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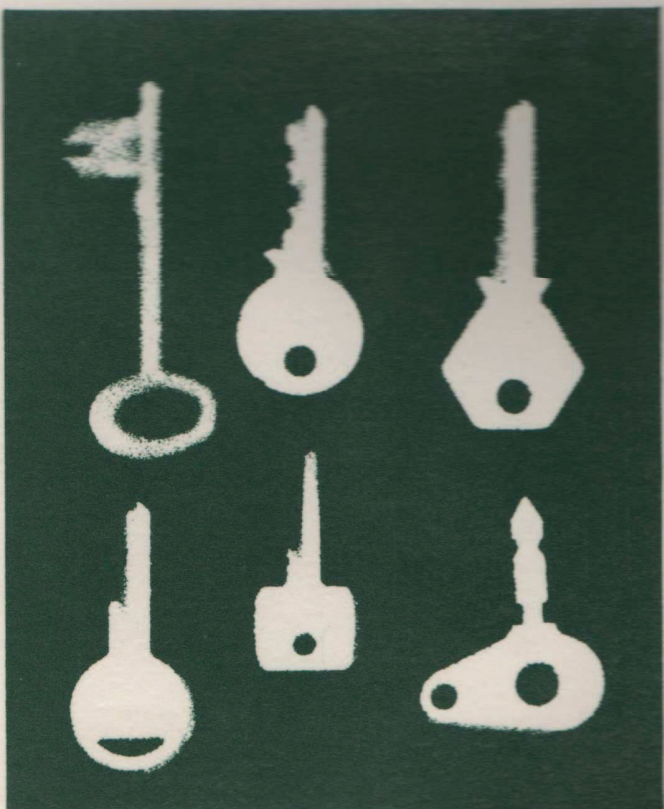
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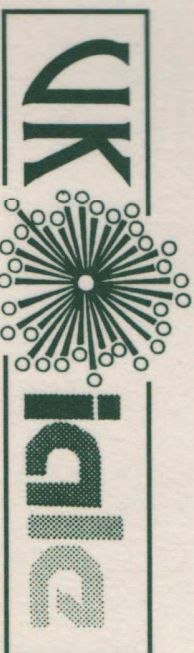
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# KEY CONCEPTS IN LANDSCAPE ECOLOGY

PROCEEDINGS OF THE 1998 EUROPEAN CONGRESS OF THE  
INTERNATIONAL ASSOCIATION FOR LANDSCAPE  
ECOLOGY



EDITED BY  
J.W. DOVER & R.G.H. BUNCE



## A regional ecological characterization method for quality and impact assessment

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## Abstract

The development of a landscape ecological assessment and evaluation method applicable to the planning and management processes, and the impact assessment is the aim of this paper.

A large scale characterization and evaluation methodology is tested in a 365 square Km area where an intensive ecological characterization was performed. This methodology is referred to two spatial referentials: land use distribution and homogeneous landscape units, which are described in terms of their spatial distribution and attributes, their matrix, patch, or corridor character, its permeability, connectivity and complementarity.

A combination of both spatial referentials allows the application of algorithms evaluating different ecological values (conservation value, productivity, heritage value, functional value). The methodology is particularly suited to be used in the assessment of ecological impacts of land use changes and the construction of local and linear infrastructures.

## Introduction

The Évora Project (Research Project STRIDE/12/Amb) aimed at developing and testing assessment and evaluation instruments for the ecological planning and management of the landscape. That framework has, not only to describe the ecological reality and potential of the landscape at the sub regional (Évora) scale, but also to determine the spatial structure of ecological networks, land use methods and intensities necessary to ensure the maintenance and promotion of the conservation value of the landscape in a scenario of land use change and evaluate the impacts of land use and landscape changes on that value.

The main objectives of the project are:

- A. Identification of the main ecological processes and functions in an extensively used landscape

- B. Identification of the ecological structures and functions responsible for an increased biodiversity and sustainability of the existing or potential ecosystems
- C. Definition of assessment and evaluation procedures for the planning and management of that landscape balancing its use and its conservation potential

The characterization and evaluation method is based in the knowledge that the ecological value of a landscape depends from the viability of the present ecosystems. This viability is a function not only of their characteristics (dimension, interior/edge ratio, relations with similar ecosystems, diversity, naturalness, degree of external stress) but also from its functional equilibrium in terms of the stability of its nature (the degree of disturbance of the stable long term nature of the site that determines the existence of the ecosystem).

The consideration of this basic conditions forms the core of the assessment and evaluation methods, where equal attention is given to the stable environmental variables and functions and to the circumstantial structures of the present ecological organization of the landscape. The use of the structural classification of Forman and Godron (1986), adapted to characterize both stable and circumstantial ecological structures, has proven very resourceful in describing both informational levels.

The differentiation of stable and circumstantial organizational levels in the landscape was determined by the different nature of the influence of each environmental factor (Table 1).

Table 1 Type of influence of environmental factors on the nature of the Landscape

Environmental Factor	Type of influence on the nature of the Landscape
Geology	Static action, building a framework for the other factors and processes in the landscape (forms, resources reserves and availability). Very stable to disturbance
Climate	Stable action, building a framework for landscape processes, is affected by circumstantial factors in terms of the intensity of the local features of its regional patterns (microclimatology). Resilient to local and regional disturbances. The microclimatological patterns express stable patterns of response to the local factors of influence.
Landform	Stable action with a dynamic influence pattern on the evolution tendency of the horizontal evolution of a site - the influence on the evolution of the site shows an intensity that is circumstantially determined. His pattern of influence on the site dynamics is independent from the disturbance types.

Soils Stable in their pattern of distribution, circumstantial in their characteristics and patterns of influence of the local dynamic. Low resilience to disturbance.

Hydrology Stable pattern of spatial organization and interrelation, within the climatic contingencies that determine the intensity and frequency of their processes. Very stable pattern of response to disturbance.

Vegetation Circumstantial pattern of spatial distribution. Determines and controls the intensity of the spatial dynamic processes with little capacity to influence their spatial occurrence pattern. Circumstantial pattern of response to disturbance. Variable resilience depending of the character and stability of the community.

Land Use Circumstantial distribution. Controls the intensity of the different dynamic processes in the landscape. Determines important changes in the spatial occurrence and distribution of patterns and processes. Disturbance factor.

Considering these patterns of influence, the environmental characterization was performed at two levels:

1. Land units, based on the identification of discontinuities (borders) of the stable environmental factors (Geology, Climate, Soil, Landform and hydrology).
2. Land use units.

determining two sets of spatially referentiated data, which where correlated with the results of thematic field researches (faunal and vegetational).

#### Methods

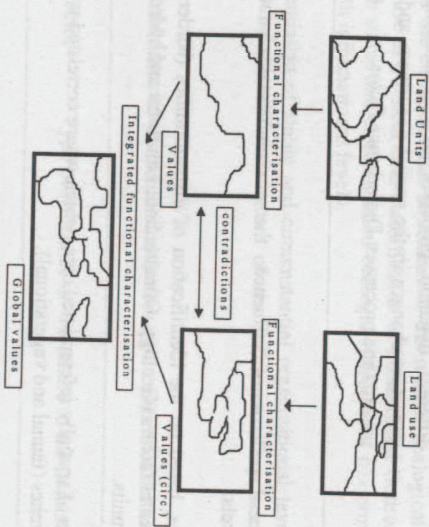
The methodological approach of the project aimed primarily at evaluating the real ecological significance of structural landscape characterization methods (land unit definition) and in calibrating evaluation procedures capable of representing, not only the ecological value of each unit "per se", but mainly its contextual value in the landscape in order to dispose of a framework for the performance of integrated analysis of land use distribution and changes. Following aspects where emphasized in the characterization process:

- I. Land Units
  - A. Structure and characteristics
  - B. Hierarchy
  - C. Functionality
- II. Land Use
  - A. Character and structure
  - B. Complementarity / Permeability

- III. Potentiality and Productivity
  - A. Fauna
  - B. Vegetation
  - C. Pedology
- IV. Particular structures and elements (characteristics, values and potentialities)

The characterization and evaluation procedure integrated the stable (the land units) and the circumstantial (the land use units) ecological structures in order to build the reference system for the information (Figure 1) allowing the identification of dynamic correlation patterns and the evaluation of its character and determining factors.

Figure 1 Characterization and evaluation procedure



The variables of quality, capacity and function were considered in the evaluation process in order to determine the following ecological values:

- **Ecotope formation ability (EFA)** - determined by the structural and genetical characteristics of the vegetation formations and the site, expresses the ability of the site to give origin and to sustain viable ecological communities.
- **Heritage value (HV)** - determined by the previous value and the degree of uniqueness and rarity of the site and formations expresses the productivity and genetical value of the ecotope.
- **Conservation Value (CV)** - determined by the previous value and by the expression of the contextual viability and functionality of the site and formation, expresses the ability of the site and formation to contribute to the ecological sustainability of the landscape.

## Results

The results that were obtained proved the interest of the approach and its applicability in the ecological planning and management processes. The simultaneous consideration of two levels of characterization allowed the comparison of two common approaches to the landscape and the evaluation of the ecological information displayed by each method. The main results obtained with this comparison are:

- The structure of the present land use is constrained by the stable factors and structure. These constraints are, nevertheless, not deterministic but determined by a balance between the environmental demands of the different land uses and the large scale ecological limiting factors: for example the regularity of the landforms and the vicinity of water sources is more important than fertility in the distribution of the agriculture uses.
- The character of the stable organization of resource corridors and patches and of the matrix is not contradicted by the organization of the land use, where new disturbance patches appear but where the stable structural framework is always identifiable.
- The hierarchical level of determination of the present structure by the stable structure is higher than the level of determination of the land use/biotope structure: the constraints have a generalized character different from the local variety of ecological features and structures.

The consideration in each level of characterization and evaluation of the nature and the interactive character of each unit, allowed a clear identification of the stability of each matrix, patch and corridor (correspondence of nature in both levels) and the identification of the relative complementarity of each area. The last information proved particular important in the consideration of the results of the intensive field research on the distribution of biological productivity of the different faunal groups and of the genetic interest of the vegetation formations. This characterization aimed at the calibration of characterization and evaluation methods and the identification of the structures and scales determinant for each biological group.

The comparison of these results with the values of relative complementarity and absolute connectivity showed that high complementarity within a low disturbance highly connected matrix are the areas with the highest faunistic value. The importance of connectivity and low fragmentation is well displayed in the urban and peri-urban areas where high complementarity within high disturbed areas determines a low faunistic value. These relations have to be further tested and analyzed in order to determine general patterns applicable in the management of landscapes.

The results also show that, although land use, determining the character, extension, interrelations and degree of disturbance of the present biotopes, builds the major factor in the definition of the biological quality of a site, the existence of particular elements (mainly water points and particular habitats) is the final determinant factor of the final quality of the site.

## Conclusions

The main conclusions that can be drawn at the present state of the research are:

- The land unit concept is a particular useful instrument in landscape characterization and evaluation. Nevertheless its real value is only fully achieved when replicable methods where used in its definition, and when its articulation with the present structure of the landscape is displayed and made operational.
- The evaluation of the stability of a landscape by comparing the degree of correspondence of the nature of both levels of characterization is of particular importance in the evaluation of the "naturalness" of the degree of fragmentation of that landscape, and the real disturbance determined by proposed land use changes. It is also of particular importance in the identification of the disturbed patches responsible for the present fragmentation.
- The consideration of the degree of complementarity within a matrix and of the presence of particular elements is of major importance, together with its connectivity and productivity in the definition of its biological significance.

The first results of the "Évora project" display a large amount of information of particular interest for the definition of planning and management tools applicable to large landscapes. Nevertheless the particular character of the area (with a combination of relatively extensive used areas, with intensive farmed orchards and irrigated areas and only one large isolated urban area and relatively important barriers), imply that a calibration of the results has to be performed in other landscape types, more intensively used or with a more natural character.

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## Biotope models and nature quality

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## Abstract

The work presented are the preliminary results of the project 'Indicators of Nature Quality - Landscape Models in Terrestrial Biotopes', carried out since 1996 at the National Environmental Research Institute in Denmark. The overall purpose of the project is to develop a biological based concept for assessing the quality of Danish biotopes. Plant communities in natural and semi-natural biotopes are classified and described according to their species composition, ecology, succession and vulnerability. The results will be made accessible for referencing via a biotope database and for visualisation and analysis within a Geographic Information System.

## Background

Over the last century or more natural and semi-natural biotopes in Denmark have suffered from a quantitative as well as a qualitative decline. Within this period many of the former uncultivated or extensively utilised areas have been transformed into urban areas, infrastructure, forest plantations or areas with intensive agricultural production. The unintended side effect of increasing human activities, such as eutrophication, acidification, disturbance and changes in management practices, have lead to an impoverishment of many natural and semi-natural biotopes. These impacts have favoured the most tolerant and widespread species at the expense of the specialised and vulnerable species.

Several attempts have been made to change these tendencies, primarily the focus have been to increase number and size of areas with natural and semi-natural biotopes. Measures taken into account are mostly nature restoration and extensivisation of agricultural land. Meanwhile the number and quality of the existing areas of high nature quality is still declining.

In order to preserve and improve the biological quality of terrestrial biotopes, local and governmental authorities need new methods for assessing the nature quality. Tools for delineating areas of potential high nature quality within existing extensively utilised areas have to be provided. Furthermore, there is a need for predicting the ecological consequences of nature restoration projects and other land use changes.