Riverine woods restoration decision support system

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INTRODUCTION

Intervention in the landscape requires wide base information, since there are many elements comprising the landscape analysis. Spatial decision support systems (SDSS) are increasingly solving in a more efficient way the management of the spatial information for landscape restoration.

The development of an SDSS to assess the restoration of riversides is justified in terms of the importance of the temporary streams in Mediterranean zones ('torrents'). Water is a limiting factor, concentrator of biodiversity and enhancer of the wildlife, especially in the Mediterranean biomass and even more in insular environments. Torrents are water conduction and infiltration circuits towards aquifers and their riversides represent the last barrier to the physical and chemical erosion of soils. On the other hand, they also play the role of ecological corridors between natural spaces or forest masses. From a conservationist point of view, in the temporary rivers of the island of Mallorca the following can be found: typical Mediterranean species, species more characteristic of deciduous forests as well as floristic remains and morphological tendencies characteristic of laurel forests.

At present, these Mediterranean riverside habitats are found to be in an absolutely remote situation in relation to that of their initial configuration. The intense human intervention has determined a significant modification of the draining network and attached ecosystems, which has usually given rise to an increase of the erosion together with a loss of both the environmental and aesthetic qualities on those sites. All the above-mentioned aspects justify the performance of restoration tasks as well as any kind of support with this aim.

BASE OF KNOWLEDGE

The design of landscape restoration or rehabilitation proposals are based on the knowledge of the environmental tolerances of the species the environmental variables which determine the distribution of species and the knowledge of the dynamics of the island's torrents.

For the environmental characterisation of the streams a geographic data base of environmental variables -significant in the distribution of plant species, has been developed. The main factors considered were: sun radiation, aspect, heights, land use, lithology, soil pH, soil texture, humidity index, temperature, precipitation, hidrologic characteristics, natural habitats, distance to roads, and distance to urban areas. The variables are represented as vector maps.

The selected species, in order to be used in restoration tasks, include autochthonous and naturalised trees in addition to some trees of rural features. The model involves information on the origin of the species. In rural environments riversides may include autochthonous species, together with species characteristic of crops and occasionally remotely naturalised species such as fig or pomegranate trees, whereas, in urban environments species characteristic of gardening may appear. However, we have avoided those presenting an invader character which are too dangerous, and, consequently, it seems inappropriate to enhance their dispersion.

The obtaining of information on the characteristics of the habitat of the selected species derives from pre-existing literature (Naves, et al. 1995, Restoration of wetlands, Gonzalez del Tánago & García del Jalón 2001), from previous studies on riverside environments with aquatic plants and from the contrast of the model with the cartographies of riverside vegetal communities derived from the Habitats Regulations.

The species used in the expert system are specified: *Tamarix africana* Poiret , *Tamarix canariensis* Willd. , *Tamarix gallica*, *Populus alba* L. , *Populus nigra* L., *Ulmus minor* Miller , *Fraxinus angustifolia* Vahl. , *Crataegus monogyna* Jacq, *Prunus spinosa* L.., *Laurus nobilis* L. , *Rhamnus alaternus* L. , *Quercus ilex* L. , *Acer granatense* Boiss, *Pistacia terebinthus* L. , *Sorbus aria* (L.) Crantz , *Nerium oleander, Vitex agnus castus* L. , *Sambucus nigra* L. , *Myrtus communis* L. , *Ilex aquifolium* L. *Arbutus unedo* L. , *Viburnum tinus* L. , *Buxus balearica* Lam. , *Rosa sempervirens* L. , *Rubus ulmifolius* Schott, *Celtis australis* L. , *Quercus faginea* Lamk. , *Ficus carica* L. , *Punica granatum* L. , *Phoenix dactylifera* L., *Ziziphus vulgaris* Lamk, *Crataegus azarolus* L., *Sorbus domestica* L. , *Juglans regia* L. , *Mespilus germanica* L.

DESIGN OF THE *ECOSIG* EXPERT SYSTEM

It is a system based on a set of rules established between the environmental configuration of each segment of each torrent and the data corresponding to vegetal species and their environmental tolerances. The system possesses a user interface based on a Cartographic Server which enables the user the identification of the torrent segment for which to assess the type of species to be sown.

The construction of the system has required the following steps:

- Obtaining from the Digital Elevation Model the hydrologic network which will be used as a base of the system
- Environmental characterization of the torrent network by overlay the stream networks with the environmental variables.
- Environmental classification of species. The construction of an ecological matrix for each species which expresses its viability for each of the selected environmental variables was carried out.
- Model of ecological aptitude. The system analyses the environmental variables of the selected segment of the torrent and contrasts these values with the tolerance of each species. It is a mathematical model based on decision-making rules which assigns to each segment of each torrent a relative aptitude value for each of the selected species.
- Finally, the model performs a hierarchical arrangement of the vegetal species according to their ecological aptitude and assigns them an order number which identifies their aptitude for colonising a particular environment.

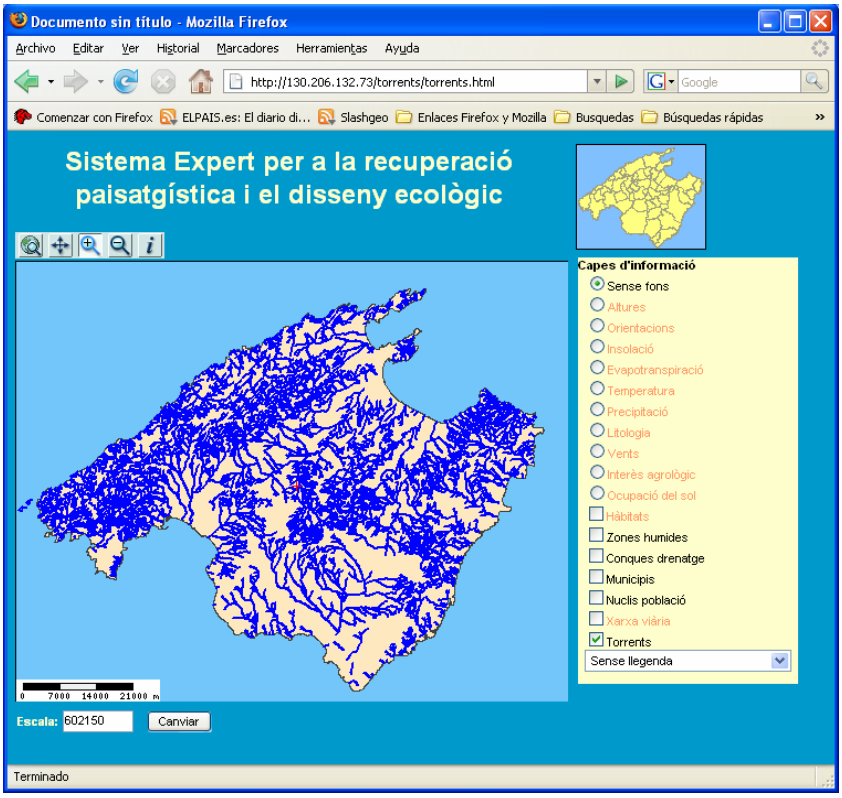

Figure 1. The ECOSIG system (*http://ecosig.uib.es*) is a prototype of the Expert System which provides information on the type of tree species which proves to be more adequate, from an ecological point of view, to be planted on each of the segments of the river network of Mallorca

The software used for the development of the project has been: ArcView 3.2 and its extensions for the cartographic analysis, the Visual Basic ver. 6.0 programming language for the applicative programming and construction of interfering rules, and the MAPSERVER program in addition to the PHP language for the generation of the cartographic server.

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