ANALYSIS OF THE ECOLOGICAL EVOLUTION OF AN AREA IN THE SETUBAL PENINSULA (APOSTIÇA) CAUSED BY CHANGES IN LAND USE PATTERNS

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SUMMARY

After conducting an inventory and characterisation of the existing elements belonging to the ecological structure at a regional level, located in a particular area at three defined moments in time, a subsequent analysis of the modification of biological structures of the area was undertaken.

This analysis involved the application of different diagnostic indices in order to evaluate the causal relationships between modifications in land use and the environmental modifications observed.

OBJECTIVES

The testing of different methodologies normally used to characterise ecological structure at a regional scale in an area of sub-regional dimensions.

The testing of the applicability of the different methods of analysis of effects originated by losses in ecological structures (cumulative losses in ecosystems).

The conception of conclusions regarding causal relationships between land use modifications and the environmental changes observed.

METHODS

The aim of the present study was to analyse the evolution of land use patterns and environmental functions in Apostiça, an sub-regional area in the Setubal Peninsula.

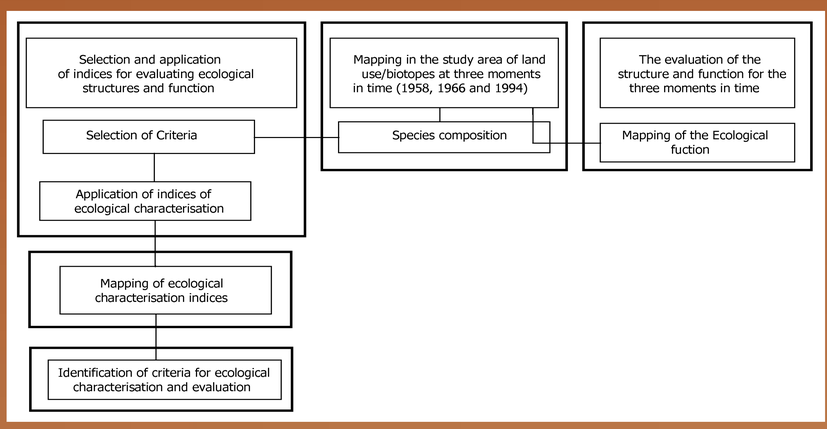
The study zone is located in the West area of the Setubal Peninsula and was chosen for study because it serves as a dynamic model of land use modification, while simultaneously playing an important role in connecting habitats of great ecological value.

The year 1966 was considered the starting point (base year) for the modifications, as that year marks the opening of a bridge over the Tagus River and the beginning of a direct traffic connection between Lisbon and the Setubal Peninsula.

A structural characterisation and analysis of the main elements belonging to the overall ecological structure was completed for each year identified in the study in order to analyse the modification of the biological structures in the study area. The applicability of the different functional and structural indices developed by several authors, were tested [e.g., SHORT (1988), SHANNON et al. (1962) and ROMME et al (1982); HOOVER et al. (1991)].

A diachronic analysis of the index values obtained provided the data necessary to characterise the environmental impacts caused by the modifications in land use patterns. This analysis will make possible the determination of the most accurate methods of evaluating environmental impacts for the study area and facilitate the analysis of the causal relationships existing between modifications in land use and the environmental changes observed.

Table 1 - Scheme of the project



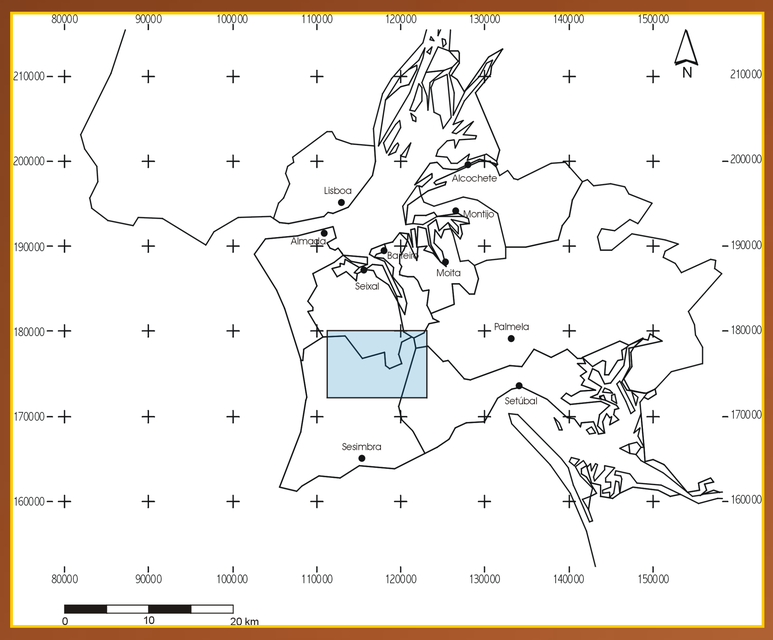


Figure 1 - Location of the study area

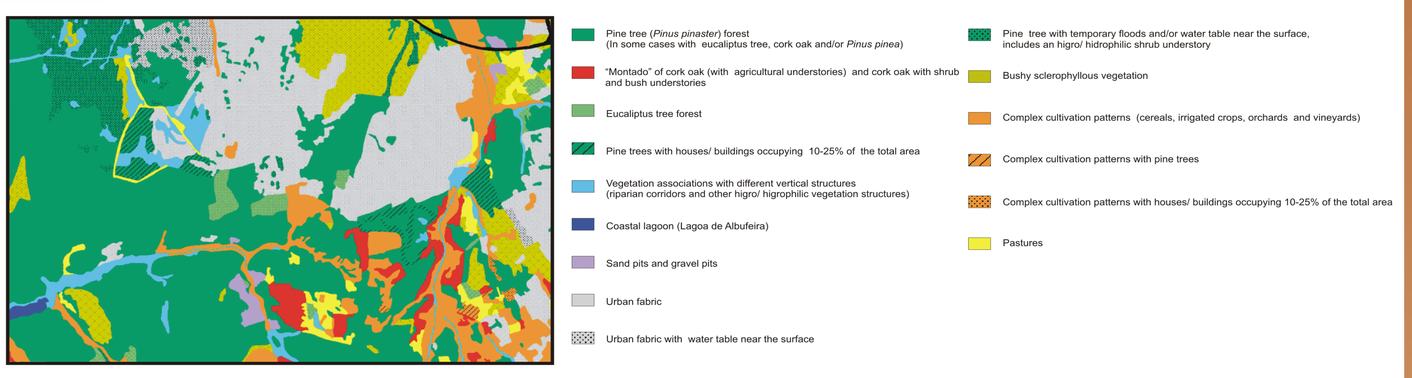


Figure 2 - Apostiça land use in 1994 (12X8 km²)

Table 2 – Functional and structural indices

Index	Parameter	Numerical expression	Description
Diversity Index (Shannon et al., 1962)	Habitat diversity	$H' = -\sum pi \log pi$	Measure of species and community diversity. p_i represents a proportion of the total habitat area covered by the category i of the canopy.
Habitat Layers Index - HLI (Short,1988)	Vertical habitat structure	$HLI = \frac{x.\sum_{i=1} Ai}{(6).(5)\sum_{j=1}^{n} Aj}$	The HLI is computed by comparing the number and area of different habitat layers present on a study area to the maximum number and area of habitat layers that could occur for that study area.
Landscape Contrast Index (Romme et al., 1982; Hoover et al., 1991)	Discontinuity between community types	$LC = \sum_{i=1}^{T} \sum_{j=1}^{T} DI_{ij} L_{ij}$	Measures the degree of compositional discontinuity across vegetation type boundaries in a landscape, was determined with a modified form of Romme's patchiness index.

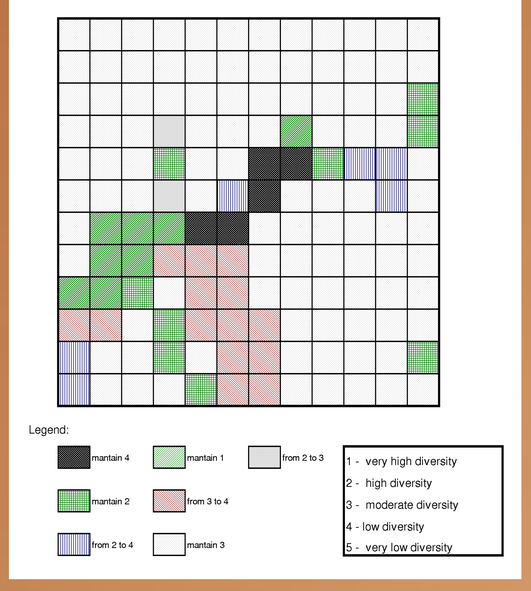


Figure 4 - Evolution of the diversity index - Area 1

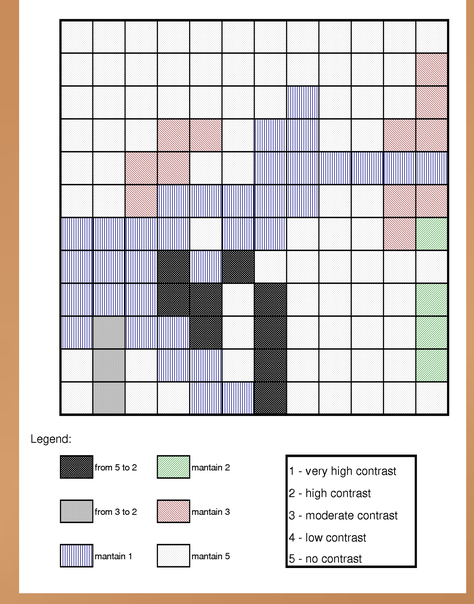


Figure 5 - Evolution of the landscape contrast index - Area 1

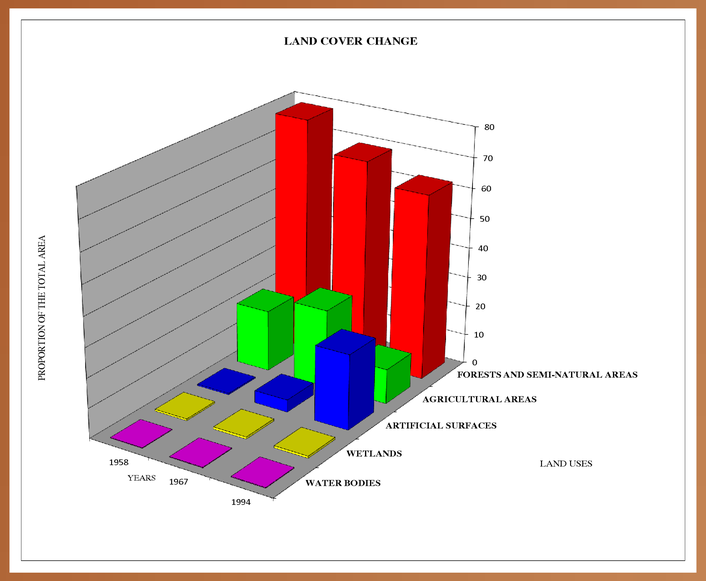


Figure 3 - Land cover change (1958 - 1994)

RESULTS

Three indices were tested as measures to describe different proprieties of the landscape, the habitat layers index (Short 1988), the diversity index originated in information theory (Shannon and Weaver 1962) and the landscape contrast index (Romme et al, 1982; Hoover et al. 1991).

The result of the application of the habitat layers index (Short 1988) indicates that this index could be useful to analyse de changes in biotope quality. The agricultural land use units abandoned, are well identified by a decrease of the habitat layers index.

To study the structural diversity of the landscape was applied a diversity index originated in information theory (Shannon and Weaver 1962). That index gives information about the degree of heterogeneity of the land forms and vegetation cover belonging to a land use unit.

The mapping of the Shannon index could be important in order to analyse the natural and semi-natural structures. For artificial structures the results are not so correct, and was difficult to establish a relation between the land use quality and its structure.

The mapping of the landscape contrast index could be useful to identify potential corridors for species flows across the landscape.

DISCUSSION

The methodologies available to characterise ecological structure and function are not sufficient. Mainly because the study of functional aspects of landscape had a very recent evolution. The main limitation of the methodologies of ecological evaluation available is due to the use of measuring units not adequate to the study of functional proprieties, like ecological relations.

The parameters usually measured by the methodologies available only represent a small number of characteristics of the systems. This approach however more accessible and convenient, determines that the ecological systems are simplified in such a way that the most important proprieties became unclear.

CONCLUSION

On the basis of above mentioned considerations it's necessary to develop models for the ecological characterisation of land use structure with application in Regional planning process, namely a methodology to analyse effects originated by losses in ecological structures, in way to identify indices of ecological evaluation.

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