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LAND CLASSIFICATION FOR REGIONAL SURVEYS

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Introduction

One of the problems of regional surveys is that workers from particular disciplines carry out specialist surveys using different units and sampling patterns. One of the main objectives of the methodology described below is to provide a common environmental base for co-ordinating different natural environmental surveys. A common data base is difficult to find since even such basic maps as those of the solid geology of an area are often unobtainable. The selection of a data base therefore involves finding information that can be recorded consistently for the entire area and is therefore always at a low level of detail.

The ecological survey of Cumbria stemmed from investigations into the application of multivariate methods to the analysis of the environment as expressed by a large number of attributes, rather than a few variables measured in detail. The approach involves the use of a wide range of environmental attributes that hold correlations with more fundamental ecological factors but are not causal in the way that ecologists traditionally treat relationships between species and environmental factors. For example, roads can be associated with particular physiographic features which, in turn, influence ecological factors, but do not have a causal relationship with individual species. Similarly, altitude acts as an index of climatic and soil influences and holds a sufficient range of correlations with other factors to be a very important integrating factor. The use of altitude in this way is widely recognised and the approach developed has extended this principle to a wide range of other information held on maps previously not used for ecological purposes. The data that is fed into the analysis is therefore designed to provide a summary of the overall environment of the area concerned. Once the summary (classification) of the environment has been achieved, it follows that a stratification base is produced, since it will hold correlations with a wide range of ecological criteria. There is therefore a parallel with the regression principle, in that the environmental parameters are used as the independent (i.e. 'X' variable), for which predictions may be required. The former are relatively easy to obtain, since they are available from maps, whereas the latter are more difficult since they require field survey. The various phases described below further elaborate these principles but it is worth repeating the main objective: that of an overall summarisation of the environment.

The British countryside is very diverse and on a small scale in comparison with, for example, Canada, and hence it has not proved possible to divide the area into major landform units - although

the extremes of flood plain and mountain summit are readily recognisable. The majority of the land surface is in relatively small scale patterns which are difficult to separate into natural units, although the morphological mapping techniques developed by geomorphologists can achieve this. Accordingly a sample system was required and a 1 km square base was adopted since it affected a satisfactory compromise in size terms, in that it was big enough to cover a whole county, but also sufficiently small to provide an adequate base for field sampling. It was also convenient for computer mapping purposes, was already available and was familiar to the majority of people as a reference system for site location. The grid squares are seen as a sampling network for landforms, in a similar way to the way in which quadrats are used to sample vegetation.

The Cumbria Survey

In the Cumbria Survey, the basic data needed to be cheap to acquire and be readily available. Such a source was available in the 1 : 63,360 (1" to the mile) Ordnance Survey maps and accordingly the first phase was to record as many attributes as possible from the maps; as well as geological data from the 1 : 250,000 map. Data were recorded from 11% of the one km^2 in Cumbria from a grid, and multivariate analysis used to classify the squares into 16 classes. These land classes showed well defined patterns of distribution within the county that related to known geomorphological features, but which also showed interesting patterns not readily apparent from direct observation.

The second phase was to visit a random sample of squares from each land class and record details of the vegetation as a test of the validity of the land classes as strata. Analysis of these data by multivariate methods defined vegetation types, that were shown to be strongly associated with the land classes. The high correlations enable predictions to be made of the vegetation composition of squares of known land classes which had not been visited. The accuracy of these predictions was assessed by enumerating the land class composition of three areas, predicting the vegetation present, and then carrying out a ground survey of the vegetation. The fit between the observed and expected vegetation was very good in all three cases.

The high correlations between the land classes and their vegetation composition made it possible to advocate their use as strata on which to base other environmental surveys. The main advantage of such an approach is that once the framework has been laid down, other detailed surveys can be based on the same squares and, not only can further information be acquired from as wide a range of land as possible, but it can be used to add detail to the description of the squares. Three other surveys have now been carried out involving tree cover, hedgerows and landscape. All relevant information has now been incorporated in enlarged descriptions of the land classes. As a result of the further studies, three land classes have been identified as continaing marginal land in the county and are now being used as a basis for studying this type of land. The land classes may therefore be used to identify the occurrence of a particular type of land within a large area. Further, the land use potential of the land

classes can be assessed and related to the whole county.

The application of the study to the comparison of areas, has been examined by using the land classes to compare the characteristics of the Lake District National Park with the rest of Cumbria, as well as different valleys in upland Cumbria and various potential reservoir sites. Such exercises are important in assessing the representativeness of areas proposed for detailed study, since they can be fitted as objectively as possible into the local context. The accuracy of such comparisons depends upon the uniformity of the land class distribution and upon the extent of the area being considered. In general, the smaller the area the greater the chance of inaccuracies, although differences from the norm can be used to assess divergence from a typical area of the county. The details of the practical applications of this technique in planning are considered in the following paper by R Smith, and are currently being developed in conjunction with several county councils.

The UK Survey

The Cumbria survey therefore showed that the analysis of map data could provide strata that could subsequently be used to survey a wide range of ecological features. As a result, the approach is now bing extended to cover the whole of the UK, with the main objective of setting up a stratification system that incorporates assessments of overall environment. The project is following the same pattern as the Cumbria survey, with further developments based on the experience of that study. The main stages of the survey completed to date are summarised below:

The UK data base includes the following types of information:

1) Climatic: data from climatic maps on a scale 1 : 1,000,000 representative of the range of climatic information available for the UK.

2) Topographic: data from the 1 : 50,000 Ordnance Survey maps, incorporating features such as altitude and slope.

3) Human artefacts: data from features available from the 1 : 50,000 Ordnance Survey maps.

4) Geological series: data concerning the presence of the main geological series and surface drift categories.

Data were recorded from 1 km grid square units for similar reasons as in the Cumbria survey. The data set initially comprised both variables and attributes. The former were divided into categories in order to utilise their quantitative characteristics but at the same time to subsequently simplify the allocation of further squares to the appropriate classes set up by the analysis. The initial sample square was taken from the central square of a 15 x 15 km O.S. grid, giving 1228 squares as a basic set for the UK. These will subsequently be expanded by identifying the affinities of further squares using the analysis of the original sample as a basis. Using a similar statistical procedure to that used in the Cumbria survey, 32 land classes have been produced. These show well

defined geographical distributions and are currently being interpreted in terms of their characteristics as defined by the original map data.

The next stage in the project is to carry out ground survey, in order to establish the correlations between ecological characteristics and the land classes. The first year of the ground survey has now been completed and the methodology developed. The remaining survey will be completed during the coming year. Eight squares have been taken at random from each of the 32 land classes and the following information will be recorded.

1) Species data from five random 200 m^2 quadrats.
2) From the centre of each quadrat standard soil profile descriptions from a pit 15 m deep.
3) Plant species data from linear quadrats placed along the sides of streams, road and hedgerows.
4) The principal ecological features of the whole kilometre square including crop types, domestic animal breeds and hedgerow composition.

These data will enable the land classes to be defined in terms of a range of ecological criteria and will then enable generalisations to be made concerning the whole of the UK. The strata can be used for a variety of environmental surveys and the project is designed to provide a method of co-ordinating a range of surveys, so that different experts can apply their knowledge to the best advantage. Interactions between various criteria can then be examined and a broad data base built upon a standard system. This data base can then be used for a variety of interrogatory purposes, as well as for examining various options within the land classes.

To summarise, the land classification technique being developed by the Institute of Terrestial Ecology at Merlewood Research Station is designed to be used at any regional or national scale, and gives a statistically sound classification of the land surface within which detailed surveys using stratified sampling procedures can be conducted.

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