Platform “Ecological Network” of the Alpine Convention

The indicators for the ecological network

Indicators for monitoring of *durable* development in the Alpine regions

A synthesis

EN

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INDEX

1. FOREWORD..4
2. THE INDICATORS………..6
   2.1. The indicators choice for ecological network…..................9
      2.1.1.The structural indicators of the landscape…..............10
      2.1.2.The functional indicators of the landscape…..............11
   2.2 Application of a model for the evaluation of the environmental system and the ecological network definition…..13
3. ECOSYSTEM SERVICES………………………………………………..20
4. REMARKS……………………………………………………………21
5. NEW BYBLIOGRAPHY……………………………………………….23

1. FOREWORD

As it can be inferred from the first mandate (dec. IX/17/3), the aim of the Platform "Ecological Network", given the technical and scientific complexity for the creation of an ecological network, should encourage the cooperation among the largest number of authorities, scientific institutions and international organizations working in this area for the same objective. For these reasons, it is worth remembering, according to the first mandate, the objectives of the Platform:

• developing a common terminology and methodology;

• Preparation of a catalogue of implementing measures and proposals of public relations activities;

• The determination of indicators for monitoring the results;

• Collaboration with pilot regions and local actors;

• identifying sources of funding;

• The start of studies for an ecological network in the whole Alpine Arc based on protected areas and the results of the pilot regions;

• The cooperation and coordination with other projects of "ecological network" or "ecological or biological corridors" at international, national and regional level.

Among the tasks listed in the mandate given to the ecological network platform by the Alpine Conference in 2009 in Evian (France), there is the definition of indicators to assess progresses of the Alpine ecological network.

This raises a certain number of technical and methodological issues, such as:

- the definition of Ecological Network;

- the nature of the indicators for assessing ecological connectivity and to monitor actions undertaken in order to improve the ecological connectivity conditions;

- the scale at which the various indicators can be used;

- problems related to data collection, their processing and the final use of the results;

- Monitoring and assessing the time on the basis of responsibilities, budget, personal abilities, etc.

After this premise, on 21st April 2010 Prof. Santolini, as Italian appointed expert within the Platform Ecological Network, was requested to undertake a study on indicators by a mandate which stated: "...the definition of indicators to evaluate progress of the alpine ecological network ....Mr Santolini will therefore, with the help of all Platform members, gather the technical knowhow present in all alpine countries" (minutes of 21st April 2010 held in Toblach). This specification of the mandate was something completely different from what sometimes was erroneously misinterpreted , i.e. “to develop issues linked to the connectivity “.

Meanwhile it has developed through the instrument ECONNET JECAMI a web-GIS with the following tools:

- The Continuum Suitability Index (CSI);
- The Species Map Application (SMA) - Analysis of umbrella species;
- The CARL with the aim to provide results and solutions to potentially increase connectivity anddecrease barrier effects and fragmentation of riverine landscapes;
- PAM not fully operational.

Considering what is expressed by the Platform, the main objective to be achieved with the contribution of the Italian expert, will be to develop the topic of the indicators for Ecological Network in a new sense of functional ecological system.

Consequently, the structural indicators, applied on a large scale, will highlight ecological functional units that are referred to the application of indicators also functional, in order to determine the useful scenarios to the design of ecological network (Fig. 1).

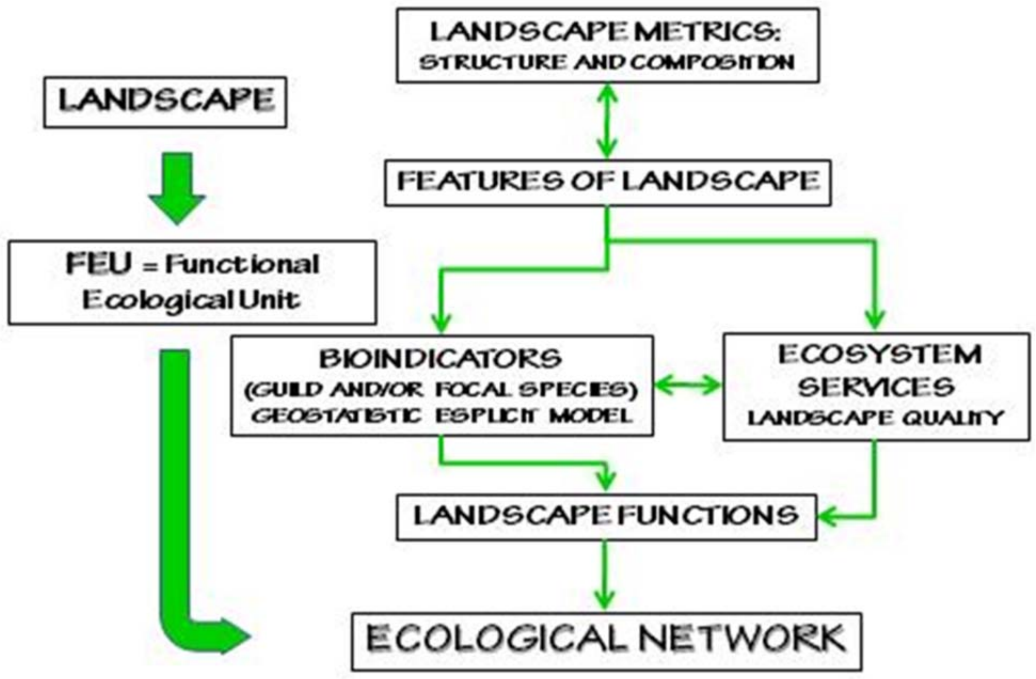

Fig. 1 – Process for the design of an ecological network

2. THE INDICATORS

The landscape analysis adopts Indexes and models that can be characterized by three properties:

1. capability to describe the phenomenon as true as possible to life,
2. precision in the quantification of the values at play,
3. simplicity of use of the model and the indicator itself.

These three properties can never be optimized at the same time in a unique model (Odum, 1973), and, in general, precision is sacrificed in favour of the other two properties: in fact, adherence to life and simplicity of use are usually fundamental characteristics for medium and high scales.

The indicators useful to landscape studies must be also able to capture the interconnections among the structural and functional elements rather than being oriented to thorough analysis that may create the risk of losing the general meaning of the object. Indicators are tools that are helpful to represent in a synthetic (often simplified) manner the territorial complexity.

In order to be useful, indicators must be:

- few, in order to escape new complexities created by a plurality of variables to be managed;

- simple, easy to be understood in order to be used also for communicating environmental issues,

- meaningful, able to represent in a close-to-life way the systems they describe.

The results obtained can be assessed also synthetically (with the required care) through the elaboration of values scale to set up controls of the original and future "environmental quality".

By using indicators and models referred to a landscape system, at the various scale of analysis, it is possible to define the fields of existence, that are critical thresholds, that include the optimal values of the indicators that allow the balance of the system itself. The comparison among the values identified in time series, those of the current situation and some standards referred to various types of landscape allows to highlight deficits and anomalies, and thus to provide dimensions for the landscape elements in function of the identified environmental needs.

With this approach, the fields of existence detect the environmental planning's objectives, and they include benchmarks for landscape transformations, directed to the realization of a balanced system. It is possible to operate evolutionary projections and check the foreseeable results of the planning actions.

Beyond the different tools that the computer technology we can provide, it is necessary documents from the Alpine Convention, has made available. A synoptic framework of 95 indicators is provided in the final report of the Working Group "Environmental Objectives and Indicators" of the Alpine Convention (3rd mandate, October 2004) titled Documenting the Transformations of the Alpine Habitat, with related possibilities of representation for the system of indicators at the Alpine level according to the OECD-identified criteria (2003).Moreover, some of these indicators can be integrated from the set developed for clear indication of the Community institutions and under the European Environment Agency (EEA), specifically to monitor the progress made in EU and Pan Region in particular in EU towards the goal of the strategy: "Halting the loss of biodiversity by 2010".

The project "Streamlining European 2010 Biodiversity Indicators (SEBI2010)" wasstarted in 2003 and finalized in late 2007. The set that results is internationally regarded as the most highly structured, comprehensive and scientifically based set of indicators exists for a regional scale (geo-politics) and a role model. The set has already been tested between 2009 and 2010 to evaluate the progress of the European strategy and became a principal tool on which re-establish objectives and lines of action and therefore, the current instruments (e.g. JECAMI but also others) would be appropriate that it took account.

The indicators that will be discussed afterwards should be integrated within the SOIA/ABIS system of the Alpine Convention.

TAB. I -Selected Indicators. ***The indicators are not underlined have been added***	**Code**	**Indicator (yellow structural; green features)**
B1 Population	B1-1	N. inhabitant
	B1-2	Demographic Density
B3 Agricolture	B3-5	Farmland used area
	B3-6	% of biological farmland area
	B3-7	% of biological farms
	B3-	High nature value farmland
	B3-8	Farmlad management with environment improvmentmesures
	B3-	Agricoltural nitrogen surplus
B4 Forest management	B4-1	Forested area
	B4-2	Naturalness rate of forested area
	B4-3	% young forest with regeneration and natural series
	B4-	Sustainable forestry
B6 Urbanization (SOIL SEALING)	B6-1	Urban, industrial, touristic and linear infrastructures area
	B6-1 Var.	Area increase of urban and linear infrastructures
B8 Turism	B8-1	bed number of accommodation capacity
B9 Energy	B9-4	Energy consumption/GDP (= energy intensity)
B10 Urban water management	B10-1	gross fresh water withdrawal (surface and ground water)

	B10-2	gross fresh water withdrawal from surface river sistem
	B10-3	gross fresh water withdrawal from ground water river sistem
B12 Protection of Nature/Protected areas	B12-1	Hectars of Protected areas
	B12-3	Area of Natural habitats (Natura 2000)
C1 Air quality	C1-1	Total emission NOx
	C1-2	Total emission SO2
	C1-3	Total emission PM10
Road traffic origin	C1-4	NOx emission
	C1-5	PM10 emission
	C1-6	Non-methane volatile organic compounds (NMCOV) emission
C2 Use of surface	C2-1	Non fragmented areas (low intensity of traffic)
C3 Landscape trasformations	C3-2	Landscape diversity
	C3-	land use change (structural and compositionlandscape indicators)
	C3-	Landscape dissection
C4 Structure, composition and loss of soil	C4-	soil compaction and erosion
	C4-1	Total consumption of mineral fertilizing
	C4-2	Pesticide total comsumtion
C5 Quality and Quantity of ground water resources	C5-	Use of water resources
	C5-1	Nitrates concentration in ground water
C6 Surface water– structure an quality	C6-1	idro-morphological status of river system
	C6-	Ecological status of surface waters (river system and basins)
	C6-2,3	% of water basins and river system quality (high, medium, low)
	C6	Status of floodplains
C-7 Natural risk	C-7	measures or the methods of calculating damages
C8 Biodiversity	C8-1	Relative surfaces of natural and semi-natural biotopes
	C8-2	Relative surfaces of priority habitat
	C8-3	% of threatened species/total number of species
	C8-4	Endemic species
	C8	Conservation Value of land use typologies
	C8-5	Pure-bred animal species selected to incomethratened in the Alp
	C8-	Awareness of biodiversity
	C8-	Naturalness of vegetation
C9 Noise pollution	C9-1	Noise emission of road traffic
	C9-2	Map of noise pollution
C10 Cultivation of genetically modified organism	C10-1	N. of Deliberate project release of GMOs
	C10-2	Surface cultivated with GMOs

2.1. The indicators choice for ecological network

Among all the indicators represented in the before mentioned document, some selected ones have been reported within TAB. I, as they have to respond to the functional requirements apt to structure and identify an ecological network.

The study of landscape-environmental processes has to be carried out through a synthetic method, by proceeding from the general to the particular. It starts by examining the dominant features of a given process, then, gradually and by successive approximations; it approaches the analysis of the single parts and of the details that determine the process. This approach is fundamental to the understanding of the true meaning of the phenomena to be studied, which are otherwise threatened of not being comprehended integrally but only by parts that does not describe the phenomenon as a whole.

The utilization of indicators for the Landscape is therefore subject to compliance with some methodological principles which can be summarized in the following points:

• The choice of the indicators must always follow a meta-analysis phase implemented at a higher scale in order to highlight what are the emerging problems to be described,

• The landscape indicators need to be synthetic in order to capture the results of the relations, rather than the "performances" of the single components or functions,

• Indicators are "scale-dependent".

Sectorial indicators are chosen on the basis of the diverse components and factors that can determine criticalities to the environment. Those were collected from multiple sources, such as the list of biodiversity indicators proposed, among the others, by Dumortier et al. (2007), EEA (2007), Küchler-Krischun and Walter (2007). Those retained the most significant at the reference scale will be chosen highlighting the origin and the field of application. The latter is given by the possibility or not of extracting the data necessary for their elaboration at the various reference scales.

In fact, the study of an environmental system has to face the plurality of relations and dynamics that constitute it. This complexity cannot be treated by decomposing the system in parts. Indeed, "the whole is greater than the sum of the parts" since it has to confront itself with complexity, and it is therefore necessary the use of an approach able to cope with the systems in their completeness through, first, an analysis of the dominant features and of the emerging properties and, afterwards, the evaluation of the single components still by taking into account the relations with the context. By the utilization of indicators able to describe the structural features of the landscape, considered as resulting from the interaction among the various environmental component parts, it is possible a synthesis of the information and the construction of a reference framework by which assessing the effects of even very specific events or transformations.

Considering what above mentioned, it is fundamental to distinguish the elaboration and the visualization of the structural aspects of a territory from the functional ones.

2.1.1. The structural indicators of the landscape

These structural indicators are fundamental to characterize a sample area and to define ecological-functional units of a landscape system. Some of these indicators derive from the *Environmental Objectives and Indicators* of the Alpine Convention (3rd mandate, October 2004). Beyond the topographic features the main indicators are:

B.1. Population

B3 Agriculture

B4 Forest management

B.6 Urbanization (*SOIL SEALING*)

C2 Use of surface

C3 Landscape transformations

C4 Structure, composition and loss of soil

C6 Surface water - structure an quality

C8-Biodiversity (biotopes, habitat, flora and fauna)

These indicators (B3-C8), defined through the levels of the CORINE Land Cover, could help to make the land use comparable. Nevertheless it is necessary an homogenous and coherent cartography of land use for the whole Alpine arc, otherwise even the most advanced cartographic data processing instruments will give back partial results.

Subsequently (Fig. 1) landscape mosaic and structure were characterized and evaluated also by applying some typical indices used in Landscape Ecology (Uuemaa et al., 2009) to show relationships between ecological processes and spatial patterns (Turner, 1990; Turner et al., 2003). To calculate size, shape, diversity and fragmentation of landscape indices, it is possible to use free software (e.g. www.geo.sbg.ac.at/larg/vlate.htm) for ESRI ArcMap and to show the same elaboration produced by JECAMI.

The **Indices of landscape metrics** extracted from Dramstad et al (2006) and from Lee et al (2008), are:

- Patch density;
- Total core area;
- Mean Euclidean nearest;
- neighbour distance;
- Area-weighted mean shape;
- Mean shape index;
- Edge density;
- Cohesion;
- Shannon's diversity index;
- No. of land types;
- No. of patches; Percent open area.

Assessment of ecological network viability can be undertaken by analyzing the inherent characteristics of the landscape elements, the interrelationshipsbetween landscape elements and external factorsaffecting the functioning of the landscape of the Pilot Area/Functional ecological Units and the ecological network.

A range of landscape element attributes are assessedthrough patch content analysis for identify the functional corridors and the core areas.Inherent characteristics include size and type, vegetativestructure and diversity, and naturalness.

2.1.2. The Functional indicatorsof the landscape

The ecological network (functional ecosystem elements of ecomosaic) is identified by deepening the analysis through the function indicators.

At the time when to be developed spatial analysis to minor scales, in addition to the metric indicators measuring the dimension of the Landscape, the functional and the structural characteristics, other useful indexes or parameters can be individuated, that can be evaluated time by time depending on the peculiar features of the reference area. Moreover, the comparison of the indicators' results in different scenarios, current state and reference scenario, provides general planning indications as well as particular orientations, with reference to the various FEU 's features.

The assessment of the compatible transformations results directly from the analysis and diagnosis of the landscape, from the problems and features found at the various scales. Consequently, the operational orientations must outline effective interventions at multiple scales. The indicators are integrated by sectorial indicators, now aiming to describe specific components and factors instead of the systemic reality.Interrelationships between individual landscape elements and thelandscape matrix are assessed through a number ofindicators that are described as context.Network structure analysis considers the overall effect of theinterrelationship of patches and corridors within thecontext of the landscape matrix.

The **Matrix of a landscape** derives from the ecosystem or the type of land use setting in a mosaic, characterized by an extensive cover, high connectivity, and/or higher control on the dynamics (R. T.T. Forman, Land mosaic, 1995).A stable matrix should have at least the 60% of the territory covered with its defining elements. The degree of stability of the matrix is an element for the vulnerability assessment of a landscape. The more the value increase drifting away from the 60% threshold, the more is its stability and the resilience to those de-structuring actions produced by the introduction of works of transformation. Nevertheless a solid matrix is not immune to the impacts of works of transformation, it is still able to respond more appropriately. In any case, protective actions shall be put in place for its safeguard.

Preliminary qualitative analysis of the context of the situation should highlight a series of criticalities diffused at large scales, so that those identified criticalities may address the choice of indicators useful to the description of emerging issues. In fact, in addition to the typical indicators of the landscape metric, they can be useful indicators to:

a. estimate of the anthropogenic load of the province and single FEU. Thanks to the identification of total ecologically tolerable levels of anthropogenic loads, the system may be prevented to be subjected to excessive environmental stress or radical balance changes, which lead to modifications for landscape typologies (FEU Matrixes and Habitat standards per capita).

b. highlight the degree of contrast and the state of depletion of natural and human ecosystems, which not only reduce the quality of the landscape and the environment but also increase their vulnerability. Therefore, landscapes are more likely to undergo transformation processes, at the expense of environmental resources and identity and aesthetic characters (compatibility, heterogeneity, presence of historical elements);

c. measure the fragmentation of the areas of interest, which strongly interact with both the ecosystem functionality and the landscape characterization and its usability (density of road and railways, indentation, grain, Mesh-size);

d. calculate the threshold depletion of environmental resources are a drivers of some FEU. IVN, *Index of Vegetation Naturalness* (Ferrari et al. 2008), can be joined with the TECI for the evaluation of naturalness of landscapes. TECI can supply additional information about the importance of landscape ecotones. The integration of this index with the use of focal species, determines the opportunity to develop a synthetic indicator of ecosystem function (IFM, Santolini e Pasini 2007)(IVN, IFM);

e. evaluate the extent of land consumption (soil permeability as index of "urban sprawl"), primary cause of degradation of rural landscape (Romano 2002, 2004).

The set of critical issues identified determines the vulnerability and functionality degree of the landscape's areas of reference and facilitate the identification of appropriate management action.

2.2.. Application of a model for the evaluation of the environmental system and the ecological network definition

Wildlife research in assessment and planning fields has always had a limited role and a descriptive except a few cases such as parks, management plans, and faunal studies of the impact still characterized by a more analytical approach summary. However, the use of some zoological groups showed a strong impulse in relation to the fact that these groups (Carabidae, songbirds, small mammals etc.. or functional groups) are employed as ecological indicators, offering the possibility to overcome the problems of the standardization method (AAVV 1983) or of different scales analysis. The use of focal species or communities (sensu Lambeck, 1997) are well suited to serve as a marker for their landscapes and are interrelated with the resulting biodiversity values (Taffetani and Santolini 1997).

The proposed model mainly considers birds community because birds are among the organizations best suited to be used as indicators of the degree of complexity or degradation of terrestrial ecosystems, on soil, vegetation and in the lower atmosphere and show high sensitivity to changes in environments in which they live (Blondel 1975, De Graaf 1977). Moreover, relations between the composition and structure of bird communities and vegetation structure were investigated by several authors (see among others MacArthur and MacArthur 1961, Karr and Roth 1971, Blondel et al. 1973), who identified correlations between the characteristics of birds community and the complexity of vegetation. Most recent authors have considered some parameters to identify descriptors of the community as a valid method for assessing the quality of ecosystems and environmental influences on the stability of the ecosystems (Landres et al. 1988; Hilty and Merenlender 2000).

The methodology shows the possibility of obtaining comparable values between different elements that characterize the landscape as a result from a critical and integrated reading of land use, vegetation and forestry cartography, if available. This allows us to obtain an Environmental Map as useful environmental indicators for a wildlife assessment of environmental system at present conditions and hence its quality. Indeed, the development integrates the assessment on coenosis with structural elements of ecosystems that are spatially considered through a process of interpolation. The map was produced showing areas delimited by isolines with the same value used on the index that represents the ecological value of that field as measured by the birds. Indeed, this representation expresses a trend, while index values emphasize the different functional levels of criticality of environmental variations.

The ecological function of the elements constituting the ecomosaic gradually emerge significantly (Kinzig et al., 2002) as function of the Nature or rather the ecosystem services as the functioning of the ecosystem (Norberg, 1999). Recent studies have tried to understand the effects of diversity on ecosystem functioning at different levels of scale, highlighting in particular positive relationships between biodiversity and primary production (Costanza et al. 2007) and between biodiversity and ecosystem services (Kinzig et al. , 2002)., beyond the evolving debate (Costanza et al., 1997, 2007), larger spatial and temporal scales is needed for greater biodiversity to provide a regular flow of ecosystem goods and services for which the biodiversity becomes a key element in achieving goals of economic, social and ecological management (Hooper et al., 2005).

With this approach, the concept of ecological network as a sole response to fragmentation processes aimed to preserve the only function to the movement of species, shows its limits. This concept must be complemented and supplemented by the consideration that both the ecological quality of the system components, quality and quantity of their duties (including the biodiversity of species which are essential for function evaluation), which becomes the emergent property to identify and assess, together with its vulnerability, as input to the planning and management of complex planning.

The synthetic index used comes from integrating the list of breeding species and types of Environmental System Map in the territory concerned. The nesting species can be obtained from literature searches and in particular the consultation of wildlife atlases or rather the result of a campaign of surveys conducted by ad hoc methods now standardized (Bibby et al., 1992). In this case a sufficient number of measurements is made in each of the types identified in the Environmental System Map, together with the collection, through the completion of a standardized survey form, of information related to the physiognomic-structural and land use of the Count Points. The definition of environmental types that make up the legend of the Environmental System Map is mainly based on physiognomic and structural criteria of vegetation and resulting analysis and synthesis mapping of land use, forest, vegetation etc. or the construction of a original map produced by interpreting aerial photographs or satellite images

Thus we can derive a summary and quail-quantitative index on the relationship between number of breeding species present in each type of map and "type" of species. The specific type is represented by the recurrence score and considering each of the species list given a directive or agreement regarding the protection of wildlife. The criteria which have been drawn up list the various Community and national legislation, meet the principles of biological conservation. Faunal lists have been considered of the various conventions Community (EU, Bern, Bonn), the national law (Italy) on the protection of homoeothermic fauna (157/92 and successive modifications and integrations), the Species of European Conservation Concern (SPEC), the state Conservation Committee (ETS) and the IUCN Red List of Threatened Species in Italy (Bulgarini et al. 1998).

The synthetic index of evaluation, and therefore environments in which it is applied, concentrates within itself the parameters as rarity, complexity, sensitivity, vulnerability and so fragility. As are the parameters for the selection of species in the lists above. Total value of wildlife is an index that summarizes the ecological value of vegetation types as formed by the selected species through the parameters and then the components of the index itself. Consequently, the average of Faunistic Index cenote (Santolini et al. 2002) embodies, through its components, several parameters of environmental quality valued through wildlife, which are then reflected on the types of vegetation which is then assigned a faunistic value (zoo sociological value) based on descriptor parameters, also called "criteria" (Usher, 1986), of biological and conservation type. Among the "criteria" was adopted biological richness (S) (Lund, 2002), i.e. the number of components each species coenosis (type investigated), which can express different aspects of maturity and stability of the ecosystem (Margules et Usher, 1981, Conroy and Noon 1996) both conceptual components of diversity.

For each typology of the environment map are derived values of each parameter (SP) and the "weight" can be defined by a simple ratio that determines the index (ISP) for each parameter (sp = richness, conservation value) for species that coenosis the second methodological approach, suitably modified and used by Mingozzi Brandmayr (1992):

$$Isp = \frac{SP}{N}$$

ISPs obtained are gathered into classes whose range has been obtained for distribution (ie, dividing equally the difference between the maximum and minimum) and thus derive parameter values for each coenosis (VCP) from which the index is calculated Wildlife cenote medium (IFm):

$$IFm = \frac{\sum Vcp}{np}$$

where np is the number of parameters, thereby giving content to any type of wildlife ecosystems previously identified. IFm values obtained were then normalized to the value 100.With this procedure we obtain a synthetic (IFm) which is the integration of the value of each type of land use determined by the weight of the different species present in every type, from the surface and the value of IVN. The geostatistical interpolation of the elements, shows cartographically connectivity of the elements at different value of ecological functionality

The mapping of model suitability for wildlife is based on the calculation of synthetic value of the IFm for each cell derived from the overlap on the Environmental System Map of a regular mesh grid (square or hexagonal). In relation to the use of the Bird of the grid step chosen was 200 meters (Farina 1990). The data of percentage area occupied by various types of patches derived from the overlapping of the grid map then allow the calculation of the IFm for each cell (VCX Fig. 2).

$$V_{cx} = \sum_{i=1}^{n} V_i \times Sup\%_i$$

dove:

V_{cx} = valore finale cella x
V_i = valore IFm tipologia i-esima
$Sup\%_i$ = superficie occupata dalla tipologia i-esima espressa in percentuale sul totale della cella

Figure 2 - Calculation of synthetic value of IFm for a single cell

To Each grid cell was assigned a value equal to the sum for each type in the cell, the product of the value of MFI type vegetation and its percentage area occupied within the cell. Keep in mind that with this setting you can create models based on transformations of the elements of the Environmental System Map (e.g. scenario planning and project number) compared with the status quo and also using atlas data (Rossi and Kuitunen 1996).

therefore , he total value of the cell, , can vary between the minimum value of IFm, in the case of a square occupied entirely by IFm type, and maximum value of IFm, in which cell is occupied entirely by this type with value. The series of records relating to the centroid coordinates of the cell (X, Y) and the value of synthesis of IFm (z, VCX Fig. 3) then can be interpolated through mathematical algorithms (e.g. spline) or geostatistical (egkriging). The map thus obtained is applied to a graduated scale of colours, between minimum and maximum values of MFIs, to see a continuous change in the value of MFI in the study area.

(Fig. 3) this representation of data allows the identification of areas at different levels of fitness wildlife through the process of interpolation merge in order to highlight trends or to potential criticality of the system, depending on the process identified by the choice of 'objective assessment and/or planning. This representation may reveal more clearly the aspects of dynamic interrelationships between the components and in particular can be assessed:

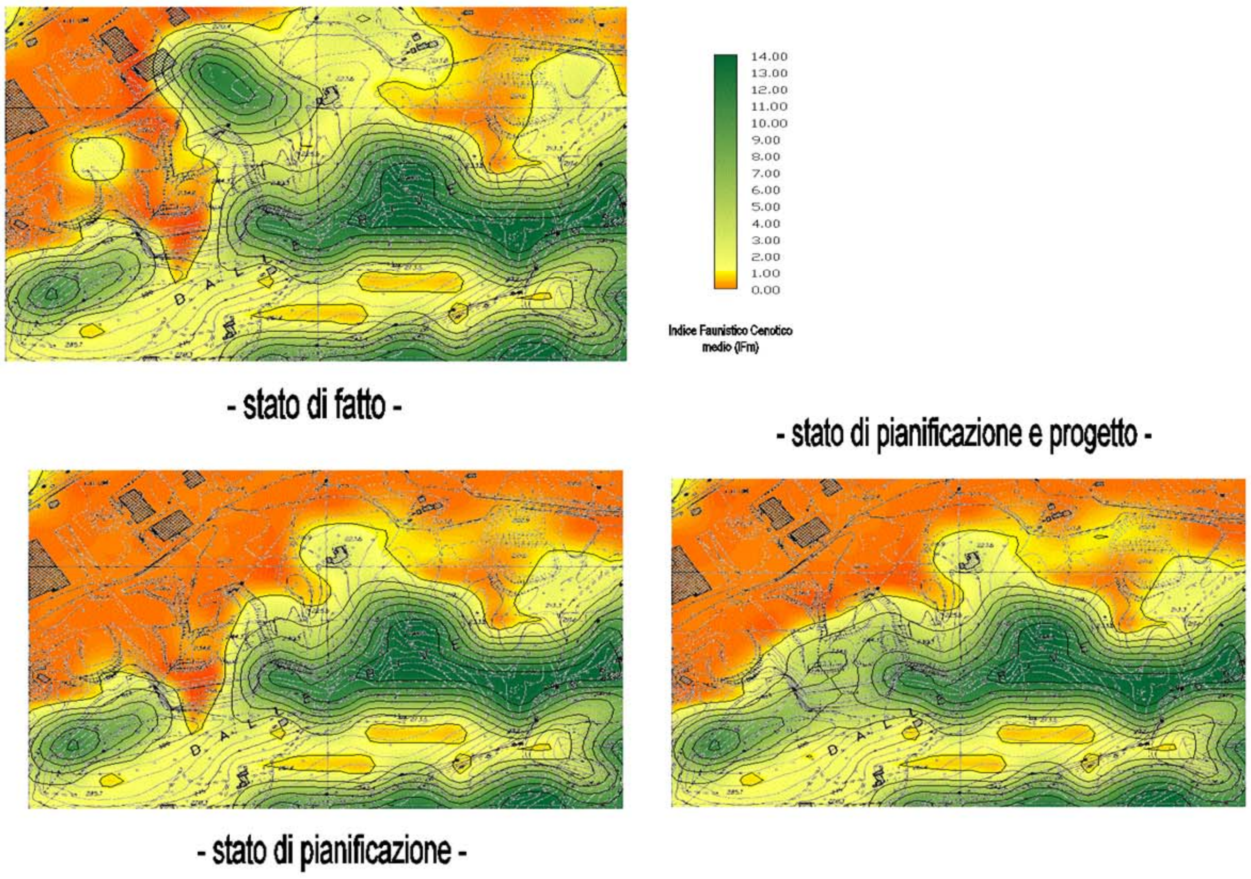

Figure 3 - Example of the predictive potentiality of the models based on the biocenotic criterion

• the fragmentation of the environmental system highlighting trends and critical issues;

• the effects of an action for positive or negative interaction with the environmental system;

• the effects of different stages or evolutionary scenario;

• responses to the recovery solution chosen.

The geostatistical model derived from processing of component information on flora and fauna can effectively respond to the demands of a summary diagnosis with identification of critical points and local features through the application of appropriate ecological indicators (Fig. 4). Furthermore, the model identifies the dynamic trends pointing in different levels, those that are compatible and consistent with local needs by providing an important basis for the review of projects and for the localization and characterization of works of mitigation and compensation.

The ecological network was born as a response to the processes of fragmentation, although over time it has been understood in different ways, depending on the features that are intended to favour, translated in turn into different operative consequences that often have little to do with the functions of ecological network. Currently, the total functional aspects of the land mosaic elements emerge gradually in a decisive way with a direct dependence between ecosystem services and functionality of the ecosystem. Biodiversity, as an indicator of ecosystem functionality, becomes key factor to achieving goals of economic, social and ecological management. Consequently, an ecological network must maintain space for the evolution of the ecological system in which biodiversity must move forward independently without any hindrance and the weight of anthropogenic actions must be commensurate with high levels of autopoiesis of the system, functional to maintain the highest efficiency of ecosystem services. The structural elements of an ecological network may define ecosystems where it is distributed even Critical Natural Capital and which assume a role of invariant landscape, both in the form of landscape structure (structural invariant), both in terms of processes (functional invariant). The quality of the landscape may be associated thus safeguarding of those territories which have special goods and services also depend on welfare of man, and that must be recognized that function as real and tangible value for the territory. The Ecological Network offers so formidably an opportunity to produce useful actions aimed at increasing the quality of the landscape and to preserve the capital stock of natural resources including biodiversity. Finally it becomes a key tool for addressing the changes on portions of renewable resources that not inhibiting the processes by maintaining. The Ecological network, acquiring a structural value as territory program-plan of ecological improvement for the integration of planning tools to help identify quality territorial standards. This program-plan must be functional to characterize the landscape according to the provision of ecological goods and services (and not only) that the system produces.

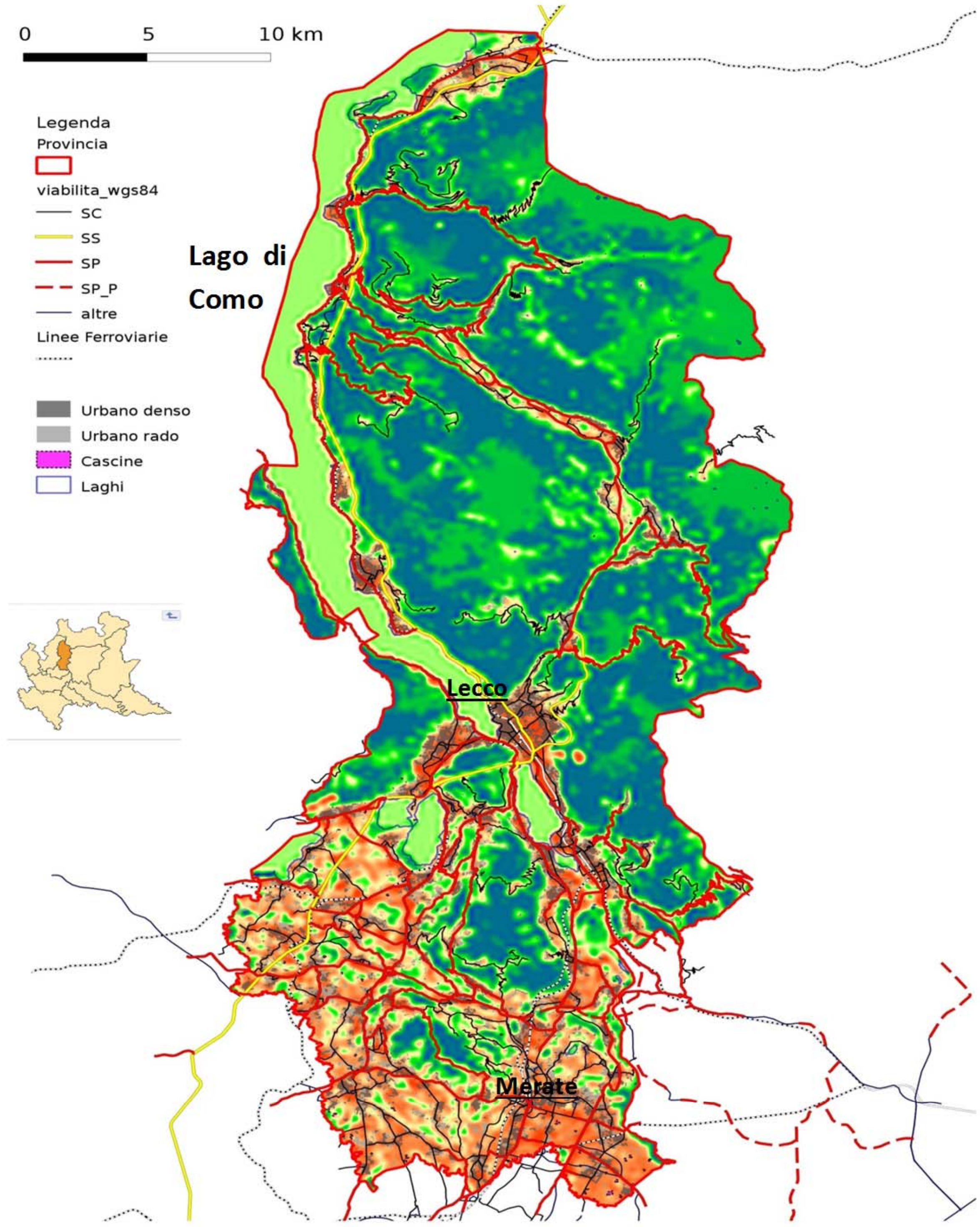

Figure 4 – Geostatistical model of Lecco Provice (Lombardy) for identification of ecological network.

3. ECOSYSTEM SERVICES

Based on work developed (Fig. 4) which defines the areas with different ecological features, you can collect a variety of information that can further characterize the identified geographical areas and assess ecosystem function and ecological quality of the regional system on the basis appropriate indicators and dedicated Staub, Oct et al. (2011), so check your choices and evaluate attitudes and concerns of the territory or FEU.

Enabling life on the planet, these services represent effective and irreplaceable benefits provided by the functioning of ecosystems in relation to the intrinsic properties and processes that occur in them. De Groot et al. (2002) developed a classification of ecosystem services, further complemented by the Millennium Ecosystem Assessment (AAVV 2005):

- Support services: services required for the production of all other ecosystem services (soil formation, photosynthesis, nutrient cycle, primary production etc..);
- Provision services: products obtained from ecosystems such as food, fresh water, wood, fiber;
- Regulation services: benefits obtained from regulation of ecosystem processes (climate regulation, water cycle, flood, water purification, CO2 fixation, etc..);
- Cultural services: non-material benefits (recreational, aesthetic and perceptual, spiritual).

The SE can be evaluated through a series of approaches, from the recognition of market prices or preferences (typical of environmental economics) to qualitative assessments (typical of social sciences), each suitable for specific contexts and spatial scales. Despite over the last ten years progress has been made in understanding how ecosystems provide services and how to translate these services into economic values, there is still no generally accepted methodology for evaluating spatially explicit SE, which would be useful to define and evaluate strategies of territorial management (Balmford et al., 2002) .

There are two main approaches to evaluate the SE in monetary terms. The first approach consists in the direct assessment of one or some SE for a specific area based on economic measurements and / or ecological models. The second approach called "benefits transfer" (Wilson, Hoehn, 2006) is based on the controlled generalization of a series of direct evaluations targeting specific areas, whole regions or entire countries (Liu et al., 2010; Metzger et al. , 2008). The major limitation of this method is that it generalizes values assuming that each hectare of a certain type of habitat (or coverage) takes on the same value, regardless of its specific quality, regional rarity, spatial configuration, and proximity to populated areas and the specific social and economic context. On the other hand, the first approach, although better in terms of reliability and reduced uncertainty of the results, often do not get to be a support to the spatial planning as its validity is spatially limited to areas of study and to the high cost (or impossibility) of replication on a large scale.

The estimate of the economic value of SE in Italy was based on an original and spatially explicit adaptation of the method of benefits transfer based on land use in 1990 and 2000 (Corine Land Cover) (Scolozzi et al., 2011).

4. REMARKS

In conclusion the recommended set of indicators is the minimum which could be taken into account in order to guarantee to the study undertaken within this Platform, the proper outlook to bring the Ecological Network -which is expected to be realized in the Alps- to be not only a mere species-specific connectivity, but it could become the prodrome of the valorization of the ecosystems maintenance able to ensure –through theirs functions- the essential services.

On the basis of what has been explained so far, it is clear that an Ecological Network assumes a valence which goes beyond the simply specie-specific landscape/habitat network (Santolini 2009). Thus the planning of a network is a complex process of integration between aspects of territorial analysis and aspects functional to the different scales, and the support and the "control", through guild or focal species opportunely extracted from an ecological analysis, of spatially explicit models (biological target oriented). In relation to that, the development of a conceptual framework for the planning of an Ecological Network –as emerged in pages 4-5- should take into account the following steps as illustrated in Fig. 4 (Battisti 2003 mod.):

a. Structural Level: is the portion of structural and functional analysis of territory where, through the comparison among scales, it is possible to identify the homogenous sub-areas, the land features and its problems, both ecosystem and territorial ones. The analysis of the Ecosystem Services is developed to define even better the weight of the natural capital and its functions also in relation to the comparison among space-time scales.

b. Dynamic- Functional level: During this phase the fauna indicators are chosen also in relation to different scales and with different resolution powers. The support coming from the spatially explicit models offers the chances to define scenario with suitability and functionality ecosystem gradient then with areas at different level.

c. Planning and Management level: During this phase there is operated the synthesis between the two previous levels, the structural and the dynamic-functional ones, where the territorial areas are identified and which are classified by the ecological network. It is possible to develop integrated analysis (GAP, Functional, etc.) in order to highlight the net problems and the chances related to the maintenance and to the recovery of the ecosystem functions. This is the phase where guidelines and provisions aimed at the defragmentation and at the conservation of resources could be developed. Furthermore this is the phase where there is the chance of using the ecological network as instrument of environmental requalification. This is clearly possible on condition that the methodological approach is in accordance to the definition of ecological network as:

"*to maintain space for the evolution of the ecological where the biodiversity must improve itself autonomously without hindrances and the weight of the anthropogenic actions must be adapted to high levels of system-autopoiesis, aimed at keeping the highest effectiveness of the ecosystem services (Santolini, 2008)*".

The identification of the eco-functional importance of the various system units in their whole, due also to theirs spatial distribution and to the reference scale, represents the role which they assume within the system itself, which characterizes the ecosystem services it produces.

Thus the Ecological Network offers a great opportunity to define some of the threshold of territorial transformation, addressing the development on actions which don't inhibit the ecological processes to be maintained, highlighting that landscape should be addressed to the maintenance of high quality standards relating to the carrying capacity of the ecosystem and to its high levels of autopoiesis.

Given the complexity of the system, the control of the process will be integrated both from a point of view of the administrative competences and from the strictly scientific ones, defining in such a way a program of territorial ecological improvement.

The project of Ecological Network becomes a tool for producing actions aimed at increasing the quality of the landscape and at preserving the stock of natural capital, among which the biodiversity. These objectives could be achieved by making use of the different programmatic instruments of land management in a strong coordinated/synergic manner, fostering the anthropic activities which are compatible with the maintenance of the ecological functionalities of the system.

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