Assessing the recuperation potential of wildlife habitats through AHP and GIS modeling

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1. Introduction

Focusing on agricultural fields in the EU, we can identify three main trends that have characterized the recent evolution of European agricultural landscapes (Wolters, 1999):

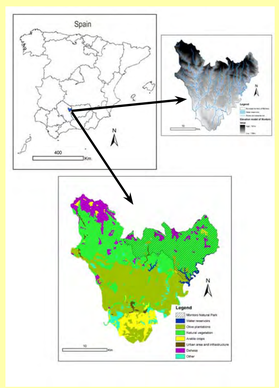
- Intensification in some Member States of the EU (Central and Eastern Europe).
- Extensification of agricultural lands as a result of the EU's environmental protection programs (intensified after the decoupling of the subsidies proposed by the EU Mid Term Review of the Common Agricultural Policy).
- Abandonment of agricultural land, a particularly important process in Mediterranean mountainous areas.

Marginal agricultural areas with a high probability of being abandoned could be used for wildlife habitat recuperation. However, there is a problem of how to evaluate marginal agricultural land in terms of its suitability for wildlife habitat recuperation.

A number of ways to include wildlife habitat exist. These include Cost-Benefit Analysis (Bräuer, 2003; Polomé et al., 2005), Geostatistical Probabilistic Modeling (Bayliss et al., 2005), Scenario Modeling (Santelmann et al., 2006) and Multi-Criteria Decision-Making. The latter is the approach adopted in the present study and, within this paradigm, we have utilised the Analytic Hierarchy Process (AHP).

2. Study area.

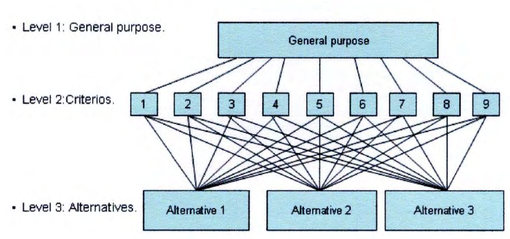
The municipality of Montoro is located in the province of Cordoba in Southern Spain. We focus on the mountain olive orchards located in the central part of the municipality (see Map). Such plantations play an important role in the Andalusian cultural landscape in addition to having an environmental value. Their low yields (less than 1,500 kg of olives/ha) will make them unprofitable after subsidies have been decoupled (changing from a subsidy linked to the production of oil to an area-based payment irrespective of whether oil is produced or not), which means that they are likely to be abandoned. This territory is a poor habitat for wildlife, due to the continuous agricultural activities and the lack of herbaceous cover between the trees. The return of parts of these plantations to their natural state with a high quality wildlife habitat could be one action to be undertaken.



3. Methods.

Analytic Hierarchy Process (AHP) multicriteria decision making technique

The hierarchy structure.



The AHP pairwise comparison scale

Degree of importance	Definition
1	Both attributes equally important
3	Very slight importance of one attribute over the other
5	Moderate importance of one attribute over the other
7	Demonstrated importance of one attribute over the other
9	Extreme or absolute importance of one attribute over the other
2,4,6,8	Internediate values between two adjacent judgments

$$A=\begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \dots & \dots & a_{ij} & \dots \\ a_{n1} & a_{n2} & \dots & a_{nm} \end{bmatrix} \quad A=\begin{bmatrix} \frac{w_1}{w_1} & \frac{w_1}{w_2} & \dots & \frac{w_1}{w_n} \\ \frac{w_2}{w_1} & \frac{w_2}{w_2} & \dots & \frac{w_2}{w_n} \\ \dots & \dots & \frac{w_i}{w_j} & \dots \\ \frac{w_n}{w_1} & \frac{w_n}{w_2} & \dots & \frac{w_n}{w_n} \end{bmatrix}$$

$$W=\lim_{k\to\infty}\frac{A^k e}{e^T A^k e}$$

where $e=(1,1,\dots,1)$.

$$CI=\frac{\lambda_{max}-n}{n-1}$$

CR=CI/RI, where RI represents a consistency index for *n* x *n random matrix.*

CR should be<0.1, the method consistency condition.

Table1. "Positive" and "negative" landscape objects for wildlife habitat recuperation potentiality

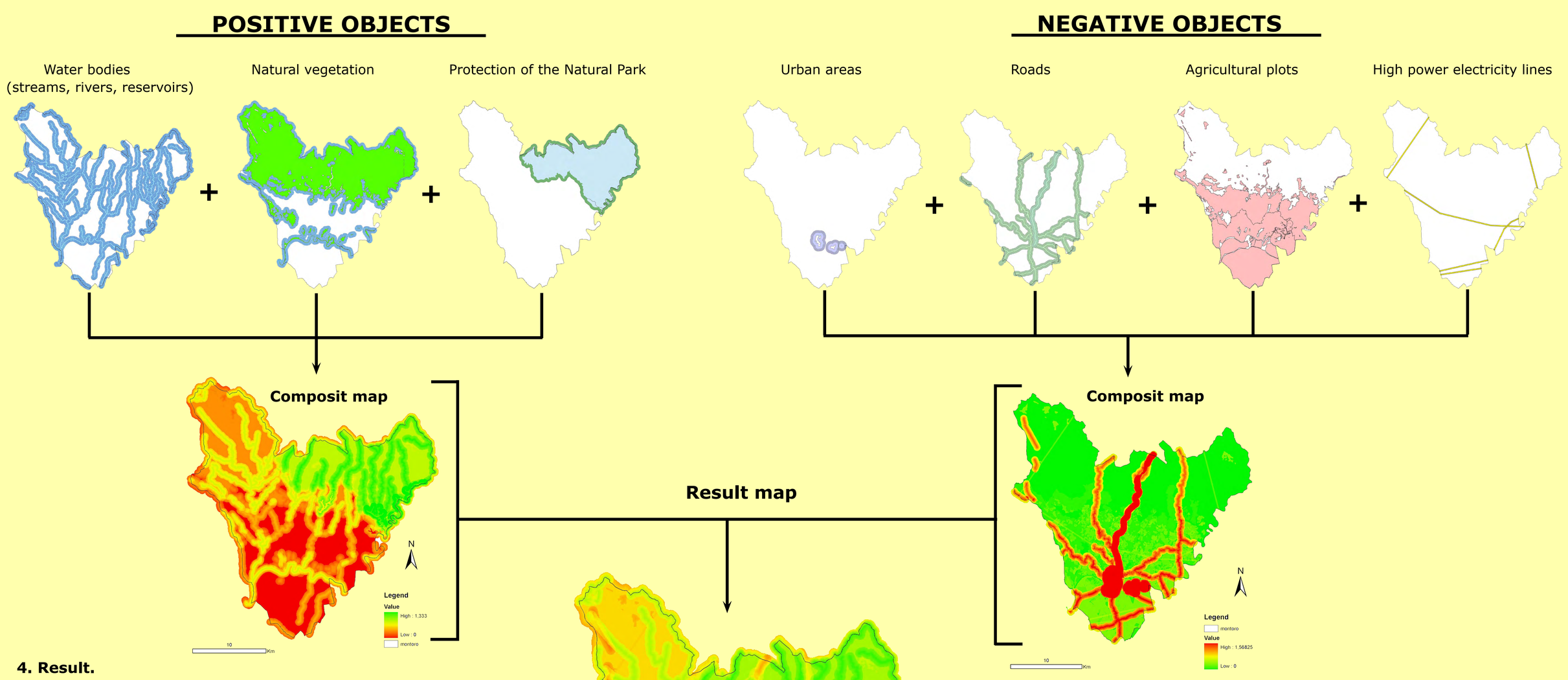
Positive objects	**Negative objects**
Water bodies (streams, rivers, reservoirs)	Urban areas
Natural vegetation	Roads
Protection of the Natural Park	Agricultural plots
	High power electricity lines

Table2. Aggregated matrix of the experts' avaluation for the "positive" landscape objects

	Water bodies	Natural vegetation	Natural Park area	Weights
Water bodies	1	1.21	1/1.16	0.3332
Natural vegetation	1/1.21	1	1/1.58	0.2647
Natural Park area	1.16	1.58	1	0.4021

Table3. Aggregated matrix of the experts' avaluation for the "negative" landscape objects

	Urban areas	Roads	Agricultural plots	High power electricity lines	Weights
Urban areas	1	2.61	7.86	7.98	0.5913
Roads	1/2.61	1	3.91	4.83	0.2698
Agricultural plots	1/7.86	1/3.91	1	1.82	0.0815
High power electricity lines	1/7.98	1/4.83	1/1.82	1	0.0573



4. Result.

The result map is reclassified in to the scale from –1 to 1. The areas that characterize relatively high potentiality for wild flora and fauna habitat recuperation are in green (values from 0 to 1). The areas with a worse potential for the recuperation of habitat for wild flora and fauna are in red (values from –1 to 0). Most attention is given to the areas actually occupied by the olive groves situated in the central part of the municipality of Montoro (see map agricultural plots).

As a result the map shows, the olive groves closed to the natural objects such as natural vegetation, water (rivers, streams and reservoirs) and the Natural Park, yield high positive values, indicating their relative suitability for wildlife habitat recuperation. On the other hand the areas situated near the main roads and urban areas represent poor habitat for wild species.

5. Conclusions.

The present study provides a methodological approach to assessing the suitability of agricultural lands for habitat recuperation. This methodology combines cartographic data with experts' judgments about the effects of specific landscape elements on wildlife habitats.

The evaluation of potential is applied empirically to the olive groves of Montoro in Andalusia in southern Spain through a combination of AHP and GIS. The first technique provides weightings of the elements of the landscape for the spatial analysis based on defining areas of positive and negative influence for each landscape element. The GIS technology aggregates the layers of landscape objects in order to determine the most suitable areas for wildlife habitat recuperation.

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