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地理資訊系統和碎形維度於森林地景空間變化上之應用
Application of Geographic Information System and Fractal Dimension in Forest
Landscape Spatial Variability

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中文摘要

碎形維度是利用物體本身的自我相似對物體的形狀做定義，而地景是由各種大小不同、形狀相異的鑲嵌體組成，這些鑲嵌體恰可符合碎形理論，所以碎形維度比一般指標更能描述自然界不規則的地景狀況。但是碎形維度只考慮鑲嵌塊的大小和形狀，為配合生態多樣性的觀念，必須考慮區塊之間相鄰的情形對碎形維度做修正。在地景的研究過程中，尺度是一個關鍵，以往地景研究受限於工具，只能研究小尺度的問題，在遙感探測和航空照片逐漸發展，可以大面積收集地面資料之後，尺度就放大了，航空照片為目前森林地景研究上之有利工具，藉由照片的判釋，可以了解地景單元的分布情形。因此在本研究中是以修正碎形維度為指標，分別以模擬的地景資料和六龜試驗區航空照片為分析之材料，了解各種經營作業下對地景可能造成的影響以及真實地景資料之維度情形。本研究所得的結果如下：1. 在森林伐採時，沿著二個區塊的邊界作業可以減少伐採對地景多樣性產生的影響。2. 不同的伐採形狀會對地景多樣性造成不同的影響，其中不規則形狀的伐採可以減少人為干擾的負面影響。3. 林道開闢時要考慮地景的完整性，不宜任意穿越地景區塊。4. 真實地景修正碎形維度的求算結果顯示，天然混合林的維度值大於人工純林，推測修正碎形維度值可為多樣性之指標；道路對森林地景而言為一種干擾，會降低修正碎形維度。

關鍵字：地理資訊系統；碎形維度；地景；多樣性

Abstract

Fractal dimension is defined with respect to the shape of an object based on its self-similarity. Landscape is composed of mosaics (patches) which are different in size and shape. These mosaics correspond with the fractal theory; therefore, fractal dimension is more suitable than other indices to describe the irregular landscape observed in nature. However, fractal dimension only considers the size and shape of the patches. To incorporate the concept of ecological diversity, the fractal dimension should be modified to account for patch juxtaposition. Scale is an important element for landscape studies. In the past, landscape studies were usually performed with small scales due to lack of proper tools. With the development of remote sensing and aerial photography technologies, the scales have been enlarged because data over large geographic areas can be easily obtained. Airphoto is a very useful tool for forest landscape studies. Interpretation of airphotos is very helpful for studying the distribution of landscape units. In this research, a modified fractal dimension was used as an index to study the effects on landscape resulted from various management activities using simulated data. In addition, the Luku experimental forest was selected as the study site to understand the fractal dimension in real landscape. The results indicate that: 1. When harvesting timber, the effects on landscape diversity can be reduced if harvesting sites are selected along the boundary between two patches. 2. The effects on landscape diversity varies with the shapes of harvest sites. Negative effects due to human interference can be reduced if the harvest sites are irregular. 3. When developing roads, the roads should not pass through the landscape in order to preserve the integrity of the landscape. 4. The resulting modified fractal dimension for real landscape indicate that: (1) mixed type natural forest has higher fractal dimension than puretype plantation forest, and the modified fractal dimension can be used as an index for ecological diversity; and (2) roads interfere forest landscape, thus reduce the modified fractal dimension.

Key words : GIS; Fractal dimension; Landscape; Diversity