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The Map of Italian Nature: The Detection of the Hotspots of Ecological Attention

By Pierfrancesca Rossi,¹ Vittorio Amadio,² Orazio Rossi,³ and Angelo Peccis

¹ARPA Lombardy Natural Resources, Milan, Italy

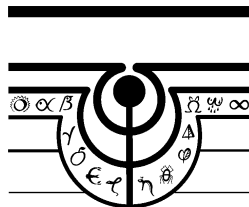
²OASI Dept., Reggio Calabria University, Reggio Calabria, Italy

³Environmental Sciences Department, Parma University, Parma, Italy

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Department of Statistics
The Pennsylvania State University
University Park, PA 16802

G. P. Patil
Distinguished Professor and Director
Tel: (814)865-9442 Fax: (814)865-1278
Email: gpp@stat.psu.edu
<http://www.stat.psu.edu/~gpp>
<http://www.stat.psu.edu/hotspots>
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THE MAP OF ITALIAN NATURE: THE DETECTION OF THE HOTSPOTS OF ECOLOGICAL ATTENTION

Pierfrancesca Rossi

ARPA Lombardy
Natural Resources
Via Restelli, 3
20124 Milan ITA

E-mail

p.rossi@arpalombardia.it

Vittorio Amadio

Reggio Calabria University
O.A.S.I. Dept.
Architecture Faculty
Reggio Calabria ITA

E-mail

vittorio.amadio@unirc.it

Orazio Rossi

Parma University
Environmental Sciences Dept.
Via Parco delle Scienze 11/A
43100 Parma ITA

E-mail

o.rossi@unipr.it

Angelo Pecci

Parma University
Environmental Sciences Dept.
Via Parco delle Scienze 11/A
43100 Parma ITA

E-mail

angelopecci@yahoo.it

ABSTRACT

Hotspot is an habitat characterized both by high Ecological Value and high Ecological Sensitivity: this kind of habitat needs a relevant Ecological Attention. Referring to the project Map of Italian Nature we used 10 indicators of Ecological Value and 10 indicators of Ecological Sensitivity in order to evaluate environmental mosaic of an italian area. The indicators of Ecological Value and of Ecological Sensitivity have been combined in an unique value by the Ideal Vector Method. Using this methodology, 3 different groups of C.B. habitats characterized by the greatest Ecological Value and the greatest Ecological Sensitivity have been found out.

CATEGORIES AND SUBJECT DESCRIPTORS

GENERAL TERMS

Hotspot, habitat, ecology, multidimensional ranking, landscape.

KEYWORD

Ecological Sensitivity, Ecological Value, CORINE Biotope.

1. INTRODUCTION

This national research project regards all Italy but, till now, we have analyzed and realized the maps of 7 millions of hectares, that is about 23% of the national territory.

The principal goals of the project are the following ones:

to supply an overall representation and evaluation of the naturalistic patrimony of Italy.

to help in the definition of the development lines of a given territory in order to balance the necessity of the nature conservation and the exigency of the socio-economic development.

The methodology of the research was applied separately to each one of the 38 italian areas chosen by the Italian Ministry of the Environment.

DATA BASE AND MAPS

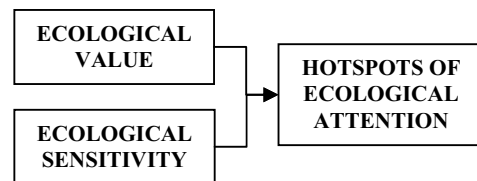
CORINE Biotopes habitat
hydrographic network
street network
built-up
administrative boundaries
Regional and National Parks
Natural Regional Reserves
Sites of Communitary importance for the Nature Conservation
Special Protection Zones
Ramsar Zones (wetlands)
geographic range of distribution of italian vertebrates
Suitability of italian vertebrates
Digital Elevation Model (DEM)
Landsat 5 TM images

2. METHODOLOGY

The FIRST STEP was to individualize the basic environmental units which compose a given area.

We utilize the CORINE Biotopes Method sponsored by the European Union. These units are called CORINE Biotopes (C.B.)

The SECOND STEP was to evaluate each C.B. of a given area as regards these characteristics foreseen by the italian law:



The Ecological Value of a given C.B. habitat was evaluated by 10 different indicators concerning the criteria: biodiversity, rarity, protective aspects, human benefits and institutional aspects. For what concerns the Ecological Sensitivity of each habitat, 10 different indicators have been utilized concerning these criteria: structural aspects, compositional aspects, isolation and abiotic risks. In this way both the Ecological Value and the Ecological Sensitivity of a given C.B. are represented by a vector of 10 elements. All these indicators are expressed on different scales and they have been standardized and normalized in the close interval 0-1 using the relation:

$$X_{norm} = \frac{(X_i - X_{min})}{(X_{max} - X_{min})}$$

The THIRD STEP was to rank the C.B. habitats in terms of Ecological Value or of Ecological Sensitivity by the Ideal Vector Method. This method calculates the multidimensional distance of each C.B. habitat, described by its specific vector of 10 elements, from the best environmental conditions represented by the Ideal Vector. For the Ecological Value the elements of the Ideal Vector are all 1, while for the Ecological Sensitivity the elements of the vector are all 0 (zero). Consequently, less is the Euclidean distance of a given C.B. habitat from the Ideal Vector and higher is its Ecological Value; for the Ecological Sensitivity we have the opposite situation.

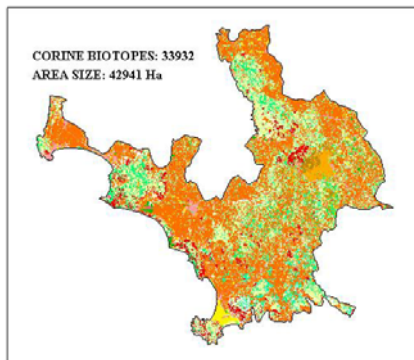
The distance is calculated using the following relation:

$$Dist_k = \sqrt{\left(\sum_{i=1}^n y_{ik} - VETT_{ID}\right)^2}$$

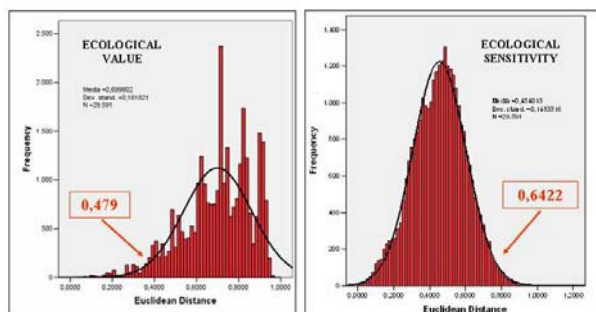
The possible maximum distance is given by the square root of n , where n is the number of indicators and k are the experimental units (C.B. units).

3. CASE STUDY AREA AND RESULTS

This methodology was applied to an Italian area called Southern-Centre Toscana. The results of the application of the CORINE Biotopes Method are represented in the following map:



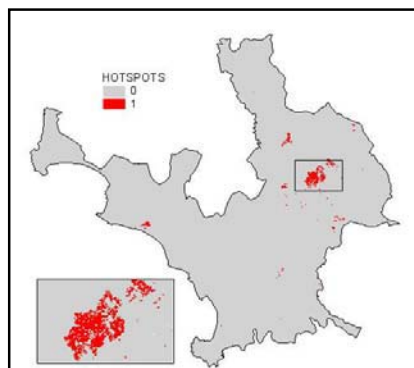
The histograms of Ecological Value and of Ecological Sensitivity obtained by using the Ideal Vector Method and concerning the Southern-Centre Toscana are the following ones:



According to our definition, the hotspot habitats are those that are characterized both by the greatest Ecological Sensitivity and by the greatest Ecological Value. When a C.B. habitat has these two characteristics needs a relevant Ecological Attention.

In order to individualize the hotspots of Ecological Attention in the Southern-Centre Toscana, we choose as threshold the 10% of habitats with the greatest Ecological Sensitivity and the greatest Ecological Value. Referring to the two histograms above, the normalized value of threshold are 0,479 for the Ecological Value and 0,6422 for the Ecological Sensitivity.

The C.B. habitats which satisfy both these conditions (HOTSPOTS) are 113 and are represented in the following map:



The frequencies of the different C.B. habitats covering the hotspots are reported below:

CATALO-PROVENNAL LOWLAND HOLM-OAK WOODLANDS: 2
CHESTNUT (CASTANEA SATIVA) WOODS: 25
CONIFER PLANTATIONS: 9
FRESH WATERS: 2
MEDITERRANEAN SALIX PURPUREA SCRUBS: 5
MEDITERRANEAN XERIC GRASSLANDS: 11
QUERCUS CARPINUS BETULUS FORESTS: 11
SOUTHERN ITALIAN QUERCUS FRAINETTO WOODS: 4
PINUS PINEA FORESTS: 2
WEST HELYCRISUM, SANTOLINA, PHAGNALON GUARRIGUES: 1
ILLYRIAN HOLM-OAK WOODLAND (ORNO-QUERCETUM ILICIS): 6
NEUTROPHILOUS BEECH FORESTS: 35

This methodology has found out at least three groups of C.B. habitats with the HotSpots characteristics:

A first relevant group, composed by 35 C.B. habitats, is located nearby the steep slopes of Monte Amiata in the Province of Grosseto. Most of these habitats are included in Conservation Zones and this aspect justifies their high Ecological Value. These habitats are prevalently covered by discontinuous Neutrophilous Beech forests and Chestnut woods which offer hospitality to several (21) Italian vertebrates at risk of extinction (i.e. the Apennine wolf). The landscape is crossed by a complex hydrographic network (Ombrone, Albegna rivers etc) with small and fragmented riparian bushes. The Ecological Sensitivity of this group of habitats is also of structural type because the elements of the mosaic are very convoluted (fractal index much greater of the mean value of the region) and with very small compactness (index much below the mean value of the region).

The second group, made of 25 C.B. habitats is placed on the wonderful hills between Castiglione d'Orcia and Montalcino (Province of Siena). All these C.B. habitats are included in Conservation Zones and are prevalently covered by Illyrian Holm-Oak woods (Orno-Quercetum Ilicis). The environmental landscape is made of elements on steep slopes with high degree of index of convolution and therefore sensitive to the external forces. Also the index of risk of fire is much greater than the mean risk of the region.

A third group is located almost on the coast of the Tirreno sea not too far from Grosseto. They are humid and brackish very close or partially included in the Maremma National Park.

4. REFERENCES

- [1] P. Rossi 2005. Stima e valutazione del grado di Sensibilit, Fragilit e Valore Ecologico del mosaico ambientale di alcune aree italiane mediante dati a terra e immagini telerilevate. PhD thesis in Ecology, University of Parma, Italy.
- [2] A. Ferrarini 2005. Analisi e valutazioni spaziotemporali mediante GIS e telerilevamento della Pressione antropica attuale e potenziale gravante sul mosaico di habitat di alcune aree italiane. Ipotesi di pianificazione. PhD thesis in Ecology, University of Parma, Italy.
- [3] A. Ferrarini, P. Rossi, O. Rossi 2003. Ascribing ecological meaning to habitat shape through a piecewise regression approach to fractal domain. Landscape Ecology.
- [4] G. Zurlini, L. Grossi, O. Rossi 2002. Spatial accumulation patterns and extinction rates of Mediterranean flora as related to species confinement to habitats. Conservation Biology vol. 16(4) pp. 947-963.