



HAL
open science

The landscape disparity index: an ecologically weighed measure of the landscape diversity

P. Roche

► **To cite this version:**

P. Roche. The landscape disparity index: an ecologically weighed measure of the landscape diversity. 25 Years of Landscape Ecology: Scientific principles in practice, Wageningen, NLD, 2007, Jul 2007, Wageningen, Netherlands. p. 609 - p. 610. hal-00585324

HAL Id: hal-00585324

<https://hal.science/hal-00585324>

Submitted on 12 Apr 2011

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

The landscape disparity index: an ecologically weighted measure of the landscape diversity.

P. K. Roche

CEMAGREF, Mediterranean Ecosystems Unit, 3275 Route Cezanne, 12182 Aix-en-Provence. e-mail: philip.roche@univ-cezanne.fr

Introduction

Typically, the analysis of landscape patterns is based on a quantitative analysis of the composition or/and the spatial arrangements of categorical units mapped from aerial photographs, satellite images or land use maps using so-called landscape metrics (Gustafson, 1998).

Usually in landscape studies, authors assume that different landscape habitats or elements categorised in the mapping process are well defined, and equally different from each other (Forman 1995 and references therein). But, in most cases the landscape element types are often not really distinct or at least are not equally distinct from each other and the degree of dissimilarity between the mapped landscape elements is not usually considered.

In order to improve the ecological relevance of landscape diversity metrics some ecologically important features should be considered. An index should integrate the habitat number and their spatial arrangements (O'Neill et al., 1988). It should also have a low sensitivity to categorical resolution (Frohn, 1998) and/or should be able to handle degrees of thematic resolution (Loehle and Wein 1994). The two last points could be addressed by integrating a measure of the ecological contrast between the thematic categories – i.e. the disparity.

Methods

I propose a new landscape diversity metric: the Landscape Disparity Index (LDI) that takes into account both the landscape elements adjacencies frequencies and the patches ecological dissimilarities (1)

$$LDI = \frac{-\sum \sum \ln \left(\frac{c_{(i,j)}^2 \cdot d_{(i,j)}}{m \cdot (m+1)} \right)}{\ln(2/(m \cdot (m+1)))} \quad (1)$$

The LDI was tested using landscape maps from two sites in southern France. Environmental variables were used to compute the dissimilarity index between and within landscape element types. Highly autocorrelated variables like altitude and slope were eliminated. The remaining variables were tested using Kruskal-Wallis tests for significant differences between landscape elements. Non significant variables were removed. The remaining variables were used to compute the dissimilarity matrices.

The LDI was compared with eight other widely used landscape metrics using the Fragstats 3.1 software (McGarical and Marks, 1994).

Scale issues were analysed by computing the LDI and the eight other landscape metrics on our test area at 4 scales (30, 50, 70 and 90 m). Thematic resolution issues were assessed by computing the LDI and the other landscape metric on the 6 and 11 theme maps. In addition, for the LDI, the sensibility to the dissimilarity measure component using the two variants of the distance matrix for both 6 and 11 theme maps.

As a biological variable of interest we used the species richness at the landscape level using both modelled and field data.

If species richness is considered to increase when landscape heterogeneity increases (Duelli 1997), then landscape metrics measuring landscape heterogeneity indexes should be positively correlated with species richness at the landscape level.

Results and Discussion

The Landscape Disparity Index appeared to belong to the group of landscape diversity metrics with some interesting properties not shared by other diversity metrics: low sensibility to thematic resolution and ecologically significant weighting. The Shannon index (SHDI) appears to be the more sensitive to thematic resolution effects with Diff% higher than 40% and four indexes have Diff% values under 10% (PLADJ, LDI, COHESION and AI). Two groups of metrics could be defined. The first one comprised the IJI, RPR, SHDI, LDI that could be defined as diversity metrics. The second group comprised the AI, PLADJ, COHESION, LPI and CONTAG indexes that are landscape compaction-aggregation metrics.

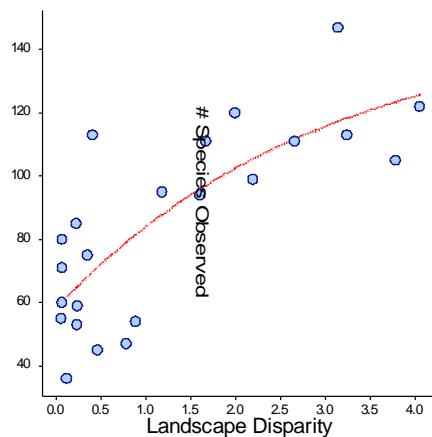


Fig. 1. Biplot of species richness and LDI. Each dot represents a landscape window of 90x90 m. The full line represents a GLM regression using a log link.

According to our results high LDI values are also related to high species richness at the landscape level (Fig1). High LDI values indicate that ecologically contrasted habitats are clustered together on the analysis scale. Traditionally used landscape diversity indexes such as the Shannon Index are not as coherent, because high values can be associated with low species richness. Thus, taking into account the degree of ecological contrast between landscape elements weights the spatial heterogeneity and improves correlation with biological patterns. These preliminary results indicate that the Landscape Disparity Index could be used to identify high diversity spots at the landscape level.

References

- Duelli, P. 1997.** Biodiversity evaluation in agricultural landscapes : an approach at two different scales. *Agri. Ecos. Env.*, 62: 81-91.
- Forman, R.T.T. 1995.** Land mosaics. The ecology of landscapes and regions. Cambridge University Press, Cambridge, 622 pp.
- Frohn, R. 1998.** Remote sensing for landscape ecology. New metrics indicators for monitoring, modelling and assessment of ecosystems. Lewis publishers, Boca Raton.
- Gustafson, E.J. 1998.** Quantifying landscape spatial pattern: what is the state of the art ? *Ecosystems*, 1: 143-156.
- McGarigal, K. and Marks, B.J. 1995.** FRAGSTATS: spatial pattern analysis program for quantifying landscape structure. General Technical Report PNW-GTR-351. U.S. department of Agriculture, Forest service, Pacific Northwest Research station. Portland, OR. 122 pp.
- O'Neill, R.V., Krummel, J.R., Gardner, R.H., Sugihara, G., Jackson, B., DeAngelis, D.L., Milne, B.T., Turner, M.G., Zigmunt, B., Christensen, S.W., Dayle, V.H. and Graham, R.L. 1988.** Indices of landscape pattern. *Land. Ecol.*, 1: 153-162.
- Turner, M.G. 1989.** Landscape ecology: the effect of pattern on process. *Ann Rev Ecol Syst*, 20: 171-197.