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Spatial Metrics of Structure and Diversity:

Calculation from Earth Observation and map data, for use as indicators in environmental management

Submitted to Lancaster University,
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for the Ph.D. degree, May 2004

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0.1 ABSTRACT

The use of spatial metrics for characterisation of landscape structure was investigated, and their application as indicators for biological diversity, sustainable land use and forest management evaluated. The main objective was to define and select spatial metrics to be derived through processing of satellite images and from map data existing in Geographical Information Systems. Metrics applied as indicators should be insensitive or predictable with respect to scale changes, appropriate for description of landscape diversity and structure and mutually uncorrelated, thus ensuring that they describe different aspects and functions of landscapes.

From eight types of spatial metrics identified in the literature survey, five were applied in this study, namely Area, Edge, Shape, Patch (count) and Diversity metrics. EO based forest maps and land use/land cover data, mainly from Italy and Denmark, were analysed. Shape metrics, especially the Matheron index, proved usable for quantification of fragmentation, while Patch metrics should be used with care due to sensitivity to grain size.

The hierarchical structure of landscapes and the Modifiable Areal Unit Problem were addressed through application of the Moving Windows method. No direct solutions to the effects of these phenomena on the values of metrics of landscapes and their representation in images and maps could be devised. Rather, it was found that multi-level descriptions of landscapes using presence-absence masks from different window sizes, metrics from a number of watershed-levels and scalograms provide useful information on forests and landscapes.

A Hemeroby index was introduced for assessment of degree of disturbance at landscape spatial and thematic level. The thematic resolution of the forest classes was however found insufficient to allow calculations of Hemeroby of forests *per se*. However, the Hemeroby index appeared to be a promising tool for summarising the amount of human influence expressed in land use maps.

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