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THE GEOGRAPHICAL INFORMATION SYSTEM AND THE NATURAL RESOURCES MANAGEMENT

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ABSTRACT

The Geographical Information System (GIS) works on databases that contain different kinds of information (town-planning, geographical and environmental). It is able to correlate, to integrate and to consult them just using simple or complex inquiries allowing in any moment the introduction of new data or the updating of those available. The management of the natural resources well it is lent to be done through the creation of a GIS : natural resources are connected to the punctual knowledge of the territory but have to be referred to lots of other factors, primarily linked to human activities, that contributes to organize and transform them. It is needed a suitable cartography containing the basic dates and the general subjects to overlap to the whole other series of information, different for origin and contents. The aim is to represent the natural and human structure of the territory, to know the spontaneous or induced events, to manage the norms and to plan the existing resources: from the integration of all the information it is created an adding value. A concrete example of this statement is represented by a project, in course of elaboration, promoted by the province of Rome for the Realization of an Ecological Network in the mountainous complex of the Lucretili-Simbruini-Ruffi. The study area is situated in the centre of Italy and more precisely in Lazio region throw the border with Abruzzo. The location of this place makes it to be a key element in the environmental continuity at territorial scale, therefore the study of the same one will be made analysing more levels, beginning from the landscape, in its components natural and human, continuing with the definition of the functional ecological network, and concluding with the aspects of managerial nature, that more than the others will receive advantages from the creation of the GIS. There are essential elements able to suggest guidelines for planning and maintaining with ecological criteria: it means to verify the planning instruments, to point out the areas with different kind of constraints and to analyze the incongruities and the conflict points that will become the most important in the new action-plan.

INTRODUCTION ON THE GEOGRAPHICAL INFORMATION SYSTEMS – GIS

The Geographical Information Systems (GIS) is, briefly, a computerized system for

- capturing,
- processing,
- enhancing,
- querying,
- analysing and
- visualising spatially referenced data.

It draws on several related disciplines and deals with spatial information: that's why it is able to relate layer of data for the same points in space, combining, analysing an mapping out the results. It is able to correlate, to integrate and to consult them just using simple or complex inquiries allowing in any moment the introduction of new data or the updating of those available.

GIS databases contain layers each one representing a particular type of geographic data. There are several techniques for processing and analysing data, but in particular it's important to focus on the overlay process, the one that allows their integration.

The Geographical Information Systems allows us to map the location of objects, and patterns are often more clear when viewing mapped data; it provides an effective mean for graphically complex information and, more of all gives an excellent support for land use planning projects and environmental assessments.

Natural resources and human activities cannot be understood without references to its spatial qualities, they are extremely complex and highly variable in space and time: that's why natural resource managers are discovering the power of GIS to help them make the critical decisions they face daily and to assist in tasks such as presenting information at planning inquiries, helping to resolve territorial disputes, and so on.

The value of the Geographical Information System depend on the capability of people that work on it, on hardware resources, but, most of all, depends on the quality, details and reliability of the base data available. Essentially, it means that the original digital data may need to be changed in some way, i.e. either by correcting it, updating it, or refining it.

The analytical functions which GIS software provides operate on both the spatial or the attribute data (or a combination of these), and digital terrain modelling is the process whereby it is possible, using digitised height data, to build a 3-D model of any desired area.

This paper want to show how a Geographical Information System can be used to assess the natural resources of an area with the aim to plan strategies for maintaining and increasing them. It will be describe an application study for planning an ecological network.

THE ECOLOGICAL NETWORKS

The fragmentation of natural environments is a process that strongly threatens the biological diversity. The protection of them through the institution of protected natural areas, that appeared in a first time the fittest form able to contrast the environmental transformations, is now no more sufficient to maintain the fauna and the ecological trials. In fact the attention on the natural environments and on the biological communities should not be constrict inside a specified perimeter but should keep in mind the dynamics and movements of animals and the possibilities to connected them with the neighbouring natural areas.

The planning of ecological networks aims to give to the residual fragmented ecosystems the necessary conditions to maintain their vitality, that's why ecological networks consist of an integrated system of protected areas, buffer zones and corridors (systems of connection) to reduce and avoid the isolation of areas, according to the maintenance of the nature (Romano 2000).

This short digression on the meaning of ecological networks seems to be necessary to introduce the theme of this article, focusing the main attention on the study case described.

STUDY AREA DESCRIPTION

The study area is situated in the centre of Italy and more precisely in Lazio region, throw the border with Abruzzo.

The area is inside the administrative borders of the Province or Rome, and contains the territories of the Natural Parks of the Lucretili – Simbruini - Ruffi Mountains, all submitted on protection laws. The whole area shows the necessity to reconcile the typical management of the Protected Areas with the active actions of restoration, in particular on the zones among the Parks, not insert in planning rules with specific regime of safeguard.

The study area includes the western part of the Province of Rome and, in that one, the territories of the Regional Natural Park of the Simbruini Apennines, the Regional Natural Park of the Lucretili Mountains, the complex of the Ruffi Mountains and some others Natural Reserves, SCIs (Sites of Community Importance) and SPAs (Special Protection Areas).

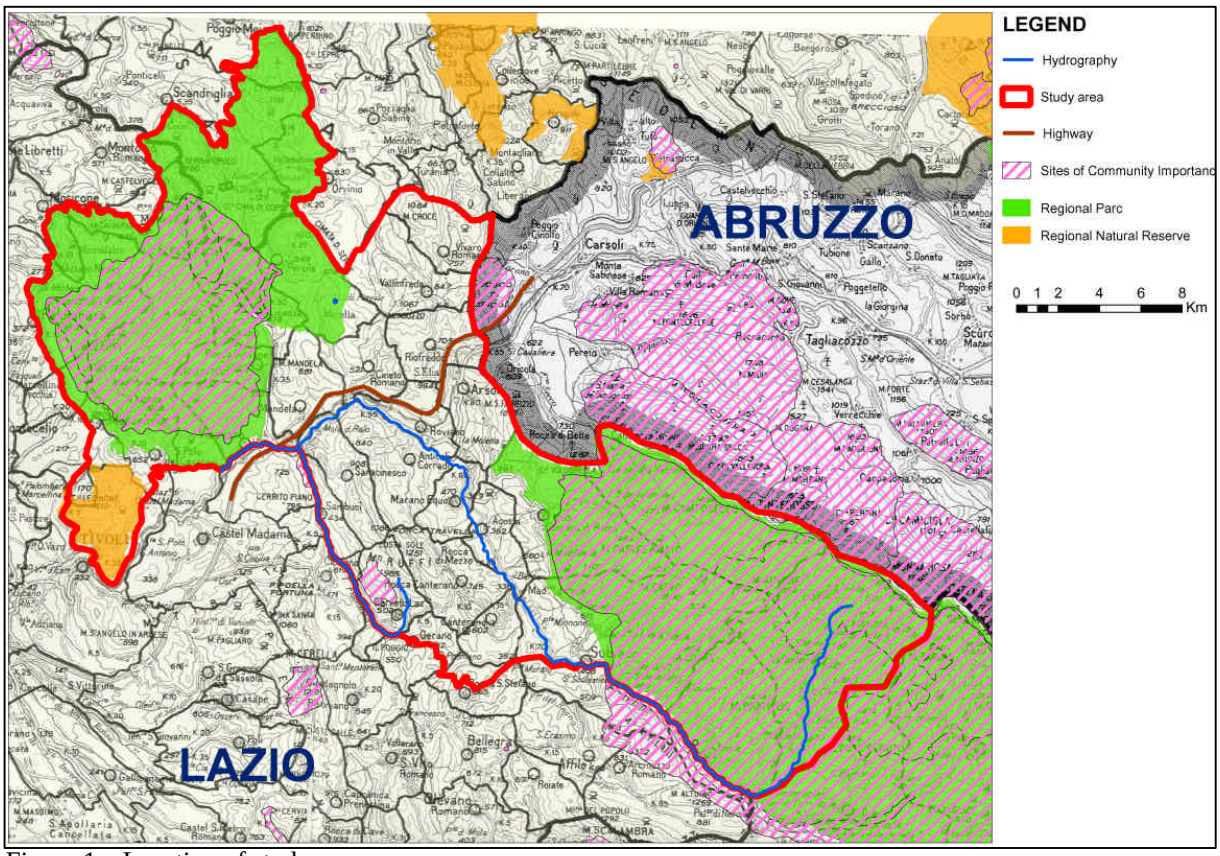
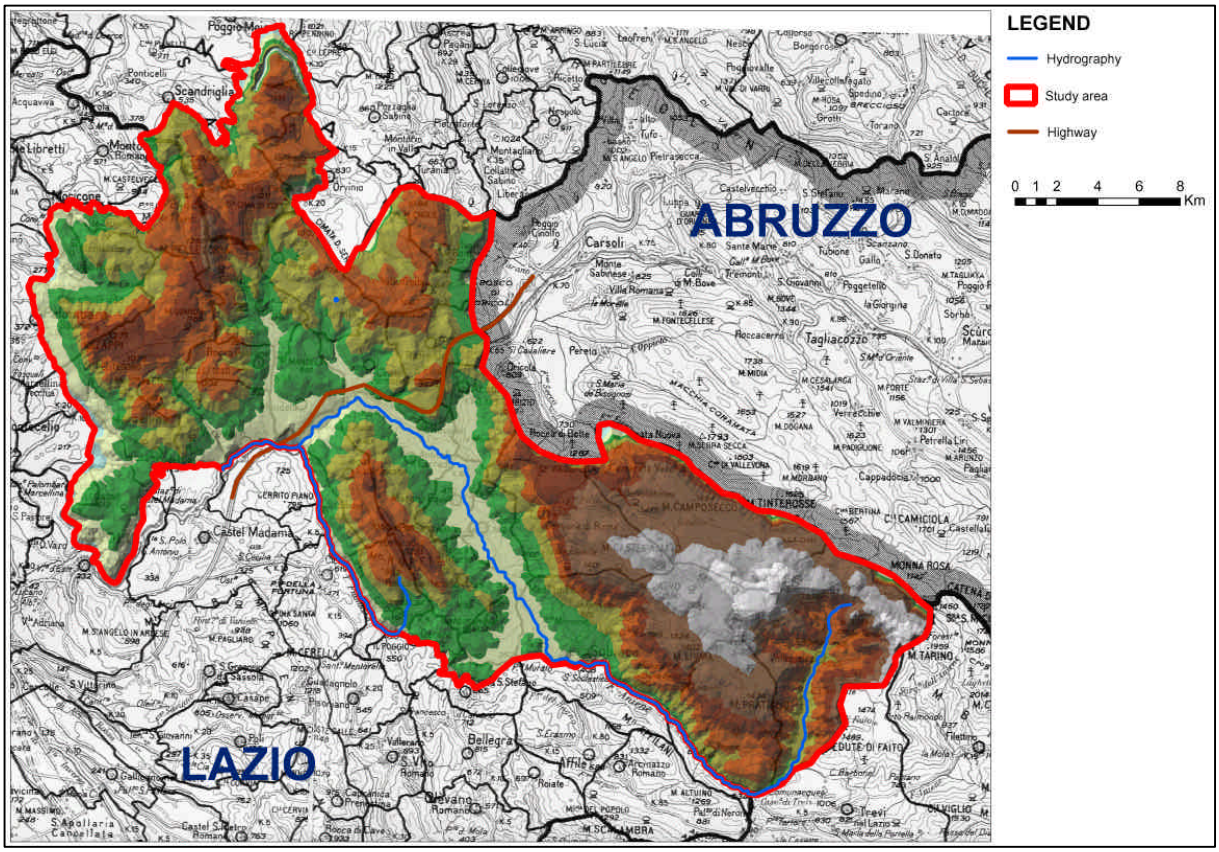


Figure 1 – Location of study area

Figure 2 – Digital Terrain Model of the study area



The location of this place makes it to be a key element in the environmental continuity at territorial scale, therefore the study of the same one will be made analysing more levels, beginning from the landscape, in its components natural and human, continuing with the definition of the functional ecological network, and concluding with the managerial aspects.
The use of Geographic Information System to manage the natural resources of the area will represent an adding value, useful more than all for the administrative and managerial aspects. There are essential elements able to suggest guidelines for planning and maintaining with ecological criteria: it means to verify the planning instruments, to point out the areas with different kind of constraints and analyze the incongruities and the conflict points that will become the most important in the new action plan.

METHODOLOGY USED

The functional analysis of the study area, with the aim to realise there an ecological network, asks specific data about fauna.
Because of the elevated number of present species, the adopted approach founds on an objective criteria of choice of target species, selecting a narrow group of them from the local check-list.

1. It was compiled the local check list on the base of the available bibliographical data, focusing the attention on the two groups of Mammals and Birds that are very good indicators for the whole area according to its land use typologies. For instance Mammals and Birds allow a functional reading of the investigated territory because of their diffuse distribution (the Amphibians for instance are tied up to small habitat such as temporary puddles, small holes, along the roads, etc). Both the groups are sensitive to fragmentation effects in the brief period and could give immediate information on the area. There are lots of bibliographical data available on them and they also are easily sampled.
2. It was selected a group of 25 target species (16 mammals and 9 birds) from the total check list realised.

The selections followed:

- ecological criteria – VULNERABILITY TO FRAGMENTATION,
- conservative criteria – THREAT CATEGORIES.

3. The study continued analysing the potential distributive patterns of species locally present with the support of GIS technologies.

Three informative layers have been used to elaborate these patterns: the Corine Land-Cover fourth level; the contour lines with the related elevations and the superficial hydrography.

The Corine Land-Cover allowed to described the potential distribution at a first level; the elevations and the ranges of altitude allowed to select the optimal ranges from biographical data and the hydrography let us to insert some species, only related to aquatic habitat, otherwise absent in the description.

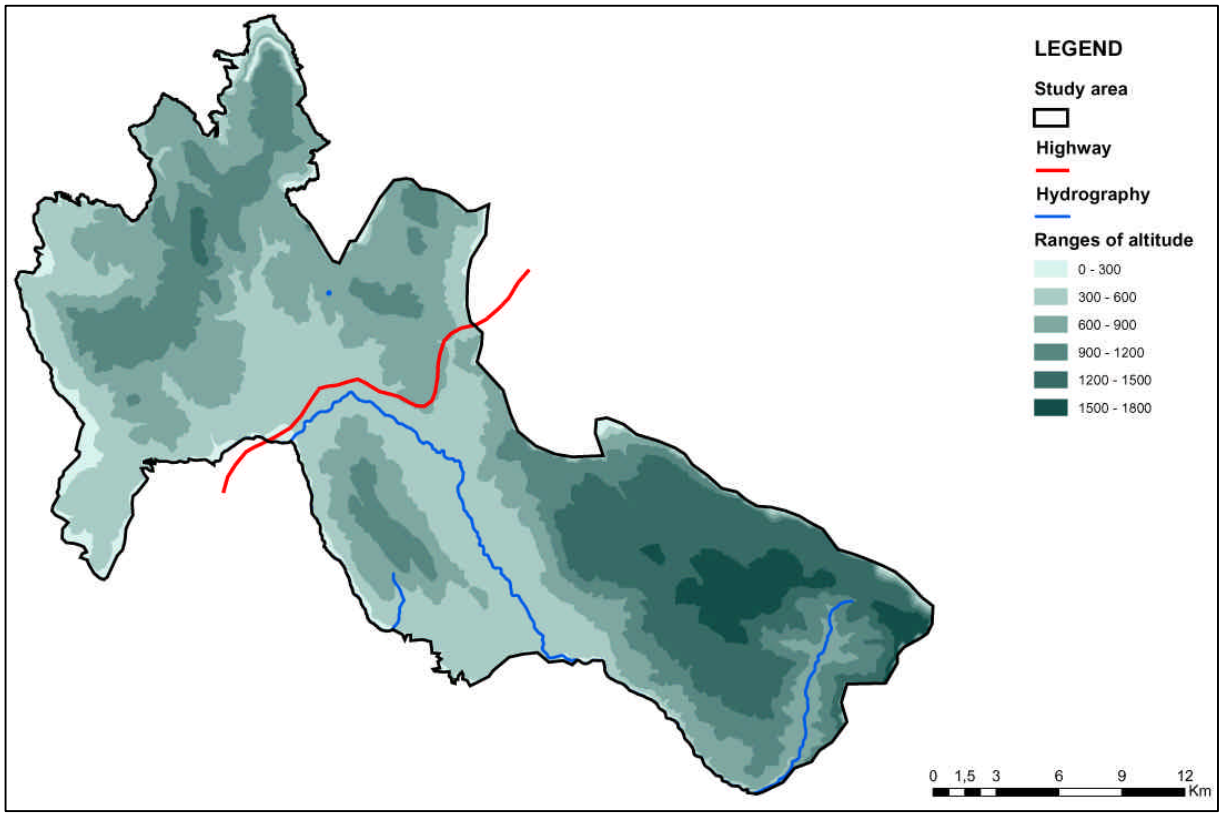


Figure 3 – Ranges of altitude obtained from contour lines

The hydrography layer was realise considering only Aniene River (the principal one) and its first tributaries: the only ones able to guarantee the necessary conditions of stability for the related species. The rest of the hydrography network has the characters of ditch or small streams with marked fluctuations of the seasonal regime during the year, that limit or exclude the stable presences of fauna.

A buffer has been realized around the network whose dimensions are been inferred, in a preliminary way and when available from the bibliography (Celada and Bogliani 1993; Bellamy et others 1996; Baldi and Kisbenedeck 1998).

In the following table there are the buffer of suitability for some species connected to aquatic habitats. The buffers were realised only on the Aniene river and its principal tributaries.

Species/buffer (meters)	200	100	50
Ixobrychus minutus	x	x	x
Charadrius dubius	x	x	x
Actitis hypoleucos	x	x	x
Gallinula chloropus		x	x
Fulica atra		x	x
Alcedo atthis		x	x
Acrocephalous scirpaceus		x	x
Remiz pendulinus		x	x
Cettia cetti			x

Table 1: Buffer for species connected to aquatic habitat

FIRST RESULTS

The data has been elaborated and let us to produce a *map of the richness of species*. Each kind of land use has a correspondent number of species. The relation between the habitat and its suitability for animals is taken from the Planeco Project database (Eds. Filpa and Romano 2003).

	1	21	23/321	24	3111/31311	3112/31312	3113/31313	3114/31314	3115/31315	3116/31316	3121/31321	3122/31322	3123/31323	322	323	331	332	41	511	512	335
Falco tinnunculus	L^{na}	D^{s}	D^{s}	D^{s}										Lpc^{s}	L^{s}	L^{s}	D^{n}	L^{s}	L^{s}	L^{s}	
Falco subbuteo		L^{m}	L^{m}	L^{m}	L^{nm}	L^{nm}	L^{nm}	L^{nm}		L^{nm}	L^{nm}	Lpc^{nm}		L^{pc}	L						
Falco biarmicus														L^{pc}			L^{n}				
Falco peregrinus		L^{wa}	L^{wa}	L^{wa}										L^{n}			L^{n}	L^{w}	L^{w}	L^{w}	

Table 2: Example of the correspondence table land use codes and species (L = localised species; D = highly diffuse species)

From the map (*Figure 4*) it was possible to extract the hot–spots of richness of the investigated area: it represents a first information on its functional potential character as regards species presence. It results that the most elevated values of wealth are assembled along the Valley of the Aniene River, made exception for some small patches located in wooded areas or inside the protected ones, and sometimes are parallel to the principal infrastructural barriers.

In the first case the elevated richness in species is due to the presence of the river ecosystem that is able to sustain elevated values of biodiversity: it gives trophic resources and high natural heterogeneity. The river ecosystem represents a natural ecological corridor, that especially in very fragmented environments it often constitutes the only sure way for animals to moves on the territory.

In the second case the elevated number of species is connected to the presence of forest ecosystems well functional (Regional Natural Park of the Simbruini Mountains and Regional Natural Park of the Lucretili Mountains).

Be careful on the last case: the high presence along the road. It could be not a good index of functionality of the area but index of a certain fragmentation cause by linear infrastructures (highway and other roads with high traffic levels) , that often, at the beginning, causes an apparent increase of the number of species (Bright 1993). The increase is due to the diffusion of generalist species that have a greater ecological plasticity: they easily succeeds in colonizing the new environments produced after fragmentation.

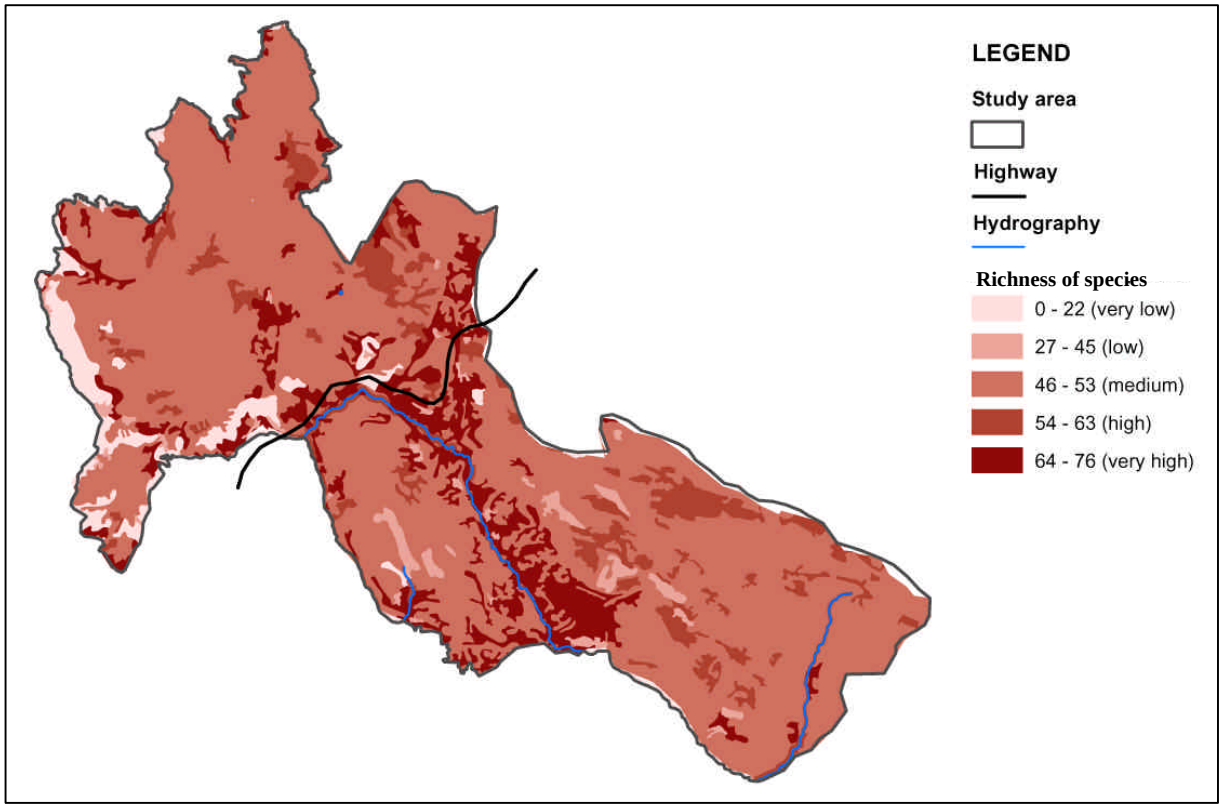


Figure 4 – Map of the Richness of species

CONCLUSIONS

The project is not jet concluded and new ideas are coming on how it will continue.

These first analysis gave a quite clear description on the potentiality of the whole area and underlined where are collocated the more difficult situations. Anyway it is clear that the territorial scale used could not give detailed information at a local one.

The work will continue analysing the areas which are close to the infrastructural systems, that represent the key barriers to the environmental continuity.

GIS technologies will be necessary but the informative layers used before are no more suitable when the scale becomes more detailed (1:10.000 – 1:2.000).

For instance instead of Corine Land Cover level IV it will be necessary to create a new land use description, coming for example on the interpretation of aero photos (1:2.000).

It means that a Geographical Information Systems is as well done as are detailed the materials used to realise it. The base information should be compatible with the scale of analysis so to create a real adding value.

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