

## PHYTOSOCIOLOGY APPLIED TO NATURE CONSERVATION AND LAND MANAGEMENT

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### Abstract

This paper is a discussion of the procedure and convenience of the use of phytosociological information for nature conservation. After a short review of this topic in Spain, a proposal about the application of phytosociology for nature conservation purposes adapted to the environmental and socio-economical circumstances of that country is made.

It is convenient to have a prior real vegetation map using syntaxa or syntaxa complexes as units and to each of them several evaluating criteria are applied: naturalness, replaceability, threat, floristic-phytocoenotic value, and rarity. A 0 to 10 point scale is used for each of them. Finally, according to the human population density of the territory, the territorial need of ecosystem protection coefficient is calculated. With these parameters simple formulae to evaluate the Total Conservation Interest of mapped or represented vegetation units and the Global Interest of areas to establish protection priorities are proposed.

### Introduction

The use of plants and of plant communities as indicators for land planning and nature conservation policy is in principle quite accepted in most countries (Blandin 1986) in so far as they are themselves the object of such eventual protection. The point is how to use them, which elements of the flora of an area should be considered. Several attempts have been made in many countries, most of them following quite diverse evaluation criteria and techniques. Actually it would be quite convenient to reach a unified system of evaluation which would be able to use the largest amount of data already collected about the biodiversity of a territory. A quite successful proposal was made by Lucas (1973) who evaluated globally the botanical value of a site, together with the zoological, geological, etc. ones, and gave an evaluation number for each of these criteria. Later, the idea of using not only the flora but also the phytosociologically defined syntaxa for these purposes, was developed (Arnaiz 1980, Asensi 1990, Géhu 1992), arguing that they integrate the environmental variables and summarize practically the whole floristic diversity as well as many of the ecological relationships between the different organisms. In addition to it, knowledge of the successional trends and the establishment of the sigmeta or vegetation series allowed the development of landscape phytosociology with its implications in land planning (Géhu 1987). Another important consequence of successional phytosociology is the perspective given to the possibilities of restoration of potential natural vegetation in degraded areas (Bonnart & Delelis 1979, Valle 1991 a & b). As vegetation description following the Braun-Blanquet approach is strongly developed in most European countries, the use of its typology for evaluating purposes will permit the construction of a unified evaluation system for Europe and other territories.

Two lines of procedure have been developed for ecological evaluation of territory. One is to take into account the flora and the plant communities of a given site or area and then to assess them. This allows one to compare that place with others and, in that way, to establish a ranking of places following their value; this permits one to take decisions according to those priorities. That sort of evaluation has been performed with high exactitude by Géhu & Géhu-Franck (1980 b) and the most important result of its application has been the huge evaluation of the French Atlantic coastal salt-marshes made by Géhu (1979). The other possibility is to assess units such as associations or plant communities which are suitable to be mapped or represented cartographically. Each mapped syntaxon or syntaxa complex will be associated with a concrete value numerically determined and consequently a vegetation map can be translated into a map of ecological values. It is possible to make this for any territory, not only for previously selected sites or areas, and such a map can be the main document for selection of sites for eventual protection.

In this last sense, there is the important work of Seibert (1980), who proposes several criteria for the ecological evaluation of the main phytosociological syntaxa of Germany. For each of these criteria a point-scale is given and other circumstances not intrinsic to the vegetation units themselves, but of importance for conservation, are also considered. This is basically the tendency we follow, although both of them can be combined if the requirements adapt to it. We have tried in this work to achieve a system of evaluation for the most common vegetation units in the Iberian Peninsula, easy to apply, and adapted to the socio-economic circumstances of that territory.

### **The Use of Phytosociology in Nature Conservation in Spain**

The history of the application of sigmatist phytosociology to nature conservation and land use planning in Spain is quite brief. The first work, by Arnaiz, appeared in 1980 and uses several criteria for the evaluation of vegetation types defined by the sigmatist phytosociological method. These criteria are the floristic value and the biocenotic value; formulae to estimate them numerically are proposed. These criteria are linked to cartographically represented vegetation units. His proposals were never used and no other work appeared till 1984 when Costa & al. made an evaluation of Mediterranean shore localities for conservation purposes in the Valencia region (see also Costa & al. 1988). After that no publications were recorded till 1987 when Rivas-Martinez publishes his important work about vegetation series in which he formulated, described and mapped the sigmeta recognised for Spain. For each of these units land use recommendations are made, specially for forestry. From that starting point in which the potentialities and the successional trends were established for the whole country, an important number of works about the application of phytosociology in nature conservation were published. With the exception of Bou (1988) who was working in Catalonia, two groups were responsible of most of them: 1- The group of F. Valle in Granada and 2- the group of Asensi in Málaga, both in southern Spain. The first one showed a bias directed to regeneration of potential natural vegetation taking into account the successional patterns studied for each vegetation series (Gomez Mercado & Valle 1988, Valle 1991a, 1991b, Valle, Alonso & Salas 1990, Valle, Gonzalez & Alonso 1990). On the other hand the formalisation of vegetational criteria in order to im-

plement a policy for protection of special sites or areas of ecological importance in which priorities could be decided with the help of quantified data, has been strongly influenced by Géhu (1979) who created an evaluation system for the French coastal salt marsh-sites. Most of the contributions of the Málaga group apply this method for the evaluation of the areas proposed for conservation in some of the southern Spanish mountains (Martín Osorio & Asensi 1988 a, 1988 b, Asensi 1990 Asensi & al.1991). For site selection the recommendations of Beguin & Theurillat (1982) are usually followed (Asensi & Diez Garretas 1991).

Nevertheless, these methods are applied to previously selected areas in order to rank them according to their landscape and phytocoenological value. They are applicable to territories which contain a certain variety of vegetation types of diverse value. The development of methods to evaluate vegetation types so that each cartographically recognised type (syntaxon associated to a specific structure) could have a specific value according to several criteria (successional, phytocoenological, biogeographical, etc.) can be useful for many conservation purposes such as the prior selection of areas needing high protection in a more or less large territory such as a National Park, for instance. This of course demands a previous mapping of the actual vegetation to an appropriate scale (at least 1:25,000 or 1:50,000) in order that each unit can be associated with a value and a phytocoenological value map can immediately be obtained.

Much less has been done in this direction, as said above, the main contribution is due to Arnaiz (1980) who proposed a system to calculate the floristic and the phytocoenotic value for each community which was on a vegetation map. The sum of them gave the value of the community which permitted the global evaluation of a given area or place which evidently should be previously mapped. In addition to this only a few contributions in order to quantify the degree of threat to plant communities (González, Madrona & Valle 1990) or to establish a floristic richness index which can be applied to syntaxa (Ferrerías Chasco 1988) have been published.

### **Proposed Criteria for Evaluation of the Relative Importance of Vegetation Units for Conservation**

In order to develop a system of evaluation for mapped syntaxa or vegetation units which are constituted by a syntaxa complex, several main criteria may be considered:

- 1- Naturalness (N)
- 2- Replaceability (P)
- 3- Threat (T)
- 4- Floristic-phytocoenotic value (F)
- 5- Rarity (R)
- 6- Coefficient of territorial need for ecosystem protection (E)

Most of these criteria (except E) can be estimated in a 0- 10 point scale and related to each cartographic unit in order to get the phytocoenological value map. This document will be then used to select different protection degree areas. For that, as well as the previously mentioned criteria, maximal biodiversity should be one of the main ones.

## 1—Naturalness (N)

Most of the environmental evaluation systems proposed, as far as we have ascertained in the literature, deal with naturalness in some way. Kirby (1986) points out the extensive use of it in ecological evaluations in Great Britain; in some other cases the opposite concept of artificiality is used (Rameau & Bricault 1988) but in a parallel sense. Naturalness, applied to vegetation types, tries to express the degree of human influence on it and comprises two aspects: 1— the damage or transformations caused by man in plant communities and 2— how these plant communities are the result of and dependent on human activity themselves. As the successional paradigm has been widely accepted by most vegetation science schools, it has been considered that naturalness can be widely expressed in terms of distance from the climax or potential natural vegetation (PNV); the highest naturalness would correspond to PNV in an undisturbed situation. This is the sense of Arnaiz (1980), Miyawaki & Fujiwara (1975) and Géhu & Géhu-Franck (1980 a & 1991) who have proposed scales to perform the numerical evaluation of the naturalness of plant communities for Japan and France respectively. Our proposal is inspired by the models and concepts of these authors.

There is, however, the possibility of enriching this relatively global and successional—inspired concept of naturalness with the consideration of maturity as Seibert (1980) does: naturalness exclusively related to human influence and to the relative position in secondary succession, and maturity, related to structure complexity. According to this, *Ammophiletea* communities have high naturalness but low maturity. In our opinion this concept of maturity can be included in a more general and more easily estimated one, such as structural diversity or complexity. As in the phytosociology school the successional trends and steps of the plant communities of vast areas of Europe and Japan have been widely discussed and established, it is quite easy and practicable to estimate the naturalness of a vegetation type in relation to its successional proximity to the PNV and the degree of human influence. The proposed evaluating scale, developed after my experience in the Iberian Peninsula, is as follows:

- 0—Intensely urbanised areas, completely occupied by building and roads, etc. Practically no plants.
- 1—Peri-urban area, surroundings of areas submitted to intense urban activities, with plant communities strongly dependent upon influence of man; cultivated fields.  
*Polygono-Poetea annuae*, *Artemisietea vulgaris* (pp), *Ruderali-Scalietea* (pp), *Plantaginetalia*, *Parietarietalia*.
- 2—Parks, gardens, abandoned crop-fields. Pioneer therophytic vegetation.  
*Onopordenea*, *Pegano-Salsoletia*, *Taeniathero-Aegilopion*, *Tuberarietea*.
- 3—Tree plantations of exotic species for timber production.
- 4—Grazed grasslands and meadows.  
*Arrhenatheretalia*, *Poetea bulbosae*, *Festuco-Brometea* (pp)

- 5—Natural scrub and grasslands of secondary origin.  
*Rosmarinetea*, *Festuco-Ononidetea*, *Cisto-Lavanduletea*, *Calluno-Ulicetea*, *Festuco-Brometea* (pp), *Sedo-Scleranthetea*, *Lygeo-Stipetea*
- 6—Shrub—mantle and fringe vegetation.  
*Prunetalia spinosae*, *Cytisetea scopario-striati*, *Pistacio-Rhamnetalia alaterni* (pp)
- 7—Cleared natural woodlands due to grazing and forested meadows (dehesas). Mixed woodland of autochthonous and exotic trees. Combined exploitation of grazing and wood extraction.
- 8—Young natural woodland (initial stage) mixed with mantle and other sèral communities linked to the forest system such as those of *Galio-Alliarietalia*, *Epilobietea angustifolii*, *Betulo-Adenostyletea* (pp). Severe forest exploitation or recent abandonment.
- 9—PNV and permanent vegetation submitted to light exploitation. The units involved are approximately the same as in the next level.
- 10—Mature non exploited forest. Rock crevices and screes. Undisturbed coastal dune communities. Salt marshes. High mountain climatic meadows and scrubs. Peat—bogs.  
*Quercu-Fagetea*(pp.max), *Quercetea ilicis*(pp. max), *Pino-Juniperetea*, *Vaccinio-Piceetea*, *Nerio-Tamaricetea*, *Asplenieta trichomanis*, *Thlaspietea rotundifolii*, *Ammophiletea*, *Spartinetea*, *Arthrocnemetea*, *Salicorniotea*, *Crithmo-Limoniotea*, *Juncetea trifidi*, *Elyno-Seslerietae*, *Salicetea herbaceae*, *Oxycocco-Sphagnetea*, *Scheuchzerio-Caricetea nigrae*, *Littorelletea*, *Potametea*, *Molinietalia* (pp).

## 2— Replaceability (P)

We can define replaceability as the capability of a vegetation type to recover itself after destruction by natural or humanly induced causes. This concept already has been used by Dumort (1988) and it has sometimes been also called healing (Richard & al. 1988). Of course the time a plant community takes to recover is very variable and its replaceability is infinite when it never recovers and high when it takes only a few months. The intensity of the damage is also a determining factor and for that reason we will consider that it will destroy the vegetation without effectively changing the previous topographic and edaphic conditions. We propose an inverse scale as the less replaceable plant communities are evidently more demanding of protection:

0—No vegetation

1—Pioneer annual communities

*Polygono-Poetea annuae*, *Ruderali-Secalietae*, *Helianthemetea annuae*.

2—Nitrophilous perennial vegetation

*Artemisieta vulgaris*, *Plantaginetalia majoris*.

### 3—Scrub vegetation

—*Rosmarinetea*, *Calluno-Ulicetea*, *Cisto-Lavanduletea*, *Pegano-Salsoletea*.

### 4—Perennial grasslands and meadows

*Festuco-Brometea*, *Molinio-Arrhenatheretea*, *Nardetea*, *Lygeo-Stipetea*,  
*Festuco-Ononidetea*

### 5—Azonal permanent vegetation: Salt marshes, coastal dunes and cliffs, swamps, fens, riverain vegetation, etc.

*Arthrocnemetea*, *Juncetea maritimi*, *Ammophiletea*, *Potametea*, *Phragmitetea*,  
*Littorelletea*.

### 6—Mantle and edges

*Prunetalia spinosae*, *Cytisetea scopario-striati*, *Pistacio-Rhamnetalia alaterni* (pp)

### 7—Natural forests of temperate and not too dry areas.

*Quercu-Fagetea* (pp), *Quercetea ilicis* (pp), *Nerio-tamaricetea*

### 8—Xeric-mediterranean climatic vegetation. Rock crevices and screes. Peat-bogs (if peat is partially removed).

—*Quercetalia ilicis* (pp), *Pistacio-Rhamnetalia alaterni* (pp), *Juniperion thuriferae*,  
*Asplenietea trichomanis*, *Thlaspietea rotundifolii*, *Crithmo-Limonietea*, *Oxycocco-Sphagnetea*,  
*Scheuchzerio-Caricetea nigrae*.

### 9—High mountain vegetation.

*Vaccinio-Piceetea*, *Pino-Juniperetea*, *Juncetea trifidi*, *Elynetalia*, *Salicetea herbaceae*.

10—Relict vegetation; no possibility of recovery by natural means after destruction. Exceptional localities, mainly belonging to 7 to 9 categories, which develop under climatically unfavourable conditions and have the character of a refuge due to topography or other circumstances. At least some of the plants have a reduced reproductive ability and the destruction of the community implies its complete or partial disappearance.

### 3—Threat (T)

The objective evaluation of this parameter is actually quite a difficult task. This is because it depends on several factors which are frequently dependent on the human socio-economic circumstances of each country or territory. Coastal vegetation is not submitted to the same threat in a touristic country as it can be in a colder region with an economy based on the production of wood. The agricultural value of the soils on which some vegetation types grow has historically been responsible for its destruction, etc. Even more, in the course of history these conditions change and what was valuable in ancient times may be of no value today; important areas in the Iberian Peninsula formerly exploited for agriculture and grazing have been abandoned a few decades ago and nowadays are being colonised by young secondary forests. There are also circumstances which are intrinsic to the environmental conditions in which the plant communities develop such as accessibility, e.g.

rock crevice vegetation in high mountains can be considered as quite a safe community type, because it is self-protected by topography.

Threat is without doubt an important factor to take into account for nature conservation policy as has been pointed out by Richard & al. (1988), Dumort (1988) and Gonzalez & al. (1990) and its evaluation has necessarily to be done by a local specialist with a perfect knowledge of all the circumstances commented above. The following scale, created for the Iberian Peninsula, tries to be more an advisory guide than a rigid protocol and has to be adapted to each case and each territory by the local specialist.

0—No vegetation

1—Rock crevices and other inaccessible mountain sites

*Crithmo-Limonietea*, *Aspleniëtea trichomanis*, *Elyno-Seslerietea*, *Juncetea trifidi*, *Salicetea herbaceae*.

2—Seral scrub

*Cisto-Lavanduletea*, *Rosmarinetea*, *Festuco-Ononidetea*, *Calluno-Ulicetea*.

3—Natural grasslands

*Festuco-Brometea*, *Lygeo-Stipetea*, *Sedo-Scleranthetea*.

4—Edges and mantles

*Prunetalia spinosae*, *Cytisetea scopario-striati*, *Pistacio-Rhamnetalia alaterni* (pp)

5—Grazed meadows and grasslands (retreat of ranching activity)

*Arrhenatheretalia*, *Poetalia bulbosae*.

6—Oligotrophic mountain forests

*Ilici-Fagenion*, *Quercenion pyrenaicae*, *Vaccinio-Piceetea*, *Pino-Juniperetea* (pp), etc.

7—Forested meadows (dehesas)

*Quercetalia ilicis*, *Quercetalia pubescentis*.

8—Lowland and foothill forests

*Carpinion*, *Quercetalia ilicis*, *Quercetalia pubescentis*.

9—Salt marshes, riverine vegetation, wet places

*Arthrocnemetea*, *Salicorniëtea*, *Juncetea maritimi*, *Salicetalia purpureae*, *Populion alba*, *Potametea*, *Phragmitetea* (pp), etc.

10—Coastal dunes, accessible mires (peat exploitation).

*Ammophiletea*, *Scheuchzerio-Caricetea nigrae* (pp), *Oxycocco-Sphagnetetea* (pp).

4—Floristic-phytocoenotic value (F)

This, together with naturalness, has traditionally been considered the main factor to take into account in order to estimate the ecological value of a vegetation type or any other

biological element capable of being protected in any way. It becomes evident that the intrinsic biological value of a formation (vegetation type) is given by the different species which constitute it, the relationships between them, and the structure, more or less complex, that, as a framework, contains them.

The objective evaluation of such a thing is really difficult. Several authors have tried to estimate aspects related to the floristic (or specific) value of a formation or site as a function of the specific richness (often calculated as a function of the real or average number of species present) or diversity (Kirby 1986, Géhu & Géhu-Franck 1980 b, Ferreras Chasco 1988, Arnaiz 1980, Seibert 1980, Petit 1980, Couderc 1980, Theurillat & al. 1988). That concept, if we take into account only the number of taxa which live in a vegetation type, is of very relative value because it does not consider the "quality" of these species. By quality we mean the characteristics of each species related to its naturalness, historical meaning, representativeness of the regional flora, etc. As an example, a ruderal nitrophilous community constituted by 20 to 30 species of wide range and recent introduction in the region is more diverse than a relict pantropical fern community an endemic species rich rock crevice community or even an apparently simple heath community. The ruderal vegetation is more diverse than the others but the quality of the flora of the others is incomparably higher because it informs us about the history of the vegetation and the climate of the area and its phytogeographical relationships; they are true representatives of the genuine regional flora and this must be taken into account. Simple numbers of how many plants (or other organisms) live in a vegetation type cannot give exact information for its specific value.

There is also the additional difficulty of knowing with sufficient exactitude which and how many plants we have in each vegetation type we are evaluating as well as in the regional flora. This requires a prior and profound floristic and phytosociological knowledge of the area which unfortunately is not always available. Some of the authors mentioned make the same estimations using phytosociologically defined association; similar considerations as for species could be also made. Others (Boulet 1988) estimate directly the similitude, i. e. representativeness, among the vegetational context of pytocones as well as its originality; both should concentrate attention for conservation.

Another possibility is to consider, in a subjective way, the biological value of a site or formation as a whole. This is the way followed by Lucas (1973), Costa & al. (1984, 1988), Nef(1980), Duval (1980a, 1980b), Petit (1980), Couderc (1980) and Raimondo & Venturella (1992), some of them applied to given sites or areas and others to vegetation units. Our proposal for global estimation of mapped or cartographically represented units includes:

- a— the floristic value: specific diversity (species richness)
- b—the phytosociological value: phytosociologic diversity ( richness of associated or included syntaxa in the appropriate unit if there is more than one)
- c—the structural complexity of the vegetation.
- d—the particular relationships between organisms (individuals and populations).
- e—the phytogeographical character: content of endemic or territorially characteristic flora and syntaxa.

Of course in this case the subjectivity is still higher and the participation of a regional specialist with good knowledge of the area essential. Nevertheless an approximate proposal is made:

0—No vegetation

1—Nitrophilous vegetation, common flora, simple structure.

*Polygono—Poetea annuae, Artemisietea vulgaris s. l., Ruderali—Secalietea.*

2—Scrub vegetation

*Rosmarinetea, Calluno—Ulicetea, Festuco—Ononidetea, Cisto—Lavanduletea, Pegano—Salsoliete.*

3—Grasslands and meadows. Helophytic and aquatic vegetation.

*Phragmitetea, Potametea, Molinietales, Arrhenatheretalia, Festuco—Brometea, Poetea bulbosae, Lygeo—Stipetea.*

4—Littoral and inland saline vegetation

*Arthrocnemetea, Spartinetea, Salicornietales, Juncetea maritimi, Crithmo—Limonietales.*

5—Rock crevices and screes, coastal dune vegetation.

*Asplenietales trichomanis, Tlaspietea rotundifolii, Ammophiletea.*

6—Oligotrophic deciduous forests and mediterranean woodlands, Mantles and edges.

*Quercetalia roboris, Quercetalia ilicis, Prunetalia spinosae, Cytisetea scopario—striati.*

7—Eutrophic species—rich deciduous forests.

*Fagion, Quercetalia pubescentis.*

8—Subalpine and oromediterranean climatic vegetation, high mountain forest and scrub vegetation, *Nardus* meadows.

*Vaccinio—Piceetea, Pino—Juniperetea, Nardetea.*

9—Alpine and oromediterranean grasslands and associated communities, Peat—bogs and mountain rivulets and ponds. Chionophylous (snow—bed) plant—communities.

*Juncetea trifidi, Elyno—Seslerietea, Scheuchzerio—caricetea nigrae, Oxycocco—Sphagnetetea, Montio—Cardaminetea, Salicetea herbaceae.*

10—Mesophytic and wet forests of thermic areas with a rich flora which contains rare or relict plants and associated communities of *Galio—Alliarietalia, Trifolio—Geranienea, Montio—Cardaminetea, Adenostyletalia*, etc. Forested meadows (dehesas)

*Populetalia albae, Alno—Padion, Carpinion.*

## 5—Rarity (R)

Many authors take rarity into account (Dumort 1988, Kirby 1986, Theurillat & al. 1988) and some of them introduce several formulae to evaluate it (Arnaiz 1980, Géhu & Géhu—Franck 1980b) which express the statistical frequency of occurrence of species and plant communities. To consider a plant as rare it is necessary that it occurs in few or very

few places at least in the geographical context in which we are working. This can happen with plants which are absolutely rare all over the area they occupy, with plants which are common in other territories but scarce in ours, or with those which are in the absolute or relative limit of their geographical distribution. For that reason rarity has to be considered in a geographical context; that means that if we are evaluating the rarity of plants and plant communities, it should be done in a phytogeographical context as Seibert (1980:13) suggests. As we deal with species and plant communities we need not only a floristic phytogeography but a floristic-phytocoenotic one, i.e. in the sense of Braun-Blanquet (1919) and Rivas-Martinez (1987 a,) which takes into account not only species but also vegetation. In other words, it is important to take into account the role a plant plays in each territory and in its plant communities. *Holcus lanatus* occurs both in Germany and in Southern Spain where it is not such a rare plant, but the participation of that species in the vegetation of these two countries is quite different. That important biological circumstance has to be taken into account by modern phytogeography and the only way is to pay attention not only to plant species but to communities too as they show us what role each plant plays in each territory.

The problem then is that it is necessary to have the country phytogeographically studied and the territorial units defined and mapped. The level of phytogeographical knowledge is not uniform in all territories but in the Iberian Peninsula fortunately these studies are progressing quite quickly and several parts have been examined down to the subsector level (Alcaraz & al. 1991), perhaps the ideal unit to evaluate the rarity of species and plant communities.

To give a scale for this criterion is pointless, as the rarity or abundance of taxa and syntaxa is peculiar to each subsector. The application of proposed formulae (Arnaiz 1980, Géhu & Géhu- Franck 1980 b) is frequently made more difficult by the insufficiently detailed floristic and phytosociological knowledge of most areas. Perhaps the use of the average distance between the places in which a species or vegetation type occurs in the sense of Seibert (1980:21) can be used and adapted to a 0 to 10 scale:

0- 500 m or less	6- 3500 to 5000 m
1- 500 to 700 m	7- 5000 to 10000 m
2- 700 to 1000 m	8- 10 to 20 Km
3- 1000 to 1500 m	9- 20 to 40 Km
4- 1500 to 2500 m	10- 40 Km or more
5- 2500 to 3500 m	

The use of one or other of these solutions to evaluate rarity will depend on the degree of floristical and phytosociological knowledge and the choice has to be made by the person responsible for the local study.

## 6—Coefficient of territorial need for ecosystem protection (E)

This parameter, inspired by Seibert (1980: 21), tries to give emphasis to ecosystems of variable value but which are situated in densely populated, and thus ecologically degraded areas. A natural forest located in the neighbourhood of a large city, or included in its peri-urban ring, has doubtless an additional value and this has to be taken into account at the time of establishing priorities for conservation. Human population density calculated in Inh. / Km<sup>2</sup> for administrative provinces can give the measurement for this.

0.5– 1 to 4	1.8– 100 to 129
0.7– 4 to 19	2.0–130 to 199
1.0– 20 to 39	2.4– 200 to 299
1.2– 40 to 59	2.7– 300 to 599
1.4– 60 to 79	3.–600 or more
1.6– 80 to 99	

### The Conservation Interest

To provide a responsible administration with a guide or document to achieve a conservation policy, the conservation interest concept is established. This has to take into account all the above mentioned criteria and the simple formula to calculate it:

$$CI = E \times (N + P + T + F + R) = E \times B$$

being B the biological value:

$$B = N + P + T + F + R$$

The value of N, P, T and F are linked to cartographic units, that means that each colour of the vegetation map is associated with a concrete value for each of these parameters. For that reason a vegetation map, using phytosociological units, is absolutely necessary. In it, as well as syntaxa or syntaxa complexes, the localities in which rare plants or populations live should also be represented using symbols. In the case of rarity (R), a global solution for each cartographic unit has to be found if the distance of the vegetation type from a similar one is high. If rarity is low, an average value should be taken, calculated as a function of the average distance between the patches on the map.

CI is linked to each mapped or represented unit; if an evaluation of the interest of an area is desired:

$$TCI_i = CI_i \times A_i = E \times B_i \times A_i = E \times BT_i$$

where, TCI<sub>i</sub> = total conservation interest of the i mapped unit, A<sub>i</sub> = area occupied by the i unit and BT<sub>i</sub> is the biological total value.

The global interest (GI) of a place or site:

$$GI = \sum TCI_i$$

This global interest GI is the parameter which can be used to assess, with some objectivity, the degree of importance for any kind of protection of a proposed area; it will give the administration its priorities in conservation policy.

### Other Botanical Elements to Consider as Regards Protection

The criteria listed here have not taken into account some elements which are considered to be valuable and in some cases worthy of conservation. Among them the ethnobotanical value of an area is noteworthy. This consideration makes it interesting to conserve the wide variety of traces of ancient human activity in relation to the exploitation of plants i. e. agriculture, forestry, coppicing, charcoal-making, the collection of wild fruits or seeds, fruit-tree cultures, medicine-plants, etc. All of them are part of human historical and cultural heritage as they are evidence of the ancient rural economy. Their living relics, like local varieties of cultivated plants, special shapes given by a particular, and today abandoned, way of cutting branches from trees to get wood, etc., are worthy of conservation more from the human point of view than from a strictly natural one. If desired the evaluator will add the amount he considers to the previous criteria.

Other criteria, quite frequently taken into account, are those related to the aesthetic aspects of plants or vegetation in connection with the quality of landscapes. As geomorphology plays an important role in the landscape, an analysis should consider both aspects and in that way we would not have a strict botanical evaluation. That links up with the evidence that multidisciplinary studies are necessary to perform a complete evaluation of the natural richness of a territory. It is necessary to consider all aspects concerning zoology, geology, geomorphology, botany, etc. and on many occasions human-cultural aspects must also be taken into account.

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