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Preserving biodiversity in the European Union: the Habitats Directive and its application in Spain

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ABSTRACT - The present paper makes some comments about biodiversity from the point of view of nature conservation. It is regarded as having essentially three levels: intraspecific, interspecific and ecosystemic. Biodiversity can be split into several components: 1- specific diversity, which constitutes the basic approach to biological diversity; 2- genetic diversity which comprises the numerous varieties and races of plants and animals created by man, 3- habitat diversity, which corresponds mostly with vegetation types in terrestrial areas, and 4- landscape diversity, which is related with the type of human society. Traditional human societies produce highly diverse landscapes, and conserve the knowledge of the ancient systems of land use and exploitation. The definition of habitats on the basis of vegetation types is useful and has been adopted by the European Union following the CORINE biotopes manual. The Habitats Directive is the result of the efforts made recently in the European Union and represents an important legal instrument which is now being applied. It will determine the implementation of a European network of protected sites called Natura 2000. The application of this Directive in Spain, which focuses on the inventory of the habitat types of appendix 1, is described here.

KEY WORDS - genetic diversity, habitat diversity, landscape diversity, specific diversity

Man has always exploited the earth's biological resources for the materials - food, medicines and industrial products - which he needs in order to survive and develop. The limited technological development of the procedures traditionally used in such exploitation ensured that, to a greater or lesser degree, these natural resources were not exhausted. However, in recent years, scientific and technological progress has intensified the exploitation of all kinds of resources in a desperate attempt to satisfy the insatiable demands of modern society. Exploitation is now so intensive that the capacity of these vital biological resources to regenerate is being seriously compromised, thus endangering their continued existence.

This situation has led to a dilemma between conservation and development that is resolved, in theory at least, by the postulates of what is known as sustainable development, which aims to limit exploitation of available resources to levels that will ensure that they can be regenerated and maintained. This also means that ecosystems should not be altered or changed beyond their capacity to absorb impacts and that they need to be protected from excessive degradation. Preserving biological diversity is a prerequisite for ecosystems if they are to function properly; it is in fact vital for the maintenance of any environment anywhere. The prudent, rational management of biological resources necessarily entails the preservation of the earth's biological diversity and is, without doubt, one of the main challenges facing man in the next millennium (Catizzone & Larsson, 1997).

One of the contributions of the Agreement on Biological Diversity, itself a result of the 1992 United Nations Conference on the Environment and Development (the Rio Summit), was the adoption of a more or less universal concept of what we call biodiversity. According to this concept, biological diversity (or biodiversity) comprehends all aspects of the variability of living organisms on Earth: that is, intraspecific, interspecific and ecosystem variability. It also stresses that organisms, as components of an ecosystem, cannot be separated from it and that their conservation depends on the proper, balanced functioning of the ecosystem. Two main ideas are thus introduced:

- biodiversity is understood as variability at three levels: genetic, specific and ecosystemic;
- the preservation of biodiversity is inextricably linked to the maintenance of ecological processes involving living beings.

THE COMPONENTS OF BIODIVERSITY

Species

Species are the basic elements in a first approach to biological diversity. When we consider the diversity of the world of living beings, we tend intuitively to think of the number of species or taxa of the different groups of organisms. Although this concept has long since been left behind, species diversity remains one of the essential components of biodiversity.

As far as vascular plants are concerned, Spain alone has nearly 8000 species, which account for nearly 80% of all the species in the EU and 60% of those in the whole of Europe. The following table shows the uneven concentration of specific phytodiversity in Europe in relation to its surface area.

Country	Richness	Diversity*	No. endemism	Density**
Germany	2.682	483	6	-0,77
Belgium	1.452	324	1	-0,48
Denmark	1.252	270	1	-0,63
Spain	8.000	1.401	1.500	1,97
France	4.630	805	133	0,38
Greece	4.990	969	742	1,72
Ireland	950	195	1	-
Italy	5.598	1.021	712	1,37
Luxembourg	1.246	365	0	-
The Netherlands	1.221	264	-	-
Portugal	2.573	518	150	1,21
United Kingdom	1.623	301	16	-0,18

* No. species/log area.

** Log (no. endemism/10,000 km²).

Plant species richness clearly increases in the southern part of the continent, basically in the countries in the three southern peninsulas, all of which participate in the Mediterranean Region and abound in mountainous zones. Endemic species - species of limited geographical distribution - are also concentrated in the southern part of the continent. For instance, some 1500 endemic vascular plant species are confined to Spain, with another 500 being shared with North Africa. Nearly half of Europe's endemic species are Spanish.

Despite efforts made in recent years, the conservation of these species is not completely guaranteed. Worse, the scientific knowledge required for a more exact understanding of this diversity and of the procedures for its conservation is still insufficient. In Spain, nearly 12% of vascular plant taxa are included in one or other of the IUCN categories indicating some degree of risk: Extinguished, in Danger, Vulnerable or Rare.

Natural habitats

Apart from theoretical refinements to the concept of habitat, the definition and systematisation applied in EU administrative practice to terrestrial habitats was done through the CORINE programme. This has led to the coincidence, in a majority of cases, of types of habitats with types of vegetation, largely because of the ease with which the latter can be catalogued, evaluated and managed. They are:

1 - Relatively quick and easy to typify. The selection of typification criteria is very important, as the purely parametrical sort, such as height, structure or colour, provide little or no biological information, which will inevitably affect subsequent evaluations of biological

resources, while biocenotic criteria - basically floristic - are the most appropriate for use in cataloguing biological resources.

2 - Maps can be used in cataloguing, which means modern computer techniques can be applied, together with automatic information treatment and analysis (GIS).

3 - Ecological or naturalistic quality can be evaluated.

Habitat typology in the EU is therefore shown in the *Corine biotopes manual*. This typology is largely inspired by the sigmatist phytosociological, or Braun-Blanquet and Tüxen, classification for units of vegetation, based on floristic-ecological criteria. As this school flourished in continental Europe, there now exists an enormous amount of data, accumulated over decades on all kinds of plant communities, obtained using the same criteria in different countries. This has encouraged the application of Braun-Blanquet types in the definition of habitats at the European level, as it is really the only viable alternative for a continent-wide project.

In almost all cases, the preservation of a habitat implies the conservation of the species living there, so conservation-oriented habitat management is, at the same time, species conservation management. This in turn means that we have to know more about the conditioning factors that determine habitat maintenance, which entails studying processes within the ecosystem with a view to designing conservation-oriented management procedures. A major research effort is called for here, as the gap in our knowledge of such ecological factors is enormous and the need for conservation-oriented management already urgent.

Genetic resources

The varieties of plants and breeds of animals created by man throughout history by artificial selection and other methods from wild strains, and bred or cultivated for his benefit, accounts for much of the biological resources we possess today. Domestic animals and cultivated plants, in all their infinite strains and local varieties, perfectly adapted to the specific conditions of each region or function desired, make up the stock of genetic resources (ANON. 1998). This group of animals and plants has accumulated an enormous wealth of genetic information which carries the impress of the efforts of generations of farmers and cattle breeders. Besides its ethnographic and cultural value, the economic interest of this information is not exactly negligible either. Perfect adaptation to local conditions facilitates optimum yield for cattle-breeders, farmers and forestry workers in regions with specific climates and lithologies; it is also a major source of genetic resources for the agricultural, textile and pharmaceutical industries, as well as the home garden sector of ornamental and indoor plants.

Another highly important aspect that makes the conservation of such variety essential is the possibility of putting it to practical use. These genetic reserves can be used, in combination with the entire range of wild strains and with the aid of modern genetic improvement techniques, to solve no end of phytosanitary problems or to create new, higher-yield agricultural varieties. Access to genetic diversity has had, and will continue to have, enormous importance as a source of genes to be used in improving productivity, in the search for resistance to plagues and disease and in the fight for survival in the face of adverse weather conditions. These genetic reserves can also be used to solve potential problems when trying to conserve natural populations of wild species in difficulty.

Phytogenetic resources for human nutrition mainly involve the traditional varieties of cultivated plants plus modern crops, not forgetting a few wild species, used as food and harvested from their natural populations, or a number of species related to the cultivated ones. This group provides the basic core of accumulated genetic material improvers use to produce new varieties; its variability is the guarantee that we will be able to adapt to future environmental, social and economic changes, which makes preservation an issue of vital importance.

While the majority of agricultural phytogenetic resources are conserved *ex situ*, natural and semi-natural ecosystems contain significant reserves of wild species related to cultivated species, as well as species that may prove useful in the future. Their classification and conservation is therefore a question of strategic interest.

In modern agriculture, the use of genetically improved varieties of a range of cultivated plants is becoming increasingly common, owing to the predominance of the big multinationals that market the seeds. As a result, many countries are now seeing a drastic reduction in their stock of traditional varieties and cultures of many cultivated species, and often the actual disappearance of the species themselves. The progressive homogenisation and simplification of agriculture in developed countries has entailed losses in agrobiodiversity, with a subsequent cultural impoverishment ranging from the loss of specific cultivation techniques and treatments to the disappearance of traditional cuisines.

In this context, the creation and development of institutions dedicated to *ex situ* conservation of wild flora, and the co-ordination of their activities, is absolutely vital. Germplasm banks, scientific collections of flora and fauna (zoos and botanical gardens), cell and tissue banks, seed, embryo and sperm banks and all kinds of scientific collections, including herbariums, are included in the archives of biodiversity, the importance of which need not be stressed any further here.

TRADITIONAL KNOWLEDGE AND DIVERSITY IN THE LANDSCAPE

Man's influence on vegetation determines the transformation from its most natural state to a group of types that substitute it. These types are the result of the differing intensities and kinds of alterations introduced. Any humanised landscape will therefore be an expression of the distribution and frequency of such alterations and, as such, a reflection of the type of human society that has shaped it. So, landscapes where human pressure is intense and homogenising, as occurs with the major cereal crops, present both extreme simplification and a non-existent equilibrium, with large exports of biomass requiring constant restoration of energy to offset their loss. Landscapes presenting proper adaptation, expressed in the minimisation of energy consumption and optimum exploitation of the system's own flows, are characterised by large-scale diversification in different, fragmented types of vegetation. This situation arises where the uses to which the landscape is put are adjusted to the capacities of the natural system in a context of a self-sufficient economy with minimum external trade. Empirically-acquired knowledge of the capacities of the local environment and its responses to a number of man's activities, has been decisive in ensuring that uses are properly suited to the area (Puerto Martín, 1993). Such landscapes, today preserved largely in mountainous or poor, generally underpopulated areas for the most part still untouched by modern development, are hosts to a whole range of units, with an abundance of ecotones ensuring niches for a multiplicity of species, thus favouring biodiversity.

Although providing a home for valuable species requiring large areas of unaltered territory if they are to settle, largely unchanged landscapes with a predominance of mature vegetation types are less diverse. This by no means reduces their value, because their naturalness assures the persistence of life forms and structures incompatible with human intervention; highly natural zones should continue to be given priority when it comes to conservation. Specific diversity is increased in anthropogenic zones with the arrival of a great number of common species to offset the loss of species from unaltered habitats. While this kind of exchange is favourable in quantitative terms, it is, in the present circumstances, qualitatively unfavourable, considering the constant reduction in the amount of unaltered spaces and habitats on earth.

The relation between traditional knowledge or cultures (cultural diversity) and the maintenance of at least a substantial fraction of the existing biodiversity is so obvious that no biological diversity conservation policy can afford to ignore it. People living in Europe, and more so in its southern countries, possess an invaluable ethnobiological patrimony, largely due to the spatial superposition, over a very long time, of numerous ethnic groups in these areas, to miscegenation and reciprocal influences, to their relations with external cultures and their assimilation in the remarkable bioclimatic and biogeographical diversity these countries are blessed with.

The sheer variety of rural architectures, cuisines, traditional arts and crafts, and models of settlement, combined with the different ways of distributing the uses of each territory, of exploiting their mountains and woods, of organising crops, of ordering pastureland and cattle systems; all of this and more helps to shape the different types of traditional rural landscapes that distinguish our districts, regions and countries. It also constitutes the expression of the equilibrium achieved between exploitation by man carried out with the aid of rudimentary technology that remained unchanged in its essentials for many centuries, in a context of a quasi-autarchic economy, and the biological component of each territory. This helps to explain why they are so often landscapes in equilibrium, and so diverse in communities, vegetation structures (landscape quality) and species.

In rural areas, people retain a respect for traditional landscapes, a respect rooted in an understanding of the fact that they depend on their environment. This respect has, over the years, guaranteed the conservation of such landscapes. Unfortunately, such respect is non-existent in urban societies, which are independent of their environment - at least in the most immediate sense - and largely ignorant, when not downright contemptuous of, its natural laws.

Such landscapes are the expression of long experience, based on empirical learning and knowledge accumulated over centuries on ways of handling each zone's biological resources. This vast cultural patrimony, in outright retreat before the unstoppable advance of modern society, needs to be taken into account in biodiversity conservation strategies, since it is part of a country's ethnographic heritage and is an essential element of its biological diversity.

FRAMEWORK OF THE EUROPEAN UNION

The increasing awareness of Europe's citizens that biodiversity must be maintained has provided the impulse for a series of initiatives that have permeated all of the multi-layered administrative levels now in evidence in western European countries in the EU, from local and regional administrations to states and the European Union itself. The adoption of measures by the EU at least has the value of introducing a degree of co-ordination in the objectives, procedures and criteria applied to the design of legal and administrative instruments oriented towards the protection of nature. However, administrative coherence and the benefits deriving from action taken on a semi-continental scale are offset by the disadvantages incurred in the inevitable distancing from each region's specific conditions. The instruments created at Community level need to be complemented by properly co-ordinated action taken by the authorities in individual countries or regions.

As a consequence of the EU's signing of the Agreement on Biological Diversity, Directive 92/43/EEC, on the conservation of natural habitats and wild flora and fauna, (known as the Habitats Directive) was issued in May 1992, joining a previous Directive, 79/409/EEC, on the protection of birds. The Habitats Directive set up the legal framework for a new European network of sites or areas of interest for the conservation of biodiversity, called Natura 2000. It also established a three-phase schedule for the implementation of the network, which should be ready by the year 2004 (Figure 1).

1992-1995: Member states are to prepare their respective National Lists of Places of Potential Community Interest, in line with the criteria included in the Directive (the period allowed was amply exceeded by the majority of member states).

1995-1998: Preparation of the Community List from the National Lists.

1998-2004: Once the List of Places of Community Interest has been finalised, member states have six years to designate the special conservation areas which, together with the Areas of Special Protection originating under the bird directive, will make up the Natura 2000 network.

The Directive's 6 appendices discuss the elements of interest to be considered in the preparation of the Lists. Of these, appendix 1 is particularly important, as it enumerates the natural habitats of community interest (which is why it is known as the Habitats Directive). Appendix 2, which lists the animal and plant species for which protection zones should be designated, is also essential. Natural habitats are defined (art. 1b) as "land or water zones differentiated by their geographical, abiotic and biotic features, whether entirely natural or semi-natural". Of the 222 types of habitats numbered in appendix 1, the most remarkable are those marked with an asterisk (*) as priority habitats. The latter are very important for the selection of sites to be included in the Natura 2000 network, since the Commissions will not be able to reject any that contain priority habitats. In this sense, the diagnosis and typology of the habitats listed in appendix 1 of the Directive are based mainly on the results of the CORINE programme included in the *Corine biotopes manual*. Except for the types of habitat defined solely by their geomorphological or abiotic characteristics, the majority of such typologies is

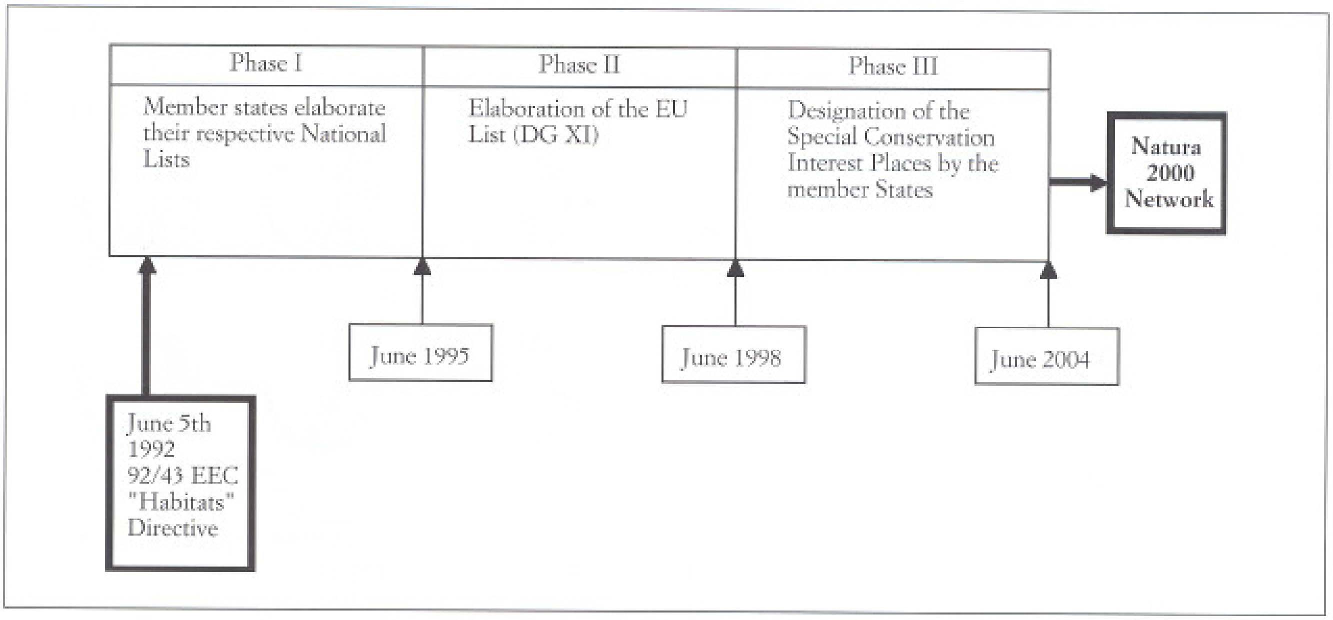

FIGURE 1 - Chronogram of the application of the Habitats Directive.

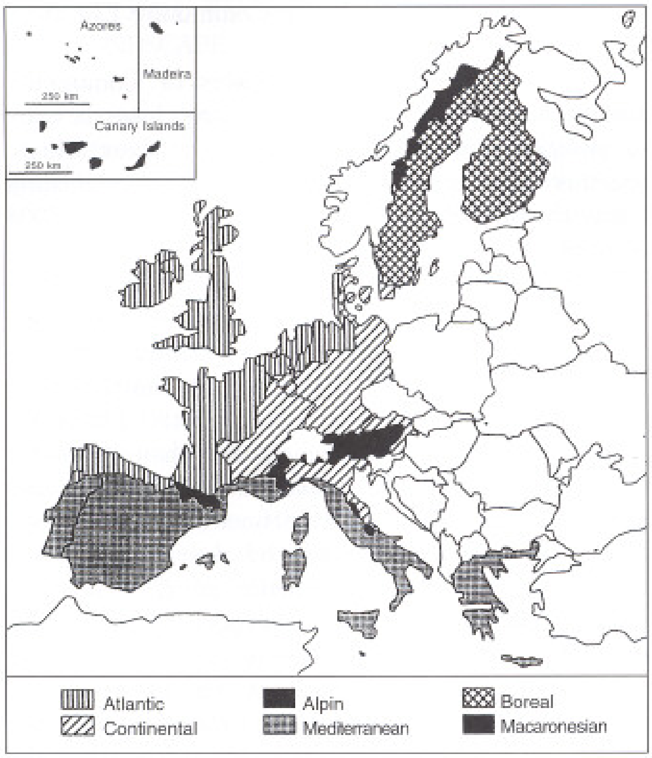

FIGURE 2 - Map of the biogeographical regions of the European Union.

inspired by the Braun-Blanquet phytosociological classification of plant communities, which has a long tradition in continental Europe. To organise the cataloguing and selection process on a balanced territorial basis, 6 biogeographical regions were distinguished: Mediterranean, Macaronesic, Alpine, Central European, Atlantic and Boreal (Figure 2).

The importance of the Habitats Directive can be better understood in the light of the following considerations (SSYMANK & HAUKE, 1998):

- A European-scale assessment of sites worth conserving will be carried out.
- Site selection should be performed according to scientific criteria.
- Habitat protection includes functional aspects, such as dynamism.
- Appendix 1 includes a wide spectrum of types of habitat, although the majority of land habitats have been defined using phytosociological syntaxa.
- Care has been taken to respect and emphasise regional diversity in the context of biogeographical regions, rather than choosing the best example of each type in the territory as a whole.
- In impact assessment, conservation status is placed above any source of deterioration. So, all action with negative effects on protected habitats and species should be prohibited, even outside the protected areas (art. 6).
- A strict protection system is set up throughout the EU, particularly for priority species and habitats.
- The state of such habitats, and their management, needs to be permanently monitored, with the obligation to issue regular reports. This should ensure the Directive is properly applied and that site handling is effectively controlled.

APPLICATION OF THE HABITATS DIRECTIVE IN SPAIN

Owing to geological, climatic, biogeographical and historical circumstances, Spain (the Canary and Balearic Islands included) has the highest levels of biodiversity of any EU member country. This is clear from the table on species richness, endemic levels and diversity shown above. Consequently, as far as the Habitats Directive is concerned, Spain is a leading protagonist, as are other Mediterranean member countries such as Italy, Greece and Portugal. Owing to its size and position, France equals Spain in that it covers four of the six biogeographical regions, which in Spain's case are the Macaronesian, Mediterranean, Atlantic and Alpine. Figure 3 shows the share of the habitats types as well as that of the species (Fernández de Tejada *et al.*, 1995).

The Spanish Institute for Nature Conservation, ICONA (now DGNA), an official body dependent on the Ministry of Agriculture, was chosen to manage the process of preparing the Spanish National List of Places of Potential Community Interest for inclusion in the Natura 2000 network. A co-ordination task force (called Grupo de Trabajo de Coordinación or GTC), was also

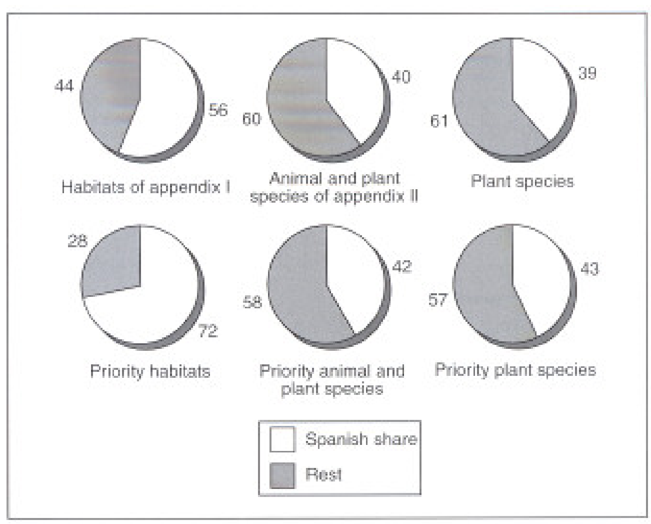

FIGURE 3 - Spanish share of the habitats and species of appendix I and II.

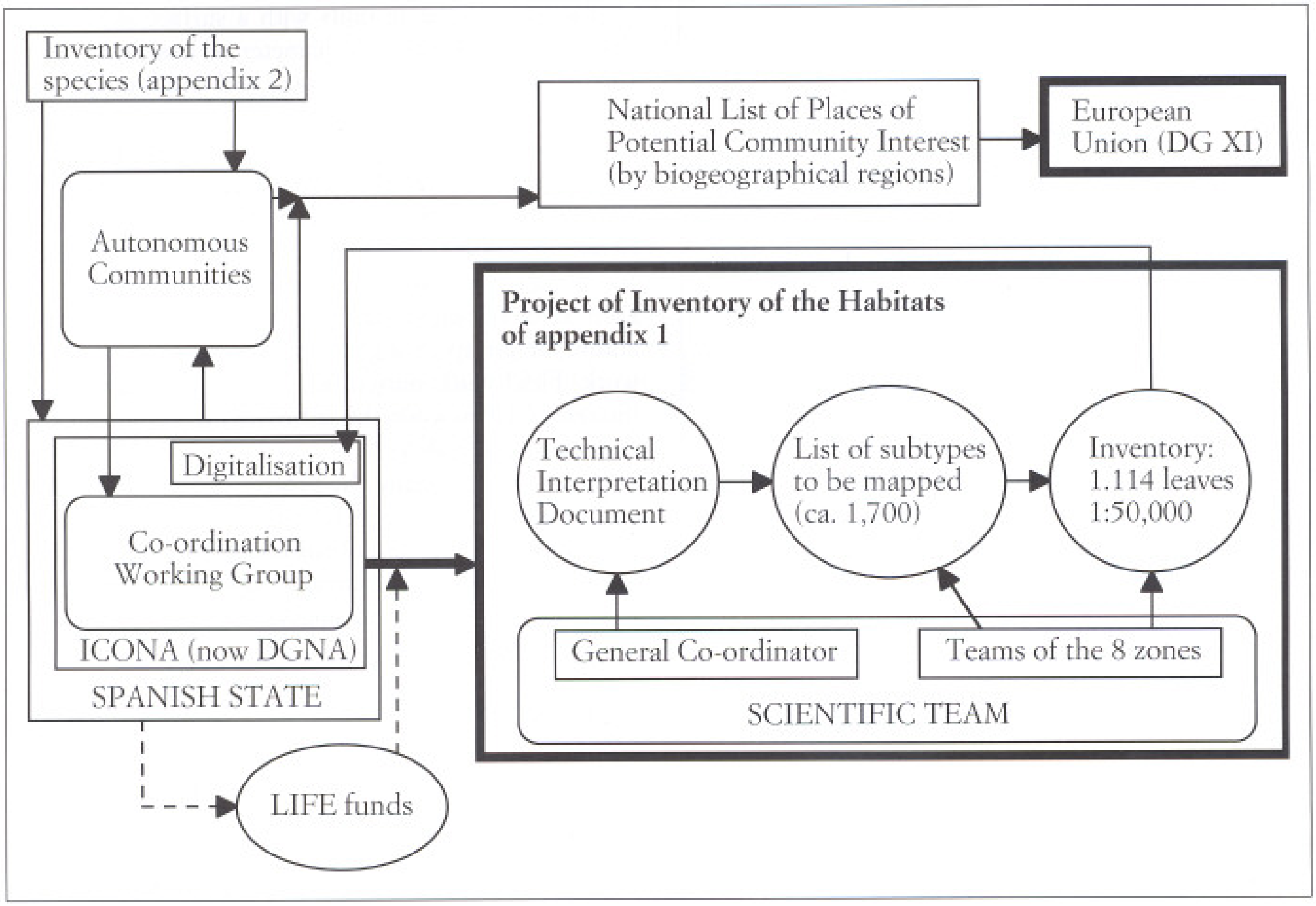

FIGURE 4 - Scheme of the procedure in the inventory of the habitats and elaboration of the List of Places of Potential Community Interest in Spain.

set up for the same purpose. Both the Spanish central authorities and autonomous community administrations were represented on the GTC, as the latter have powers over nature conservation issues. With a view to preparing a List that complied with the conditions of coherence, integrity and biogeographical representativity required under Article 4 of the Directive, it soon became clear that a major effort to classify and catalogue the types of habitat and species listed was needed. Unlike other EU member countries, with regard to the habitats in appendix 1, the Spanish central authorities opted for a prior *ex novo* classification procedure covering all such habitats in Spain. This meant that 1:50,000-scale maps had to be made of each type of habitat, and this was structured in the corresponding Project (Figure 4).

It was also clear from the first that the definition of the types of habitats in appendix 1 was not very precise and that a Technical Interpretation Document was needed to resolve any doubts or ambiguities that might arise. The GTC commissioned Prof. S. Rivas-Martínez to prepare the Technical Interpretation Document and named him general co-ordinator of the scientific team entrusted with the project, as well as the Spanish representative on the Scientific Committee for Directive 92/43/ECC. This document, in line with the units of the *Corine biotopes manual*, broadened the definitions of the types of habitats and designated the syntaxons of which they consist in Spain.

Work on the project began immediately. Funds secured from the community instrument LIFE were managed by ICONA. Formal invitations were sent out to potential members of the scientific teams of more than 80 university departments and scientific institutions all over Spain. Finally, more than 250 researchers were organised at some 30 centres. Most team members were botanists and phytosociologists, although a significant number of ecologists, geographers and other specialists were also involved. Spain was divided into eight zones, six of them peninsular, the remaining two insular, each with its own Area Co-ordinator (Figure 5).

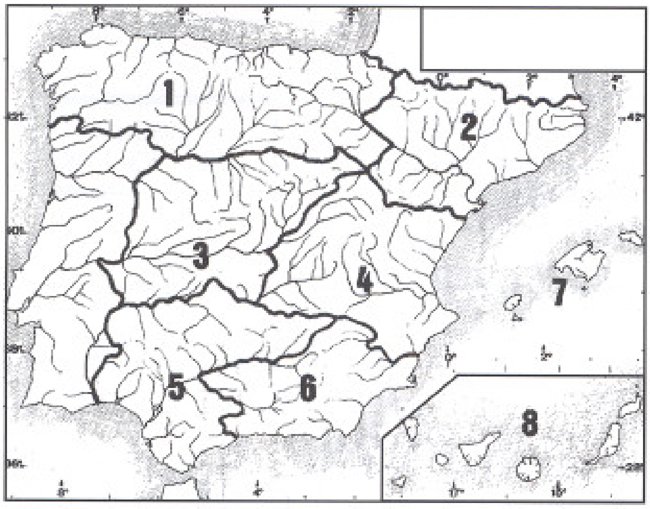

Figure 5 - The eight zones in which the Spanish territory was divided in the Project of Inventory of the habitats of appendix I.

Before field work began, the scientific teams in each zone met under the chairmanship of their respective co-ordinators, to draw up the list of lower-range syntaxa into which each of the types of habitats in appendix 1 of the Directive could be subdivided, with the aid of the Technical Interpretation Document and in line with the principles set out in the *Corine biotopes manual*. Nearly 1,700 subtypes were obtained, which had to be mapped at a scale of 1:50,000 for the whole of Spain. The large majority corresponded to phytosociological associations, although in some cases recourse was made to the subassociation level. In others, where transcription into phytosociological units was impossible, it was decided either not to subdivide or to subdivide using other criteria. The remarkably high number of subtypes is a clear reflection of the richness and diversity of Spain's natural patrimony.

Mapping and cataloguing at 1:50,000 concentrated essentially on these subtypes. As many of them cover areas big enough to be represented at that scale, only 4 graphic symbols were used:

- Polygon (or precinct): for catalogue units with areas greater than 6.25 hectares and a diameter exceeding 250 m.
- Cross: for catalogue units with a surface area of less than 6.25 hectares and a diameter of less than 250 m.
- Line: for linear catalogue units and width of less than 250 m.
- Crossed circle: for subterranean units (caves).

The information matching the symbols shown on each map was filed on computer using a programme supplied by ICONA.

Work was distributed in such a way as to ensure that each 1:50,000 sheet was entirely assigned to a single author or group of authors responsible for doing the work. Field work started in 1994 and was finished by the end of 1996, when the last maps - 1,114 in all - were delivered to ICONA.

One way of continuing the project would be to extend cataloguing to other types of habitat not included in the Directive but which are of sufficient interest at national or regional level to warrant inclusion in a global biodiversity conservation policy.

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