
Aspect (W)
750-999'
White road
Footpath
Grey house

Selective Attributes:

chi sq 30

1000-1249' (89, 17)
1250-1499' (87, 16)
750- 999' (70, 23)

chi sq 10-30

Bracken/heath (89, 42)
Unfenced road (76, 42)
1500-1749' (38, 14)

Species Cover:

over 5%

Agrost tenui (8)
Callu vulg (7)
Festu ovina (7)
Pteri aquil (6)
Poa trivi (6)

1-5%

Juncu squar (4)
Holcu lanat (4)
Desch flex (2)
Loliu peren (2)
Nardu strict (2)
Juncu effu (1)
Trifo repen (1)

pH:

3.1-3.5	3.6-4.0	4.1-4.5	4.6-5.0	5.1-5.5	5.6-6.0	6.1-6.5	6.6-7.0	7.1
	10	14	5	10	5	3		

Distribution:

Eastern Fells, Western Fells, Southern Fells, Pennines, Skiddaw

Comments:

Land form: very variable mountainous land with variable slopes and rocky formations often covering a wide range of altitude.
Land use: mainly sheep grazing with much marginal land.
Vegetation: mainly grassland, but with quite a large degree of variation. Mainly walls and diversity coming from streamsides and improved land at lower altitudes. Extensive semi-natural vegetation.

Cumbria Survey

Map type eleven (33, medium)

No. of Attributes:

91 (high)

Constant Attributes:

80%	60-80%
Bracken/heath	Aspect (N)
Stream	Aspect (W)
	Aspect (E)
	750-999'
	Aspect (S)

Selective Attributes:

chi sq 30	chi sq 10-30
750-999' (62, 22)	Bannisdale slates (36, 15)
Bracken/heath (94, 48)	
700-749 (59, 25)	

Species Cover:

over 5%	1-5%
Agros tenui (25)	Nardu strict (4)
Pteri aquil (11)	Juncu effu (3)
Festu ovina (10)	Holcu lanat (3)
	Poa trivi (3)
	Desch flexu (2)
	Cynos crist (2)
	Trifo repen (1)
	Molin caer (1)

pH:

3.1-3.5	3.6-4.0	4.1-4.5	4.6-5.0	5.1-5.5	5.6-6.0	6.1-6.5	6.6-7.0	7.1
	13	9	4	8	5	1		

Distribution:

General

Comments:

Land form: complex, patterns of rock outcrops and different angled slopes on the lower folls.
Land use: very varied, but mainly improved land with grazing by sheep and cattle. Sometimes afforested.
Vegetation: very varied, with much heterogeneity from the many habitats present e.g. hedges, walls, streams, and bogs and copses. Variable amounts of semi-natural vegetation but mainly highly modified.

Cumbria Survey

Map type twelve (33, medium)

No. of Attributes:

44 (low)

Constant Attributes:

80%	60-80%
Bracken/heath	Stream 750-999' Aspect (S) Slope Limestone

Selective Attributes:

chi sq 30	chi sq 10-30
Fell sandstone (55, 2) Slope (64, 7) 750-999' (64, 23)	Wood conifer (39, 10) Bracken/heath (88, 50) Limestone (61, 29)

Species Cover:

over 5%	1-5%	
Pteri aquil (12)	Poa trivi (3)	Juncus squa (1)
Nardu stric (10)	Holcu lanat (3)	Desch flexu (1)
Agros tenui (7)	Trifo repen (3)	
Loliu peren (7)	Phleum prate (3)	
Festu ovina (5)	Cynos crist (2)	
	Juncu effu (2)	

pH:

3.1-3.5	3.6-4.0	4.1-4.5	4.6-5.0	5.1-5.5	5.6-6.0	6.1-6.5	6.6-7.0	7.1
	10	5	2	4		5		1

Distribution:

Pennines

Comments:

Land form: gently rolling hill slopes at an intermediate elevation.
Land use: extensively afforested moorlands.
Vegetation: dependent largely upon drainage conditions and highly modified by tree planting. Where not planted extensive semi-natural vegetation.

Cumbria Survey

Map type thirteen (35, medium)

No. of Attributes:

42 (low)

Constant Attributes:

80%	60-80%
1500-1749'	1750-1999'
Stream	Aspect (W)
Bracken/heath	Aspect (N)
	Aspect (S)
	Limestone
	Aspect (E)

Selective Attributes:

chi sq 30	chi sq 10-30
1700-1749' (100, 12)	Millstone grit (31, 7)
1750-1999' (69, 9)	1250'-1499' (51, 18)
	Bracken/heath (91, 49)
	Limestone (63, 28)

Species Cover:

over 5%	1-5%
Juncu effu (13)	Nardu stric (5)
Festu ovina (13)	Agros tenui (3)
Desch flexu (10)	Eriop an/va (2)
Juncu squa (8)	

pH:

3.1-3.5	3.6-4.0	4.1-4.5	4.6-5.0	5.1-5.5	5.6-6.0	6.1-6.5	6.6-7.0	7.1
8	15	4	2	1	1	1		

Distribution:

Pennines, Skiddaw, Southern Fells

Comments:

Land form: mainly the steeper sides of the hills and valley bottoms, with rounded slopes and relatively featureless scenery.
Land use: sheep grazing and much marginal land.
Vegetation: mainly various types of upland grassland and heaths with walls and diversity related mainly to streamsides. Extensive semi-natural vegetation.

Cumbria Survey

Map type fourteen (33, medium)

No. of Attributes:

34 (low)

Constant Attributes:

80%	60-80%
Stream	Spot height
Bracken/heath	1750'-1999'
2000'-2249'	Aspect (N)
	Aspect (E)
	Aspect (W)

Selective Attributes:

chi sq 30	chi sq 10-30
2000'-2249' (87, 5)	Bracken/heath (88, 50)
2250'-2749' (36, 2)	Limestone (58, 29)
1750'-1999' (64, 10)	

Species Cover:

over 5%	1-5%
Vacci myrt (9)	Nardu stric (5)
Juncu squa (8)	Molin caeru (1)
Eriop an/va (7)	
Juncu effu (7)	
Desch flexu (6)	
Festu ovina (6)	

pH:

3.1-3.5	3.6-4.0	4.1-4.5	4.6-5.0	5.1-5.5	5.6-6.0	6.1-6.5	6.6-7.0	7.1
9	19	10		2				

Distribution:

Pennines, Skiddaw, Southern Fells

Comments:

Land form: the high plateau like tops of hills, with rounded outlines, relatively featureless compared with types 15 and 16.
Land use: sheep grazing and relatively little used because of low potential and remoteness.
Vegetation: variation on grassland and heaths, with a pronounced upland affinity. Extensive semi-natural vegetation.

Cumbria Survey

Map type fifteen (28, low)

No. of Attributes:

46 (low)

Constant Attributes:

80%	60-80%
1500'-1749'	Aspect (W)
Stream	1750'-1999'
1250'-1499'	Footpath
Bracken/heath	Aspect (S)
Borrowdale volcanics	Aspect (N)
	Aspect (E)

Selective Attributes:

chi sq 30	chi sq 10-30
1500'-1749' (100, 12)	Bracken/heath (96, 49)
1250'-1499' (96, 16)	1000'-1249' (50, 18)
1250'-1999' (75, 10)	
Borrowdale volcs. (82, 14)	
N.T. property (46, 8)	

Species Cover:

over 5%	1-5%
Callu vulga (23)	Festu ovina (5)
Nardu stric (18)	Agros tenui (4)
	Desch flexu (3)
	Juncu squar (2)
	Vacci myrti (2)
	Trich caesp (2)

pH:

3.1-3.5	3.6-4.0	4.1-4.5	4.6-5.0	5.1-5.5	5.6-6.0	6.1-6.5	6.6-7.0	7.1
1	18	10	3	6				

Distribution:

Eastern Fells, Western Fells

Comments:

Land form: steep mountainsides, usually on the fringes of the highest mountains, with a wide range of rocky features.
Land use: generally light grazing from sheep and much protected land.
Vegetation: upland grasslands and heaths, relatively uniform and related largely to slope with diversity coming from streams. Extensive semi-natural vegetation.

Cumbria Survey

Map type sixteen (22, low)

No. of Attributes:

36 (low)

Constant Attributes:

80%	60-80%
2000'-2249'	1500'-1749'
Bracken/heath	Aspect (S)
Borrowdale volcanics	Aspect (E)
Stream	Footpath
1750'-1999'	N.T. property
Aspect (N)	2250'-2499'
Aspect (W)	
Scree/crag	

Selective Attributes:

chi sq 30	chi sq 10-30
2000'-2249' (100, 6)	Bracken/heath (96, 50)
2250'-2499' (59, 2)	1250'-1499' (50, 18)
scree/crag (82, 8)	
1750'-1999' (86, 10)	
Borrowdale volc. (96, 14)	
2450'2745' (32,1)	
N.T. property (64, 8)	
1500'-1749' (77, 14)	

Species Cover:

over 5%	1-5%
Nardu stric (22)	Juncu effu (4)
Juncu squa (15)	Desch flexu (4)
Festu ovina (10)	Trich caesp (4)
Agro tenui (8)	Vacci myrt (1)
Eriop repen (7)	

pH:

3.1-3.5	3.6-4.0	4.1-4.5	4.6-5.0	5.1-5.5	5.6-6.0	6.1-6.5	6.6-7.0	7.1
3	31	5	1	1	3			

Distribution:

Eastern Fells, Western Fells

Comments:

Land form: steep, rocky fells usually containing the mountain summits.
Land use: sheep grazing and recreational use with much protected land.
Vegetation: upland grasslands and heaths, relatively uniform, with diversity originating from streams. Extensive semi-natural vegetation.

Table 1. Area of each class type in Cumbria

Class	Area (km^2) in sample	Total area (km^2)	% of total area
1	77	667	9.8
2	89	769	11.3
3	86	749	11.0
4	83	722	10.6
5	76	660	9.7
6	31	266	3.9
7	14	123	1.8
8	24	211	3.1
9	54	470	6.9
10	37	320	4.7
11	53	463	6.8
12	33	286	4.2
13	35	306	4.5
14	33	286	4.2
15	28	245	3.6
16	22	191	2.8
		6734	

Fig.1 A key to the classification of land in Cumbria.

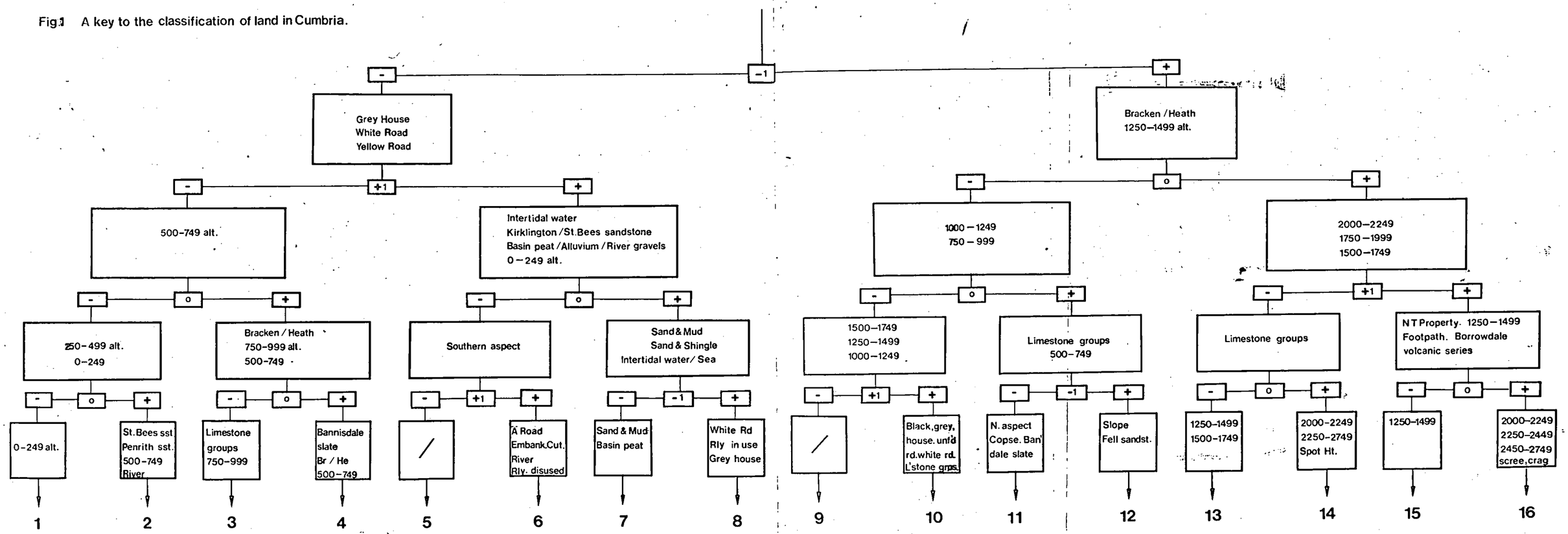


Fig. 2.

Distribution of map classes 1-8 in Cumbria. N.B. This is a first draft computer map, and is in the process of development.

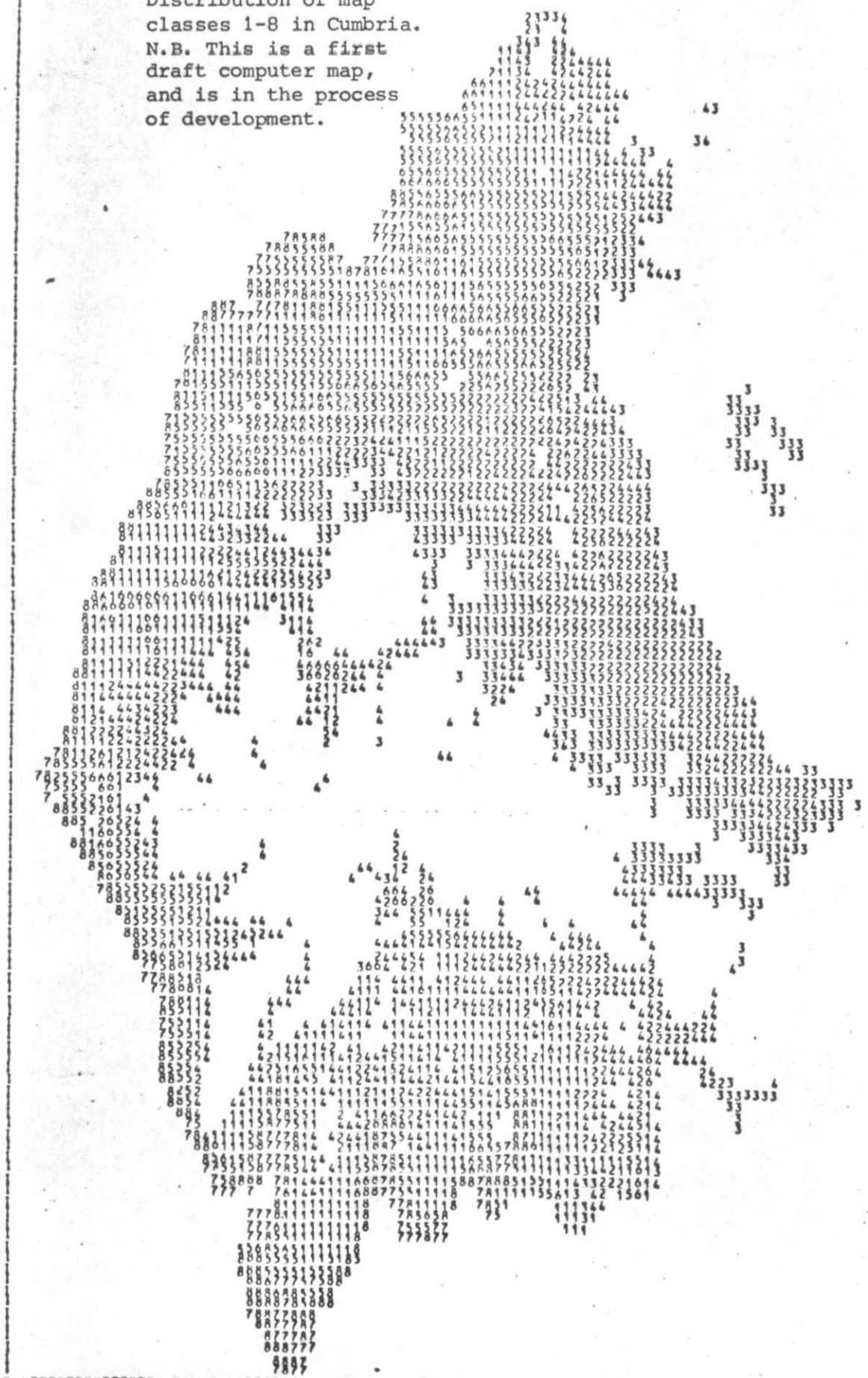


Fig. 3.

Distribution of map classes 9-16 in Cumbria.

N.B. This is a first draft computer map, and is in the process of development.

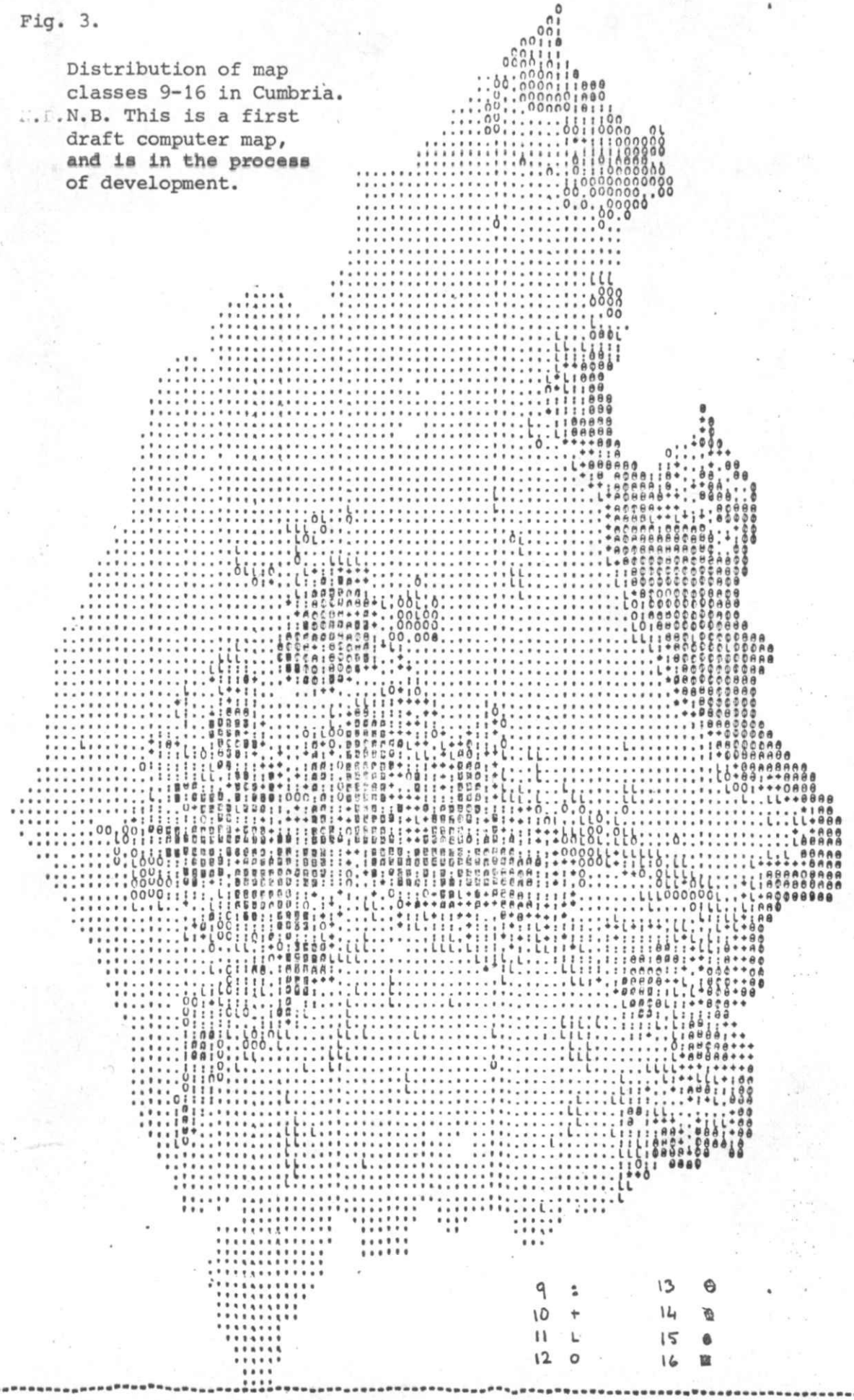
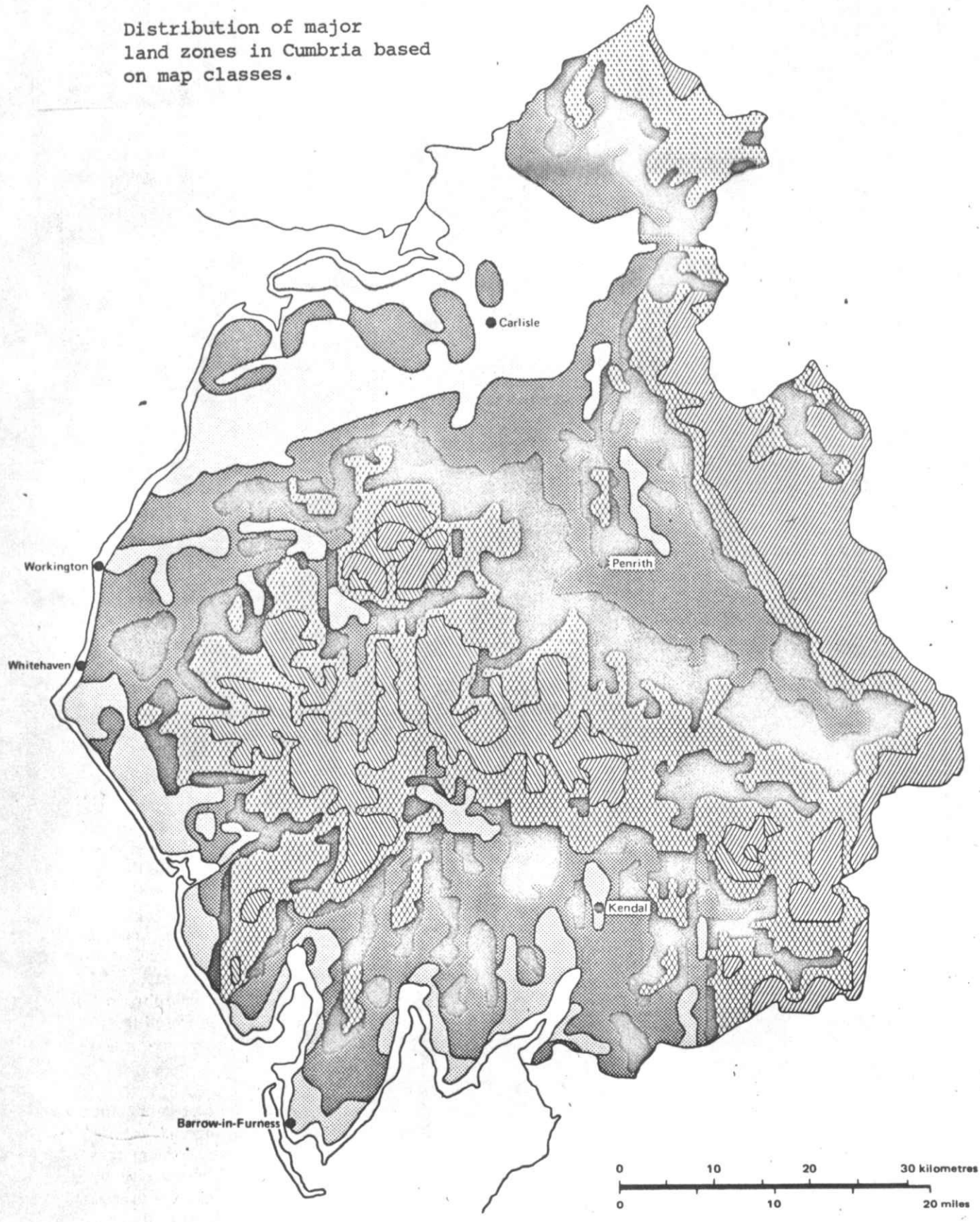


Fig. 4.

Distribution of major land zones in Cumbria based on map classes.



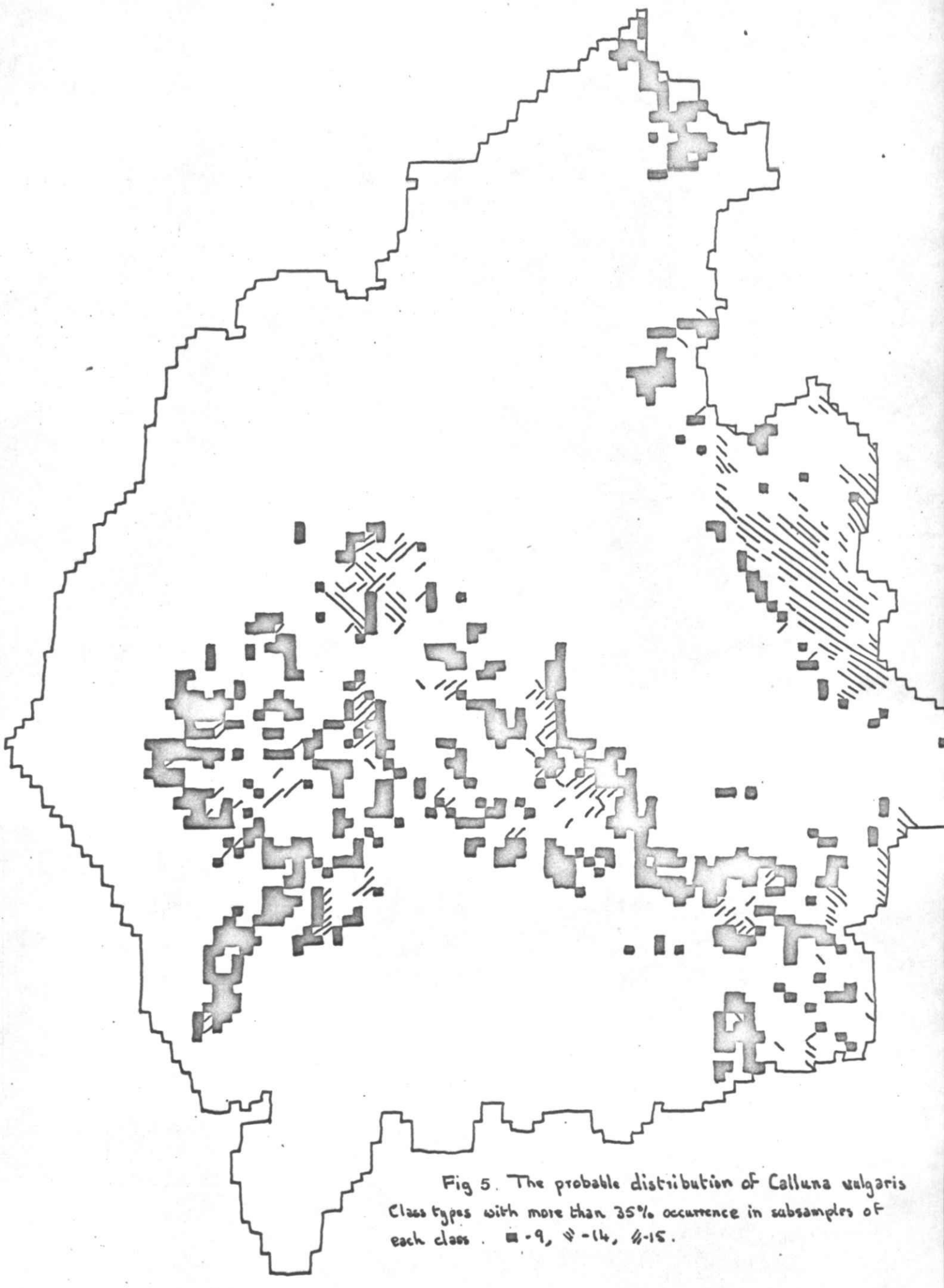


Fig 5. The probable distribution of Calluna vulgaris Class types with more than 35% occurrence in subsamples of each class. ▦ - 9, ▽ - 14, ▨ - 15.

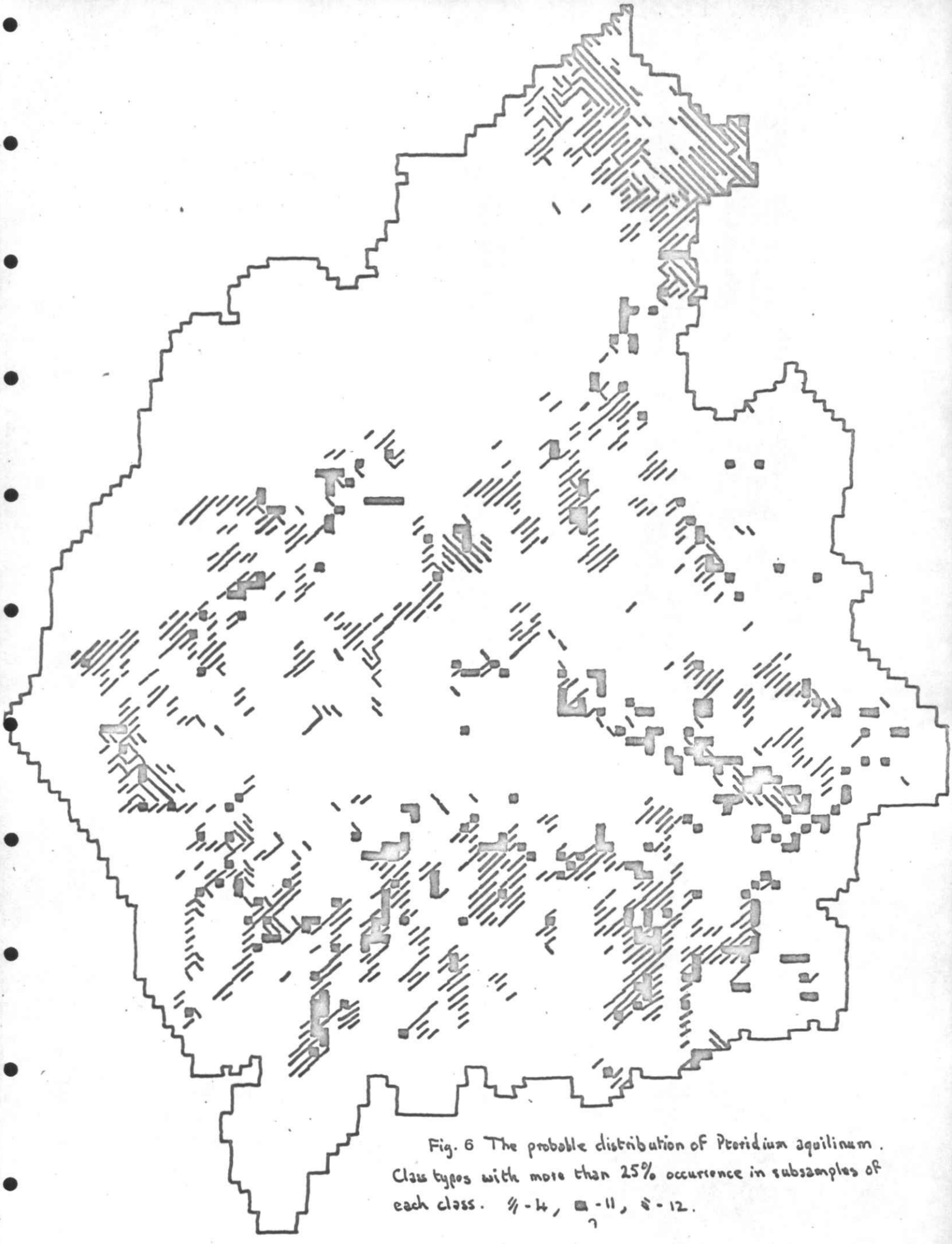
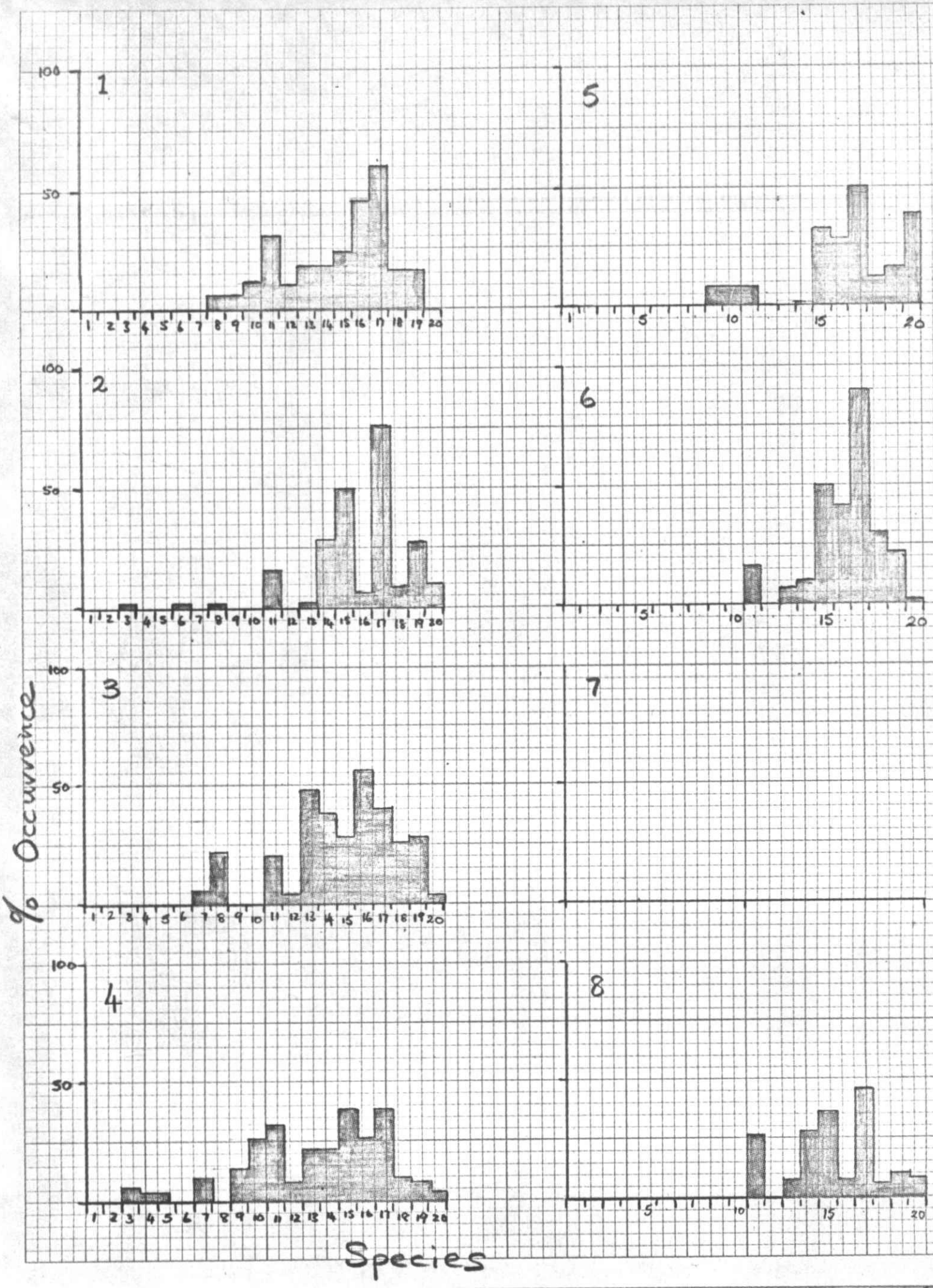
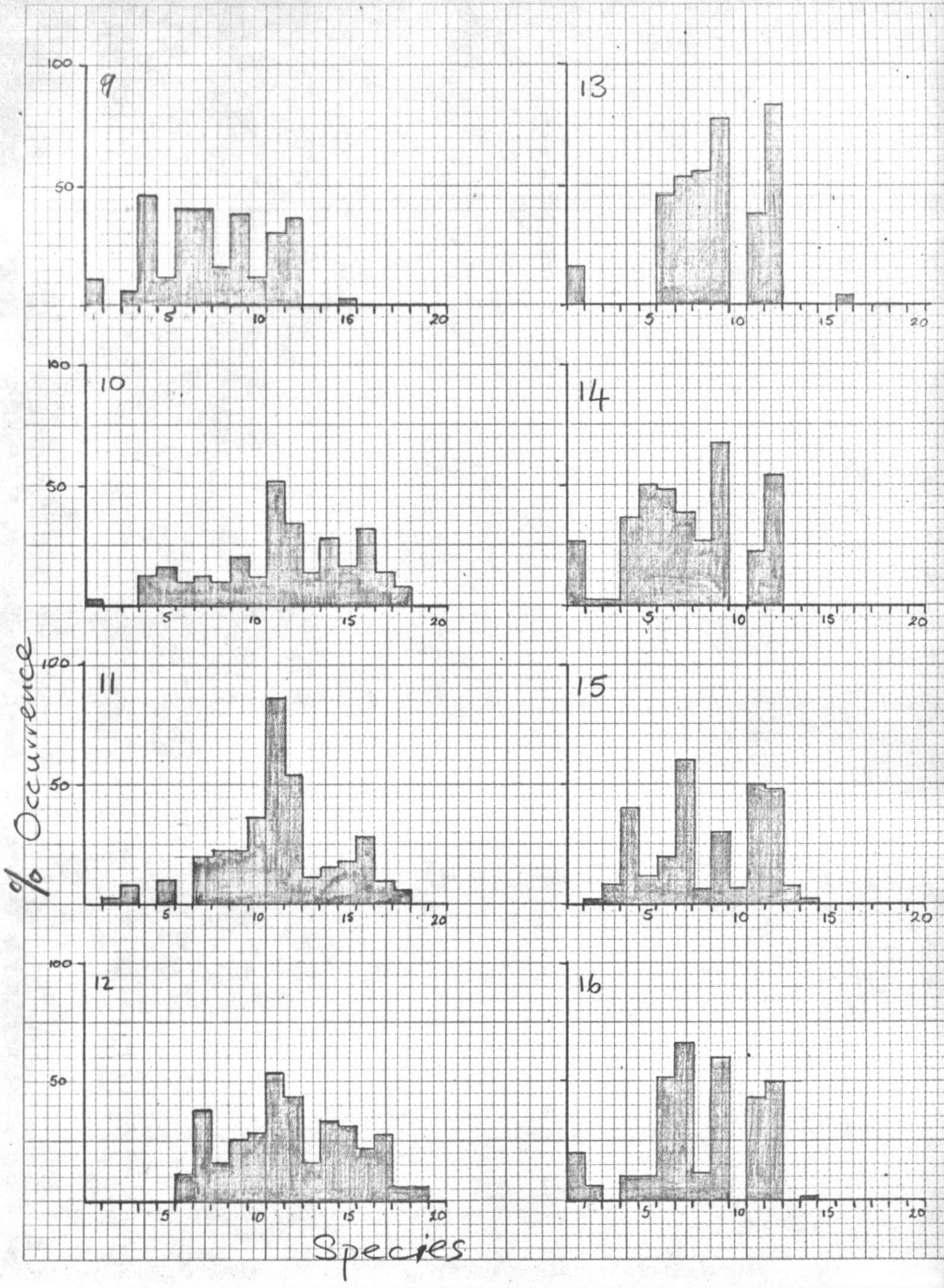


Fig. 6 The probable distribution of Pteridium aquilinum. Class types with more than 25% occurrence in subsamples of each class. ▨ - 4, ▩ - 11, ▪ - 12.

Fig. 7. Occurrence of the 20 most frequently occurring plant species in subsamples of the 16 map classes in Cumbria

1. *Eriophorum angustifolium* and *E. vaginatum*
2. *Trichophorum caespitosum*
3. *Molinia caerulea*
4. *Calluna vulgaris*
5. *Vaccinium myrtillus*
6. *Juncus squarrosus*
7. *Nardus stricta*
8. *Juncus effusus*
9. *Deschampsia flexuosa*
10. *Pteridium aquilinum*
11. *Agrostis tenuis*
12. *Festuca ovina*
13. *Cynosurum cristatum*
14. *Holcus lanatus*
15. *Trifolium repens*
16. *Poa trivialis*
17. *Lolium perenne*
18. *Dactylis glomerata*
19. *Phleum pratense*
20. **Cereals**


1
2
3
4
5
6
7
8
100
50
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
1 5 10 15 20
% Occurrence
Species


9
13
10
14
11
15
12
16
100
50
5
10
15
20
% Occurrence
Species

2. UPLAND VALLEYS

2.1 The map attribute analysis assigns a class type from 1 to 16 to each km^2 in Cumbria, and thus subdivides Cumbria on the basis of topography, geology and to some extent land use. However, land use and landscape are not necessarily related to the arbitrary national grid and we have examined the combination of km^2 into units relevant to land use planning.

2.2 Agricultural practice in Cumbria is invariabily based on a "valley" system. Parish boundaries in many cases cross water-sheds, and the Agricultural Returns may contain data from parts of several valleys. Clearly then, if agricultural data is available on a Parish basis, then an attempt must be made to relate this to the discrete topographical units. These land units may then be analysed or examined for susceptibility, rate and direction of change that may result from the introduction of a change in land use.

2.3 Upland Cumbria could be divided to give 50 discrete topographical areas. These areas are not only discontinuities in land form, but also units of 'organization' in terms of agriculture, water management, social factors, communications, tourism and recreation. Although in most cases the area defined is a clear valley system, this is not always the case and the position of the lower end was debateable. For clarity the units are hereafter termed as 'valleys'.

2.4 The first objective was to determine the variation between valleys in their land type. The map class composition of each of the 50 valleys was recorded (see Appendix 1) and the valleys ranked on the percentage of the upland (13-16), intermediate (9-12) and lowland (1-8) map classes (Table 2). The ranking procedure and composition of all valleys is given in Appendix 2
The valleys vary considerably in the proportion of lowland classes within their boundaries and the ranking emphasises that many of the upland valleys contain only a small proportion of valley bottom land which is of high agricultural value. Hartsop, the subject of an intensive study by Feist, Leat and Wibberley (1975), is shown to

be in the latter category and the ranking indicates other valleys in Cumbria which have similar land characteristics, patterns of development and land use. Thus the analysis indicates a method for selecting areas for intensive study and for placing individual studies into a regional context.

2.5 To examine the variation in land use within these valleys, 10 valleys were selected covering the range of class structure (Fig. 8 Table 2). These 10 valleys range from relatively open areas with moderate proportions of valley bottom at low altitude (100') including lakes e.g. Bassenthwaite (6) and Tarn Hows and Coniston (7) to steep sided upland valleys dominated by rough fells e.g. Wetsleddale (49) and Hartsop (50) with one (Crowdundle 30) running from about 2500' on the Pennine ridge down to the wide, agriculturally rich, Eden Valley. They vary considerably in their socio-economic status - population change, income, communications, proximity to towns - and in their recreational and conservation pressures (Comparative data to be extracted from Cumbria Structure Plan).

2.6 Agriculture is the major land use in these valleys, the farm type varying from upland livestock rearing on small to medium sized farms with a low labour input (Fig. 8 Garsdale 44 and Hartsop 50) to valleys which include more labour intensive poultry and dairy farms (Crowdundle 30, Bassenthwaite 6), but all contain upland livestock rearing in part of the valley. The farm type reflects the classification of the land on its agricultural potential (Agricultural Land Service Classification) with Class 5 land dominating most of the valleys, Class 4 varying from 3 to 35% of the valley. Only three of the valleys contain land of Class 3 (Table 3). The valleys in Table 3 are arranged in their order of ranking on map class and there is obviously a strong correlation between map class and ALS class composition.

2.7 The soils of the valleys, in conjunction with climate and slope, determine the agricultural use, but mapping of the major soil types from air photographs shows the complexity of soils within these areas (Fig. 9). In general the brown earths, gleys and brown podzolic soils are the better agricultural soils compared with the

peats, peaty gley, peaty podzols and rankers. For the ten valleys the pattern of soil composition is complex but shows a trend from dominance of the better to poorer soils over the map class ranking (Table 4). Most of the valleys contain a full range of soils and it is the balance which determines the agricultural potential. Thus Crowdundale, although containing only 16% of map class 1-8 has 34% of brown earth to offset the 49% of peaty gley. This is also reflected in the ALS class for Crowdundale with 11% of class 3.

The distribution of soil types between map classes 1-16 has been derived from the valley soil maps and can be used as an indication of the probability of occurrence of soil types throughout Cumbria, but the bias towards uplands must be recognised (Table 5).

2.8 More detailed information on the type and structure of agriculture in an area can be obtained from the MAFF Agricultural Returns for parishes. These returns provide readily available data which can indicate trends in agriculture and be used to identify areas of particular agricultural characteristics as well as for monitoring of predicted changes. Interpretation of the returns must be cautious; for various reasons the data are sometimes misleading. In the present study the main parish associated with each of the 10 selected valleys was identified and the parish returns for one year examined

a) to give more detailed information on farm type and structure in the valleys

b) to define the range of variation in farming in upland Cumbria, the selected parishes being taken as representing the full range

c) to determine the relationship between map classes and agriculture.

2.9 The map class structure for each parish (Appendix 3) was summarised and correlated reasonably well with the class composition of the associated valley (Table 6). The parishes

of Coniston and Hawkshead, both associated with the valley of Tarn Hows and Coniston (7), were combined for the correlation but treated separately in further analyses. The major anomaly was the relationship of Crowdundle to the parish of Culgaith. The parish extends further into the Eden Valley than did the defined valley, and thus contained a much higher proportion of lowland classes.

A summary of the parish returns for June 1974 (Tables 7, 8 and 9) indicates the uniformity of agriculture over these upland parishes with dairy and livestock rearing being the main farm type in all cases. Dairy (farm type 1 and 2) dominates in four parishes with a high percentage of map classes 1-8 (36-83%) with livestock rearing (5) as the second farm type. In the seven parishes with a low percentage of 1-8 (1-39%) livestock rearing is dominant (4 and 5) and often secondary. The only exception to the pattern is Barbon which has dairy as primary and secondary farm type which is surprising considering the low percentage of grassland (34%) and high percentage of rough grazing (65%) compared with the other three parishes in which dairy predominates. One other feature is that only Culgaith has a significant area (20%) under crops, related to the relatively rich conditions in the Eden Valley and associated with the highest percentage (46%) of map class 2, the class with the highest proportion of brown earth and gley soils.

2.10 The correlation matrix between the main agricultural variables for the 11 parishes, plus the percentage of map classes 1-8 (Table 10) shows that the map class is correlated with a number of farm characteristics. As the cover of classes 1-8 declines the area of grassland and the numbers of cattle also decline while the parish size, area per worker and area of rough grazing increase. Amongst the farm variables there are the expected high correlations between grassland, crop and rough grazing area and cattle. Labour intensity also relates to these features.

Thus although the number of parishes sampled is small the major trends in upland farming are apparent, probably because of the initial stratification. However interpretation must be treated with caution because of the coarse nature of the parish data and the limited sample.

Table 2. Ranking of 50 valleys

	Classes 1-8 % total	Classes 9-12 % total	Classes 13-16 % total	Ranking on 9-12	Ranking on 13-16
1. Coniston Water	100	0	0	6=	3=
2. Elterwater	100	0	0	6=	3=
3. Windermere east	91.29	8.71	0	5	3=
4. Claife Heights	87.50	12.50	0	4	3=
5. Lorton Vale	70.79	21.35	7.86	2	2
6. *Bassenthwaite*	69.71	18.19	12.10	3	1
7. *Tarn Hows and Coniston*	64.51	35.49	0	1	3=
8. Duddon Valley	48.84	34.88	16.28	10	6
9. Lickle Valley	45.00	56.00	0	2	11
10. Bannisdale	44.44	48.14	7.42	7	9
11. Dentdale	42.85	44.64	12.51	8	7
12. Ullswater west	37.50	52.50	10.00	3	8
13. *Loweswater*	36.00	58.00	6.00	1	10
14. *Greta Valley*	33.75	32.50	33.75	11	1
15. Ravenstonedale	31.68	50.49	17.83	4	5
16. Derwentwater	31.66	43.34	25.00	9	2
17. Kentmere	30.77	49.99	19.24	6	4
18. Eskdale and Upper Esk	26.95	50.25	22.80	5	3
19. Wasdale	22.22	33.34	44.44	14	7
20. Longsleddale	22.22	51.85	25.93	9	14
21. Little Langdale	21.43	57.14	21.43	5	17
22. Rawthay/Cawtley	20.64	55.56	23.80	7	16
23. *Caldew*	19.52	24.38	56.10	18	1
24. Newlands	19.05	47.62	33.33	11	9
25. *Barbondale*	18.75	81.25	0	1	18
26. Troutbeck	17.39	56.53	26.08	6	13
27. Dufton	16.66	33.33	50.01	15	5
28. Grasmere	16.36	49.08	34.56	10	8
29. Blengdale	16.00	60.00	24.00	3	15
30. *Crowdundle*	15.78	31.58	52.64	17	3
31. Buttermere	15.65	53.13	31.22	8	10
32. Coledale Beck/Braithwaite	13.65	31.80	54.55	16	2
33. Great Langdale	13.33	40.00	46.67	12	6
34. Martindale	11.90	61.91	26.19	2	12
35. Mitredale	11.76	58.83	29.41	4	11
36. Ennerdale	10.20	38.77	51.03	13	4
37. Stockgill	9.09	63.63	27.28	5	13
38. Coniston Fells	7.70	38.46	53.84	10	6
39. High Cup Gill	7.14	21.43	71.43	13	2
40. Borrowbeck	6.26	65.63	28.11	3	13
41. Longstrath	5.88	35.29	58.83	11	4
42. Thirlmere	5.56	52.78	41.66	6	9
43. Grizedale Beck/Patterdale	5.26	26.32	68.42	12	3
44. *Garsdale*	4.76	90.48	4.76	1	14
45. Black Burn	3.77	18.87	77.36	14	1
46. Swindale/Mosedale	3.70	51.85	44.45	7	8
47. Haweswater	2.78	44.45	52.77	8	7
48. Wormgill	0	68.75	31.25	2	11
49. *Wetsleddale*	0	64.71	40.29	4	10
50. *Hartsop*	0	41.46	58.54	9	5

Valleys shown in italics are those selected for further study

Fig. 8.

The ten valleys selected for study, and the distribution of main farm types.

Based on MAFF Agricultural Census 1973

Table 3. Upland valleys in Cumbria. The agricultural potential of land in each valley, expressed as percentage of land in each ALS class

	Valley	ALS Class 5	4	3	Other use*	Total km²
6	Bassenthwaite	33	33	12	22	66
7	Tarn Hows and Coniston	48	35	-	17	31
18	Loweswater	73	23	-	5	50
14	Greta Valley	73	28	-	-	80
23	Caldew	80	18	-	1	41
25	Barbondale	86	6	5	3	16
30	Crowdundle	76	13	11	-	19
44	Garsdale	83	17	-	-	42
49	Wetsleddale	94	3	-	3	17
50	Hartsop	93	4	-	2	40

* mainly forest or lake

Fig. 9.

The main soil types in Hartsop valley.
P = peat, PP = peaty podzol,
PG = peaty gley, G = gley,
BPS = brown podzolic,
BE = brown earth, R = ranker,
Map class is shown in each km²

Table 4. Soils of upland valleys in Cumbria. The percentage cover of each major soil type in each valley is derived from analysis of aerial photographs, only the main soil type is given but in many instances other soils were present in association with the main type

	Peat	Peaty gley	Peaty podzol	Gley	Brown podzolic	Brown earth	Ranker	Rock, scree	Others
6 Bassenthwaite	15	1	7	29	19	12	11	1	4
7 Tarn Hows and Coniston	2	-	-	29	9	5	54	-	1
13 Loweswater	9	3	8	13	31	25	10	1	-
14 Greta Valley	6	12	12	28	20	2	6	5	8
23 Caldew	17	13	40	15	6	7	-	-	1
25 Barbondale	3	28	-	-	45	24	-	-	-
30 Crowdundle	5	49	-	7	1	34	2	-	1
44 Garsdale	42	29	1	25	-	2	-	-	1
49 Wetsleddale	41	18	17	6	12	6	-	-	-
50 Hartsop	15	11	-	3	23	8	39	-	-

Table 5. Soils in relation to map classes. Percentage cover of soil in a sample of km² from each class, calculated from analysis of ten valleys. Results must be interpreted with caution because some classes are dominated by a single valley, especially 1, 2, 5 and 6 reflecting Bassenthwaite.

Map class	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Number of km²	11	14	8	61	14	8			69	61	27	4	25	20	21	34
Peat	8	9	6	5	27	27			14	22	10	5	21	16	26	16
Peaty gley			1	5					17	22	17	15	31	26	10	6
Peaty podzol				1					11	8	1		27	18	34	14
Gley	32	63	72	44	34	56			3	17	17	10	1			
Brown podzolic	30	6	2	12	9	4			35	12	10		8	13	15	20
Brown earth	24	26	9	19	18	11			4	9	13	12	5	1	5	1
Ranker	2		6	12	12	2			13	8	29	45	3	10	5	33
Rock screes										1			1	7	3	6
Others	3		4	2					3	2	3	13	3	10	2	2

Table 6. Map class structure of ten selected valleys and their associated parishes.

Valley	% class 1-8	Parish	% class 1-8
Bassenthwaite	69.7	Bassenthwaite	70.0
Tarn Hows and Coniston	64.5	Coniston and Hawkshead	58.4
Loweswater	36.0	Loweswater	39.0
Greta Valley	33.7	St. Johns	15.3
Caldew	19.5	Mungrisdale	32.8
Barbondale	18.7	Barbon	35.9
Crowdundle	15.8	Culgaith	59.0
Garsdale	4.8	Garsdale	0.6
Wetsleddale	0.0	Shap Rural	10.9
Hartsop	0.0	Patterdale	3.0

$$y = 12.1852 + 0.7712\,x$$

$$r = 0.7752 \qquad P > 0.01$$

Table 7. Agriculture data for selected parishes, derived from parish returns of June 1974

	Hawkshead	Bassenthwaite	Cuigaith	Barbon	Loweswater	Coniston	Mungrisdale	St. Johns Castlerigg	Shap Rural	Patterdale	Garsdale
Total area (acres)	1795	4318	7602	4808	7804	2457	8609	10721	11433	11143	6522
Total sheep	1847	8428	12075	7471	8228	8408	19888	18888	22268	18228	11944
Sheep per 100 acres	103	195	155	105	342	342	231	176	190	164	183
Total cattle	807	2286	4151	1306	1717	686	4425	1459	2869	804	1406
Cattle per 100 acres	45.0	53.0	27.0	22.0	22.0	28.0	50.0	14.0	25.0	7.2	21.6
Total temporary grass per 100 acres	0.39	5.2	28.3	3.28	2.5	-	5.3	0.014	4.4	0.26	-
Total permanent grass per 100 acres	74.9	61.1	29.5	30.9	24.3	37.8	64.1	24.6	24.9	10.0	24.4
Total grass per 100 acres	75	66	58	34	27	39	69	25	29	10.3	24
Total crops (acres)	0	15.1	1504	43	1.23	5	137.5	33	255	6	0
Total crops per 100 acres	-	3.5	20	0.9	1.6	0.2	1.6	0.3	2.2	0.5	0
Rough grazing (acres)	432	1239	1601	3101	5463	1452	2412	7930.5	7779	9932	4924
Rough grazing per 100 acres	24	27	21	65	70	59	28.0	74	68	89	75
Woodland (acres)	0.5	64	57	0	53	70	78.5	10.5	7	10.75	4.5
Woodland per 100 acres	.03	1.5	0.7	-	0.6	2.8	0.9	.09	.06	0.1	.07
Other land (acres)	10	2	10.5	19.5	73.5	1.25	7.25	109.75	22.75	45	1.5
Other land per 100 acres	.56	.05	.1	.4	.9	.05	.8	.02	.2	.4	.02
Total workers	20	40	107	34	43	20	71	49	51	40	52
Area per worker	89.75	107.9	71.05	141.4	181.5	122.85	121.25	218.8	224.2	278.2	125.4
Total number of holdings	19	24	39	14	23	18	43	26	24	16	33
Proportion of holdings 1-274 S.M.D.	68	21	33	43	22	44	21	23	21	25	42
Proportion of holdings 275-599 S.M.D.	11	42	10.3	-	39	28	19	23	17	12.5	45
Proportion of holdings ≥ 600 S.M.D.	21	37	56.4	57	39	28	60	54	62	62.5	13
Main farm type and % of holdings*	1 = 50	2 = 32	2 = 31	2 = 50	5 = 44	5 = 50	5 = 32	4 = 45	5 = 58	4 = 58	5 = 31
Secondary farm type and % of holdings	5 = 33	5 = 26	5 = 23	1 = 25	2 = 17	4 = 20	1 = 29	2 = 25	1, 4, 13 = 11	5 = 33	2, 4 = 26

*Key

1. Specialist dairy: 2. Mainly dairy: 3. Livestock rearing and fattening (mostly cattle): 4. Livestock rearing and fattening (mostly sheep): 5. Livestock rearing and fattening (cattle and sheep)

Table 9. Parish returns 1974 for selected parishes. Percentage full-time holdings in each farm type

Parish	% 1-8	Farm type 1	2	3	4	5	6	7	13	No
Bassenthwaite	70	16	32	11	11	26	-	-	5	19
Hawkshead	83	50	-	16	-	33	-	-	-	6
Culgaith	50	4	31	15	-	23	-	-	15	26
Loweswater	39	6	17	11	11	44	6	6	-	18
Barbon	36	25	50	-	13	13	-	-	-	8
Coniston	34	-	10	-	20	50	-	10	10	10
Mungrisdale	33	29	24	6	6	32	-	-	3	34
St. Johns	15	10	25	5	45	15	-	-	-	20
Shap Rural	11	11	5	5	11	58	-	-	11	19
Patterdale	3	-	-	-	58	33	-	8	-	12
Garsdale	1	-	26	-	26	31	-	-	16	19

Farm types:

1. Specialist dairy
2. Mainly dairy
3. Mostly cattle)
4. Mostly sheep) Livestock rearing and fattening
5. Cattle and sheep)
6. Predominantly poultry
7. Pigs and poultry
13. Mixed

Table 9. Mean values for farming characteristics derived from the eleven selected parishes

	Mean	Standard deviation
Total area (acres)	6928	3369
Sheep 100 acres^{-1}	182	64
Cattle 100 acres^{-1}	28.6	14.6
Total temp. grass 100 acres^{-1}	4.5	8.2
Total perm. grass 100 acres^{-1}	36.9	20.5
Total grass 100 acres^{-1}	41.5	21.8
Total crops 100 acres^{-1}	2.8	5.8
Rough grazing 100 acres^{-1}	54.5	24.6
Woodland 100 acres^{-1}	.6	.9
Other land 100 acres^{-1}	.3	.3
Total workers	48	24
Area per worker	153	64
Total no. of holdings	25	9
% holdings 1-274 SMD	33	15
% holdings 275-599 SMD	22	15
% holdings $\geq$ 600 SMD	45	18
% AA class 1-8	35	26

Table 10. Data from Agricultural Returns for 1974 for eleven parishes. Only significant correlations are given; negative correlations are underlined.

		1 Total area (acres)	2 Sheep 100 acres^{-1}	3 Cattle 100 acres^{-1}	4 Total temp. grass 100 ac^{-1}	5 Total perm. grass 100 ac^{-1}	6 Total grass 100 acres^{-1}	7 Total crops 100 acres^{-1}	8 Rough grazing 100 ac^{-1}	9 Woodland 100 ac^{-1}	10 Other land 100 acres^{-1}	11 Total workers	12 Area per worker	13 Total number of holdings	14 % holdings 1-274 SMD	15 % holdings 275-599 SMD	16 % holdings $\geq$ 600 SMD	17 % map AA class 1-8+
% map AA class 1-8+	17	.68		.73		.77	.84		.84				.70					-
% holdings $\geq$ 600 SMD	16	.71													.62	.58	-	
% holdings 275-599	15															-		
% holdings 1-274 SMD	14	.73													-			
Total number of holdings	13											.82		-				
Area per worker	12	.74		.69		.66	.79		.81				-					
Total workers	11				.85			.82				-						
Other land 100 ac^{-1}	10										-							
Woodland 100 ac^{-1}	9		.79							-								
Rough grazing 100 ac^{-1}	8			.85		.82	.97		-									
Total crops 100 ac^{-1}	7				.99			-										
Total grass 100 ac^{-1}	6		.	.92		.93	-											
Total perm. grass 100 ac^{-1}	5	.60		.94		-												
Total temp. grass 100 ac^{-1}	4				-													
Cattle 100 ac^{-1}	3			-														
Sheep 100 ac^{-1}	2		-															
Total area (acres)	1	-																

\+ Per parish not valley

$> .57$ * $0.01 < P < 0.05$

$> .70$ ** $0.001 < P < 0.01$

$> .82$ *** $P < 0.001$

3. AGRICULTURE AT A REGIONAL LEVEL

Introduction

3.1 The four major constraints on agricultural practice are relief, soil, climate and economics, and these four variables are inter-related. For example, relief is not only a constraint on the case with which land may be cultivated, but also acts as a modifying factor upon the climatic conditions at a local level. Similarly, the climate, while restricting crop husbandry will also affect the pedogenesis, which in turn is related to the parent material demonstrated in the relief.

3.2 In the uplands of the north and west of Britain these interactions are particularly evident. These uplands are essentially dissected plateaux or denuded domes, largely the result of glaciation. The proportion of good 'in-bye' land to rough grazing is low, while the steep sides of the valleys do not lend themselves to tillage which might increase winter feedstuffs. These features, together with a shortened growing season, steep climatic gradients with elevation and high humidity have determined the agricultural practices that are possible.

3.3 Since the eighteenth century the overall farm practice in the Cumbrian hills has been hill sheep farming. The constraints outlined above have precluded, to a large extent, any other agricultural enterprise. Compared with many other areas the present agricultural practice is remarkably unchanged. Individual holdings in the bottoms of valleys remain the dominant feature of the Cumbrian landscape. Even to the casual observer there is a sharp discontinuity between the enclosed 'in-bye' land and the rough grazing that it supports at a higher altitude.

3.4 Although the basic land form is, of course, the result of glaciation, the superficial landscape characteristics are those of the eighteenth century 'statesmen' and the results of their pioneering agricultural practices are often regarded as 'natural'.

3.5 There has been some fluctuations in stocking rates of sheep due to economic pressures, but many parishes show a remarkable stability

in this respect (Table 11). It is evident that there is a steady slow increase in stocking rates, presumably as animal husbandry, veterinary science and availability of fertilizers has improved but the trend is free from any large fluctuations in stocking rates. However, it is probably ture to say that we may expect changes larger than any to date over the next five decades, and simple examination of historical data is of limited value.

3.6 The hill farmer is particularly sensitive to national economic changes. A change in subsidy can have a catastrophic effect to individual holdings where profit margins are low. Adverse weather conditions in the uplands may prove critical where there is a fine balance between winter stocking rates and feedstuffs available. As a source of breeding stock and 'stores' for fattening on lowland farms, the hill farmer is vulnerable to small changes in demand due to external factors. He is forced into a buyers market at autumn sales as in most Cumbrian farms the ratio of 'in-bye' support land to 'intake' is low and the hill farmer must reduce his stock. To buy in quantities of winter feedstuffs is uneconomic and as a consequence he finds each year that he is entering a monosonistic market.

3.7 The only method by which the breeding stocks for lowland fattening can be maintained is by Government subsidy to the hill farmer. Indeed, this subsidy is as important to the lowland fatstock industry as it is to the hill farmer himself. If the fatstock industry was forced into a situation where it had to supply it's own stores, then it would lose a large proportion of it's profitable arable and dairy land. So long as it is policy to subsidize food prices to the consumer in this way, then it is unlikely that there will be large changes in hill farming practice. The replacing of the various subsidies by EEC support for less favoured area (Directive No. 75/268/EEC) indicates continued assistance for hill farming and most of the upland area of Cumbria falls within the EEC definition.

There is also the possibility of an increasing demand for food production within UK which could result in additional support for hill farming and better prices for produce. However the rapidly increasing cost of fertilisers, machinery and labour complicate the matter.

Trends in agriculture

3.8 The statistics on agriculture in England and Wales, presented for ADAS districts by Coppock (1976) show the dominance of dairy and livestock rearing in the County. In the 12 districts in Cumbria only 10% of the land is under tillage, producing barley, mixed corn and turnips, and situated mainly in the coastal areas and the Eden Valley. The districts which are predominantly uplands are about equally divided between rough grazing and crop and grass, with dairy, beef and sheep comprising 95% of the livestock units. The labour intensity in upland districts is usually between 100 and 300 man days per 100 acres - at the low end of the national range. These district data are characteristic of most of the upland districts in England and Wales, but because of the size of the districts they include considerable proportions of lowlands.

Over the period 1951-71 there appears to be a shift from arable (-40%) to permanent grass (+15%) over the County and some reduction in rough and common grazings (-8%). The fate of the latter (20,000 acres) is uncertain but may be related to a general decline in upland farming. As with other upland areas, and farms in general, there has been a marked increase in the size of holdings those over 150 acres rising from 12% (1951) to 30% (1971) of the total. There was also a decline in the total acreage in agriculture from 10.6 to 7.5 thousand acres between 1951-1971 (Cumbria Structure Plan Report).

3.9 Agriculture is currently showing low returns and low profitability, upland farms being dependant for their existence on subsidies. There is a long-term trend of depopulation and abandonment of upland areas, therefore a likely future trend is for agricultural decline in certain areas. If these areas can be identified, the causes for decline determined, and their potential for alternative uses defined, this will profide useful information to assist in local and regional planning decisions. Such an approach has been adopted by Cumbria Country Council in their Structure Plan. The agriculturally marginal land has been defined on four criteria:

parishes showing depopulation of greater than 15% for the period 1961-71 (Fig. 10)

areas classified as Grade 5 agricultural land

parishes devoted to the least economic type of farming in Cumbria, i.e. sheep rearing

parishes dominated by medium to small livestock rearing farms with a small labour input.

These criteria were weighted and the scores for different areas identified (Fig. 11). Areas with highest scores, amount to about 7% of the area of Cumbria, belonging mainly to map classes 4, 9, 10, 12, 13 and 16. It is in these areas that agriculture is likely to decline. The landscape changes will probably occur in classes 4, 9, 10 and 12 where pasture and rough grazing will tend to revert to more 'natural' vegetation as a result of decreased grazing pressure and management. Deterioration of walls and buildings can be expected and as these areas tend to be the more isolated, less attractive parts of Cumbria, it is unlikely that buildings will be purchased as holiday or second homes. The main land use option open in these areas is forestry, especially on the better land of classes 4, 10 and 12, and this option could be associated with re-development of hill farming in adjacent areas - a debatable point, but an option which should be considered. Some increase in scrub woodland will occur on the better land, especially where seed sources are near at hand, but the increase will be noticeable only over decades. Landscape changes in the upper parts of these areas (classes 13 and 16) will be negligeable because they are already subject to very low levels of grazing and, as the altitude is mainly above 1500', vegetation change will be slow and forestry is not a viable alternative land use.

The areas where landscape changes are expected to occur as a result of agricultural decline are shown in Fig. 12.

3.10 Maintained and increased agricultural management in the uplands is likely to occur mainly in parishes where the population is not declining, where the land has reasonable agricultural potential, farm type is not concentrated on sheep rearing and farms are of medium or large size. Such areas have low scores in Fig.11 and are shown on Fig. 12 where they correspond to land of classes 3 and 4, 9-12. It

is in these areas where pasture improvement, bracken eradication, maintenance of walls and buildings, new buildings and fences can be expected. The probability of these changes will be increased if the expected national demand for food rises and hill farming is supported by EEC. The forestry option in these areas could be developed on larger holdings as integrated land use.

3.11 The direction and rate of change in the upland areas seems to be dependent on european, national and regional policies and on economics. Prediction is hazardous but criteria for change can be specified and used to identify areas likely to change given certain conditions. The accuracy of such predictions is unknown and it is necessary to refine the techniques and monitor key areas to determine both the accuracy of the predictions and to detect actual trends.

4. BRACKEN

4.1 The distribution of bracken in Cumbria is the result of a combination of its preference for moderately good soil conditions, its climatic inhibition at higher altitudes and mans management. It is generally associated with low intensity of management and has probably spread with the decline in numbers of cattle on the fells, its use as bedding for stock and in numbers of small farms (Pearsall and Pennington 1973). The need for an efficient and economic method of control has been partly met by the development of Asulam which has opened up the opportunity of reclamation of potentially productive grassland. It is a moderately expensive herbicide and best results are associated with stock control after spraying.

4.2 What is the extent and distribution of the "bracken problem" in Cumbria? No detailed maps of bracken are available but the estimates of % cover in the vegetation subsampling of map classes shows that it is mainly in class 4 land, and to a lesser extent in 11 and 12. Field sample of common and non-common land (see later) confirmed its frequent occurrance in class 4 and showed that it was particularly abundant on the commons of that class - the low fells which are partly enclosed as pasture. The total area of bracken, estimated from the % cover and total area of each class is 344 km^2 i.e. about (5%) of the total area of Cumbria, and about 40% of the bracken (137 km^2) is

in class 4 land (Table 12). Although there is a low % cover in class 1, because of its large area, a total of 53 km^2 is probably bracken covered.

4.3 Where are control measures likely to occur? Given encouragement through continued government subsidy and reasonable prices for stock, the more foreward looking farmers with reasonable finances will be most likely to control and reclaim bracken covered land. Those with cattle as well as sheep will also have the opportunity to follow up spraying with use of stock to maintain pressure on the bracken and are therefore likely to be encouraged to undertake reclamation. The reward in terms of new pasture production is probably greatest in the lower altitude areas. Thus it could be predicted that control will probably take place in land of classes 1 and 4, Class 1 is lowland and outside the context of the report, but class 4 is often just at or below 800' and is often associated with upland farms. The map of farm types given earlier shows the distribution of "Upland livestock rearing on medium to large sized farms, some dairy farms", and these are the farms which are likly to benefit from, and be capable of bracken control. Such interpretations are tenuous and the opinion of agricultural advisors should be sought, but it is suggested that a more detailed analysis of the distribution of bracken, in conjunction with information on farm structure and variability could identify more closely the position and extent of bracken control. Data on the distribution of places where spraying has already occurred could test the validity of the predictions, or of alternative hypotheses.

5. COMMON LAND

Introduction

5.1 All common land is private property, subject to certain rights of the commoners. Not even all the inhabitants of a parish or village prossessing common land necessarily have rights over the common. However, public access has been granted to some common land. Within the Lake District the public has the right to walk where they please over 16,889 acres of fells - Langdale Fell, Wrynose Fell, Grasmere Common, Patterdale Common, Deepdale Common, Glenridding Common, Loughrigg Fell and Rydal Fell (Law of Property Act, 1925).

Because common land is subject to common rights, including rights of free access from all commoners, the owner is prevented by law from erecting upon it any building or even a fence and is obliged to leave the land open unless the consent of the appropriate Minister is first obtained. Government permission must also be obtained before fencing a trunk road on common land, such as the A591 over Dunmail Raise.

5.2 In the Lake District invasion by bracken and consequent deterioration in quality of the grazing has been so serious in many areas that grazing rights may be little used. A similar situation occurs in the North York Moors National Park where few of the grazing rights are taken up (Statham, 1972). In the central mountain core of the Lake District it seems to make little difference to the present farming economy - hill sheep farming - whether the hill grazing is common or not, nor to scenic character (Dudley Stamp, 1963).

Some commons in the Lake District are stinted (the number of animals that may be pastured on the common is limited), but most are unstinted, when limits to the number of sheep are set only by the number of ewes which the farmer's enclosed pasture will feed at lambing time. Sometimes there is strong contrast between degraded pasture, now mainly Nardus and bracken, of unstinted and hence over-grazed fell commons, and neighbouring areas where the common grazing is stinted and so restricted. On the north-west slope of Skiddaw this contrast can be seen between Bassenthwaite Common, which has been stinted since the enclosure of the open fields in 1796 and has much good Agrostis-Festuca grassland and adjoining commons on the Skiddaw fells where the grazing is unstinted and Nardus and bracken predominate (Pearsall and Pennington, 1973).

5.3 In 1956 the Royal Commission on Common Land reported 139,336 acres of common land in Westmorland. This represents about 50 per cent of the rough grazing and 26 per cent of the total area of Westmorland. Comparable figures for Cumberland were 110,357 acres of common land, being 31 per cent of the rough grazing and 11 per cent of the total area of Cumberland. (Of the total 1.5 million acres of rough grazing in England and Wales 29 per cent is common land). Approximately 17,000 acres of common land were reported for North Lancashire. Thus the total acreage for Westmormand, Cumberland and North Lancashire was

was reported to be approaching 258,000 acres which is a little over 1000 square kilometres.

5.4 From maps provided by Cumbria County Council, the areas of both provisional and final registration common land within each attribute analysis category was estimated to the nearest $\frac{1}{4}$ square kilometre (Table 13). This estimate is approximately 150 square kilometres greater than that reported by the Royal Commission on Common Lands, but this is partly accounted for by the inclusion of part of the old West Riding of Yorkshire in the new county of Cumbria. Field observations also revealed that within some of the areas marked as common land on the map, there were often areas of enclosed land in the valleys which were presumed to be non-common land. Thus the figures given in Table 13 must be regarded as only approximations.

Changes in common lands in Cumbria

5.5 Common land is characterised by the lack of management of the vegetation and soil. It is possible that new legislation may come into being which encourages improvement of the commons. One method of assessing the landscape consequence of a change in management is to compare samples of land within the same class but which differ in the presence and absence of rights of common. Observed differences may be assumed to reflect the extent to which common land could be developed given current management techniques.

Common lands do not exist in Scotland and north Cumberland seems to have come under Scottish influence as there are very few commons in this area. It was therefore decided to restrict the target population to south of latitude $54^{\circ}46'$. The attribute analysis categories were used as strata within this population. It was felt that, of the categories with appreciable areas of common land, the ones most likely to show change due to the removal of the commons restrictions were categories 4, 9, 13 and 14. Random samples of kilometre squares of both common and non-common land were drawn for categories 9, 13 and 14. It was found that there were only about 8 full squares of category 4 common land and some of these proved to contain some non-common land. Landscape features listed in Appendix 4 were recorded for both common and non-common land in each class.

The differences in common and non-common land in each class are summarised as follows:

5.6 Class 4 (Appendix 4)

Although about 5 per cent of common land is in this category, very little is whole kilometre squares. When visited some of the squares which were marked on the map as all common land were found to contain areas of enclosed land which were presumed to be non-common. Such squares are not included in the table. If any further data is required it would be necessary to use a smaller sampling unit.

The samples are small but it is fairly obvious that this is a category where the land use and hence the landscape could change quite markedly. The common land squares are all rough-grazing whereas the non-common squares are either enclosed land with permanent or temporary grassland and arable land or a mixture of cultivated fields and rough grazing. Associated enclosure boundaries are virtually absent from the common land but plentiful and often in good repair on the non-common land. Roads and tracks on the non-common land were also generally fenced.

Pteridium aquilinum was much more abundant in the common land squares than the non-common ones which had a high proportion of good Agrostis-Festuca swards. Woodland was more frequent in the non-common land squares. The planting of trees is one change in land use which could well occur on this category of land and alter the landscape considerably (50 per cent of the non-common squares had some woodland).

Within this category it was sometimes difficult to imagine that the common land could ever look like the non-common land but there is obviously considerable scope for improvement of the common land.

5.7 Class 9 (Appendix 4)

Both types are predominantly rough grazing but there are more enclosures, chiefly large intakes, in the non-common land squares. The associated boundaries are most frequently walls. Because of the current low level of farm labour, if the commons restrictions were lifted, any

enclosure boundaries erected would most likely be fences unless special Government help was given.

Twenty per cent of the non-common land squares sampled in this category were predominantly coniferous plantations. This is a land use which could well become more frequent on this category of land if the commons restrictions were lifted. One of these coniferous plantations accommodated an organised picnic site and car park. There were also more small deciduous woodlands and shelter belts on the non-common areas than on the commons. An increase in area of woodland would add diversity to the landscape which tends to be rather monotonous.

5.8 Classes 13 and 14

Apart from a few large enclosures there was hardly any difference between common and uncommon land in these categories.

5.9 This preliminary trial shows that within the land classes identified by attribute analysis, significant differences can be detected related to management practice. A change in the status of common lands would probably lead to agricultural improvement. The interpretation from the field survey suggests that the impact would be greatest in classes 4 and 9 with an increase in enclosed land and with the possibility of forestry options. An increase in scrub and copse would probably result from greater control of grazing. The enclosure of land would probably differ from that on currently non-common land with the use of fencing rather than hedges and stone walls. The specific areas of common which would be developed would probably occur where there are relatively good soil conditions, good access and where farming is currently most viable. Further definition of these areas is possible but has not been attempted because of lack of time.

5.10 An additional interpretation of the results is that if farming declines in the uplands of Cumbria, many areas currently managed will increasingly resemble common land, as management is discontinued.

Table **11.** Total sheep (ewes, lambs, rams, hogs, drafts and wethers) for Milburn Parish (3516 acres).

Year	Total sheep	Sheep per 100 acres
1867	6353	152.2
1887	6056	172.2
1897	6909	196.5
1900	6985	198.6
1905	6820	193.9
1910	8019	228.1
1914	7721	219.6
1918	6234	177.3
1922	6867	195.3
1926	7497	213.2
1930	7529	214.1
1934	7443	211.7
1938	7414	210.9
1942	6919	196.8
1946	6865	195.3
1950	7299	207.6
1951	7231	205.7
1952	7803	221.9
1953	7864	223.7
1954	8289	235.8
1955	7668	218.1
1956	7814	222.2
1957	7842	223.0
1958	8654	246.1
1959	9184	261.2
1960	8504	241.9
1961	10042	285.6
1962	10192	289.9
1963	9653	274.5
1964	9404	267.5
1965	9317	264.9
1974	8679	246.8

Fig. 10.

Population change

Source: 1961 and 1971 census, county reports table 3: persons present in private households

Fig. 11

Areas of probable unprofitable agriculture based on weighted criteria; high score is least profitable.

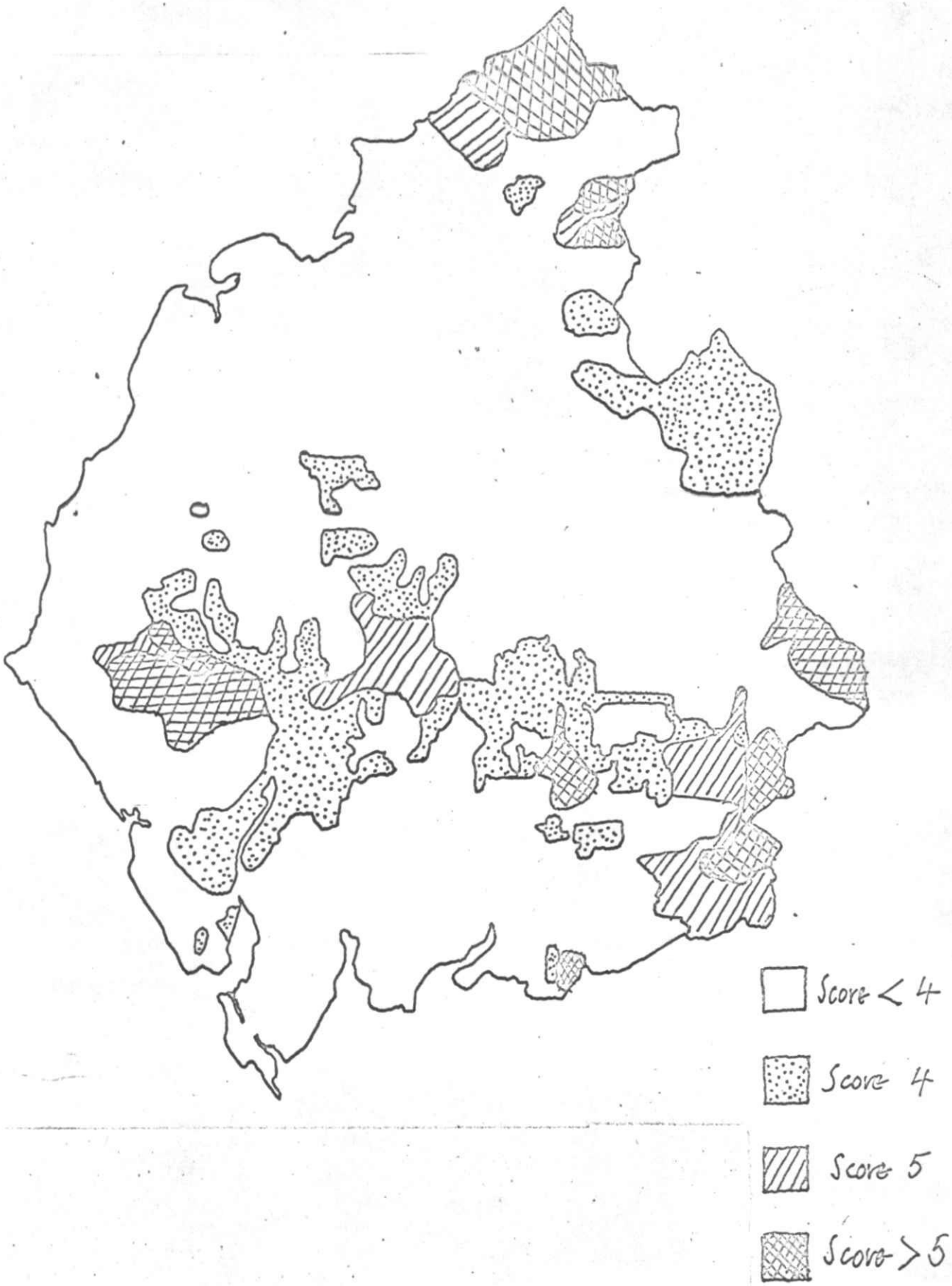
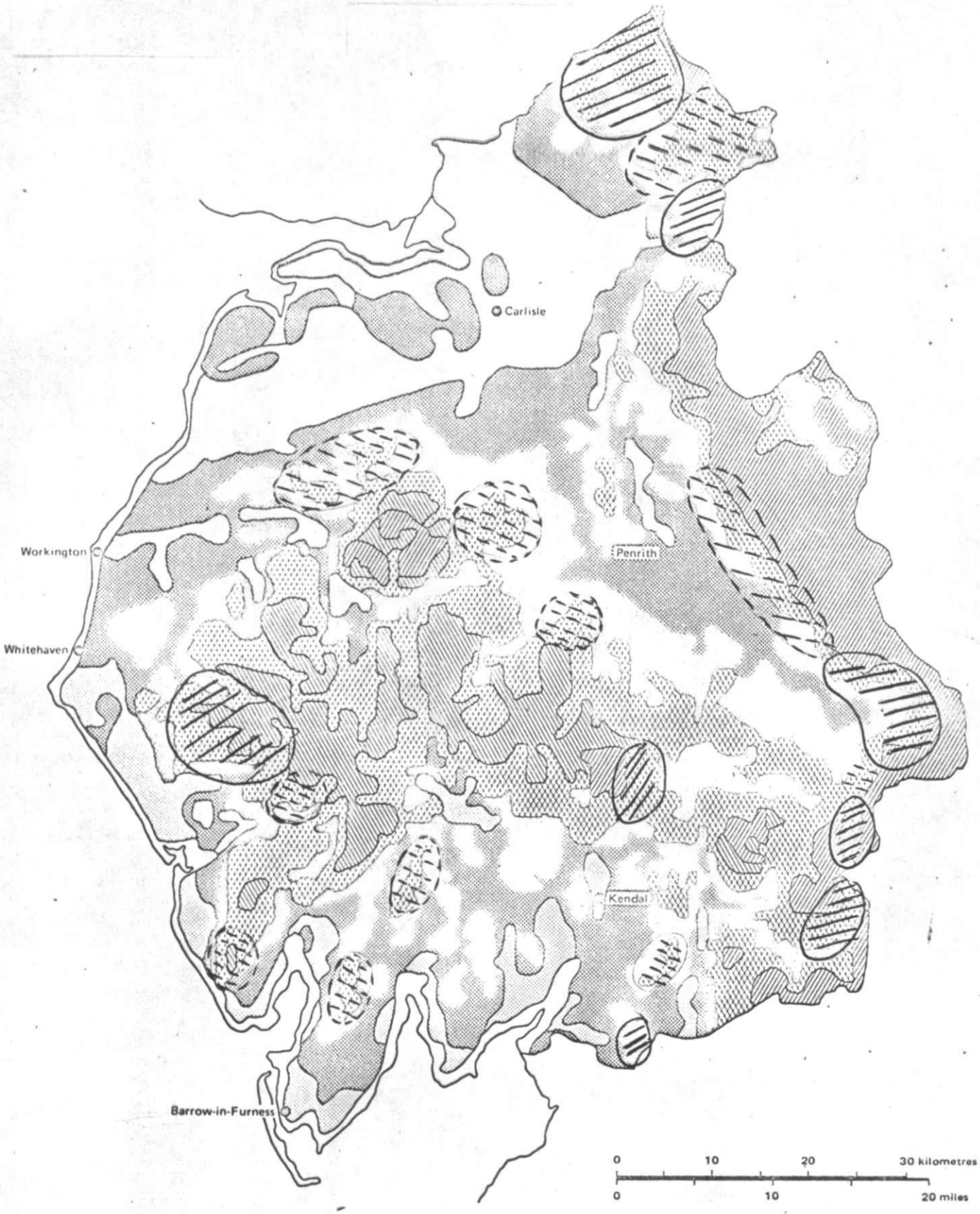


Fig. 12. Areas of probable agricultural decline and improvement



Map class

7,8		Zone A: Coast
5,6		Zone B: Sandstone and alluvial lowland
1,2		Zone C: Subcoastal and Eden Valley lowlands
3,4		Zone D: Low fells

Map class

9,10,11,12		Zone E: Lake District and Pennine foothills
13,14		Zone F: High fells of the north Pennines
15,16		Zone G: High fells of the Lake District

Source: Institute of Terrestial Ecology

landscape change through agricultural decline.

landscape change through agricultural improvement.

Table 12. The % cover of bracken (*Pteridium aquilinum*) in Cumbria map classes and the estimated area of land in each class which is covered.

	Class							
	1	4	5	9	10	11	12	15
% cover	8	19	3	6	6	11	12	1
Total area (km^2)	667	722	660	470	320	463	286	245
Bracken area (km^2)	53	137	20	28	19	51	34	2

Table 13. Area of common land in Cumbria (km^2)

Attribute analysis class	Provisional registration	Final registration	Total (Provisional + final)	% common land (provisional + final) in each category
1	11	13	24	2
2	2	2	5	<1
3	0	23	23	2
4	13	48	61	5
5	14	7	21	2
6				<1
7	7	9	16	1
8	5	8	13	1
9	46	212	258	22
10	7	92	100	8
11	12	64	76	6
12	16	44	60	5
13	7	152	160	13
14	14	119	134	11
15	12	59	72	6
16	46	118	165	14
Total	216	977	1193	

6. FORESTRY

6.1 Close to a half of the Forestry Commission area, and nearly a quarter of the total woodland area in Cumbria is concentrated in the two forests of Kershope and Spadeadam (Table 14). If it were not for these two forests, most of the area outside the Lake District would be privately owned, and individual areas are small - only four private forest estates in the whole of Cumbria exceed 500 ha. In the Lake District, State ownership is nearly double the privately owned area, presumably with the National Trust being among the bigger landowners. Individual areas are much larger than in the rest of Cumbria.

6.2 No information has been given about site factors, species planted or distribution of age classes but a rough indication of the latter can be obtained by converting the figures for 1975/76 timber production to a unit area basis and assuming that higher production is associated with greater mean age of forest. On this basis the oldest forest would be Thornthwaite, followed by Greystoke, Kershope, Grizedale, Blengdale and Ennerdale. Spadeadam is just beginning to produce timber, presumably from first thinnings, and the remaining forests are not expected to start production until after 1979/80.

6.3 There is a considerable area of open fell and moorland lying between 500' and 1500' O.D. where the agricultural potential is low and since any new areas for afforestation must come from areas currently in some form of agricultural use, there should be a strong presumption for using land of relatively low agricultural value, much of which could carry more sheep without serious depletion of the nutrient status. Likely areas in which suitable land for tree planting might become available are those with a declining population.

6.4 There is evidence in the southern Uplands of Scotland that hill land managed for sheep and trees can give improved management for sheep with better control of grazing, provision of shelter and land improvement. 80,000 ha of hill land in Galloway has been afforested in the past thirty years and sheep numbers have increased (data to be confirmed).

6.5 To meet the demand for recreation and to improve the forests as landscape features, the Forestry Commission may modify the management

of a forest on up to 15 per cent of its area. Picnic areas, car parks, forest trails, etc. are relatively commonplace and within the Lake District group of Forests, Grizedale has become particularly well known for its recreational developments and provisions for wildlife, whilst in Thornthwaite Forest extensive landscaping has been performed on the Knott to cure the previous unsympathetic treatments. Elsewhere, selection forestry has been started to maintain continuous tree cover and other measures have been taken to soften the impact of felling operations.

6.6 Detailed information on Forestry Commission forests in terms of species structure and age class has now been obtained to assess the probable time and place of felling and replanting - times when landscape and possibly ecological changes are dramatic and management options are most flexible. Further information on the distribution and type of deciduous woodlands is also being obtained but assessment of change in these woodlands is very difficult without historical research.

Table 14. Present woodland area in Cumbria

	Lake District Area ha	Rest of Cumbria Area ha	Total area ha	1975/76 Timber prod. m^3/ha
Forestry Commission				
Kershope Forest	-	5,097	5,097	3.7
Spadeadam Forest	-	3,850	3,850	0.2
Inglewood Forest	-	947	947	0.0
Greystoke Forest	313	846	1,159	3.9
Thornthwaite Forest	1,954	220	2,174	5.3
Ennerdale Forest	1,573		1,573	1.8
Blengdale Forest	1,036		1,036	2.0
Grizedale Forest	3,054		3,054	2.5
Dunnerdale Forest	800		800	0.0
Dalton Forest (part)	870	538	1,408	0.0
	9,600	11,498	21,098	
Private				
Managed under a plan of operations	4,950	10,409	15,359	
Planted with the aid of the Small Woods Planting Grant Scheme	?	?	881	
Other woodlands	?	?	?	
Total			16,240 +	
	14,550 +	21,907 +	37,338 +	

7. LANDSCAPE

Introduction

7.1 There is probably no better area for a pilot landscape survey than Cumbria. It is a discrete area with well defined boundaries. The complex underlying geology has dictated almost every topographical feature that occurs in the British Isles. There are good examples of topography ranging from coastal and estuarine to the high fells of over 3000 ft. Mining and heavy industry are present on the west coast and the industrial towns of Barrow, Whitehaven and Workington present a sharp contrast to the tourist centres in the Lake District National Park.

Man has left superficial features on the landscape through the ages. The Viking invasion up the south-western river approaches is still evident from the early settlement enclosures, building styles (c.f. barns in Cumbria and Norway) and place-names. The Romans used Cumbria as a trade route to supply their northern defences through the port of Ravenglass and over Hardknott Pass and High Street. The 'statesmen' of the eighteenth century and Victorians have left their distinctive architectural styles which are today the yardsticks used by planners in their efforts to 'preserve traditional building styles in the Lake District'.

7.2 Attempts to classify landscape is fraught with the problems of making subjective judgements. Personal preferences for landscape types are dependent on social background and experience and one is inevitably lead into the difficult field of the psychology of perception. A series of photographs of landscape types shown to a randomly selected group of viewers, produces some "mean preference types" of landscape. However we are concerned to characterise the landscapes of Cumbria, not to apply value judgements.

7.3 The method adopted in a trial study was simply to record the presence or absence of landscape attributes, and relating a land unit of a mosaic of landscape types to another mosaic. This makes no judgement as to whether, say, peat hags are beautiful or ugly. It simply records that within that sampling unit there is a peat hag. The

list of attributes for all the areas sampled is then analysed to define a series of classes each with similar combinations of attributes. The advantages of classification by presence or absence are that, firstly, one uses a standardised approach and does not have to apply different criteria for different landscape types. Secondly, the degree of resolution of recording can be changed to the survey's needs. Obviously, at a farm or valley level it is necessary and possible to use a large number of attributes. By adjusting the number of attributes used in the survey one may use the same method of analysis at a farm, valley, sub-regional, regional or national levels; and the context of one within another, and the interrelationships between the various levels is quickly and accurately assessed.

Given some major change in land use, landscape changes may be illustrated by examination of an area of similar class structure that has already been subjected to such a change. A further advantage of landscape classification by attribute analysis; and that is its simplicity in data collection. Once a list of attributes has been compiled, the actual field or map recording may be carried out by unskilled personnel.

7.4 We have therefore attempted, in a trial run, to classify and characterise the main types of landscape in Cumbria using an attribute analysis, and to determine the extent to which the 16 map classes are associated with recognisable landscape types. The map classes provide a sampling framework which covers the major environmental variation within the County and two independent studies were made to indicate sensitivity of the approach to varying combinations of attributes.

Two lists of landscape attributes, to be determined in the field, were developed independently (Appendix 56). Random km^2 were selected from each map class, omitting the coastal and estuarine classes 7 and 8, and 112 km^2 were sampled in study A and 84 km^2 in study B. In each square the presence or absence of each attribute was recorded and the data analysed by indicator species analysis, as for the map data (p. 5).

7.5 The resulting hierarchical classifications (Figs. 13, 14) show broad similarities both in the type of classes which are identified and in the attributes which are distinctive. The two classifications identify classes which are readily interpretable and which accord with field experience. Similar classifications could be produced by general observation of the area, but the main advantage of the present system is that it provides an objective sorting of all the visually discernable features of an area and identifies those features which are selective. From the key other landscapes within the area can be readily classified by a range of people without bias. The selection of the attribute list may be debateable but this is always the case in landscape assessment.

7.6 A preliminary description of the classes defined by A (Fig. 13) are:

Class 1: Lowland, built up areas, with good communications. Boundaries mainly hedgerows. Scattered woodland often planted.

Class 2: Lowland, generally flat landscape. Few buildings. Hedges prominant feature.

Class 3: Lowland, mixed hedge/wall boundaries. Gently rolling countryside. Mainly pastural.

Class 4: Upland/Lowland margin with few hedgerows. Dry-stone walls a feature.

Class 5: Upland slopes. Often with mixed woodland and farming. Mainly walls as field boundaries. Small fields. Well maintained artefacts.

Class 6: Open craggy lower fell slopes, with small fields and walls. Central fells.

Class 7: Rocky mountain summits and ridges. Open aspects. Central Lakes area.

Class 8: Rolling upland with peat hags, mainly in Pennines.

7.7 For classification B (Fig. 14) the limited number of squares in some classes makes interpretation dangerous, therefore only six classes are accepted i.e. only classes with more than 25 squares are sub-divided further. The classes are recognisable as:

Class 1: Broken, rocky lowland.

Class 2: Arable lowland.

Class 3: Pasture with small woods.

Class 4: Farmed hill land.

Class 5: Non-farmed hill land.

7.8 The selection of squares for development of both classifications was based on the map classes to provide a representative spectrum of land types in Cumbria but this does not mean that correspondence between landscape and map class can be expected. Rather it allows an assessment of the extent to which the map classes are distinguishable as in landscape terms. The correspondence between map and landscape classes in the two trial runs (Tables 15, 16) shows a general grouping of lowland (map classes 1-6), middle (9-12) and upland (13-16) into three sets of landscape classes - 1-3, 4-6, 7-8 in A and 2+3, 1+4, 5+6 in B. However there are some marked deviations from this broad grouping; Map class 4 includes both lowland and intermediate landscape classes reflecting the variation in agricultural development of this land as indicated in earlier sections. Map class 9 includes both intermediate and upland landscape classes indicating that in its landscape it shows variable development and often has more in common with upland classes than do the other intermediate map classes (10-12), a feature reflected in its vegetation (Fig. 7).

7.9 It must be emphasised that this attempt at landscape classification is only a trial, the keys are not regarded as more than examples of what might be produced. Many aspects of the method require further examination - the influence of variation in the initial list of attributes, variation between observers etc. The method has been developed for a scale of the order of a km^2 but assessment of distant landscapes has not been included because they are less likely to be affected by changes in land use.

The classification provides a means of characterising upland areas on their visual features. When changes in land use occur, landscape changes will follow and the method may be of value in monitoring

landscapes in an area over time - with a change in land use will an area change from one landscape class to another? If the classification is sensitive to small changes in land use it may be of value in monitoring change but it may be sensitive also to variation in observers and to small variations between areas.

Fig. 13. Landscape classification for Cumbria, A

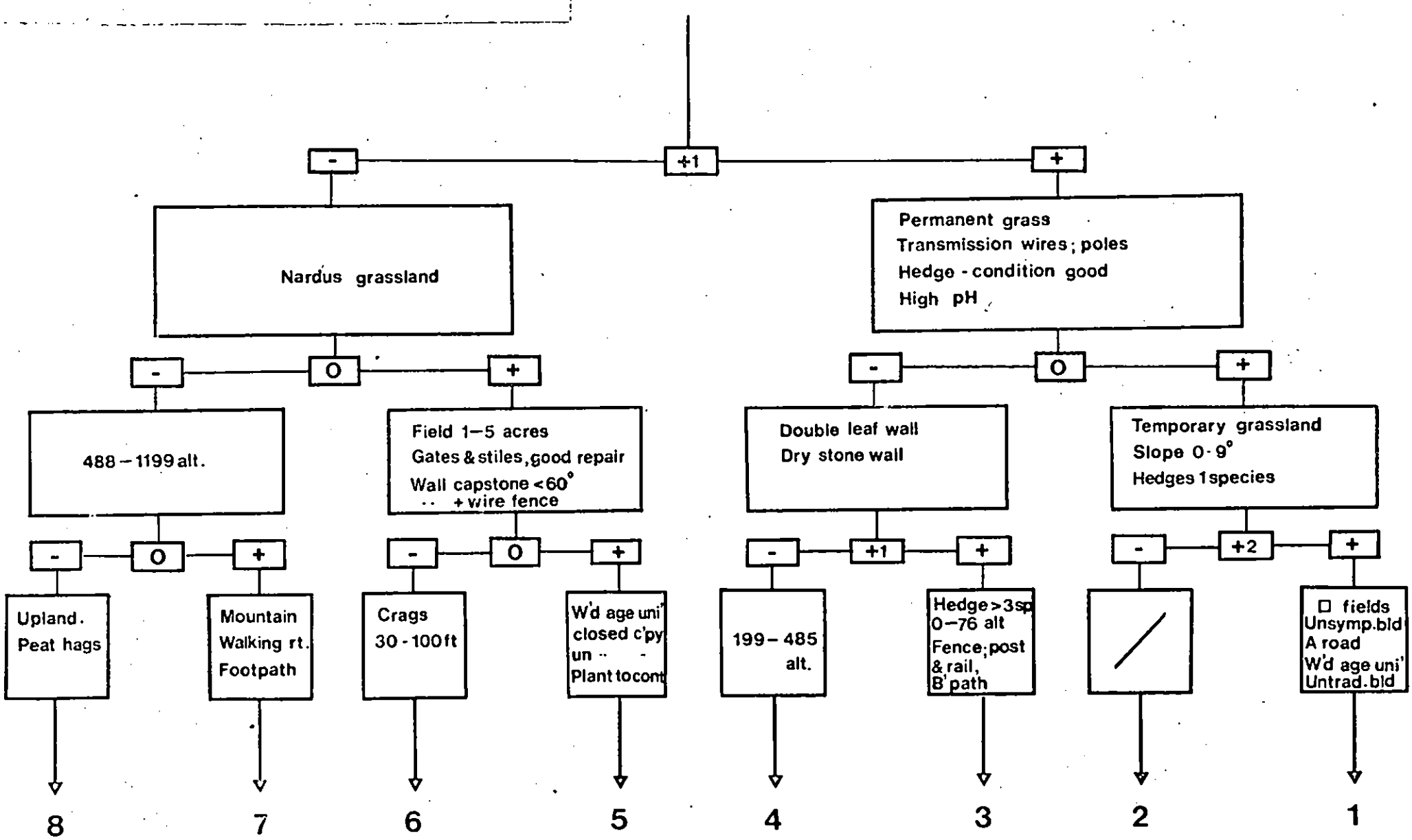


Fig. 14. Landscape classification for Cumbria, B

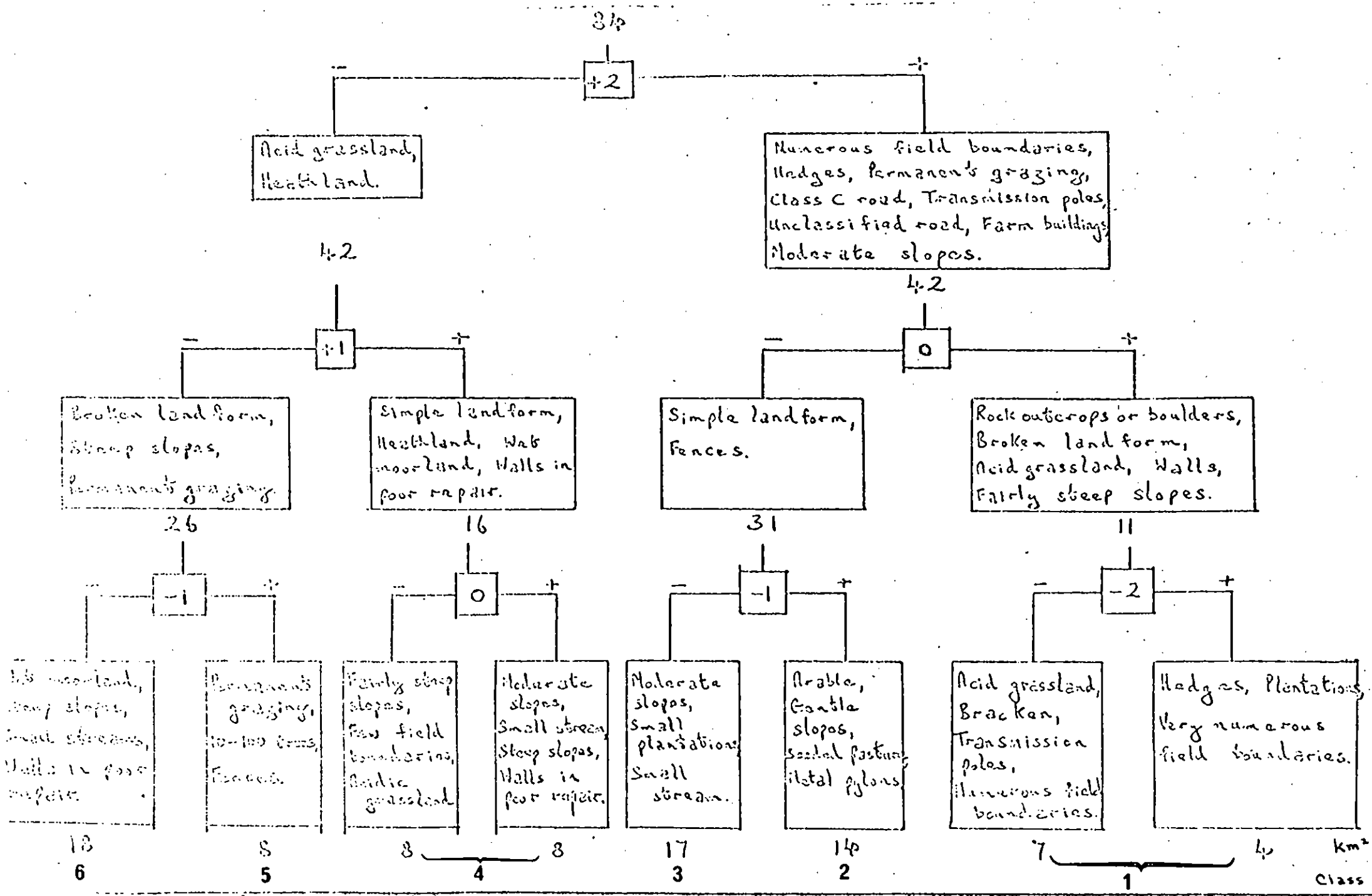


Table 15. Relationship between landscape and map classes, eight km² sampled for each map class. NB Landscape classification A

Landscape class	Map class 1	2	3	4	5	6	9	10	11	12	13	14	15	16
1		3			2	3				1				
2	2	4	1	2	3	3								
3	5	1			2	2			1					
4	1		7	3	1			1	3	2				
5				3				5	3	3	1			
6							3	2	1	2		1	4	1
7							4				4	1		6
8							1				3	6	4	1

Table 16. Relationship between landscape and map classes, six km² sampled for each map class. NB Landscape classification B

Landscape class	Map class 1	2	3	4	5	6	9	10	11	12	13	14	15	16
2	2	2	2	1	3	3				1				
3	1	4	4	1	3	3				1				
1	3			3				2	3					
4							3			4	6	1		2
5				1				3	3			1		
6							3	1				4	6	4

8. PRELIMINARY CONCLUSIONS

8.1 A rapid method for classification and survey of land at regional level is available based on map characteristics. The classes show major environmental gradients which relate to ecological and land use characteristics. The method provides a sampling framework through which the total area and probable distribution of particular characteristics e.g. vegetation, soil type or land use can be readily estimated. Although based on km^2 the classes can be combined into other units e.g. valleys or parishes for sampling and characterisation of land use.

8.2 From a preliminary trial a parallel method of landscape classification, based on the presence or absence of landscape features, appears to be useful.

8.3 The main changes in upland land use which are likely to affect the landscape in Cumbria are in the marginal land, classified as 4, 9, 10, 11 and 12, representing a total of 2261 km^2 i.e. 33% of Cumbria.

a) a continuing decline in upland farming would probably have greatest affect in areas already showing a population decline plus poor land with medium to small sheep rearing farms. Such areas have been identified in the Cumbria Structure Plan Report. In these areas pastures will tend to revert to natural vegetation, walls and buildings deteriorate but with the possibility of forestry as an alternative land use.

b) pasture improvement, including bracken control, is likely to occur in areas not showing a population decline plus relatively good land with medium to large holdings and a range of farm types - these areas have not been identified yet. Combined forestry and grazing could occur in these areas especially if there is an increased national demand for wood.

UPLAND VALLEYS IN CUMBRIA AND THEIR MAP CLASS COMPOSITION (% OF VALLEY AREA). THE VALLEYS ARE ARRANGED IN DECREASING PROPORTION OF LOWLAND CLASSES (1-6).

VALLEY NAME	No.	Total km²	Map Class 1	2	3	4	5	6	Total 1-6	9	10	11	12	Total 9-12	13	14	15	16	Total 13-16
Coniston Water	1	21	61.90	4.76	-	33.33	-	-	100.0	-	-	-	-	0	-	-	-	-	0
Elterwater	2	10	-	30.00	10.00	20.00	-	40.00	100.0	-	-	-	-	0	-	-	-	-	0
Windermere East/ Bowness/ Ambleside	3	23	30.43	17.39	-	17.39	13.04	13.04	91.29	-	4.35	-	4.35	8.7	-	-	-	-	0
Claife Heights	4	24	41.67	-	-	16.67	25.00	4.17	87.51	-	-	12.50	-	12.50	-	-	-	-	0
Lorton Vale	5	89	24.72	8.99	-	19.10	12.36	5.62	70.79	8.99	4.49	7.87	-	21.35	2.25	-	-	5.62	7.87
Bassenthwaite	6	66	13.64	10.61	4.55	16.67	15.15	9.09	69.71	13.64	4.55	-	-	18.19	4.55	3.03	1.52	3.03	12.13
Tarn Hows and Coniston	7	31	6.45	6.45	-	32.26	12.90	6.45	64.51	3.23	6.45	25.81	-	34.49	-	-	-	-	0
Duddon Valley	8	43	4.65	6.98	-	37.21	-	-	48.84	11.63	2.33	9.30	11.63	34.89	-	-	4.65	11.63	16.78
Lickle Valley	9	20	25.00	-	-	10.00	10.00	-	45.0	20.00	-	20.00	15.00	55.0	-	-	-	-	0
Bannersdale	10	27	-	22.22	-	22.22	-	-	44.44	22.22	14.81	11.11	-	48.14	7.41	-	-	-	7.41
Dentdale	11	56	-	5.36	21.43	16.07	-	-	42.85	16.07	17.86	10.71	-	44.64	7.14	3.57	1.79	-	12.5
Ullswater West	12	40	-	7.5	15	15	-	-	37.50	15	30	5	2.5	52.5	-	-	7.5	2.5	10.0
Loweswater	13	50	-	-	-	36	-	-	36.0	42	6	8	2	58.0	4	-	2	-	6.0
Greta Valley	14	80	-	2.5	-	30	-	1.25	33.75	12.5	10	6.25	3.75	32.5	7.5	8.75	6.25	11.25	33.75
Ravenstonedale	15	101	-	-	25.74	5.94	-	-	31.68	20.79	11.88	11.88	5.94	50.49	12.87	-	3.96	0.99	17.82
Derwentwater	16	60	10	6.67	-	8.33	3.33	3.33	31.66	20	18.33	-	5	43.33	-	-	8.33	16.67	25.0
Kentmere	17	26	-	3.85	-	26.92	-	-	30.77	15.38	26.92	7.69	-	49.99	-	-	3.85	15.38	19.23
Eskdale	18	48	4.1	4.1	-	12.5	6.25	-	26.95	27.08	2.08	10.42	10.42	50.25	-	-	8.3	14.5	22.8
Wasdale	19	54	9.26	3.70	-	9.26	-	-	27.22	20.37	7.41	5.56	-	33.34	-	-	12.96	31.48	44.44

	VALLEY NAME	No.	Total km²	Map Class 1	2	3	4	5	6	Total 1-6	9	10	11	12	Total 9-12	13	14	15	16	Total 13-16
	Longsleddale	20	27	-	-	-	22.22	-	-	22.22	22.22	18.52	11.11	-	51.85	-	-	3.70	22.22	25.92
	Little Langdale	21	14	-	-	-	21.43	-	-	21.43	21.43	28.57	7.14	-	57.14	-	-	7.14	14.29	21.43
	Rawthey/Cautley	22	63	-	3.17	3.17	14.29	-	-	20.53	30.16	11.11	12.70	1.59	55.56	20.63	1.59	1.59	-	23.81
	Caldew Valley	23	41	-	-	9.76	9.76	-	-	19.52	4.88	17.07	2.44	-	24.39	19.51	9.76	21.95	4.88	56.1
	Newlands	24	21	-	-	-	19.05	-	-	19.05	28.57	19.05	-	-	47.62	-	4.76	-	28.57	33.33
	Barbondale	25	16	6.25	-	-	12.5	-	-	18.75	50	6.25	25	-	81.25	-	-	-	-	0
	Troutbeck	26	23	-	4.35	-	13.04	-	-	17.39	26.09	17.39	8.70	4.35	56.53	-	-	4.35	21.74	26.09
	Dufton	27	30	-	13.33	-	3.33	-	-	16.66	6.67	23.33	3.33	-	33.33	20	26.67	3.33	-	50.0
	Grasmere	28	55	1.82	9.09	-	5.46	-	-	16.36	27.27	10.91	5.45	5.45	49.08	-	-	5.45	29.09	39.54
	Blengdale	29	20	-	5	-	10	-	-	16.0	30	-	-	30	60.0	-	-	5	20	25.0
	Crowdundale	30	19	-	5.26	5.26	5.26	-	-	15.78	10.53	-	15.79	5.26	31.58	26.32	26.32	-	-	52.64
	Buttermere	31	32	-	-	-	15.65	-	-	15.65	31.25	6.25	12.50	3.13	53.13	3.13	-	6.25	21.88	31.26
	Coledale Beck/ Braithwaite	32	22	-	-	4.55	4.55	-	4.55	13.65	18.18	13.64	-	-	31.82	4.55	9.09	-	40.91	54.55
	Great Langdale	33	30	-	-	-	13.33	-	-	13.33	26.67	10.00	-	3.33	40.0	-	-	-	46.67	46.67
	Martindale	34	42	-	-	-	11.90	-	-	11.90	35.71	19.05	7.14	-	61.9	-	2.38	4.76	19.05	26.19
	Mitredale	35	17	-	-	-	11.76	-	-	11.76	29.41	5.88	5.88	17.65	58.52	-	-	5.88	23.53	29.41
	Ennerdale	36	49	-	2.04	-	8.16	-	-	10.20	28.57	4.08	2.04	4.08	38.77	-	-	6.12	44.90	51.02
	Stockgill	37	11	-	-	-	9.09	-	-	9.09	45.45	18.18	-	-	63.63	-	-	18.18	9.09	27.27
	Coniston Fells	38	26	3.85	-	3.85	-	-	-	7.7	30.77	7.69	-	-	38.46	-	-	15.38	38.46	53.84
	Highcup Gill	39	14	-	7.14	-	-	-	-	7.14	7.14	14.29	-	-	21.43	28.57	35.71	7.14	-	71.42
	Borrowbeck	40	32	-	-	-	3.33	-	-	3.33	37.5	21.88	6.25	-	65.63	21.86	-	6.25	3.33	-
	Langstrath	41	34	-	-	-	5.88	-	-	5.88	26.47	5.88	-	2.94	35.29	-	2.94	11.76	44.12	58.82
	Thirlmere	42	36	-	-	2.78	2.78	-	-	5.56	27.78	16.67	-	8.33	52.78	-	-	8.33	33.33	41.66

	VALLEY NAME	No.	Total km²	Map Class 1	2	3	4	5	6	Total 1-6	9	10	11	12	Total 9-12	13	14	15	16	Total 13-16
	Grizedale Beck/ Patterdale	43	19	-	-	-	5.26	-	-	5.26	10.53	15.79	-	-	26.32	-	-	-	68.42	68.42
	Garsdale	44	42	-	-	-	4.76	-	-	4.76	14.29	64.29	11.90	-	90.48	4.76	-	-	-	4.76
	Blackburn/ Gilderdale	45	53	-	-	3.77	-	-	-	3.77	1.89	13.21	3.77	-	18.87	45.28	32.08	-	-	77.36
	Swindale-Mosedale	46	27	-	-	-	3.70	-	-	3.70	29.63	18.52	3.70	-	51.85	3.70	3.70	22.22	14.81	44.43
	Haweswater	47	36	-	-	-	2.78	-	-	2.78	30.52	5.56	8.23	-	44.41	-	8.33	11.11	33.33	52.77
	Wormgill	48	16	-	-	-	-	-	-	0	31.25	-	-	37.50	68.75	6.25	-	12.50	12.50	31.25
	Wetsleddale	49	17	-	-	-	-	-	-	0	47.06	17.65	-	-	64.71	5.98	5.88	28.53	-	35.20
	Hartsop	50	41	-	-	-	-	-	-	0	14.63	24.39	2.44	-	41.46	-	2.44	4.88	51.22	58.54

Appendix 2

Cumbria Analysis. Procedure used for multiple ranking of 51 valleys.

1. The total number of 1 km^2 in each valley system was calculated.
2. The number of km^2 of each class type 1-16 was calculated and expressed as a percentage of the total km^2.
3. The percentages of classes 1-8 were summed.
4. The systems were ranked in descending order and assigned an accession number.
5. The systems were plotted against their percentage total classes 1-8, and divided into four categories at the points of discontinuity (see graph).
6. Within each category the percentage total of (a) Classes 9-12 (b) Classes 13-16 were calculated.
7. These sub-sets were then ranked in descending order.
8. The highest ranked of each sub-set was extracted as a multiple ranked valley system.
9. Hartsop and Crowdundle were added to these valleys to give ten systems for further analysis.

Appendix 3

Map class structure of the parishes associated with the ten selected valleys. The percentage of each class in the valley is given. Data for both Hawkshead and Coniston parishes are given because both were associated with valley 7. The parishes are ranked in order of the percentage of lowland classes (1-8)

Parish	Associated valley	Map class														Totals		
		1	2	3	4	5	6	9	10	11	12	13	14	15	16	1-8	9-12	13-16
Hawkshead'	7	15	5	-	45	15	3	-	-	18	-	-	-	-	-	83	18	0
Bassenthwaite	6	10	13	7	20	20	-	10	-	-	-	7	10	-	3	70	10	20
Culgaith	30	-	46	2	9	2	-	3	-	4	7	11	16	-	-	59	14	27
Barbon	25	17	-	-	9	9	-	33	-	12	-	5	2	-	-	36	58	6
Loweswater	13	-	-	-	35	-	-	44	3	6	-	6	-	3	3	335	53	12
Coniston	7	10	2	2	15	-	5	-	13	12	12	-	-	10	20	34	37	29
Mungrisdale	23	-	-	21	12	-	-	6	12	3	6	21	7	6	6	33	27	40
St. Johns	14	3	1	1	11	-	-	16	12	4	9	-	1	10	32	15	441	43
Shap Rural	49	-	-	9	2	-	-	28	14	9	5	7	3	13	11	11	55	34
Patterdale	50	-	-	-	3	-	-	13	25	2	3	-	1	1	51	3	43	54
Garsdale	44	-	-	-	1	-	-	11	43	13	-	31	2	-	-	1	66	33

Table Percentage occurrence of attributes in Category 4, common and non-common land

N.B. Sample size: common 3, non-common 4

For vegetation cover d = dominant, f = frequent, o = occasional, a = absent

	Common Final Registration	Non-common
Land form		
Upland	-	100
Hill land	100	25
Land use		
Permanent grassland	-	100
Temporary grassland	-	25
Arable: roots	-	25
Fallow/early tillage	-	50
Rough grazing	100	50
Grouse moor	-	-
Drainage good	100	100
Drainage poor	100	75
Drainage channels	-	-
Woodland: scrub	33	50
copse	-	50
shelterbelt (buildings)	-	25
shelterbelt (livestock)	-	25
scattered trees	33	-
deciduous: monoculture	-	25
2 species	-	-
3 or more species	-	25
coniferous: monoculture	-	25
2 species	-	-
3 or more species	-	-
mixed coniferous/deciduous	-	25
less than 2 acres	33	50
2-100 acres	-	25
more than 100 acres	-	-
age structure uniform	-	50
age structure mixed	-	-
unclosed canopy	33	25
closed canopy	-	50
understorey: 1 species	-	-
understorey: 2 or more species	-	25
evidence of recent management practice	-	-
planting to contours and land form	-	75
planting unsympathetic blocks	-	25
Vegetation		
Pteridium aquilinum	66d, 33f	75o, 25a
Calluna vulgaris	33f, 33o, 33a	25o, 75a
Nardus stricta	33o	75o, 25a
Juncus sp.	100o	50o, 25a
Molinia caerulea	-	-
Festuca/Agrostis	-	50d, 25o
Enclosures		
Field sizes: less than 1 acre	-	25
1-5 acres	-	100
5-10 acres	-	75
more than 10 acres	-	25
Intake enclosure	-	-
Fence	-	75
Hedge	-	50
Hedge: overall condition good	-	25
overall condition poor	-	50
Wall	33	75
Wall: state of repair good	33	75
state of repair poor	-	50
Gates and stoops: state of repair good	-	100
state of repair poor	-	50
Stile	-	25

	Common Final Registration	Non-common
Communications		
Unclassified road: fenced	-	75
unfenced	33	-
Unmetalled track: fenced	-	75
unfenced	-	25
Bridlepath	-	25
Footpath	33	100
Cattle grid	-	25
Parking: grass	33	-
5-50 cars	-	-
more than 50 cars	-	-
Buildings		
Single house	-	-
Farmstead	-	75
Barn/shippon	-	25
Sheep folds: state of repair good	-	-
state of repair poor	-	-

Percentage occurrence of attributes in category 3, common and non-common land.

Sample size: common 10 final registration, 6 provisional registration, 14 non-common

	Common		
	Final registration	Provisional registration	Non-Common
Land form			
Upland	-	-	43
Hill land	100	100	50
Land use			
Permanent grassland	10	-	-
Temporary grassland	-	-	-
Arable: roots	-	-	-
Fallow/early tillage	-	-	-
Rough grazing	100	100	93
Grouse moor	-	-	7
Drainage good	90	100	100
Drainage poor	100	66	64
Drainage channels	10	-	-
Woodland: scrub	10	-	-
copse	-	-	-
shelterbelt (buildings)	-	-	7
shelterbelt (livestock)	-	-	21
scattered trees	-	33	14
deciduous: monoculture	-	-	-
2 species	-	-	14
3 or more species	-	17	29
coniferous: monoculture	-	-	7
2 species	-	-	-
3 or more species	-	-	21
mixed coniferous/deciduous	-	-	7
less than 2 acres	-	17	14
2-100 acres	-	-	21
more than 100 acres	-	-	14
age structure uniform	-	-	43
age structure mixed	-	17	7
unclosed canopy	-	-	29
closed canopy	-	-	29
understorey: 1 species	-	-	7
understorey: 2 or more species	-	-	7
evidence of recent management	-	-	21
planting to contours and land form	-	-	29
planting unsympathetic blocks	-	-	7
Vegetation			
Pteridium aquilinum	10f, 20o, 30a	50f, 33o, 17a	14d, 14f, 50o, 21a
Calluna vulgaris	40o, 50a	17d, 17f, 17o, 50a	7d, 21f, 7o, 64a
Nardus stricta	20d, 10f, 60o	33d, 17f, 50o	21d, 7f, 57o
Juncus sp.	30f, 30o	17f, 33o	14f, 36o
Molinia caerulea	10d	17o	14o
Festuca/Agrostis	10f	-	7d, 7f
Enclosures			
Field sizes: less than 1 acre	-	-	-
1-5 acres	-	-	7
5-10 acres	-	-	7
more than 10 acres	-	-	36
Intake enclosure	10	-	29
Fence	-	17	50
Hedge	-	-	-
Hedge: overall condition good	-	-	-
overall condition poor	-	-	-
Wall	10	33	86
Wall: state of repair good	10	-	57
stage of repair poor	-	33	57
Gates and stoops: state of repair good	10	-	43
state of repair poor	-	-	21
Stile	-	-	7

		Common		
		Final registration	Provisional registration	Non-Common
Communications				
Unclassified road:	fenced	-	-	14
	unfenced	10	-	7
Unmetalled track	fenced	-	-	-
	unfenced	30	17	21
Bridlepath		20	33	14
Footpath		20	100	57
Cattle grid		-	-	-
Parking: grass		10	-	7
5-50 cars		-	-	14
more than 50 cars		-	-	-
Buildings				
Single house		-	-	7
Farmstead		-	-	7
Barn/Shippon		-	-	-
Sheep folds:	state of repair good	10	-	7
	state of repair poor	20	33	-
Picnic area:	organised	-	-	7

Appendix 5

Project 398 CUMBRIA

FIELD RECORDING CHECK LIST

Grid ref for km^2:

Recorder:

Associated Parish:
Attribute anal. class:
Date:

A. Land Form

1. Mountainous
2. Upland
3. Hill Land
4. Upland Valley
5. Lowland Valley
6. Steep craga/scarp
7. Maximum altitude
8. Minimum altitude
9. Slope
10. Aspect

B. Land Use

11. Permanent grassland
12. Temporary grassland
13. Arable:cereals
14. Arable:roots
15. Arable:other
16. Fallow/early tillage
17. Rough grazing
18. Grouse moor
19. Moorland:worked peat
20. Moorland:deep ploughed for plantations
21. Moorland:burning regime evident

22. Drainage good
23. Drainage poor
24. Shallow soil
25. Deep soil
26. Low pH
27. High pH

28. Woodland:scrub
29. Woodland:parkland
30. Woodland:copse
31. Woodland:shelterbelt (building)
32. Woodland:shelterbelt (livestock)
33. Woodland:deciduous:monoculture
34. Woodland:deciduous:2 species
35. Woodland:deciduous:3 or more species
36. Woodland;coniferous:monoculture
37. Woodland:coniferous:2 species
38. Woodland:coniferous:3 or more species
39. Woodland:mixed coniferous/deciduous
40. Woodland less than 2 acres
41. Woodland:2-100 acres
42. Woodland:more than 100 acres
43. Woodland:age structure uniform
44. Woodland:age structure mixed
45. Woodland:unclosed canopy
46. Woodland:closed canopy
47. Woodland:understorey:1 species
48. Woodland:understorey:2 or more species
49. Woodland:evidence of recent management practice
50. Woodland:planting to contours and land form
51. Woodland:planting unsympathetic blocks

52. Bracken ~~dominant~~ prominant
53. Bracken absent
54. Calluna ~~dominant~~ prominant
55. Calluna absent
56. Nardus grassland

57. Water:ditch with standing water
58. Water:small beck:slow flowing
59. Water:small beck:fast flowing
60. Water:small river:slow flowing
61. Water:small river:fast flowing
62. Water:large river
63. Water:waterfall
64. Water:natural lake less than 1 acre
65. Water:natural lake 1-10 acres
66. Water:natural lake 10-100 acres
67. Water:natural lake:more than 100 acres
68. Water:man-made reservoir:less than 10 acres
69. Water:man-made reservoir:10-100 acres
70. Water:man-made reservoir:more than 100 acres
71. Water:dam prominant feature
72. Water:landing stages
73. Water:no public access
74. Water:public access

C. Enclosures

75. Field sizes:less than 1 acre
76. Field sizes:1-5 acres
77. Field sizes:5-10 acres
78. Field sizes:more than 10 acres
79. Intake enclosure
80. Field shapes square
81. Field shapes rectangular
82. Field shapes rounded

D. Enclosure Boundaries

83. Deer fence
84. Fence:wooden post and rail
85. Fence:metal post and rail
86. Fence:metal chain link/barbed-wire
87. Hedge:1 species only
88. Hedge:1-3 species
89. Hedge:more than 3 species
90. Hedge:with standard trees
91. Hedge:laid within 4 years
92. Hedge:overall condition good
93. Hedge:overall condition poor
94. Bank
95. Bank and Hedge
96. Ditch
97. Wall:dry-stone
98. Wall:mortared stone
99. Wall:single leaf
100. Wall:double leaf
101. Wall:cap-stones less than 60° to horizontal
102. Wall:cap-stones vertical
103. Wall:through-stones prominant
104. Wall:state of repair good
105. Wall:state of repair poor
106. Gates and stoops:state of repair good
107. Gates and stoops:state of repair poor
108. Wall with wire fence in support
109. Stile

E. Visible Rock

110. Rock outcrops:angular
111. Rock outcrops:smooth
112. Drumlins
113. Large erratic boulders
114. Scree slopes:stable
115. Scree slopes:unstable
116. Rock pavement
117. Rock cuttings:road/rail
118. Gullies
119. Near-verticle crags:less than 30 ft
120. Near vertical crags:30-100 ft
121. Near vertical crags:100-300 ft
122. Near vertical crags:more than 300 ft
123. Tors
124. Clitter slopes
125. Quarry:disused
126. Quarry:worked

F. Communications

127. M-way
128. 'A' class:dual carriage-way
129. 'A' class:single carriage-way
130. 'B' class road
131. Unclassified road:fenced
132. Unclassified road:unfenced
133. Unmetalled track:fenced
134. Unmetalled track:unfenced
135. Bridlepath
136. Footpath
137. Cattle grid
138. Railway B.R.
139. Railway:other
140. Railway:B.R.:overhead electric
141. Transmission wires:pylons
142. Transmission wires:poles
143. Above surface pipelines
144. Parking:grass
145. Parking:5-50 cars
146. Parking:more than 50 cars
147. Road signs prominant feature
148. Snow marker posts
149. Bridge:road:metal
150. Bridge:road:stone
151. Bridge:rail over road
152. Bridge:rail over river
153. Bridge:road over river
154. Bridge:road over rail
155. Bridge:road over road
156. Bridge:pedestrian

G. Services

157. Cafe
158. Restaurant
159. Public house (non-residential)
160. General stores
161. Post Office
162. Specialist stores and crafts
163. Farm produce for sale
164. Telephone kiosk
165. Post box
166. Public conveniences
167. Picnic area:organised
168. Litterbins
169. Nearest rail station within 3 miles
170. Nearest bus route within 3 miles
171. Tourist information centre

H. Accommodation

172. Hotel
173. Guest house
174. Public House (residential)
175. Bed and Breakfast (house)
176. Bed and Breakfast (farm)
177. Youth hostel
178. Outdoor pursuits centre
179. Caravan site:laid out
180. Caravan site:not laid out
181. Isolated caravans
182. Campsite
183. Campsite:caravans and tents
184. Isolated tents
185. Campsite and caravans:screened
186. Campsite and caravans:not screened

I. Recreation

187. Popular picnic site
188. Popular walking route
189. Rock climbing
190. Shooting
191. Fishing
192. Sailing
193. Motor boats
194. Water skiing
195. Hang gliding
196. Grass skiing
197. Snow skiing
198. Ski-tow
199. Pony trekking
200. Orienteering
201. Neture trail
202. N.N.R.
203. N.T.:Historic interest
204. N.T.:other
205. Historic interest:not N.T.
206. Golf course
207. Race course
208. Hill-climb circuit (motors)
209. Motor cycle scrambling

J. Buildings

210. Single house
211. Framstead
212. Barn/shippon
213. Church:spire
214. Church:tower
215. Church:neither
216. Hamlet
217. Village
218. Town
219. Buildings largely in the vernacular
220. Buildings materials local
221. Buildings largely untraditional
222. Buildings unsympathetic

K. Additional Attributes

Appendix 6

Attributes for landscape analysis (1 km grid squares or ½ km squares)

1.	Difference between max. and min. height	0-25'
2.	Difference between max. and min. height	25-100'
3.	Difference between max. and min. height	100-300'
4.	Difference between max. and min. height	300-600'
5.	Difference between max. and min. height	600' +
6.	Landform - simple, i.e. flat or rounded or smooth slopes	
7.	Landform - broken, i.e. hillocky or irregular	
8.	Landform - very complex, i.e. flat bits plus steep slopes, cliffs, etc.	
9.	Scree	
10.	Rock outcrops or large boulders	
11.	Small stream	
12.	Stream	
13.	River	
14.	Waterfall	
15.	Drainage ditch	
16.	Pools (< 1 ha))	
17.	Tarn (1-20 ha)) at least 0.5 ha in the square	
18.	Lake (20 + ha))	
19.	Reservoir (obviously man-made)	
20.	Arable)	
21.	Seeded pastures (*Lolium* mixtures))	
22.	Hay meadows (herb-rich))	
23.	Permanent grazing (not herb-rich))	
24.	Marshland)	More than 0.5 ha
25.	Acidic grassland (*Nardus*, etc.))	
26.	Wet moorland (*Juncus*, *Molinia*, etc.))	
27.	Heath (*Erica*, *Calluna*, etc.))	
28.	Acidic mires (*Eriophorum*, *Narthecium*, etc.))	
29.	Bracken)	
30.	Scrub)	
31.	Individual trees, or groups 1- 10)	1-5
32.	Individual trees, or groups 10-100 trees)	5-25 for ½ km²
33.	Individual trees, or groups 100 + trees)	25 +
34.	Semi-natural woodlands 0.5 to 5 ha)	
35.	Semi-natural woodlands 5 to 20 ha)	
36.	Semi-natural woodlands 20 + ha)	
37.	Plantations with "compatible" outline 0.5 to 5 ha)	0.5-2 ha
38.	Plantations with "compatible" outline 5 to 20 ha)	5-10 ha
39.	Plantations with "compatible" outline 20 + ha)	10 + ha
40.	Plantations with straight or hard edges or rides divorced from landform or field pattern 0.5-5 ha)	for ½ km sq
41.	Plantations with straight or hard edges or rides divorced from landform or field pattern 5-20 ha)	
42.	Plantations with straight or hard edges or rides divorced from landform or field pattern 20 + ha)	

Roads, etc.

43. Footpath or bridleway
44. Unmetalled or unclassified road
45. Class C road
46. Class B or A road (not dual-carriageway)
47. Dual-carriageway or motorway
48. Lay-by or car park for less than 10 cars
49. Lay-by or car park for more than 10 cars
50. Railway

Buildings, etc.

51. Farm buildings or farm cottages in local materials or style
52. Farm buildings or farm cottages in obviously modern materials and style
53. Derelict buildings
54. Houses, cafes, hotels, shops, etc. 1-5
55. Houses, cafes, hotels, shops, etc. 5-20
56. Houses, cafes, hotels, shops, etc. 20 +
57. Permanent camp-site, well screened
58. Permanent camp-site, not well screened
59. Isolated caravans or tents, well screened
60. Isolated caravans or tents, not well screened
61. Shooting-butts
62. Wooden transmission poles
63. Metal pylons
64. Quarry or mine, disused
65. Quarry or min, in use

Field boundaries

66. Total length of field boundaries 0.1- 1 km)[1/] 10- ½ km (for
67. Total length of field boundaries 1- 4 km) ½ -1 km (¼
68. Total length of field boundaries 4-10 km) 1 -2½ km (km
69. Total length of field boundaries 10 km +) 2½ + km (sq
70. Walls, in good repair, >10% of field boundaries
71. Walls, in poor repair, >10% of field boundaries
72. Hedges, in good repair, >10% of field boundaries
73. Hedges in poor repair, >10% of field boundaries
74. Fences, in good repair, >10% of field boundaries
75. Fences, in poor repair, >10% of field boundaries