Biotopes - Contents

Colophon

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Preface

An important feature of successive Community environment action programmes has been the adoption of measures to protect and conserve the biosphere; these measures have greatly benefited from the early and sustained support of the European Parliament. Examples of such Community actions include Directives on the conservation of wild birds, the implementation in the Community of the Convention on International Trade in Endangered Species, and the proposed Directive to protect important Community habitats.

Fundamental to these policies are the principles of the world conservation strategy - the maintenance of essential ecological processes and life support systems, the preservation of genetic diversity and the sustainable use of species and ecosystems. Above all, it is recognized that the conservation of threatened biological organisms is critically dependent on our ability to maintain suitable habitats in sufficient numbers, sufficient in extent and with adequate geographic dispersal to ensure their survival.

None of these measures can be properly implemented, nor can their effects be monitored without the existence of reliable and accessible information about the status, condition and geographic location of the habitats and ecosystems in need of protection. A priority theme of the CORINE programme, as constituted by the Council Decision of June 1985, was therefore to assemble comprehensive and compatible information on the location and state of important biotopes in the Community, through the compilation of a computerized inventory of sites of major significance for nature conservation.

This report presents the achievements of the biotopes project. It describes the approaches used, the results obtained and the lessons learned; it also illustrates some of the potential applications for the data. This constitutes the final report of just one of the CORINE projects, and should be read in conjunction with similar reports describing related work in the other thematic areas addressed by CORINE. Together, these provide a record of the complete CORINE programme and its associated information system on the state of the environment and natural resources in the European Community.

I wish to express my thanks to the project leader, Dr Barry Wyatt and his assistant Dr Dorian Moss, and to each of the experts who make up the biotopes team. Pierre Devillers, of the Royal Belgian Institute for Natural Sciences, deserves special thanks for the development of the Community classification of habitats.

The involvement of J.-P. Ribaut, as a representative of the Council of Europe, as well as the contributions of colleagues of international organizations, was decisive for the design and realization of the biotopes inventory, as a tool of wide use, for the policy of nature conservation at Community and international level. Also essential to the progress of the work were the stimulating discussions with the colleagues responsible for nature protection within the Directorate-General.

Thanks are equally due to the scientific coordinator of the CORINE programme, Professor David Briggs and to Michel-Henri Cornaert for guiding the project, and to Ronan Uhel, Marc Roekaerts and Vital Schreurs for technical help.

Finally, I wish to make a special acknowledgement to Professor Albert Noirfalise for his general and always enthusiastic advice on the project.

Gunter Schneider

Directorate-General
Environment, Nuclear Safety
and Civil Protection

December 1990

The CORINE biotopes project was carried out during the period 1985-90 by a group of European experts working under the guidance and in close cooperation with the CORINE central team at the Directorate-General for the Environment, Nuclear Safety and Civil Protection of the European Commission. The main contributors to the project were:

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This report has been prepared by Dorian Moss, in collaboration with Barry Wyatt, Michel-Henri Cornaert and Marc Roekaerts

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Summary

This report details the CORINE biotopes project: its rational, its aims; how those aims have been fulfilled during the period 1985-90; the working procedures and scientific methodologies which have been adopted for the selection and description of sites of Community importance for nature conservation. It also identifies the various outputs that have been incorporated into the CORINE geographic information system. The report describes lessons learned in compiling the database and some uses which have already been made of the data, evaluates future needs in the Community for information on nature and the environment and recommends further actions required.

The biotopes project forms part of the CORINE experimental work programme of the Commission of the European Communities, concerned with 'gathering, coordinating and ensuring the consistency of information on the state of the environment and natural resources in the Community'. It is one of several projects, intended to demonstrate the feasibility of assembling a coherent and consistent database to support Community policies in a number of priority areas.

The first task for the biotopes project was to establish a Community network of sources of information and expertise on all aspects of nature conservation. Within this network, agreed procedures were then developed and implemented: (a) to allow sites of Community importance for nature conservation to be selected using criteria which are consistent in all Member States, (b) for information on these sites to be recorded and exchanged in a common format, (c) for the use of agreed data procedures to ensure that the information conforms to these standards, (d) for the interrogation, analysis and dissemination of information from this database and (c) for the integration of these data within the overall CORINE geographic information system.

These procedures (in particular, the selection criteria and the various standard nomenclatures developed in the biotopes project) are now also accepted as a basic standard by many international, national and regional agencies responsible for nature protection.

A database describing some 6 000 sites of Community importance for nature conservation has been created and represents the most comprehensive European source of such information. Use of the database has been demonstrated in support of research, policy and management applications. Many of the human, scientific, technical and management problems which the project confronted and successfully overcame have general relevance for the creation of distributed information networks of environmental information. The report documents the key lessons and solutions. These have particular importance in the context of the establishment of the European Environment Agency, its information and observation network.

Finally, the report makes recommendations for the future management of information on nature and the environment in the Community covering arrangements for the collection of compatible data, development of methods for storage, dissemination, analysis and interpretation of these data and the needs for underpinning research.

1. Content and objectives of the CORINE biotopes project

1.1. The CORINE programme

1.1.1. Objectives

Given the concern and responsibilities of the European Commission for environmental protection, expressed in the Community environment policy and programmes, there is a pressing need for better knowledge of the environment its present state, its future evolution and the reasons for its change. This information is needed at the Community level, in the wider global and international contexts and also in the member countries and the regions. Information is required to determine the direction of Community environment policy, to assess the effects of that policy and, above all, to facilitate policies which integrate the environmental dimension into sectoral planning within the Community. It is therefore essential to have more knowledge of and insight into the different elements subject to environment policy: the location and state of the natural environment and wildlife; the quality of soil and water resources and their uses; the harmful substances discharged into the environment; natural risks which must be taken into consideration in the processes of land management.

Since the beginning of environmental policies in the 1970s, a large number of inventories and data collection and measurement programmes have been drawn up in response to this need. However, these programmes, virtually without exception, have been undertaken on a case-by-case basis to solve specific problems. In addition to the inevitable waste of resources, one of the consequences of this method of operation has been the lack of comparability of environmental data from one country to another, or even from one region to another, because of differences between data collection and organization, for example in methodology, nomenclature or reference periods.

The absence of comprehensive, complete and compatible information on the environment across the Community as a whole was a major impediment to the development of an effective Community environmental policy.

In response to this need, the Commission realized a series of preparatory works which led the Council to adopt a decision on a Commission work programme - the CORINE programme - concerning an 'experimental project for gathering, coordinating and ensuring the consistency of information on the state of the environment and natural resources in the Community' (European Communities, 1985a). Initially planned for a four-year period, the programme was subsequently extended by two years (European Communities, 1990a).

The programme involved three complementary areas of work. For the Commission it meant:

(i) gathering the information required on priority topics, to determine the direction of Community environment policy, to implement this policy, and, in particular, to incorporate the environmental dimension into other policies;

(ii) organizing, influencing or encouraging initiatives by international organizations, national governments or regions whose aim is to obtain environmental information, in order to ensure consistency in data collection and hence optimum use of financial and human resources;

(iii) developing the methodological bases needed to obtain data which are comparable at the Community level.

1.1.2. Content and realization

Given the fact that the programme was to be involved with information system technologies which were either new or under development, and furthermore that it covered an extremely wide and diverse area of expertise, encompassing
all sectors of the environment, the Council's decision focused the programme on a series of priority applications:

(i) compiling an inventory of biotopes of major importance for nature conservation in the Community;

(ii) collating and making consistent data on acid deposition and in particular the establishment of a cadastral survey on emissions into the air;

(iii) the evaluation of natural resources in the southern part of the Community, in particular in those regions which are eligible for support from the structural Funds;

(iv) work on the availability and comparability of data.

In order to carry out the programme, the Commission, with the support of a committee of national experts, established a series of specialized technical groups, corresponding to the different priority applications. These groups defined the working methodologies and gathered the data under the guidance of a project leader. The whole programme was conducted by a technical and scientific secretariat at the Commission (Figure 1.1).

Figure 1.1 - The CORINE programme organization scheme

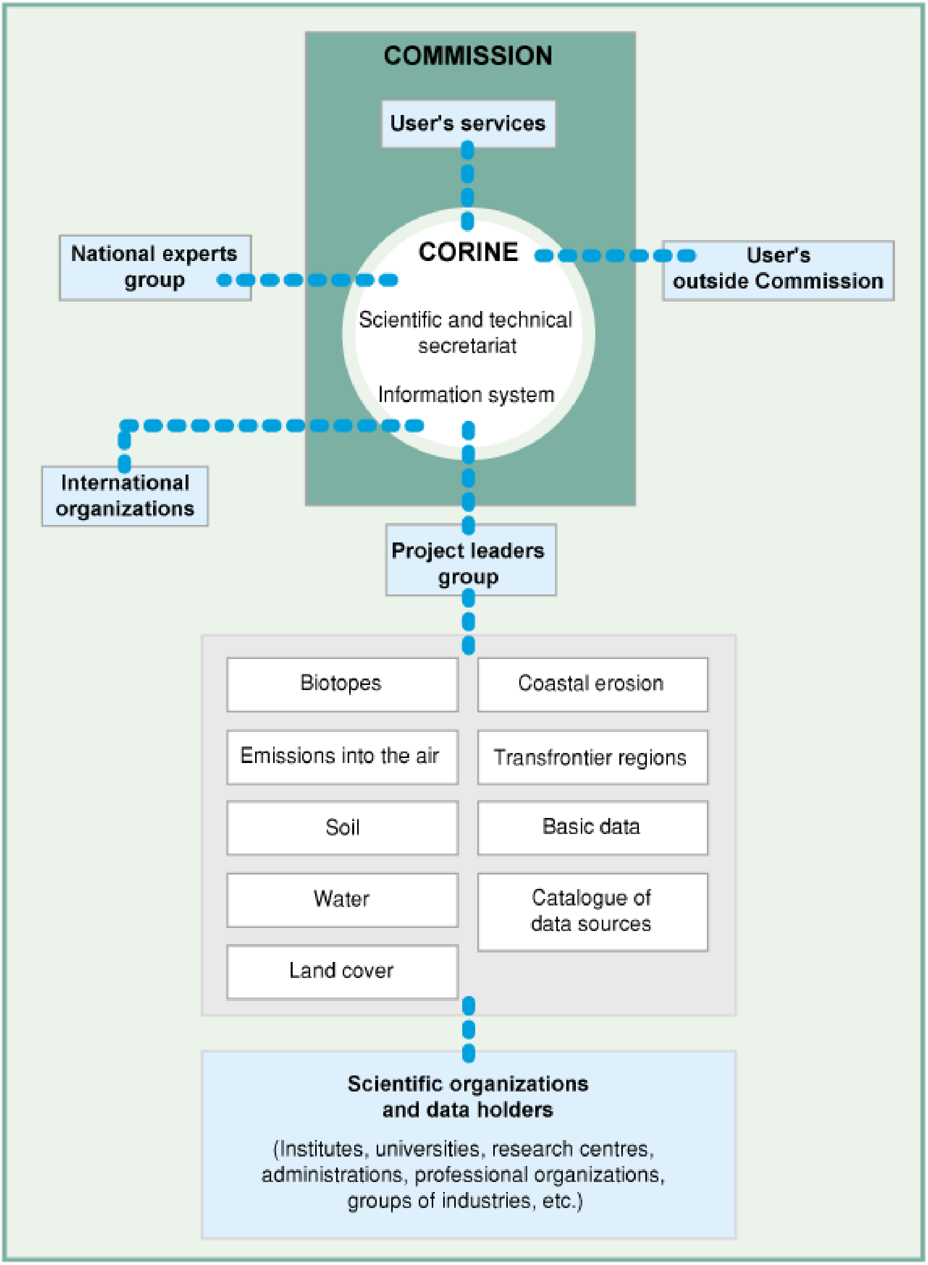


Table 1.1 - The CORINE database - Summary of contents

A - The geographic base

B - Nature

C - Land

D - Air

E - Water

F - Socio-economic data

Table 1.1. A - The geographic base

Theme	Nature of the information	Volume of information description	Mbytes	Resolution/ scale
Coastline and national boundaries	Coastline and national boundaries (Community and adjacent territories)	62 734 km	0.3 3.2	1/3 000 000 1/1 000 000
Administrative units	EC NUTS regions (Nomenclature of territorial units 4	829 NUTS-regions digitized for hierarchical	0.8	1/3 000 000 statistics) levels
Administrative boundaries	SOEC localities database extending NUTS to level IV and level V (communes)	Benelux countries: 1 421	1.5	1/500 000 communes
Water pattern	Navigability, categories (rivers, canals, lakes, reservoirs)	49 141 digitized river segments 983 digitized river segments	13.8 0.3	1/1 000 000 1/3 000 000
Slopes	Mean slope per km' (southern regions of the Community)	1 value per km^2, i.e. 800 000	45.0	1/100 000 values
Settlements	Name, location, population of urban centres > 20 000 inhab.	1 542 urban centres	0.1	Location of centre
World map	Coastlines, country boundaries and	196 countries rivers	1.5	1/25 000 000 (planet)
Transport network	Road coverage EC + CH, A	27 050 road segments	6.5	1/1 000 000

Table 1.1. B - Nature

Theme	Nature of the information	Volume of information description	Mbytes	Resolution/ scale
Biotopes	Location and description of biotopes of major importance for nature conservation in the Community	5 600 biotopes described, according to approx. 20 characteristics	20.0	Location of the centre of the site
		Boundaries of 440 biotopes computerized	2.0	1/100 000 (Portugal, Belgium)
Designated areas site	Location and description of areas classified under various types of protection	13 000 areas described according to approx. 11 characteristics(file being completed)	6.5	Location of the centre of the
		Computerized record of the limits of the areas designated in compliance with Article 4 of Directive 409/79/EEC on the conservation of wild birds		1/100 000
Natural potential vegetation	Mapping of 140 classes of potential vegetation	2 288 homogeneous areas	2.0	1/3 000 000

Table 1.1. C - Land

Theme	Nature of the information	Volume of information description	Mbytes	Resolution/ scale
Soil types	320 soil classes mapped	15 498 homogeneous areas	9.8	1/1 000 000
Climate	Precipitation and temperature (other climatic variables: some	Mean monthly values for 4 773 stations data	7.4	Location of station incomplete)
Land quality/ important land resources	Assessment of land quality by combining four sets of factors: soil, climate, slopes, land improvements	170 000 homogeneous areas, southern regions of the Community	30.0	1/1 000 000
Soil erosion risk	Assessment of the potential and actual soil erosion risk by combining four sets of factors: soil, climate, slopes, vegetation	180 000 homogeneous areas, southern regions of the Community	40.0	1/1 000 000
Coastal erosion	Morpho-sedimentological characteristics (four categories), presence of constructions, Generalization: characteristics of coastal evolution: erosion, accretion, stability	17 500 coastal segments described	25.0	Base file: 1/100 000 1/1 000 000
Land cover	Inventory of biophysical land cover, using 44 class nomenclature	Vectorized database for Portugal, Luxembourg	51.0	1/100 000

Table 1.1. D - Air

Theme	Nature of the information	Volume of information description	Mbytes	Resolution/ scale
Emissions into the air large sources	Tonnes of pollutants (S0,,N0x,VOC) emitted in 1985 per category of emission: electric power station, industry, transport, nature, oil refineries, combustion	1 value per pollutant, per category of emission and per region, plus data for 1 400 sources i.e. +/- 200 000 values in total	2.5	Regional (NUTS III) and location of emission

Table 1.1. E - Water

Theme	Nature of the information	Volume of information description	Mbytes	Resolution/ scale
Water resources	Location of gauging station, drainage basin area, mean and minimum discharge, period:1970-85, for the southern regions of the EC	Data recorded for 1 061 gauging stations, for 12 variables	3.2	Location of gauging station
Surface fresh water quality	Annual values for 18 parameters, 1 1 3 stations, for 1976-86, supplied in compliance with Directive 77/795/EEC	2 034 records/year	0.2	Location of station

Table 1.1. F - Socio-economic data

Theme	Nature of the information	Volume of information description	Mbytes	Resolution/ scale
Socioeconomic activities	Statistical series extracted from the SOEC-Regio database.	Population, transport, agriculture, etc.	40.0	Statistical units NUTS II and NUTS III
Air traffic and airports	Name, location of airports, type and volume of traffic (1985-87).	254 airports	0.1	Location of airport
Nuclear power stations	Capacity, type of reactor, energy production.	97 stations, update 1985	0.03	Location of station
Areas designated under Community	Eligibility for the structural Funds Eligibility for the Interreg-initiative	309 regions classified 219 regions classified	0.01 0.01	Eligible regions NUTS regions

1.1.3. Results

The programme had two aims:

(i) developmental: to verify the usefulness of a permanent information system on the state of the environment for Community environmental policy, to check the technical feasibility of creating such a system, and to identify the conditions required for its installation and functioning;

(ii) operational: to supply information useful for Community environmental policy on topics of priority concern (biotopes, acid deposition, and the Mediterranean environment).

With reference to the first of these aims, the CORINE programme results show that a permanent information system on the state of the Community environment is necessary, and technically feasible. Furthermore, the programme has permitted a more precise definition of the conditions necessary for the realization and operation of such a system.

The second of the programme's aims has also been successfully attained. Data on the priority topics were collected within the framework of a reference cartographic database, and organized in an operational geographic information system. Table 1. 1 gives an overview of the contents of the CORINE information system.

The Council of Environment Ministers took these results into consideration when they adopted the decision to create a European Environment Agency (European Communities, 1990b), and as a consequence, the CORINE prototype will be transformed into a permanent information system. The first task of the Agency, which will he supported by a European environment information and observation network, will be to continue to supply the Community and its Member States with objective, reliable and comparable information on the state of the environment, notably by using and further developing CORINE.

1.2. The importance of information on nature conservation for European Community environmental policy

1.2.1. The value of nature conservation

The 12 Member States of the European Community cover the major part of Western Europe from the north-west Mediterranean Sea to the Atlantic Ocean and the Baltic Sea, with a total land area of 2.25 million square kilometers and a human population in excess of 340 million. This vast area encompasses a great diversity of natural ecosystems as a result of its geographical spread and the range of climates to which it is subject, and of the soils and rock types which occur. These ecosystems range from the warm, dry grasslands of the Mediterranean region to cool, humid bogs of the north Atlantic seaboard; from Alpine screes and meadows to the alluvial valley forests of large lowland rivers; from precipitous sea cliffs to sand dunes and shallow coastal lagoons. The Community also includes several important island groups sufficiently isolated for the evolution of endemic species and the development of unique habitat types.

Each of these and the many other ecosystems found in the Community is formed by a combination of habitats to which a great diversity of species of fauna and flora has become adapted over the course of hundreds of millions of years of evolution. Radical variations in altitude, climate and soils within small distances, which frequently occur over many parts of the Community territories, contribute further to the inherent diversity. As a result, the Community supports, in addition to man, over 150 species of mammal, 500 birds, 180 amphibians and reptiles, 150 fish, 10 000 plants and at least 100 000 invertebrates (Figure 1.2). The distribution of species however is far from even across the Community territory, as shown for birds for example in Figure 1.3.

Figure 1.2 - Total number of species in the EC

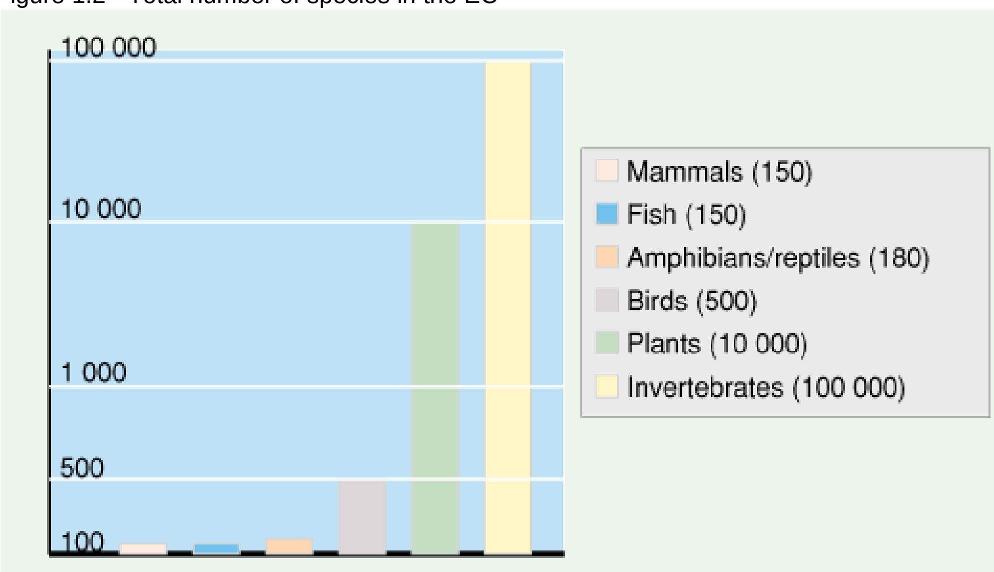
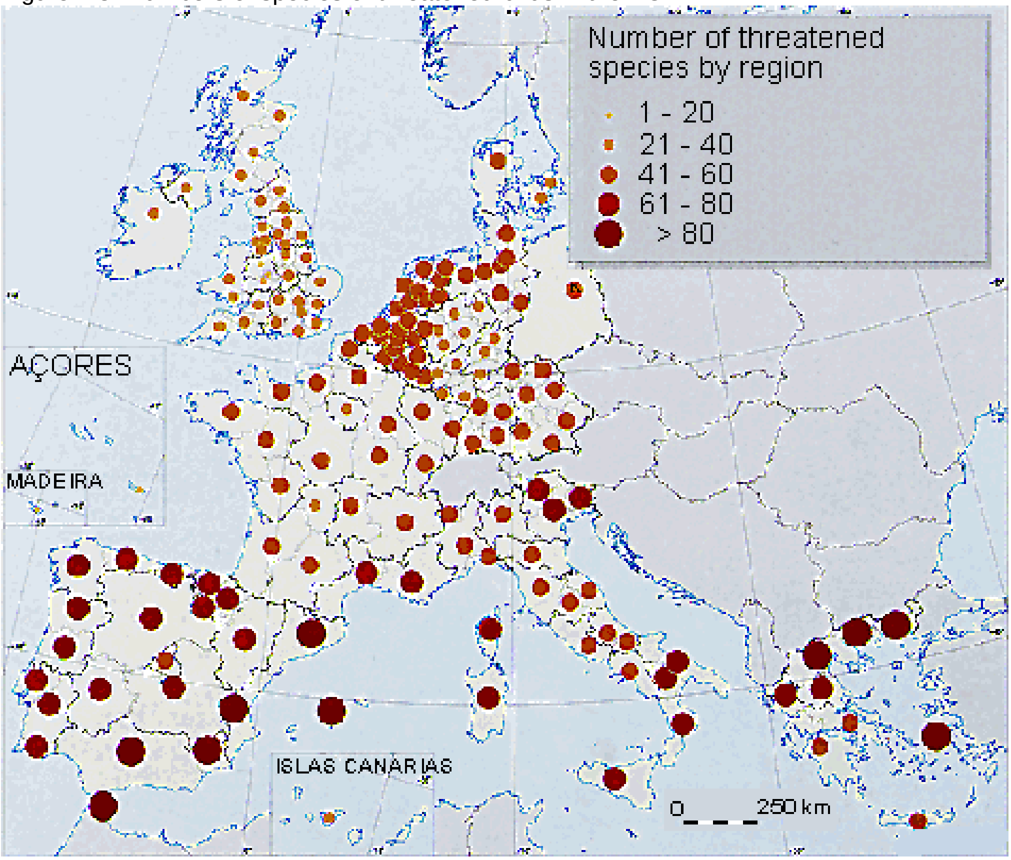


Figure 1.3 -Numbers of species of threatened birds in the EC

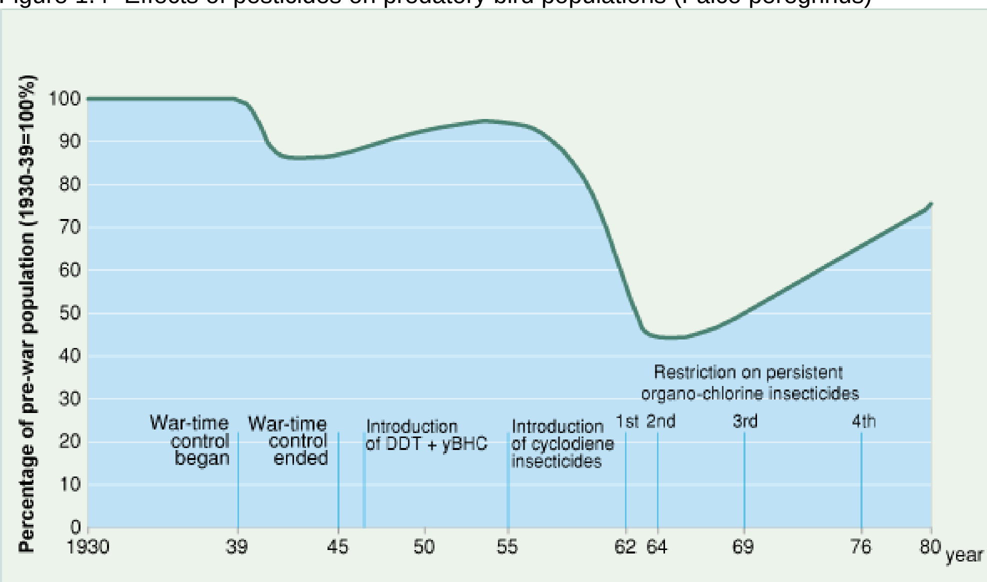


Alone amongst these species, man has acquired the potential to affect the numbers and distributions of all the other species, so changing the ecosystems and balances of nature. However, also uniquely, man has the ability to appreciate the value of wildlife to further his own development, to maintain his life-support systems, and to provide him with fulfillment in his leisure activities, and has come to realize that this position gives him a responsibility for stewardship over the other species sharing the planet. As evidence of the strength of this attitude, a survey of public opinion within the European Community in 1986 reported that 79% of respondents stated that they were concerned about the extinction of the world's plant or animal species (European Commission, 1986).

The amenity value of nature conservation in the Community has never been greater, as ever-increasing mobility gives a greater proportion of the population the opportunity to leave behind their home environments and search for natural beauty and tranquillity, while an increased awareness of wildlife and the countryside is encouraged by modern communications media, heightening the public's expectations of what they might experience. The growth in the direct recreational value of wildlife is shown by an increase in activities such as bird-watching, and by the surge in public membership enjoyed by nature conservation societies over the past two decades. Amenity and recreation are aspects of the aesthetic quality of the natural environment which human society demands to be maintained in order that we can enjoy its beauty, study its complexity and relax in its peace.

Apart from the moral obligation which the Community's population might feel to conserve its natural heritage, there are other overwhelming reasons for the maintenance of the ecological balance and of the maximum biological diversity within the European Community. Many wildlife species can be regarded as indicators of the health of the environment. There may be warnings for the continued health of the human population should it no longer be possible to maintain stable populations of these species. For example, in the early 1960s, many species of predatory bird suffered widespread and severe declines due to their uptake of organochlorine pesticide residues. Had these chemicals not subsequently been banned, these residues might have had dire effects for the human population. Fortunately, the affected bird species substantially recovered following the removal of the cause of their decrease (Figure 1.4).

Figure 1.4 -Effects of pesticides on predatory bird populations (Falco peregrinus)



Genetic diversity must be maintained, so that in future, adaptation to changing environments can be achieved as rapidly as possible; such processes would be impaired were there to be a reduced gene pool on which selection could operate. This capacity is all the more necessary at a time of rapid change, such as during the period of global climate change which is now being predicted. The implication is that viable populations of all species of fauna and flora (and their supporting habitats) must be retained across as wide a geographical area as possible; that is, within the full range of the natural ecosystems in which they are found at present.

Maintenance of biological diversity can have direct benefits to mankind through our ability to exploit many different species, for example in their use in agricultural improvement of the genetic stock of our food plants, or for hitherto undiscovered medical treatments. lt is only relatively recently that manufacturers (for example of toiletries and cosmetics) have begun to return to the use of natural products, and their scope would be limited were these sources no longer to be available.

1.2.2. The threats to wildlife and its habitats

The ecological balance of the Community has been modified by man's activities for many centuries, but the threats have intensified dramatically during the past few decades, and the variety of wildlife and richness of ecosystems is now considered to be less than at any time in recent history. The various pressures can be considered to act either directly, indirectly or globally.

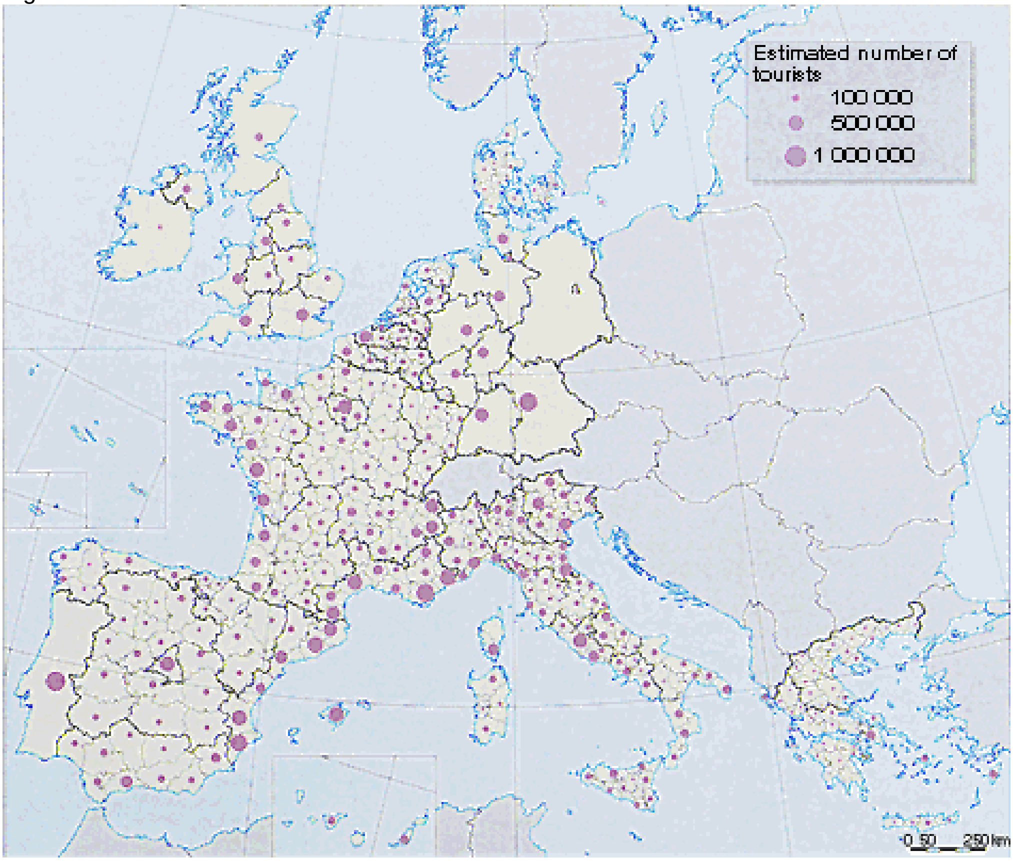
Direct pressures are the most obvious but not necessarily the most damaging to wildlife. They include the hunting and shooting of mammals and birds, uncontrolled fishing, and plant collecting. These activities can cause serious damage to certain rare and vulnerable species, but most target species have survived such activities almost unscathed over the centuries, so long as only surplus productivity was cropped.

Much more serious and often insidious are the indirect pressures. Paramount amongst these is habitat destruction, a process which has been taking place since man began to practice agriculture, but which has increased dramatically as demands on land for industry, housing and agriculture have grown during the current century. Land which has been used for agriculture over long periods has had time to reach new ecological balances, but these are now being upset by intensification processes, such as the removal of hedgerows, land drainage and increasing use of fertilizers. Industrial processes often not only make direct demands on land resources, but also lead indirectly to urban expansion.

The removal of land previously available to wildlife has immediate effects. However, human developments often also result in pollution of the environment, for example of water by excessive fertilizers, industrial effluents and sewage, and of the air by sulfur dioxide and other gases which lead to 'acid rain'. Overgrazing and deforestation give rise to increased problems of erosion, while conversely, afforestation of upland areas, in particular with exotic tree species, replaces valuable natural habitats. Peatlands in the uplands, and even more so at low altitudes, are threatened by increased rates of peat extraction for use in horticulture and for fuel.

Many further impacts upon natural ecosystems arise from the expansion of human populations themselves. Urban and suburban encroachment and increased road building require land directly; road traffic results in further air pollution, and ever-increasing tourist development threatens many habitats, especially on the coasts (Figure 1.5). Meanwhile there is also greater human pressure on the uplands because of the recreational opportunities which they provide. The potential damage this pressure can cause is particularly well illustrated by the problem of the unfettered development of ski slopes to the detriment of fragile alpine ecosystems.

Figure 1.5 -Estimated number of tourists in August 1987



In recent years, awareness has grown of far-reaching global changes to the environment, especially global warming (the 'greenhouse effect'), and the hole in the earth's ozone layer. Should global warming be as drastic as is currently predicted by the majority of experts, its effects on the wildlife and habitats of the European Community could be much greater than any man-induced changes which have been observed hitherto.

1.2.3. The Community response

Faced with the growing threats to its wildlife and natural habitats outlined above, most Member States of the European Community have responded with policies aimed at wildlife protection through the designation of protected areas and legislation concerning plant and animal species under threat. At the Community level, policies are being developed, not least with a view to avoiding damage to habitats or species which might occur as a result of the Community's own activities, for example through agricultural or regional development programmes.

Meanwhile, beginning with the first action programme on the environment, which took effect in 1973, the Community has developed policies to protect natural habitats and vulnerable species of fauna and flora. Of particular interest is the Directive on the conservation of wild birds (European Communities, 1979), which implements and stimulates national actions for the protection of wild birds.

Further actions were the adoption in 1981 by the European Community of a Decision on the Berne Convention on the Conservation of European Wildlife and Natural Habitats, which calls upon Member States to take action to maintain wildlife populations and control pollution and other threats to their fauna and flora; the adoption in 1982 of the Bonn Convention on the Conservation of Migratory Species of Wild Animals, which requires Member States to take action to protect listed endangered migratory species of animals; and the implementation in 1984 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (Cites), which prohibits or controls trade in endangered species of animals and plants both at the frontiers of the Community and within Community markets.

It should be noted that, since environmental protection was not mentioned in the Treaty of Rome, policy instruments in the first instance were based on principles of Community competence such as free circulation of goods and fair competition. These were not relevant enough to allow for the laying down of the legal basis for wildlife policy. The Commission, actively supported by the European Parliament, took a number of initiatives to demonstrate that action was needed at the Community level. The Council Directive on the conservation of wild birds (European Communities, 1979) was the first piece of legal text which pointed out that not every Community action need be seen through commerce and competition, but that conservation and prudent management of the Community's natural resources is a justified aim for Community policies. The European Parliament supported further Community policies on nature protection by voting financial resources. Eventually, environmental protection became an integral part of the Treaty with the adoption of the Single European Act. It is likely that full use of these powers will be needed in the future in order to make sure that environmental protection is duly integrated in the development processes which are expected to be generated by the completion of the internal market (European Commission, 1990).

The requirement to ensure a greater uniformity in the practice of nature conservation across the Community, once trade barriers are removed, becomes increasingly urgent. Therefore in 1988, as part of the fourth environmental action programme, a far-reaching initiative was drafted which aims to protect the fauna, flora and habitats of the Community (European Communities, 1988). The proposed Directive on the protection of natural and semi-natural habitats and of wild fauna and flora would strengthen measures to be taken for the safeguarding of habitats of importance for the protection of endangered and vulnerable species, and also habitats which are themselves vulnerable.

This logical extension of the Directive on the conservation of wild birds would establish a comprehensive network of protected areas aimed at ensuring the maintenance of threatened species and threatened habitat types in all the regions of the Community where they occur. Furthermore, the proposed Directive would help in the establishment of Community-wide priorities for conservation so that Member States would be obliged to safeguard ecosystems and landscapes which are abundant within their own countries but absent elsewhere in the Community. Examples are the 'flow country' of Northern Scotland, the peat bogs of Ireland, and the 'dehesas' of Spain.

Community policy is thus firmly established towards ensuring that the three main objectives of the world conservation strategy are met:

(i) the maintenance of essential ecological processes and life support systems;

(ii) the preservation of genetic diversity;

(iii) the sustainable utilization of species and ecosystems.

1.3. Aims of the CORINE biotopes project

Fundamental to the effective implementation of the Community policies outlined above is the requirement for reliable and accessible information about the location and status of the ecosystems, habitats and species in need of protection. In order to be applicable at the Community level, such information must be collected to consistent standards throughout the Community territories. It is only through such information that it will be possible to identify fully the priorities for nature conservation and to monitor the effectiveness of protection policies.

With these considerations in mind, the Council of the European Communities, in adopting the experimental CORINE programme (European Communities, 1985a) chose the biotopes project as a priority application of CORINE to Community-scale problems. The decision of the Council identified the aim of the project as 'to identify and describe biotopes of major importance for nature conservation in the Community'. In pursuing this aim, the foundations would be laid for more consistent data collection and analysis at the international level as well as within Member States. In selecting, describing and designating internationally important sites, it is particularly important to ensure consistency
with measures adopted by wider international bodies, such as the Council of Europe and the IUCN.

Ultimately an information system would be available so that policies on the environment could be developed and assessed in a much more informed and objective framework than hitherto. It was intended that this information should be widely available, not only to the planners and legislators in the European Commission, but also to other international agencies, to governmental and non-governmental organizations within the Member States, and to the interested public.

In practice, several subsidiary aims were generated in order to achieve the goal set by the Council of the European Communities. These can be itemized as follows:

(i) To gather together and coordinate a team of experts who would be able to supply the data required.

(ii) To determine criteria to ensure consistency in selecting sites important for nature conservation in the Community.

(iii) To specify what data fields should be recorded for each site.

(iv) To set up standards for the recording of such data fields.

(v) To design or use existing computer systems for data compilation, storage, retrieval, analysis and display.

(vi) To compile, collate and computerize the data on the selected sites.

(vii) To validate the data.

(viii) To make the database available to users of the information, whether they be at the European Commission, other international bodies, national organizations or private individuals.

All these goals had to be pursued without 're-inventing the wheel', but by drawing together existing methods, nomenclatures, etc. This was possible up to a point, but, as shown in following chapters, many new initiatives were needed in order to ensure that the resulting methods were consistent, comprehensive and feasible.

2. Working procedures

2.1. Organization of the work

The precursor to the biotopes project was a pilot study of biotopes of significance for nature conservation in the 10 Member States at that time, undertaken for the European Commission in the early 1980s (Wyatt, 1982). The results of that study provided the initial framework for the biotopes project, in terms of the types of data which were to be collected and also, importantly, a network of experts in the Member States who had access to the relevant information. Further initial groundwork was available through the expertise of the Council of Europe, and additional site data had already been collected for important bird areas (Osieck and Bruyns, 1981).

The stages in the creation of the biotopes database are shown schematically in Figure 2.1. At the outset of the project, a project leader, Dr Barry Wyatt, was appointed at the UK Institute of Terrestrial Ecology by the European Commission. Experts were identified in each Member State who were either already working on national collection of relevant data, or who had ready access to information on nature conservation sites at a national level. As far as possible, the intention was to choose only a single expert from each Member State, so as to avoid duplication of effort and of recording: in addition, representatives from the Council of Europe and observers from the Royal Society for the Protection of Birds, the International Council for Bird Preservation, the International Union for Nature Conservation and the World Conservation Monitoring Centre were invited to participate in the project. These experts constituted the 'biotopes team'. During the course of the project, some experts have inevitably left the team due to changes in their work, but continuity has been maintained throughout. Members of the biotopes team are listed in Appendix A.

The function of the team has been to ensure that there would be consistency in the data standards operated within the different Member States, and to oversee the coordination of the project. To maintain regular contact of the group as whole, there have been five biotopes team meetings (Table 2.1) These meetings have brought together the experts supplying data for each Member State with officials from DG XI and members of the project leader's team who coordinated the data. The meetings have provided a forum for the discussion of methodology, for progress reports and future planning, and have provided a stimulus for the adoption at the national and regional level of standards which are compatible with the Community ones.

The format of the biotopes standard site record, together with its detailed specification and those of codes for habitats, designations, motivations and human activities, was agreed by the biotopes team during the initial stages of the project. Lists of endangered and vulnerable species based on Council of Europe inventories, Berne Convention annexes, and other specialist sources were also adopted, and a technical handbook (Volume II of this publication) to specify the database contents was compiled and circulated to team members. Together, these standards and conventions define the scope of the project and the information which is sought.

Table 2 .1 - Biotopes team meetings

Date		Hosting body	Location	
20-21 June	1985	Institute of Terrestrial Ecology	Bangor, United Kingdom	
25-26 February	1986	Council of Europe	Strasbourg,	France
20-21 November	1986	European Commission	Brussels,	Belgium
8-9 October	1987	Ministry of Environment, Nordrhein Westfalen	Düsseldorf,	Germany
3-4 October	1989	Institute of Terrestrial Ecology	Huntingdon, United Kingdom	

Figure 2.1 Key operations in the CORINE biotopes project

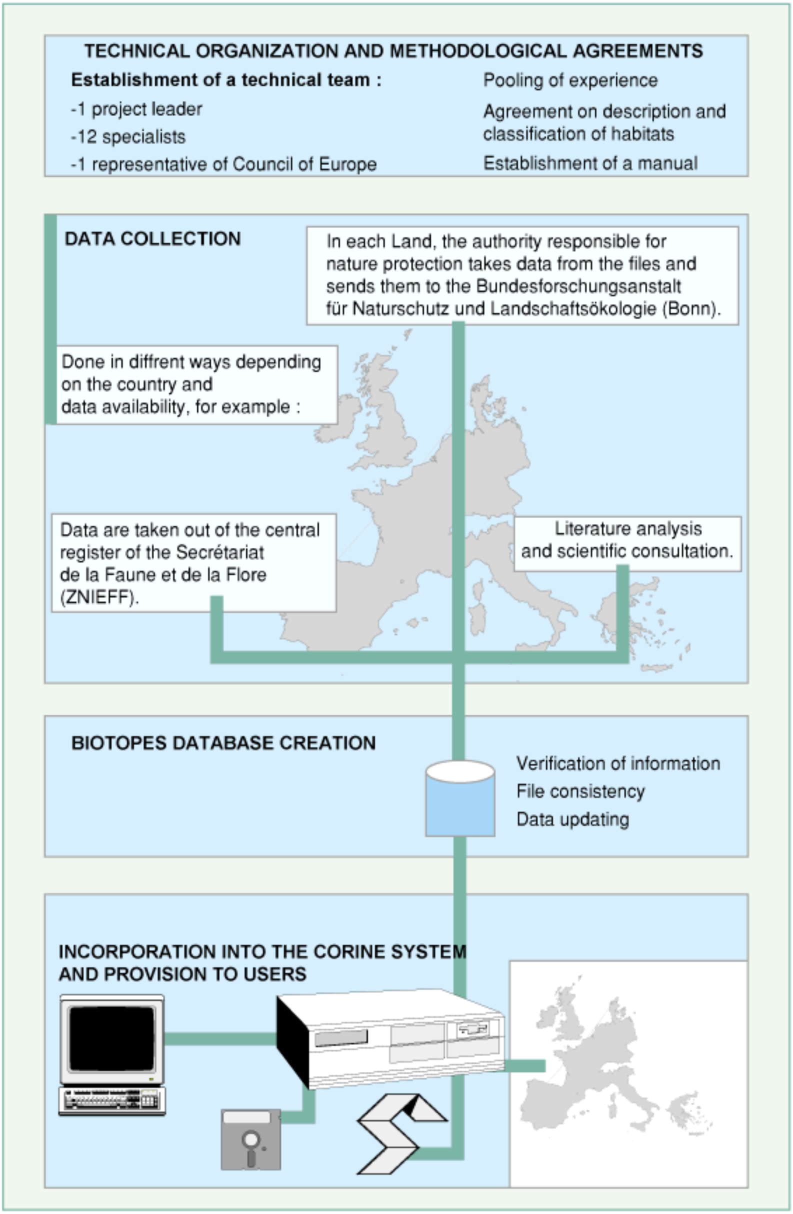


Figure 2.2-The two phases of CORINE biotopes data collection

PHASE I

-Site name

-Region name

-District

-Site location represented by longitude and latitude of the site centre

-Site area

-Mean, minimum and maximum altitudes

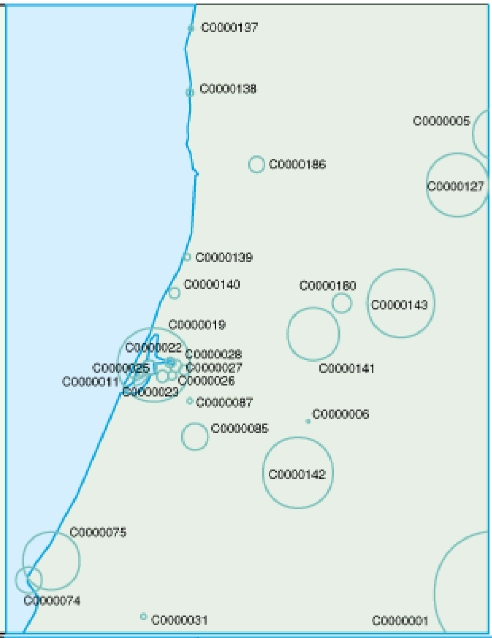
-Generic habitat description taken from a set of 44 possible codes

-Designations applying to the site

-Reason for the inclusion of the site in the database

-Lists of any endangered species present

-Name and address of a contact, from whom further, information could be obtained



PHASE II

-Site location represented by digitised boundaries

-Detailed habitat description taken from a set of over 600 possible codes

-Percentage ground cover by each generic habitat type

-Criteria for selection on the basis of habitats or species

-Human activities influencing the site

-Extention of species data to include vulnerable and rare species

-Text description of the site under the headings of character, quality, vulnerability, designation, ownership and documentation

lt was suggested at the first biotopes team meeting and agreed at the second meeting that data should be compiled in two phases (Figure 2.2).

The individual tasks outlined in Figure 2.2 were specified in more detail in a working manual. At the second meeting, coding systems for habitat, motivation, designation and human activity were adopted. At the fourth meeting it was agreed that the criteria used for site selection should be formalized and noted explicitly as part of the site description. lt was also agreed that percentage cover of each habitat type should be reported. Estimates of habitat cover were to be made only at the generic level of the habitat coding system, but the complete surface area of the site should be so described. An additional text descriptive field, 'history', was added to allow changes in the status of the site record to be documented.

Team members compiled data as appropriate to their national circumstances. For example, in some cases, data were extracted from existing national data holdings; in others, new national data holdings were set up, whilst in others, data had to be extracted from a number of existing regional sources. Those members who could call upon existing data sources supplied data for phase I and then updated them for phase 11, while others worked towards data for both phases simultaneously. Where prior national records did not exist, the CORINE biotopes project has proved to be a powerful catalyst in creating them.

In parallel with the organization of these procedures for coordinated data compilation, the computer systems required for the storage, validation, retrieval and display of the data were under development. Decisions were taken jointly by the project leader and by the CORINE central team as to the most suitable hardware and software environments for the handling of the data. Inevitably, as the database developed and also as more advanced technology became available, adaptations had to be made to ensure that appropriate equipment and methods were used. The development of software followed a logical progression: initially systems were devised for handling the raw data received from compilers and for converting them to suitable storage formats; then validation procedures were required and also analytic approaches which would highlight those aspects of the data where gaps existed. Meanwhile, as the body of data assembled acquired its own value as an information source and so started to attract users, a central geographical information system (GIS) was also installed at the CORINE headquarters in Brussels. Here the data could not only be analysed and mapped as such, but also brought in overlay with data resulting from the other CORINE subprojects (land cover, soil erosion, designated areas, etc.). From here many users, Commission services as well as external institutes and individuals, could be supplied with subsets of the data and maps. lt was also valuable to be able to produce display material to publicize the work being achieved by the project team.

2.2. Data transfer procedures

By its very nature, the biotopes project has been designed as a distributed information network. Data exchange is central to the effective operation of this network. Data transfer takes place at several stages of the project (Figure 2.3): for example from those gathering data within Member States to their representative on the biotopes team; from the team member to the biotopes project leader; from the biotopes database to the central CORINE GIS. At each of these points, it would have been impossible to transfer data faithfully without agreed standards and formats.

2.2.1. Data transfer within Member States

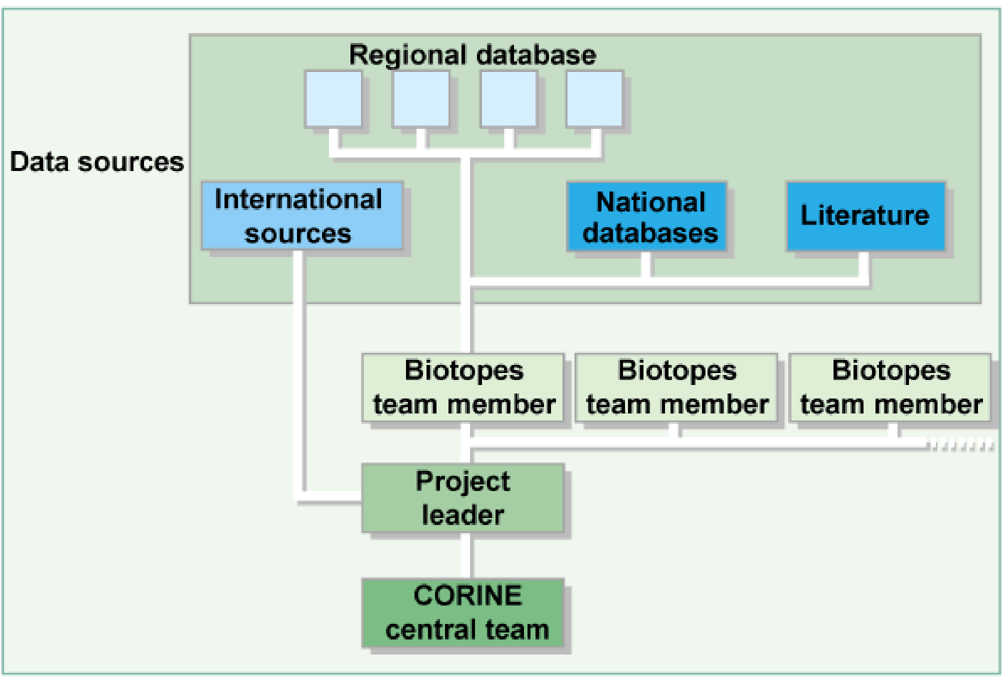
2.2.2. Data transfer from Member States to the biotopes database

2.2.1. Data transfer within Member States

The initial source data occurred in a great variety of forms. These included regional or national computerized inventories in few cases, data on the national distributions of species or habitats, and inventories held on paper in different forms. Indeed, had this not been true, the work of the biotopes project would have been largely completed before it began! It was the initial lack of uniformity in the treatment of data on nature conservation sites which gave the project its impetus.

It was considered appropriate for each national compiler to use whatever techniques were applicable to assemble the data required, within the common framework of the data specifications of the *CORINE biotopes project technical handbook.* In the case of those with preexisting national computer databases, this entailed writing software to extract the relevant information required for the project. In most other Member States, national databases were developed following the guidelines set by the requirements of the biotopes project, and suitable arrangements were made for transfer of data from the preexisting sources to such databases. In several instances, this has resulted in the adoption of Community standards for site description at the national level or has stimulated the creation of federal databases for individual local sources where no national database previously existed.

Figure 2.3 -Data-transfer operations within the CORINE biotopes project



2.2.2. Data transfer from Member States to the biotopes database

Biotopes team members were asked to adopt one of a number of options for the transfer of their data to the project leader. A 'standard site record' was specified (Section 3.3), and data were requested in that format either on standard paper forms specifically designed for the purpose and published as part of the technical handbook, or as Ascii text files supplied on a machine-readable medium (computer diskette or magnetic tape). As an alternative, the project leader also developed a database system within DBase-IIIplus for the storage of data. This system included a data input program, so that site information could be readily computerized within the Member State and then transferred to the project leader on diskettes containing standardized files.

Following the compilation, checking and validation stages, data were subsequently transferred from the project leader to the central CORINE GIS, initially using the CORINE transfer format (Hayes-Hall, 1988). This format was designed to be sufficiently generalized to be able to accommodate all types of data which would be collected at any stage of CORINE, for example map attributes such as points and lines and their associated labels, or points with associated text. Subsequently, the CORINE transfer format has been replaced by a limited number of widely-used formats for the exchange of geographically-referenced data, especially the standard export formats from commercially supported geographic information systems, preferably the ARC/INFO export format.

3. Scientific methodology

3.1. Definition of a biotope

Needless to say, a prerequisite to the construction of a biotopes database is the definition of the entities which are to be recorded. In this report, the entities recorded by the biotopes project are referred to as sites. They correspond to the term ‘biotope’, which is used in the title of the project.

The following definition was used to identify a site:

‘An area of land or a body of water which forms an ecological unit of Community significance for nature conservation, regardless of whether this area is formally protected by legislation.’

‘Community significance’ is indicated by one or more criteria which are described in the following section.

3.2. Site selection criteria

The above definition of a biotope implies that it is possible to distinguish particular sites which can be demonstrated, on the basis of objective, scientific criteria, to be of importance for nature conservation at Community level.

3.2.1.The need for criteria

An illustration of the need for such objective criteria for site selection can be given by reference to the situation in Germany. Here, the regional authorities in each Land have compiled independent databases of nature conservation areas which are important at that level, which together include more than 170 000 sites (Table 3.1). Procedures are needed to select those sites, which should be included in the biotopes database. Of course, this selection of priority sites does not imply that the remaining 99% of sites are unimportant.

Table 3.1 Sites identified by the German Länder as important for nature conservation

Land	Number of sites	Area (kM2)	% of surface area
Schleswig-Holstein	c. 10 000	1 258	c. 8.0
Niedersachsen	c. 5 650	2 259	c. 4.8
Nordrhein-Westfalen	c. 17 000	3 406	c. 10.0
Hessen	c. 12 000	1 253	c. 6.0
Rheinland-Pfalz	c. 45 000	2 300	c. 12.0
Baden-Württemberg	c. 40 000	2 500	c. 7.0
Bayern	c. 35 000[1]	4 464	c. 6.3
Saarland	c. 3 600	195	c. 7.6
Total	c. 170 000	17 644	c. 7.0

[1] Excluding woodland mapping, which is included for other Länder.

3.2.2.Theoretical principles

In order to ensure the long-term conservation of species, it is necessary to preserve their full genetic diversity to guarantee their adaptive capabilities. This requires that the network of recorded sites should include a balanced representation of the various geographical populations of the species. The ideal way to achieve this, would be by identifying the most important sites for the species in each cell of a geographical grid, within its potential geographical distribution area. The administrative regions of the Community have been taken as a practicable approximation of such a geographical grid.

A similar approach to the choice of sites supporting a particular habitat type is applied to ensure a balanced representation of the whole range of geographical diversity of this habitat type.

The selection criteria are concerned with the following characteristics:

(i) the presence of threatened species of plants or animals;
(ii) the presence of sensitive habitat types;
(iii) the richness of a site for a taxonomic group of species, such as birds, mammals, dragonflies or orchids;
(iv) the richness of a site for a collection of habitat types.

With a view to achieve the necessary geographical coverage and biogenetic diversity of species and habitats, sites of importance at the Community level must satisfy at least one of the following conditions:

(i) the site is one of 100 or fewer sites in the Community or one of 5 or fewer sites in a region (Figure 3.1) supporting a threatened species;
(ii) the site is one of the 100 most important in the Community or one of the 5 most important sites in a region for a threatened species;
(iii) the site is one of 100 or fewer sites in the Community or one of 5 or fewer sites in a region for a sensitive habitat type;
(iv) the site is one of the 100 most important or representative sites in the Community or one of the 5 most important or representative sites in a region for a sensitive habitat type;
(v) the site supports at least 1% of the Community population of a threatened species.

The criteria which depend on the presence of threatened species or sensitive habitats have thus been defined precisely, as detailed above, and systematically used in site selection. Criterion (v) is only relevant to those species whose Community population can be established by census, and usually criterion (i) is the more appropriate. The level of 1% (or 100 sites) was chosen by analogy with other assessments of international importance, for example the threshold ap-plied for the protection of aquatic bird species in the context of the Ramsar agreement.

Although the concepts of richness for a taxonomic group or richness for a collection of habitat types have not been defined explicitly as criteria for site selection, they have been used implicitly as a basis for the selection of many of the sites.

The selection criteria should be applied independently of any considerations of the current formal protection status or the ownership of sites.

3.2.3.Definitions

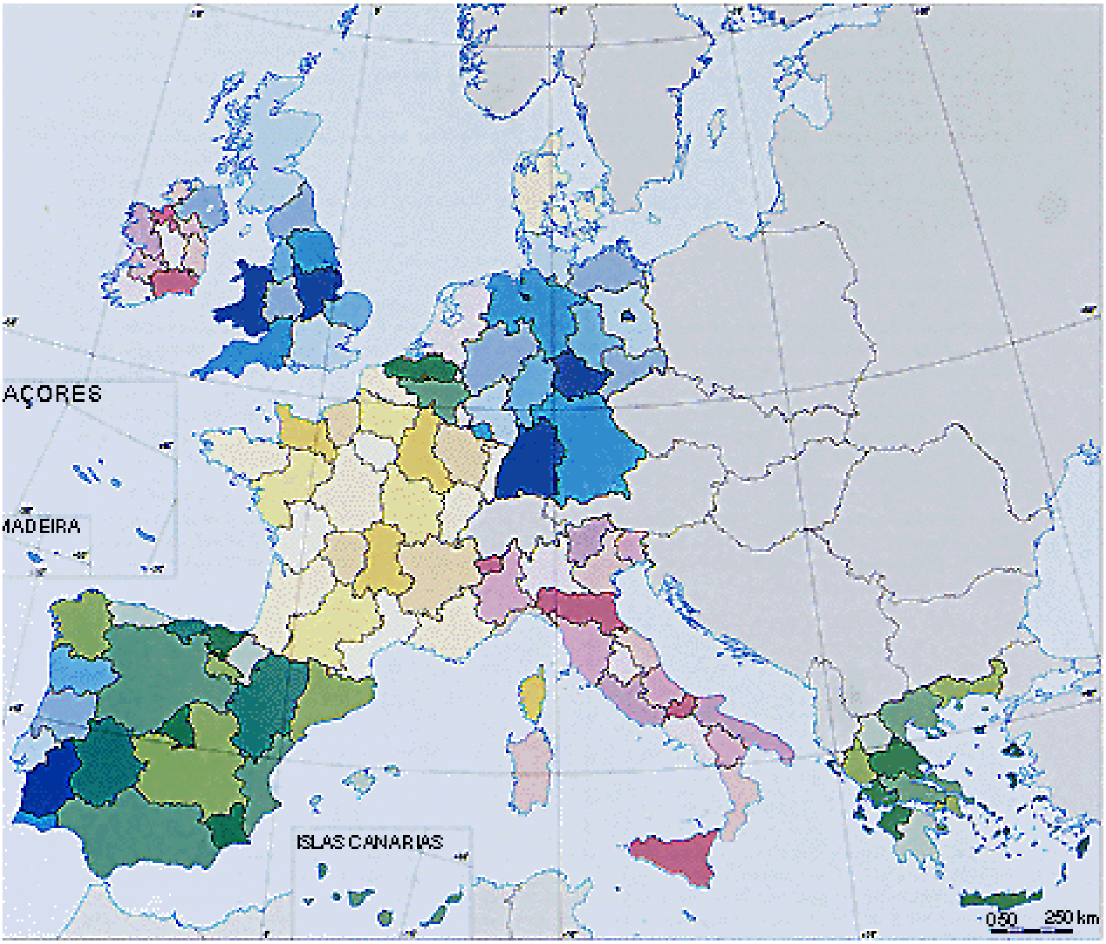
‘Importance’ in this context is assessed not solely in terms of numbers present or extent of habitat but also the rarity of the ecological characteristics exhibited, the typicality of the site as a representative of its type, the quality of the site as a natural environment free from damaging human influences, and the existence of scientific observations on the site.

‘Threatened’ species were identified through expert discussions of the biotopes team and are listed in the CORINE biotopes technical handbook; they are based on those listed in the Annexes to the Berne Convention and classed by the IUCN as endangered or vulnerable and are supplemented where necessary from specialist scientific sources. Thebasis for the lists of threatened species is explained more fully in Section 3.4.21.

‘Sensitive’ habitats have not hitherto been defined explicitly because of the previous lack of comprehensive and consistent information about the distribution of habitats. This information has now become available as a result of the biotopes project, and a list of such sensitive habitats has been drafted for the European Community ‘Habitats’ Directive (European Communities, 1988).

The regions used in the definitions given above were chosen using the administrative boundaries designated by the Statistical Office of the Commission of the European Communities (Eurostat), referred to as the nomenclature of territorial units for statistics (NUTS). This is a hierarchical system of classification, and so it was possible to select different levels of the classification in different Member States so as to divide each Member State into regions of very approximately equal surface area (Figure 3.1).

Figure 3.1 - Regions of the Europaean Community delimited for the purposes of site evaluation



3.3.The habitat classification

Any attempt to characterize sites in terms of their importance for nature conservation, to inventory such sites, to constitute coherent networks of protected sites or to monitor the evolution of such networks requires that the habitats and ecosystems present are recorded in detail. To this end, a typology is needed which describes the recognizable communities formed by interactions between flora, fauna and the abiotic environment; this typology must cover the complete geographical and environmental range of the European Community territories.

The present typological list, developed within the context of the CORINE biotopes project, but also suitable for wider applications, has been designed to meet a number of objectives:

1. It should identify explicitly all communities which satisfy one or more of the following conditions:
   - (i) they have the potential to cover large enough surfaces to be important for animal species which require extensive habitats;
   - (ii) they are physiognomically significant in the landscape;
   - (iii) they are essential to the survival of distinctive populations of rare or sensitive species of plants or animals;
   - (iv) they constitute necessary elements of larger ecosystems;
   - (v) they have value in their own right because they exhibit particular ecological characteristics or because of their aesthetic value.

2. It should strike a balance between the need to emphasize extremely interesting, but rare, natural or near-natural communities and more widespread semi-natural ones which result from a long history of extensive use by man and domestic animals and which constitute most of the habitats of the larger species of wild fauna in Europe.

3. It should be sufficiently flexible to allow the classification to be adjusted to meet specific needs - for example, for sub-division of the agreed classes to record particular localized features.

4. It should define ecological units that are easily identified by persons in charge of data collecting, monitoring or conservation decision-making.

5. It should aim for compatibility with other existing schemes, in particular with those that concern the whole European Community.

Flexibility has been ensured by the adoption of a hierarchical decimal list that can be ‘opened up’ at any point to accommodate further additions or sub-divisions. Such additions can take place whenever needed, either for greater descriptive and predictive precision or to accommodate existing local schemes.

The need to make the contents and the limits of the various units easily recognizable and communicable between different users led to the adoption as a main reference of the basic units of the phytosociological classification of vegetation. In spite of its well-known limitations, the phytosociological system has the advantage of being founded on a regulated procedure of field sampling, description, definition and agreed nomenclature. However, in order to take into account the significance of communities for fauna and for the landscape, and to allow due emphasis on human-influenced habitat types, the agreed system departs from the higher phytosociological hierarchy and incorporates many references to physical features, to integrated ecosystems and to facies which have no phytosociological significance. Although this has introduced some redundancy, in practice this has not been a serious problem.

Throughout the development of the classification, great efforts were made to establish or to retain compatibility, in the sense of one-to-one equivalence, between the CORINE classification and two other Europe-wide projects. This was in particular the case for the map of natural vegetation of the Member States of the European Communities and of the Council of Europe (CEC, Council of Europe, 1987) that was being prepared by Professor Noirfalise simultaneously with the CORINE project and the Council of Europe. Also, the initiative undertaken by the Council of Europe to develop a classification of European ecosystems (Géhu, 1984) has been coordinated right from the start of the development of the CORINE habitat classification system. Both systems were adjusted to finally produce the present CORINE classification system.

In addition, whenever the possibility arose, efforts were made in the same way to take account of local schemes that either existed or were being prepared. For example, bridges have been made with systems currently in use in Denmark and in the United Kingdom. The facility has recently been demonstrated (Hill, not yet published) for identifying common objective field units in parallel habitat classifications at the level of phytosociological associations, sub-associations or their facies.

The habitat classification is complemented by brief descriptions of the units of habitat and of plants that they incorporate. These are intended primarily as a means of facilitating identification by users: a secondary use is in drawing attention to sensitive taxa which the units may host. The phytosociological terms used in these definitions are indicative only and are meant to facilitate identification of the unit; allowance must be made for situations where the definitions include implicit restrictions (e.g. ‘in particular’, ‘among others’) on their use in formally distinguishing between the habitat unit and a phytosociological syntaxon. Whenever possible, the best-known phytosociological names and synonyms have been listed, regardless of syntaxonomic or nomenclatural implications. Extensive use has been made of the recent syntheses of Ellenberg (1988) and Oberdorfer (1990). Plant names are, for the most part, those of Flora Europaea, but again, this should not be taken to imply that its taxonomic conventions are necessarily the most appropriate.

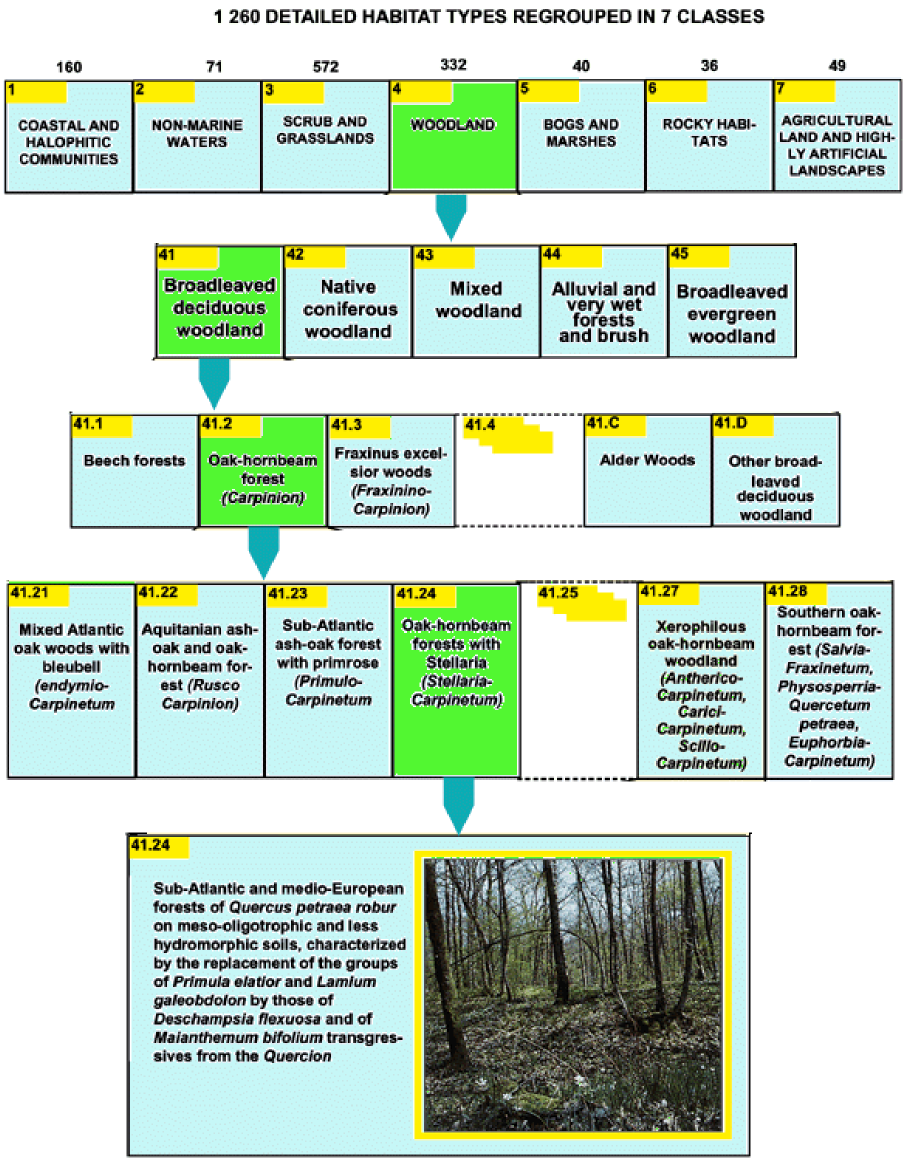
Finally, it should be noted that only natural, near-natural and sub-natural habitats have been treated in detail. All of these are today threatened, either because they are rare and extremely local or because they are dependent on extensive agro-pastoral activities that no longer have a place in the economic fabric. The more artificial habitats, which together probably cover the larger part of the territory of the Community, have for the most part been described summarily.

The coding system used to record these habitat units (Figure 3.2) isdescribed in detail in the CORINE biotopes technical handbook. lt embodies the hierarchical structure of the habitat classification. The first digit defines the broadest division, into seven categories: coastal, wetland, grassland and scrub, woodland, marsh and bog, rocky and agricultural habitats. The second digit defines the most important subdivisions of each of these categories. The first two digits together denote the ‘generic habitat type’, of which there are 44 in all. A decimal point separates these two digits from up to five further digits which can be used to define individual habitat types or phytosociological associations with increasing precision. Any code which has at least two decimal digits is referred to as a ‘detailed habitat code’. (This description is also used for codes with less than two decimal digits and for which no further subdivision exists, for example, ‘12 - Sea inlets’.)

The advantages of this system are that all habitat types and associations which are known in the Community can be included, and that the hierarchical nature makes it possible to retrieve information at the required level of detail (for example, for all woodlands, 4 or for only Pyrenean beech woods, 41.14), and to add new categories to the coding system without disturbing any existing codes. The system can easily be expanded to accommodate highly detailed sub-divisions of the more important habitats, for example for use in national or regional inventories, while retaining upward compatibility with the Community-wide system.

At the generic two-digit level there is also a correspondence with the CORINE land cover nomenclature (Table 4.2 in Section 4.5.3).

Fig 3.2 - An illustration of the CORINE habitat coding system



3.4. The standard site record

In order to achieve consistency in the reporting of data to be stored in the biotopes database, and in data handling, a standard format was designed to hold all the information pertaining to each site. The format contains a fixed number of data field headings. Several of the data records are obligatory and of fixed format, and the remaining data are entered as free data records, whose number can vary, although several of these also have fixed formats. Data stored in coded form can, of course, be printed as narrative descriptions.

The standard site record will be described in detail with reference to an example from the database (Figure 3.3).

3.4.12. Region code

3.4.13. Surface area

3.4.14. Longitude and latitude

3.4.15. Altitude

3.4.16. Habitat codes

3.4.17. Habitat cover

3.4.18. Designation codes

3.4.19. Motivation

3.4.21. Species

3.4.22. Site description

3.4.23. Site boundaries

Fig 3.3 - An example of a standard site record in the CORINE biotopes database

1 – Site identification

```
Site code        A00040099   Date 198706    Update 198912   Complex Code A00010068
Respondent       SFIKAS, GEORGE, 73 Democratias Street, Helioupolis, 163.44 Athens,
                  Greece; HALLMANN, BEN, Panagia 45, 400.08 Rapsani, Greece:
Site name        KORIFES OF LEFKA ORI, FARANGHI SAMARIAS KE ALLA FARANGHIA:
Site-complex     LEFKA ORI:
Sub-site codes
Desig. areas
```

2 – Site location

```
Region name      Chania:
District name
Region codes     A362:                  Area     28000 Long/Lat  24:00:   35:17:
Alt-mean           -99                  Alt-max  2453 Alt-min                    0
```

3 – Ecological information

```
Habitat codes    16.1    /   , 17.2    /   , 18.22  /   , 24.11  /   , 31.7B  /   ,
                 32.12   /   , 32.132 /   , 32.144 /   , 32.19  /   , 32.34  /   ,
                 33.3    /   , 33.4    /   , 41.7C  /   , 42.85  /   , 42.A1  /   ,
                 44.71   /   , 45.1    /   , 62.17  /   , 80.    /   :
Habitat cover    16/  2, 17/  2, 18/  1, 24/  1, 31/  5, 32/ 25, 33/ 15, 41/  8,
                 42/ 18, 44/  2, 45/  8, 62/  5, 80/  8:
Desig. codes     08.A.01/017, 02.A.00/083:
Motivation       01, 02, 03, 05, 06, 07, 08, 11, 12, 13, 14, 15, 17, 19:
Human act.       03/    , 05/    , 07/    :
```

4 – Species

```
                                   SPECIES
Mammals          Glis glis argenteus/**,Apodemus sylvaticus creticus/**,
                 Acomys minus/**,Mustela nivalis galinthias/**,
                 Felis silvestris agrius/**,Capra aegagrus cretica/**:
Birds            Gypaetus barbatus/n**///,Gyps fulvus/n///,
                 Aquila chrysaetos homeyeri/n$///,Falco peregrinus/n///,
                 Pyrrhocorax pyrrhocorax/n$///:
Amphib/rept      Bufo viridis/,Hemidactylus turcicus/,Lacerta trilineata/,
                 Podarcis erhardii leukaorii/**,Chalcides ocellatus/$,
                 Coluber gemonensis/:
Fish
Invertebrates
Plants           Hypericum aciferum/**,Bupleurum kakiscale/**,
                 Nepeta sphaciotica/**,Silene vittata/**,
                 Onobrychis sphaciotica/**,Ranunculus radinotrichus/**:
```

5 – Site description

```
                             SITE DESCRIPTION
Character        It is a region of high, bare-looking, rocky peaks and deep gorges.
                 Locally, there are forests of Cypressus sempervirens, Pinus
                 brutia and Quercus coccifera. On the lower slopes there are
                 shrubs and Phrygana. At the bottom of the Samaria gorge runs a
                 torrent. In the gorges there are small riparian forests of
                 Oriental plane:
Quality          Very important region for the protection of the rare flora of
                 Crete because of the presence of a great number of endemic plants.
                 Other interesting features of the region are the presence of
                 Capra aegagrus cretica and the big birds of prey:
Vulnerability    Overgrazing is the main threat to the flora of the region. The
                 rare fauna is endangered by the illegal shooting and poisonous
                 bait. At present (1988-89), many roads are being constructed to
                 improve stock farming, and will cause many other disturbances:
Designation      A part of the region (Samaria gorge) is a national park and is
                 fairly well protected. Rest of area needs much better protection:
Ownership        5 100ha of the Samaria national park is owned by the State.
                 Absent data re ownership of the rest of the region:
Documentation    1) Damboldt J., Matthas U. & Melzheimer V. "Bericht uber die
                 griechenland, excursion (Kerkyra, Epirus),1975".
                 2) Snogerup S. "The Aegean Endemics" Lund, Sweden. Unpublished,
                 1978.:
History
```

3.4.1.Site code

This is an obligatory data record with a fixed format. It is a unique 9-character code used to identify the site in the biotopes database. The initial character is the country Code, and distinguishes sites located in each of the Member States. The remainder of the site code is allocated by the biotopes team member responsible for the data, and can be used in a variety of ways. For example, it can form a cross-reference to a national database or it can be used to record geographical or administrative classifications within the country's data. In Figure 3.3, the site code is A00040099, signifying a site in Greece (country code A).

3.4.2.Date

This is the date when the information about the site was first compiled or published. Year and month are recorded. Once a site has been registered in the database, the value of the date field is not changed. In Figure 3.3, the information was first compiled in June 1987.

3.4.3.Update

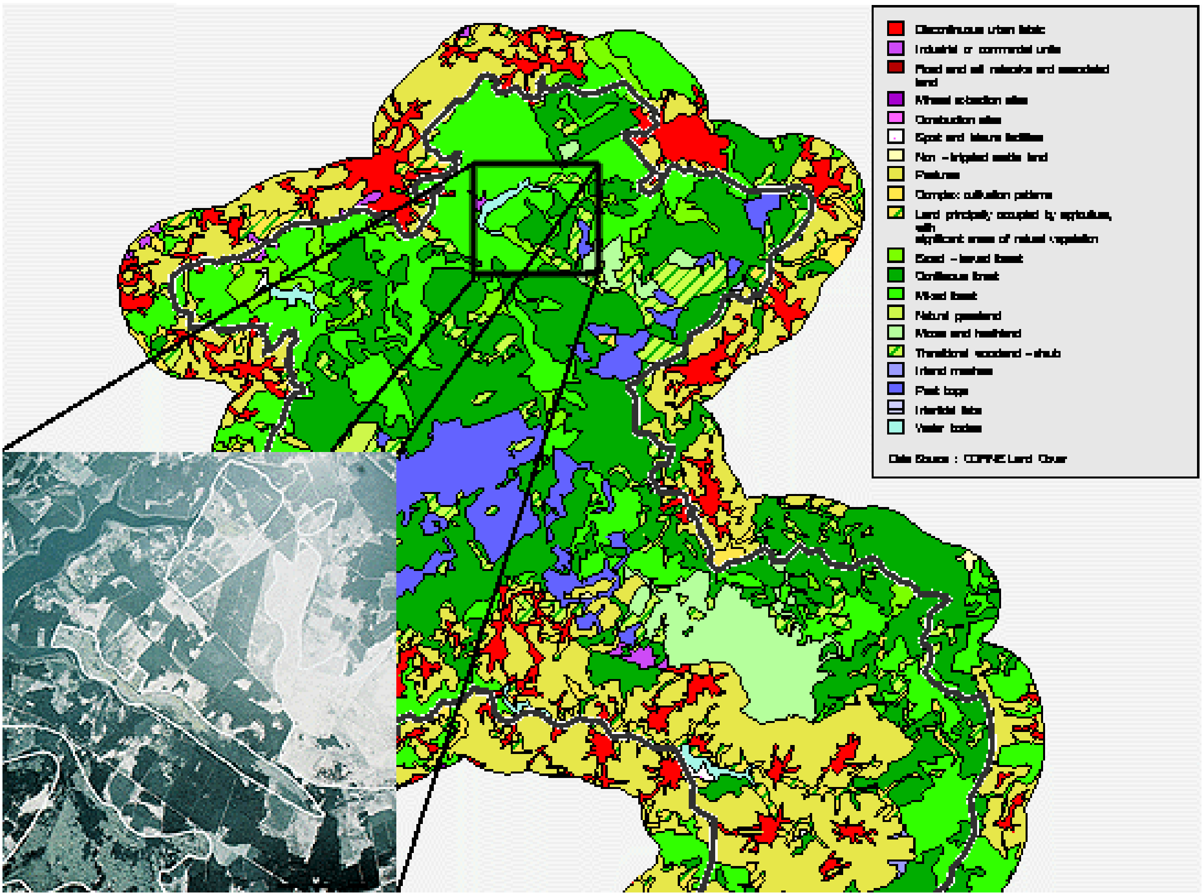
The date when the information for the site was last changed. This is left blank if the data have not been updated. In the example, the site information was last updated in December 1989.

3.4.4.Complex code

Provision has been made within the database to record relationships between sites which either contain or are contained within other database sites. In these cases, the larger site is called a ‘site-complex’, and the smaller site a ‘subsite’. Examples of situations where this facility is used include small distinct sites of particularly high conservation value within a large area such as an upland massif or wetland complex, or smaller protected sites within a larger mainly unprotected site (Figure 3.4). Three data fields are used to record these relationships: complex code, site-complex, and sub-site codes. By recording this hierarchical relationship explicitly, it is possible to retrieve all information for a large site-complex (by accessing sub-sites as well as the parent site-complex), or to restrict searches to specific localities or habitats (by accessing sub-sites only).

If the site being recorded is part of a larger site, the complex code is the nine-character site code of that larger site (the data field is left blank if the site does not form part of a larger site). In the example of Figure 3.3, site A00040099 is a part of the site coded A00010068. This principle is also illustrated in Figure 3.4, where site 500240101 is a sub-site of the complex site 500240100.

Figure 3.4 -The site-complex/sub-site relationship



3.4.5.Respondent

This data field, which is given as free text, contains the name or names of the suppliers of the information about the site, together with their affiliation and address. It serves to identify data submitted to the biotopes team member from different sources. Where data have been compiled by that team member, his or her name is usually entered. In the example, data were supplied by both Mr Sfikas (a botanical specialist) and Mr Hallmann (whose speciality is zoology).

3.4.6.Site name

This is the name by which the site is generally known, in the local language (or its transliteration). It is given as free text, in upper-case letters. The transliterated Greek site name in the example is translated, in English, as ‘Peaks of the Lefka Ori, Samaria Gorge and other gorges’.

3.4.7.Site-complex

The site name of the site whose site code was given in the field complex code, see 3.4.4 above. In the example of Figure 3.3, the site-complex A00010068 bears the site name 'Lefka Ori', and refers to a site which encompasses the whole of this mountain massif in western Crete.

3.4.8. Sub-site codes

This field records the site codes of all the sites in the database contained within the site being described. In the example of Figure 3.3, there are no sub-sites of site A00040099. However since, as noted above, site A00040099 is a subsite of site A00010068, the database entry for site A00010068 contains the corresponding record, that is:

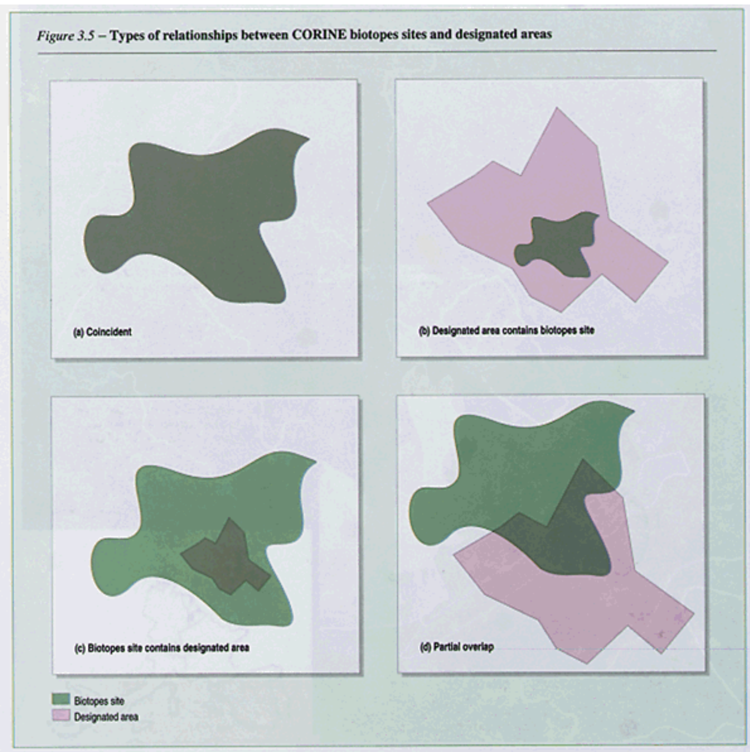
Sub-site codes A00040099.

3.4.9. Designated areas

The field heading ‘Desig. areas’ allows for cross-referencing with the CORINE designated areas database, an inventory of nationally and internationally designated zones, for example nature reserves; national parks; wetlands designated under the Ramsar Convention. The coding used enables the relationship between the biotopes site and the designated area to be recorded. The possible relationships are (Figure 3.5):

(a) the biotopes site and designated area may be coincident (for example, the biotopes site is the whole area of a nature reserve); (b-c) one of them may include the other (for example, site A00040099 contains within it the designated area of the Samaria Gorge National Park); (d) or they may partially overlap. The cross-referencing between the two databases has not been completed at the time of writing. In the case of Belgium, where the biotope sites as well as the designated areas boundary files already exist, the correspondence could be found by overlaying them in the CORINE geographical information system. In this way, the designated areas field in the biotopes points database was automatically updated.

Figure 3.5 -Types of relationships between CORINE biotopes sites and designated areas



3.4.10. Region name

The name of the administrative region (or regions) in which the site lies. The names used are those of standard economic regions listed by the Statistical Office of the Commission of the European Communities (Eurostat), referred to as the nomenclature of territorial units for statistics (NUTS). The most detailed level of the NUTS hierarchy is used. In the example, the region name Chania refers to the 'nomos' (of which there are four comprising Crete) in which the site lies (Figure 3.6).

Figure 3.6 - Example of the coding system for administrative regions in the EC (NUTS)

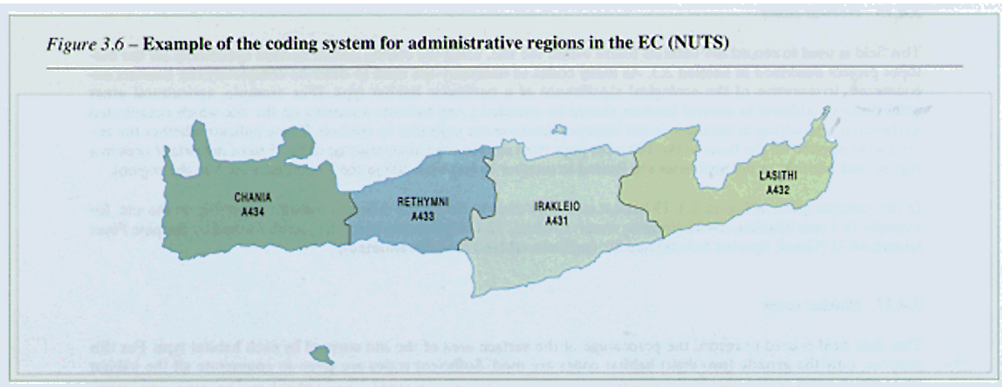


Figure 3.6 – **Example of the coding system for administrative regions in the EC (NUTS)**

3.4.11. District name

This field can be used to record the name of an administrative district or districts in which the site lies, at a lower hierarchical level than is defined in the NUTS, for example a commune. It is optional and has not been entered in the example.

3.4.12. Region code

This is a four-digit code which refers to the region whose name is given in Section 3.4.10, and is selected from the NUTS list referred to above. The data format allows for up to four region codes to be given for a site; no sites recorded to date cover more than four administrative regions. The code system is hierarchical: in the example, the first digit A is the country code for Greece, and the three digits A36 define the island of Crete (Figure 3.6). The full list of codes is given in the technical handbook.

3.4.13. Surface area

The data field is headed ‘Area’ in the standard site record. The total surface area of the site in hectares, including (for marine sites) both land and sea area, is recorded. Where the boundaries of the site have not yet been digitized, the surface area is estimated from maps, hence the round figure in the example of 28 000 hectares.

3.4.14. Longitude and latitude

This data field, whose heading is abbreviated to 'Long/lat', gives the geographical coordinates of the centre of the site. Values can be given to the nearest second of arc where this is appropriate, but accuracy to the nearest minute is sufficiently precise in most cases. Site location is held in alternative coordinate systems (for example, UTM grid) in a number of Member States and, if supplied as such, is converted to longitude and latitude. The alternative coordinates can be retained in the documentation text field (see Section 3.4.22) if required. Location of the site centre can also be calculated automatically on a geographic information system when the site boundaries have been digitized.

3.4.15. Altitude

The altitude (in metres) of the site above sea level is recorded under three sub-fields: the mean or typical altitude of the site overall (headed ‘Alt-mean’), the maximum (‘Alt-max’) and the minimum altitude (‘Alt-min’) found on the site. In the example, the overall mean altitude of the site is not known, and this field is coded with the missing value code ‘-99’. The site ranges in altitude from sea level to 2 453 metres above sea level.

3.4.16. Habitat codes

This field is used to record the habitats found within the site, using the coding system devised specifically for the biotopes project described in Section 3.3. As many codes as necessary are used to describe completely the habitats encountered, irrespective of the ecological significance of a particular habitat type. (For example, agricultural areas within sites in addition to natural habitats should be encoded.) Any habitats occurring on the site which contributed to the criteria justifying its inclusion in the biotopes database are indicated by symbols. These indicate whether the criteria were applied on the basis of the 100 most important sites in the Community or of the 5 most important sites in a region, and whether or not such sites are limited in number to less than 100 in the Community (or 5 in the region).

In the example given in Figure 3.3, 19 habitat codes are used to define the different habitats occurring on the site, for example 16.1 (sea beaches), 24.11 (running water: rivulets), 32.144 (sclerophyllous (dry) scrub formed by the pine Pinus brutia), 44.71 (Greek riparian forests) and 80. (agricultural land (undifferentiated)).

3.4.17. Habitat cover

This data field is used to record the percentage of the surface area of the site covered by each habitat type. For this purpose, only the generic (two-digit) habitat codes are used. Sufficient codes are given to enumerate all the habitat types which occur on the site. In the example, running waters (code 24) cover 1% of the site surface area, and broadleaved evergreen woodlands (code 45) 8%, for example. The values of percentage cover assigned to the various habitat types should total 100%. Eventually, data from the CORINE land cover project will offer further possibilities in defining percentage area under different habitat types (see Table 4.2).

3.4.18. Designation codes

This data field (headed ‘Desig. codes’) is used to indicate situations when all or part of a site has been designated under national or international statute or agreement. As many codes as apply are given. The coding system used is described in detail in the technical handbook. The types of designations include, for example, hunting prohibition zones, national forests, national parks and nature reserves. International categories include sites registered as special protection areas under EC Directive 79/409/EEC (protection of wild birds), Council of Europe diploma sites and sites registered under the Ramsar Convention. Where known, the percentage of the site surface area under each designation category is recorded. In the example, the code ‘08.A.01/017’ indicates that 17% of the site is a national park, and ‘02.A.00/083’ that 83% of it is unprotected by legislation.

3.4.19. Motivation

This data field is used to indicate in general terms the reasons for the inclusion of a site in the biotopes database. Detailed justification for the inclusion of a site within the database is indicated by codes attached to either habitat type codes or species data showing the site selection criteria (Section 3.2).
There are to date 22 possible motivation codes in use, signifying such reasons as general botanical interest (code 02), importance for amphibians or reptiles (code 08), or the presence of endemic species (code 19). These codes mentioned above, as well as several others, apply to the site given in Figure 3.3.

3.4.20. Human activities

This data field (headed ‘Human act.’) is used to record any activities which may affect the integrity of the site, its continued existence in its present form or any other factor which may require special conservation measures. As many codes as appropriate can be given. There are currently 21 possible codes available, including for example, as in Figure 3.3, stock farming (code 03), hunting and shooting (code 05) and tourism and leisure (code 07). Other codes refer to residential development, industrial activity and transport activities such as roads and airports, as well as to potentially damaging operations in areas adjacent to the site. Within the CORINE geographic information system it is possible to identify threats to sites in the biotopes database using other available data-sets such as those on roads, density of population or land cover.

3.4.21. Species

Six sub-fields are used to record the presence at the site of species of mammals, birds, amphibians and reptiles, fish, invertebrates and plants. Particular emphasis is placed on the recording of threatened species which are listed in the technical handbook; these lists are generally derived from the annexes of the Berne Convention and from lists of endangered, vulnerable and rare species in Europe published by the Council of Europe (Collins and Wells, 1986; Heath, 1981; Honegger, 1978; Lalek, 1980; Maitland, 1986; Smit and Wijngaarden, 1976; van Tol and Verdonk, 1988) and by the European Commission (Nature Conservancy Council, 1982). The list for birds is taken from Annex 1 of Directive 79/409/EEC (European Communities, 1979) with additions relevant to the Iberian peninsula and Atlantic islands (European Communities, 1985b).

In the case of two species groups (Odonata and Orchidaceae) further threatened species were identified by the use of indicators of the rarity of species assemblages, based on an approach suggested by Bezzel (1980).

Records of other important, characteristic or interesting species are also documented in the database at this point. Threatened species whose occurrence is sufficiently important that they satisfy a criterion for the selection of the site are indicated as such using codes. These codes also show whether these species are of Community or regional significance, and whether or not they occur in total in less than 100 sites in the Community (or 5 sites in the region).

There are also facilities which allow for the abundance of species to he recorded. In the case of birds, the abundance figures differentiate between numbers of nesting pairs, wintering or migrating individuals, or individuals of unknown status on the site. If counts are not available, it is still often possible to indicate status, for example, nesting (n) or wintering (w). For mammals, counts of individuals using the site can he given; this has most frequently been used for seals and bats. For plants, the abundance field can be used for percentage cover by the particular species: this has proved a difficult field to use in practice.

The example (Figure 3.3) shows in the mammal data field a number of subspecies which are endemic to the island of Crete and carry the ** code, which indicates that they occur at less than 100 sites in the Community. All the birds listed have the status code /n///, indicating nesting species, and Gypaetus barbatus (the bearded vulture or lammergeyer) occurs at under I 00 sites in the Community (code * *), while for Aquila chrysaetos homeyeri (a subspecies of the golden eagle) and Pyrrhocorax pyrrhocorax (the chough) code $ shows that this is one of the five most important sites in Crete. This site is also of Community significance for one of the reptile subspecies listed and for all of the plants, since Crete is a centre of endemism. The lack of fish and invertebrate records in the example demonstrates a lack of documented information rather than that species of those groups are absent.

lt was recognized during the development of the methodology for the project that certain records of particularly sensitive species would have to remain confidential, for example rare birds subject to disturbance or egg collecting, and plants at risk from collecting or trampling. However, since it is a general principle that many more species have been lost due to ignorance, as their individual sites have suffered from habitat destruction, than due to direct damage of the types mentioned above, it was generally accepted by the biotopes team that the numbers of confidential records withheld from the biotopes database should be kept to an absolute minimum.

3.4.22. Site description

Seven sub-fields are used to record descriptions of key characteristics of the site as free text. These fields are used to amplify the coded information given earlier in the site record, and to provide a concise and structured description of the site when details of the site are printed, for example as a result of a search using the data retrieval program.

The sub-field headings are:

Character A brief summary of the general characteristics of the site, including the main landscape features and habitats. This complements the coded information recorded in the habitat codes field.

Quality An indication of the importance of the site, including an assessment of the rarity of species or habitats found there, its typicality and naturalness, and the extent of scientific information recorded for the site.

Vulnerability The nature and extent of pressures upon the site from human and other influences, and the fragility of the ecosystems found there. This field is used to expand upon coded information recorded under ‘Human activities’.

Designation Used to record any aspects of the site designation not adequately covered under the designation codes field.

Ownership A general description of the site ownership (for example, State, local authority, private), and where known, the proportion of the site surface area in each ownership class.

Documentation Key scientific references or site management plans which contain further relevant information about the site. This field is also used to hold other important text information about the site, for example grid coordinates.

History Used by the database manager to record the stages by which the current site record developed.

3.4.23. Site boundaries

As explained in Figure 2.2 site boundaries are delineated in phase 11 of the project. For this purpose the national team members are asked to draw site boundaries on a set of original published topographical maps with a scale of 1:100 000 or the nearest possible scale. Preference is given to sites with an area of more than 100 hectares, which can still be visualized on this scale.

The boundaries are subsequently digitized according to the relevant national topographic map projection. The projection details are clearly specified, so data can be converted into the projection system of the CORINE geographical information system (Lambert azimuthal equal area projection). More technical details about the digitization can be found in the technical handbook.

Where orthophotomaps or satellite images are available, site delineation can be performed in close connection with the actual terrain situation. This can be of particular interest in regions where no recent topographical maps are available or where the land use is rapidly changing.

Once the boundaries have been recorded, they can be brought in overlay with results of other CORINE projects or be used for various applications such as environmental impact assessment of big infrastucture works.

The correspondence Table 4.2 illustrates that the completion of the habitat codes and percentage cover can be facilitated by overlaying the land cover with the site boundaries.

3.5. Data collection procedures used

Prior to the initiation of the CORINE programme, data on important nature conservation sites had been collected in different Member States in a variety of ways: there was no standardization of methodology or data content, sometimes even within countries. The range of existing sources of site-based information are categorized in Table 3.2. In addition, several Member States held information on the distribution of one or several groups of species of fauna and flora.

Table 3.2 Status of conservation on nature conservation sites prior to 1985

Status	**Examples**
National computer-based inventory	France
National inventory on paper, in process of computerization	United Kingdom
National inventory on paper	Italy, Ireland
Regional computer-based inventories	German Länder
Regional and national inventories on paper	Spain
Dispersed data sources	Belgium, Greece, Portugal

Several of the pre-cxisting data sources had already been tapped in compiling the Biotopes pilot study (Wyatt 1982), and the information obtained in this pilot study, together with data from the Council of Europe's Register of biogenetic reserves, and the Inventory of important bird areas in Europe (Osieck and Bruyns, 198 1) formed the initial basis for the biotopes database until information could be collected so as to implement the CORINE methodology as specified in the technical handbook. Such new data either augmented the previous data-sets, bringing them up to the CORINE specifications, or completely replaced them, following the CORINE guidelines.

The procedures used for data collection inevitably depended upon the previous state of knowledge. The methodology used in compiling the data therefore had to be customized to take account of individual situations, but consistency in the output product was maintained as the major goal.

For those Member States which already held computer databases, the major tasks were to apply the CORINE site selection criteria, and to extract from their data the information fields required in the appropriate formats. For example, in France, data on 13 000 sites were held in the inventory 'Zones naturelles d'intérêt écologique, faunistique et floristique' (ZNIEFF) compiled by the Secrétariat de la faune et de la flore. Sites were selected from this database largely on the basis of the presence of vulnerable habitats or the richness of a zone for a collection of phytosociological units, and were chosen to include a selection of representative sites in each administrative region. For Denmark, the main task was to synthesize data holdings of the National Forest and Nature Agency from a variety of sources in order to compile the site records, and to ensure that all sites satisfying the selection criteria were included.

In two Member States (Ireland and Italy), national inventories existed only on paper. These were in the form of publications whose scope was too limited to provide the full range of information required for the biotopes database. As an interim measure, these sources were merged with information from the important bird areas inventory, whilst data were collected afresh to satisfy the aims of the biotopes project. This process has been completed in Ireland by the Wildlife Service of the Office of Public Works, and at the time of writing is still in progress in Italy, where data are being combined from regional sources. In Luxembourg, data from the paper files of the Musée d'histoire naturelle have been extracted and supplied to the biotopes database. Finally in this category, data for the Netherlands were extracted from the files of the Rijksinstituut voor Natuurbeheer, and were supplemented with data on the distribution of species held by the Biogeographic Information Centre at Arnhem.

The problem of assimilation of information already collected and computerized by regional authorities has been unexpectedly arduous, as exemplified in the case of the Federal Republic of Germany. Here, the responsibility for the protection of nature conservation areas rests at the regional level with the governments of the Länder Each of these had developed site recording and mapping methods independently of each other, and had operated at different speeds, so that data content and availability were not comparable. The numbers of sites recorded included a high proportion which would not satisfy the CORINE site selection criteria (Table 3.1). There was a keen interest in the Federal and in Land environment protection committees (Länder AusschuB für Naturschutz) to create consistent national and Community inventories, demonstrated by the hosting of the fourth biotopes team meeting in Düsseldorf by the North Rhine-Westphalia Ministry of the Environment. On the practical side, it was then necessary for the CORINE biotopes team member in Germany to work with the authorities in each Land separately, explaining the objectives of the biotopes project, drawing up lists of selected sites, extracting the relevant data to meet the standards of the biotopes project, and applying the coding conventions required. At the time of writing, this process has been completed for the Länder in the north of the country, but is still in progress for those in the centre and south.

Equally unexpected were the difficulties met in the United Kingdom, where the Nature Conservancy Council is developing its Coredata information system for sites of special scientific interest. The main problems to be overcome were the establishment of a conversion key of habitat data from the NCC's coding system to that used by the CORINE biotopes project, the need to identify from the national site list those which are of Community importance, an d the fact that data were being still being loaded into Coredata and that this was proceeding at different rates in England, Scotland and Wales. For Northern Ireland, where nature conservation is administered separately, data were compiled from paper records, without particular problems.

Information is also collected routinely on a regional basis in Spain, where the data for CORINE are being coordinated by the Instituto Nacional para la Conservacion de la Natureza (Icona), who are taking the opportunity presented by the requirements of CORINE to set up a national database on the natural history of Spain (Hispanat). Information is being derived not only from the regional offices of Icona, but also from experts in different fields of natural history in universities throughout Spain, and other bodies of experts such as the Sociedad Española de Ornitologia. The synthesis of information is being coordinated by Icona with the aid of external consultants. At the time of writing, the results of the first of three stages of this work have been completed and included in the biotopes database.

Data collected on important bird areas formed the foundation for the CORINE database in Belgium and Greece, where in both cases information was added on other types of sites and other data fields not collected for the important bird areas database. In Belgium the data sources of the Institut royal des sciences naturelles, Brussels, were used, and in Greece a botanist was contracted to collect information about sites important primarily for. plants.

Finally, in Portugal, where no data existed in a single location prior to CORINE, a national database was set up at the Serviço Nacional de Parques, Reservas e Conservaçao da Natureza, to collate information held by that Service and to combine it with data on bird sites being collected for a revision of the Inventory of important bird areas (Grimrnett & Jones, 1989) by the Centro de Estudos de Migraçoes e Protecçao de Aves, Lisbon.

In conclusion, the variety of mechanisms by which data were gathered reflected the differences in the types of information available, and were inevitable, given the principle that existing data sources would be used, since embarking on fresh data collection would have duplicated effort and prolonged the project considerably. However, since each individual or group collecting the data included a member of the biotopes team, all of whom had agreed the data specifications set out in the technical handbook, the necessary coordination was maintained within the project and it was possible to ensure that all the data conformed to the set standards. Any possible departures from these standards which might have arisen were eliminated during a further phase of data validation (Section 3.8).

3.6. Data transfer to the project leader

The technical aspects of data transfer from biotopes team members to the project leader are covered in Section 2.2.2. Data were transferred on the conclusion of each major update, and were either processed as complete new data-sets, or were used to edit specific parts of the preexisting data-sets. So that it would be possible to know which version of a particular data-set was in use at any time, the data holding for each Member State was given a version number corresponding to the month in which those data were last substantially updated. The version numbers were used, for example, when the data were written in CORINE transfer format and sent from the project leader to the CORINE central team (Section 2.2.2).

The majority of team members supplied data written in the standard site record format, either on paper forms or as machine-readable Ascii files. Data for three Member States were received in the alternative standard format using DBase-IIIplus, and one used its own format for data compiled using that database software system.

3.7. Data treatment and analysis

3.7.1. File specifications for data storage and analysis

For analysis and retrieval purposes, the data were converted from standard site records and stored as thematic database files. There is one file for each data field (with the exception of the fields whose number and format is fixed, which are all combined in a single file). There may be one database record per site, or several, depending on the record type: for example, there is only one site name record per site, but the numbers of bird records per site range from zero to over 100. Brief specifications of the data storage files are given in Table 3.3.

Table 3.3 Contents of the data storage files

Field type	Field contents	Notes
1	Site code, date, region codes, area, longitude, latitude, altitudes	All fields whose format is fixed, and whose number per site is also fixed
2	Site complex code and name	Only filled for sites which are sub-sites of larger sites
	Site codes of sub-sites	Only filled for sites which have smaller sub-sites
	Designated areas site codes	Cross-reference to CORINE designated areas project
3	Site	name
	Region name	Usually the name corresponding to the most detailed level of NUTS
	District name	Smaller unit than region
	Respondent	Name and address of primary data source(s)
4	Detailed habitat codes	
	Generic habitat codes, percentage cover	
	Designation codes, percentage cover	One or more records per site
	Motivation codes	
	Human activities codes, percentage cover	
5	Amphibian & reptile species	
	Fish species	Multiple records per site, but site omitted if
	Invertebrate species	taxonomic group not recorded
	Mammal species and quantity	
	Plant species and cover/quantity	Taxonomic group codes (families)
	Bird species, breeding, wintering and migrating numbers	are included in these files
6	Character text	
	Designation text	

Documentation text History text Ownership text Quality text Vulnerability text	One record per site, but record lengths can exceed 2 000 characters

Note: For explanation of the data fields, refer to the details of the standard site record (Section 3.3).
Note that every file record is cross-referenced by the site code, which forms the first nine characters of every file record

3.7.2. Species data handling

As mentioned in Section 3.4.21, the compilers of the biotopes data were invited to record important, characteristic or interesting species which occur on a site, in addition to the ‘handbook’ species of endangered, vulnerable and rare species. The only information requested was the scientific name of the species and, where available, information on its abundance. As a result, names of reported species included many errors and contained many undocumented synonyms. It therefore became necessary to construct reference lists of species names, and to classify them according to the taxonomic hierarchy in order to validate and use the species data. These lists were compiled using standard reference works for each taxonomic group. This work was undertaken by the project leader, except for plant names, which were verified by the Natural History Museum, London. The reference lists were generated as computer files which could be used in checking input data and, during retrieval, to select by taxonomic group, as well as by individual species or genus name.

A coding system was devised by the project leader, since although other similar systems were available (for example, the Rubin coding system developed for the Scandinavian region), none covered the range of fauna and flora found in the European Community. All families which have been recorded in the database were classified according to the standard taxonomic hierarchy: phylum/division > (subphylum/subdivision) > class > (subclass) > order > family. (Note that not every phylum/division contains subphyla/subdivisions, and not every class contains subclasses). Eight digits were used to define the hierarchical coding (Figure 3.7), so that, for example, all families of an order share the same first six digits. Every species in the master files of species names was allocated to the correct family, and the corresponding eight-digit code was included both in the reference files of all species names, and in the corresponding data files in the database storage files.

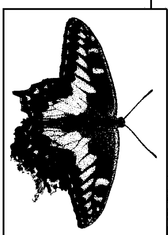
The coding system makes it possible to use the retrieval program (Section 3.7.5) to search for sites with species of a particular phylum, class, order or family using the coding system, or if a particular genus or species is required, the actual genus or species name is used. A further invaluable feature of this coding system is that, since it is hierarchical, one can immediately determine to what taxonomic group a given species or family belongs. For example, one can use the retrieval program to find that invertebrate species Papilio hospiton carries the family code 18062441. Reference to the coding system (Figure 3.7) indicates that this species belongs to family Papilionidae (swallowtails) of order Lepidoptera (butterflies and moths) of class Insecta (insects). The coding system has also been written so that further parts of the coding can be inserted without any need to alter the existing codes, should, for example, new data introduce more marine fauna than have been recorded hitherto. This would not have been so easy if a sequential coding system had been used. The coding system forms part of the technical handbook, although it should be noted that it is not necessary for data compilers to insert codes with their species data since these are added automatically by the project leader during initial data validation. An appendix to the coding system lists the reference works used in its development.

Figure 3.7 - Extracts from the coded taxonomic list of families occurring in the CORINE biotopes database

Coding conventions

Code	Taxonomic level
xx000000	Phylum and sub-phylum or plant division and sub-division
xxxx0000	Class
xxxxx000	Subclass
xxxxxx00	Order
xxxxxxxx	Family

Examples



Code	Name of taxon	Taxonomic level	English name
	THE ANIMAL KINGDOM		
18000000	ARTHROPODA	Phylum	Arthropods
....			
18030000	Diplopoda	Class	Millipedes
18060000	Insecta	Class	Insects
....			
18060900	Orthoptera	Order	Grasshoppers and crickets
18061400	Isoptera	Order	Termites
18062300	Trichoptera	Order	Caddis flies
18062400	Lepidoptera	Order	Butterflies and moths
....			
→18062441	Papilionidae	Family	Swallowtails
18062442	Pieridae	Family	Whites
18062443	Lycaenidae	Family	Blues, coppers, etc.
....			
18062500	Coleoptera	Order	Beetles
18062700	Hymenoptera	Order	Ants, wasps and bees
18062800	Diptera	Order	True flies
18070000	Crustacea	Class	Crustaceans
....			
25000000	CHORDATA (Vertebrata)	Sub-phylum	Vertebrates
25400000	Pisces	Class	Bony fishes
25500000	Amphibia	Class	Amphibians
25600000	Reptilia	Class	Reptiles
25700000	Aves	Class	Birds
25701300	Falconiformes	Order	Eagles, hawks and falcons
25701302	Pandionidae	Family	Osprey
25701303	Accipitridae	Family	Eagles and hawks
25701305	Falconidae	Family	Falcons
....			
25800000	Mammalia	Class	Mammals
25831100	Carnivora	Order	Carnivores
25831101	Canidae	Family	Dogs
25831102	Ursidae	Family	Bears
25831104	Mustelidae	Family	Weasels, otters, etc.
25831105	Viverridae	Family	Civets
25831107	Felidae	Family	Cats
....			
	THE PLANT KINGDOM		
32000000	RHODOPHYTA	Division	Red algae
40000000	EUMYCOTA	Division	Fungi and lichens
50000000	BRYOPHYTA	Division	Mosses and liverworts
60000000	PTERIDOPHYTA	Division	Ferns and allies
70000000	SPERMATOPHYTA	Division	Seedplants
71000000	Gymnospermae	Sub-division	Gymnosperms
72000000	Angiospermae	Sub-division	Angiosperms
72010000	Monocotyledonae	Class	Monocotyledons
72020000	Dicotyledonae	Class	Dicotyledons

3.7.3. Data checking and format conversion

Two computer programs are used to handle data received as standard site records: the first of these checks that all the data field names have been given in the correct order, and that data formats are correct. An example of the type of error report produced by this initial data checking program is given in Figure 3.8. Following such a report, the data are then edited as appropriate to correct the format errors and insert any missing data headings, and the program is run again. This process continues until no more errors are found.

The second program converts standard site records to the database storage files listed in Table 3.3. An example of the diagnostic report produced during the running of this program is given in Figure 3.9. This compilation program checks formats of the various data fields in more detail, including checks of the various codes, for example for habitats or motivations, against a master file of all possible such codes. Species names are checked against computer files containing the taxonomic reference lists described in the previous section. Any names for which there are known accepted synonyms are substituted, and any corrections which have previously been stored are made. Species names which are not recognized (either because they are spelling errors or names not previously recorded in the databasc) are reported.

The next step is a manual editing stage, in which the diagnostics report is used to correct syntax errors and any coding errors which can be corrected from the context without risk of introducing further errors. For example, an incorrect designation code for a national park might be given, but the designation text field might state that the site lies within a national park. Any other coding errors are referred back to the supplier of the data for correction. The lists of species names which are new to the database are scrutinized using standard reference works, and names are either added to the reference files together with the appropriate family code, or corrected if they arc found to be in error.

The validation of lists of species names previously unknown to the database is often a lengthy process, involving extensive use of reference works, and also demanding considerable ingenuity in correcting names which had been spelt wrongly during data compilation.

Two examples serve to illustrate the extent of this work:

(i) the December 1989 update of data from Spain, which greatly increased the extent of species data, included over 1 900 names of plant species not previously recognized: some 400 of these proved to be spelling errors;

(ii) the June 1987 data from Portugal contained the following incorrect spellings of the name of the invertebrate *Craspedosoma hespericum* (a millipede):

Casppedopoma hespericum
Caspeodopoa hespericum
Craspedoforma hesparicum
Craspedopoma bespericum
Craspepodoma hespericum
Crospedoma hesperiana.

The compilation program is run again following the editing of errors until no more errors are found.

Once this process has been completed, the internal checking of the data is complete. At this stage, an interim data-set is transferred using CORINE transfer format files to the CORINE central team (Section 2.2.2), and the evaluation and scientific validation of the data content begin.

3.7.4. Data analysis

Initially statistics on the completeness of each data-set are compiled. For example, the percentage is computed of sites for which there are details of altitude, habitat cover or species records in each taxonomic group. These analyses are used to pinpoint data fields in which a particular data-set is strong or weak, and to report back to the biotopes team member on those data fields which are missing for each site, so that, if possible, these data can be gathered in the subsequent round of data collection. Examples of reports generated using these data to make comparisons between Member States will be shown in Chapter 4.

At the next stage, the data are analysed to provide outputs required for data validation, particularly maps of sites in each NUTS region, or of sites with each habitat code (Section 3.8 below). Other analyses are used to validate the selection criteria specified, by grouping sites according to the regions used for site selection and sorting by habitat and species. In this way, it is possible to check that, for example, no more than five sites in each region have been selected on the basis of any one species or habitat type.

Several examples of the results of other programs written for data analysis will be shown in Chapter 4. These include statistical analyses of the distribution of site surface areas and of the major habitat types; calculation of areas covered by each habitat type by combining the surface area and habitat cover data fields; numbers of species records per site, differentiated between the ‘handbook’ (threatened or vulnerable) species and other species; maps of the distribution of sites for particular species or taxonomic groups.

3.7.5. The database enquiry and retrieval program

There would be no merit in compiling a sophisticated computerized database and then expecting potential users to answer their queries from lengthy printouts of the data. Therefore, in order to make the database accessible to its users, an effective enquiry and retrieval program is necessary.

Such a system has been developed by the project leader on a VAX computer system at ITE, Monks Wood. This is widely accessible over international telecommunications networks and the system is regularly accessed from Brussels by the European Commission.

Examples of the types of questions which have been answered using the retrieval system are:

(i) What are the locations of sites within a particular geographical area subject to a road construction proposal?
(ii) What is the area of sites in a particular region which are important for endemic species?
(iii) Where are the sites important for a particular animal or plant species (or family)?
(iv) In what regions does a particular habitat occur?

Figure 3.10 gives an example of the information displayed on the user's computer terminal and the responses which the user should give in order to find out what sites in Belgium contain both the habitat type 'poor fens' (code 54.4) and the plant species *Dactylorhiza sphagnicola*, which is typical of that habitat. The result of this analysis is mapped in Figure 4.26.

The logical processes of the retrieval system are as follows:

1. Choose a country to be searched, or the whole database. A memory array is loaded with all the site codes in that country.
2. *Search options*: choose a search condition: for example sites in a particular administrative or geographical region, sites with a particular habitat, or sites with particular species. Many of the search options then lead to further menus, as shown in Figure 3.10, where the option F (habitat search) leads to the choice between habitat cover and habitat type data, and the option J (species search) leads to a choice of taxonomic group to be used. Only sites satisfying the required condition are retained in the memory array.
3. *Output selection*: report the number of sites selected, and choose an output option (stage 4) or a further search option (stage 6).
4. The output options include display on the terminal or output to a disk file. The form of the output is optional, including site codes alone, or brief details such as site code, region code, longitude and latitude, surface area and site name. Alternatively full standard site records can be generated for the selected sites.
5. *Further options*: choose a further search option (stage 6), a further output option (stage 4), or end the program. The further search option allows the search criteria to be modified (either narrowed or broadened, using a different data field if required). The further output option allows the existing search results to be presented in a different format.
6. *Search options*: choose a further search option from the choice offered in stage 2. Either the same search type can be selected, with different parameters (for example, find sites with either estuaries or brackish lagoons: option F (habitat search) repeated twice), or the search can be made on a different

data field (for example, find sites with brackish lagoons important for birds: option F followed by option H (motivation code search)).

7. *Method of combination with sites already found*: should the sites found in the new search be combined with the sites found previously either to narrow or broaden the search criteria (for example, either ‘sites in national parks important for endemic species’, or alternatively, ‘sites either in national parks or important for endemic species’)? The new search can also be made on all the sites in the country, as in stage 2. Following selection of the combination method, return to stage 3.

In the example given in Figure 3.10, these stages are followed in the order 1 -> 2 -> 3 -> 5 -> 6 -> 7 -> 3 -> 4.

At every point in the program where the user is asked to give a response, one option offers HELP information onscreen to assist with using the database. The type of response required is explained, and lists of codes can be accessed without leaving the retrieval program, for example so as to determine the correct NUTS region code, or required habitat code, without having to consult the technical handbook. The HELP information also includes details of the species recorded in the database and of the taxonomic coding system and can enable the user to list species or families from a particular taxonomic group. An example of such use is given in Figure 3.11.

In parallel, procedures for retrieval, analysis and mapping were developed by the project leader using the dBase package for personal computers and by the CORINE central team on ARC/INFO and Mapinfo.

3.8. Data validation

The initial data validation, consisting of format checking and correction, checking of codes against the lists given in the technical handbook, and verification of species names, has been described in Section 3.7.3 above. Once these checks had been completed and data had been converted to the storage format, sites were plotted on maps so as to check for accuracy in the geographical coordinates given, by ensuring that their locations plot within the correct administrative regions specified in the region codes data field.

Biological validation of the data was undertaken by the Institut royal des sciences naturelles, Brussels. The biogeographical and ecological content and coherence of the database was verified following three lines of investigation:

(i) comparison of the distribution of recorded sites holding a particular habitat type with the known distribution of that community;
(ii) comparison of the distribution of sites holding particular species with the known distribution of those species;
(iii) cross-checking of the simultaneous presencc of particular species and of their known habitats at the same recorded site.

The first line of analysis allowed the detection of:

(a) trivial coding errors (for example, the code for coastal sand dunes was given when the code for inland sand dunes was required: Figure 3.12);
(b) misunderstanding of the habitat codes, or, more fundamentally, lack of clarity in the definition of the coding units (for example, the term ‘blanket bog’ was wrongly interpreted, partly because its definition was inadequate: Figure 3.13);
(c) insufficient or unbalanced coverage of the geographical spread of the habitat type considered (for example, phrygana: Figure 3.14).

The results of this approach have been used, not only to improve the quality of the data, but also to augment the habitat classification when it was found that particular habitat types had been omitted. However this approach was only applicable when habitats had been recorded with sufficient precision, that is using codes with sufficient digits beyond the two-digit ‘generic habitat’ level. It has therefore not yet proved possible to apply it for all Member States.

Figure 3.12 -An example of errors in habitat coding detected during validation

Coastal dunes

Sand dunes occur mainly along the coastline but also inland as evidence of marine trans- and regressions. Dune ecosystems are characterized by a highly specialized flora comprising particular ecological types and a very diversified fauna. The inland dunes support a vegetation which differs markedly from coastal sand dune communities.

A trivial coding error consisted in recording some of the fluviatile Po-valley sand dunes as “coastal” (16.2) when they should have been recorded as “inland” (64.4). This error was corrected during the validation process.

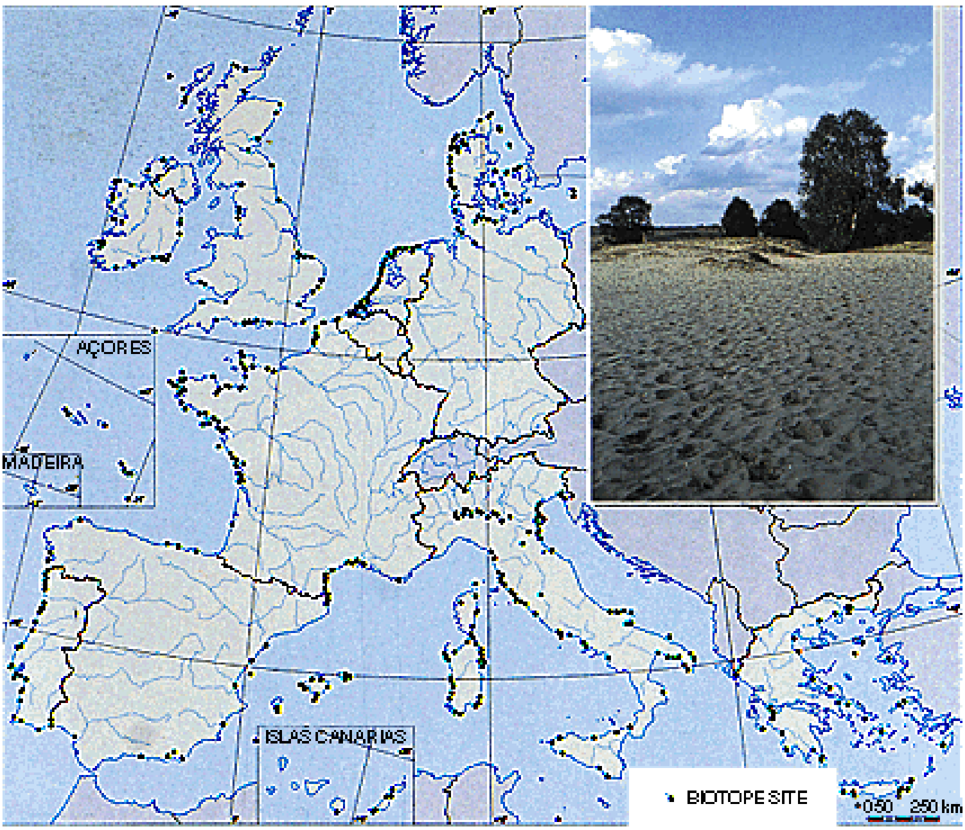


Figure 3.13 -An example of misunderstanding of definition of the CORINE habitat classification

Blanket bogs

Blanket bogs are characteristic for the uplands of north-western Europe: north-western Britain, western Ireland, Shetland Islands and Hebrides. They develop on flat or slightly sloping ground with poor surface drainage and depend on high rainfall and a cool and humid climate. Peat is used for fuel on a small scale, but the main threats are pollution and afforestation.

The habitat has been reported in 110 sites of the CORINE biotopes inventory. However, some of these sites have been recoded as blanket bogs due to a misunderstanding of the habitat code. Indeed, the composition of blanket bogs differs little from that of raised bogs (peat moss: Sphagnum). These errors were communicated to the biotopes team members and they will be corrected in the next update of the database.

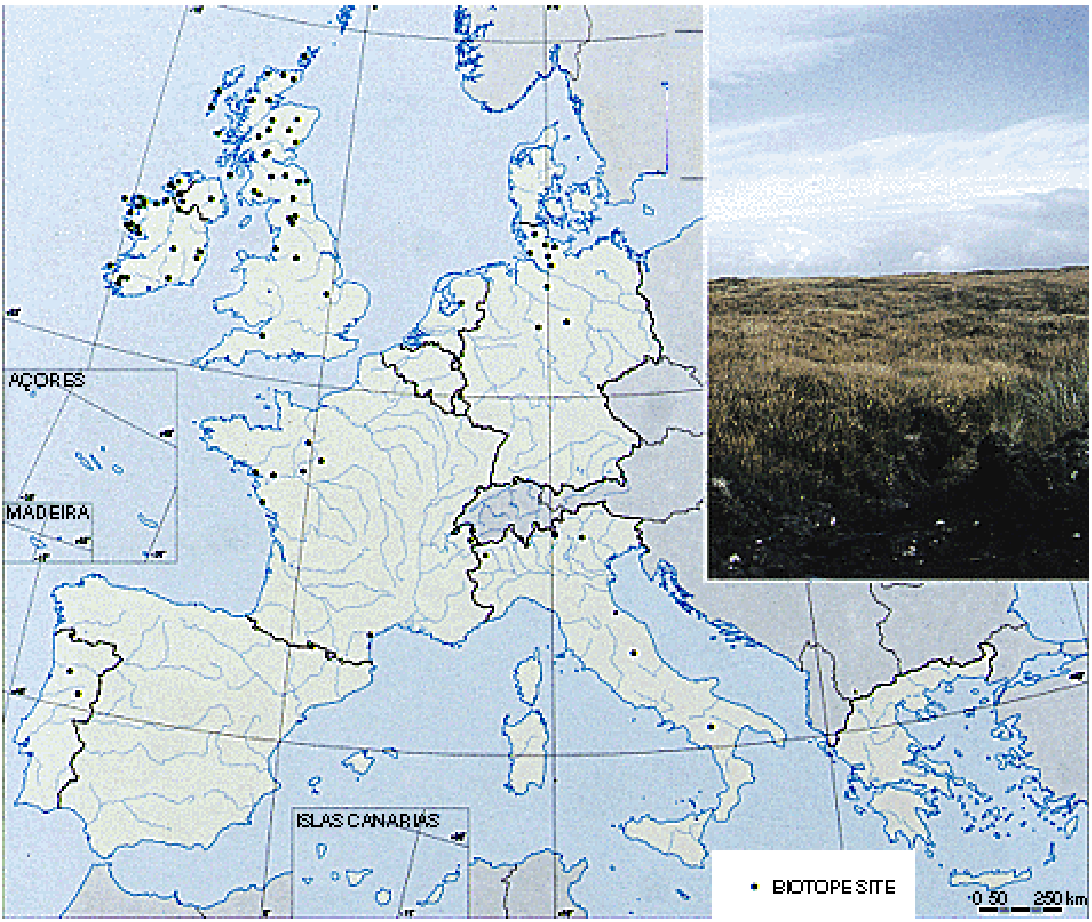


Figure 3.14 -An example of unbalanced coverage of a habitat type

Phrygana

Phrygana are cushion-forming sclerophyllous and thorny formations, typical of the eastern therm-mediterranean region (mild winters and hot summers, high evapo-transpiration) where they occupy considerable areas in coastal districts and occasionally occur inland. In the western Mediterranean a few rare relict associations can still be found (Sardinia, Corsica, Provence, Catalonia and south-western Portugal).

As can be seen on the map, Greek Phrygana sites are well represented in the CORINE biotopes database, with 49 sites. The Phrygana sites in other Member States are presently missing from the database but will be added during the next update.

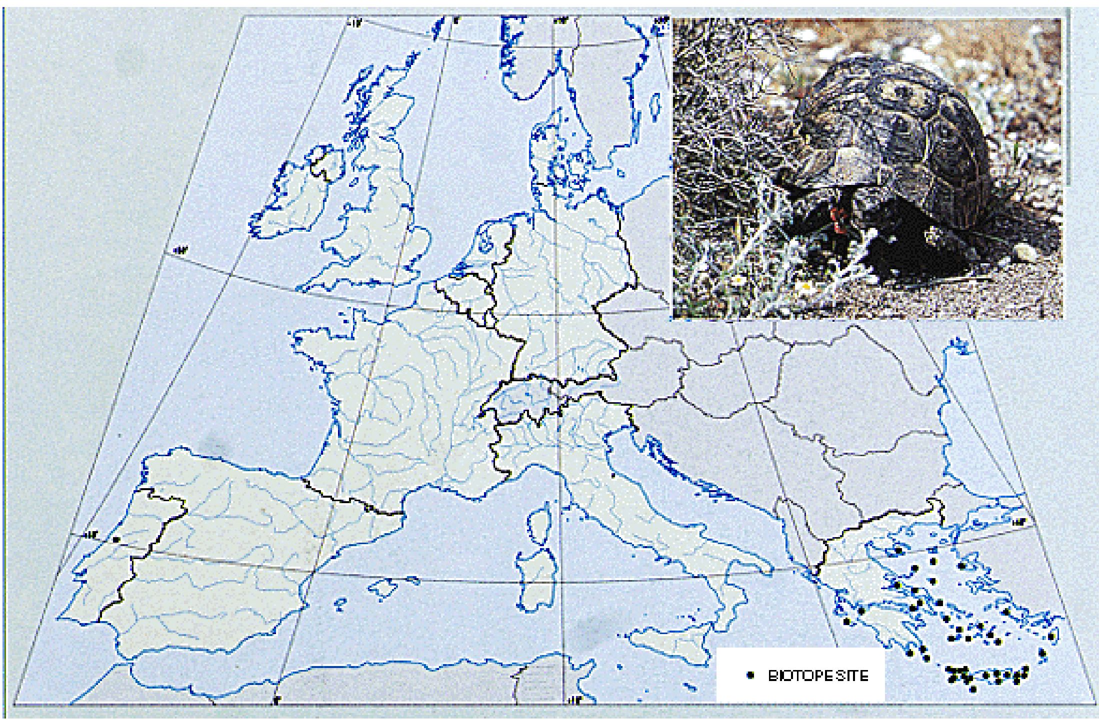


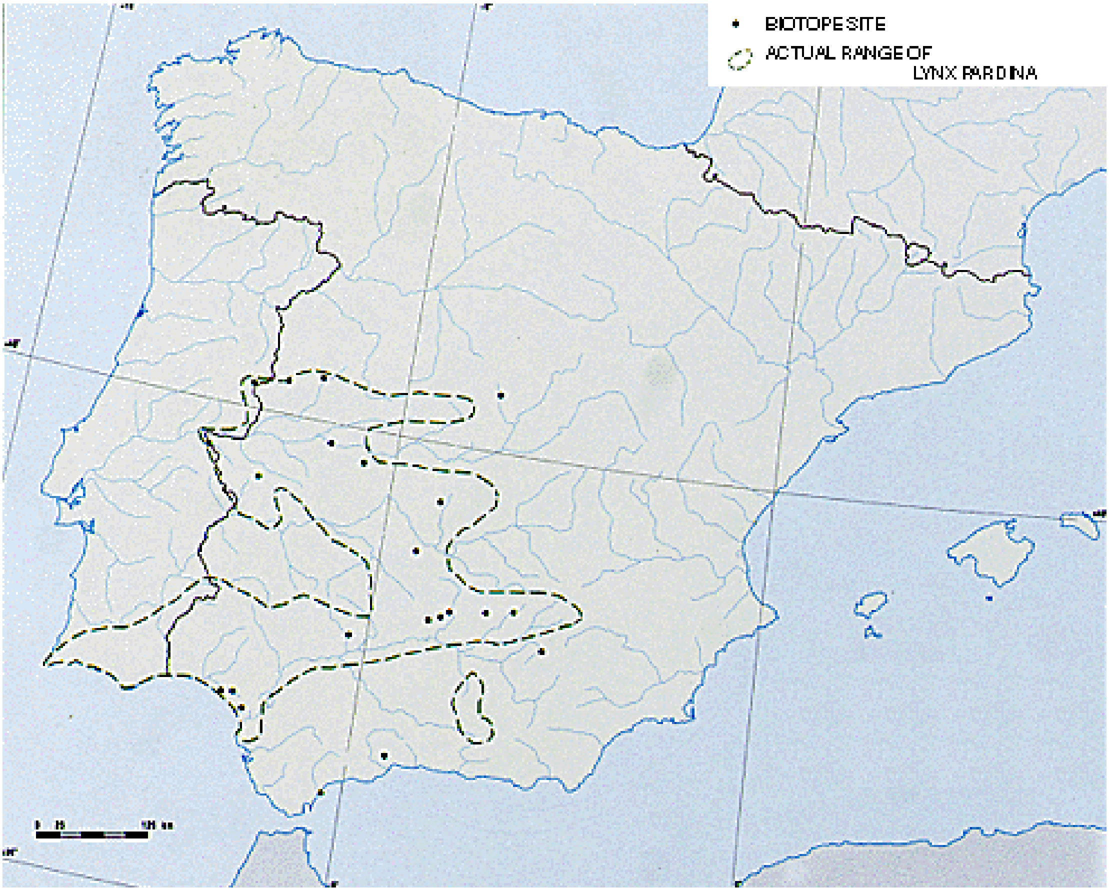
Figure 3.15 -An example of inadequate correspondence between records of a species and its known range

Pardel lynx

The range of the lynx formerly covered the forests and woodlands of the whole of Europe. The present distribution of the European lynx (Lynx, lynx) is restricted to Eastern Europe, and of the pardel lynx (Lynx pardina) to the Iberian peninsula. Some taxonomic authorities do not recognize the two forms as distinct species, and place the separation at the sub-specific level.

In its usual forest habitat the lynx hunts rabbits and young ungulates, living solitary and requiring an extensive territory. Habitat loss caused by deforestation for agriculture and reforestation with eucalyptus and pines, and the decimation of rabbit populations by myxomatosis are the main reason for its extinction from much of its range. One problem is that the range has become fragmented into rather small isolated populations which cannot inter-communicate, risking insufficient diversity in the genepool. Consequently, efforts should be made to connect the lynx sites with corridors of suitable protected habitat.

The map shows a generalization of the range of the pardel lynx and the sites where the species has been reported in the CORINE biotopes inventory. The total population has been estimated at 400 to 1200 head, depending on the method of investigation. Points outside the range may refer to individuals rather than population.


BIOTOPE SITE
ACTUAL RANGE OF
LYNX PARDINA

The second line of analysis permitted the detection of:

(a) incomplete species lists for recorded sites (for example, sites within the range of *Lynxpardina* for which a suitable habitat was recorded but the species was not recorded: Figure 3.15);

(b) more importantly, insufficient representation of some species in the network of recorded sites (for example, parts of the range of *Lynx pardina* in which there are no sites in the database: Figure 3.15).

The third line of analysis permitted the verification of internal coherence in site descriptions. However it could only be used for sites with very complete information.

lt is very important that once this validation process has been applied, the results should be communicated back to the suppliers of the data or field specialists for each species or major habitat type, so that any errors and omissions can be corrected, and subsequently the whole validation process iterated until the database is coherent and comprehensive.

4. Results

The Decision of the Council of the European Communities to set up CORINE (European Communities, 1985) included in its title the three aims of 'gathering, coordinating and ensuring the consistency of information on the state of the environment and natural resources in the Community'. It is appropriate to assess the results of this project in relation to those aims and to show how they have been satisfied.

Consistency and coordination are prerequisites for the creation of a Community information base, to ensure that data are comparable across all Member States and across all environmental media. The following paragraphs therefore consider firstly the activities undertaken to ensure the consistency of information on sites, followed by the measures introduced to improve the coordination of these activities throughout the Community. Finally, the results of applying these principles in gathering the necessary information for the compilation of a Community inventory of important biological sites are presented.

4.1. Improvement in consistency of the information

The methodology which was developed for the description of the sites, published as the *CORINE biotopes project technical handbook,* and described in the previous chapter of this report, is itself a vital result of the biotopes project. It proved to be one of the key elements in the success of the creation of the database. It was the precondition which enabled team members to do their work in a consistent way.

Moreover, the technical handbook is now useful for other people or institutes who are or will be involved in inventory work, as proved by the many inquiries which have been received and contacts made both within and outside the 12 countries of the Community.

4.1.1. Standardized procedures for site description

Prior to the start of this project, some significant but limited efforts had been made towards standardization of site description, especially by the Council of Europe in the framework of the establishment of a network of biogenetic reserves, and by the European Community in the context of Directive 79/409/EEC on the conservation of wild birds. However, apart from the uniform information sheet, there was a lack of any detailed explanation of the field contents.

Beyond these examples of international cooperation, there were no internationally accepted standards for the recording of nature conservation sites. In some cases, individual Member States had begun to assess and catalogue areas of importance for nature conservation (for example, the United Kingdom (Ratcliffe, 1977), Ireland (An Foras Forbartha, 1981)). However the methodology employed for site description (where this was formally specified) differed from one Member State to another. There was no consistency in the list of data fields which were recorded for each site, or in the criteria used to select the sites to be catalogued.

In initiating the CORINE project, it was necessary to give more explicit guidance as to how to record the data fields, with clear explanations so that there could be no doubt about their meaning. Considerable investment of effort was therefore expended in order to ensure that the many people working in different ways, areas and circumstances completed their data such that once assembled, the composite data which resulted formed a consistent set of information.

The explanation needed to specify some of the data fields was quite straightforward and simple, for example the geographical location of a site in the form of the coordinates of a central point (the field Long/lat). By contrast, other fields required extensive descriptive and coding work, for example the habitat classification system.

4.1.2. Community criteria for site selection

At least as important as measures to ensure consistency in site descriptions is the achievement of consistency in the choice of areas to be included in the inventory. Therefore, it was essential to develop criteria for the selection of sites which are important at a Community level. These are aimed to ensure that the full range of habitats, and the locations for all the species recognized as vulnerable which occur in the Community, are well covered by the database. Community policy on nature protection needs to be properly balanced: the protection of particularly rare species and sites is necessary, but it is also vital to ensure an adequate geographical representation of important flora and fauna throughout their natural range. Common criteria have been established and implemented to give a proper scientific basis to such an approach to nature conservation in the Community.

4.1.3. Harmonization of nomenclatures

In addition to standardizing what types of data should be recorded, the project has generated or adopted nomenclatures and coding systems to facilitate consistency in site description and also data retrieval. As far as possible, to ensure compatibility with existing systems, supersets were generated from nomenclatures and classifications in current use in national or international agencies. In certain cases, no suitable system was available. For example, preexisting habitat classifications were inadequate for Community use, both because of the methods used and because of the geographical extent over which they were applicable. Therefore, starting from existing knowledge, particularly work being undertaken by the Council of Europe (Géhu, 1984), the biotopes team members developed a classification system comprising seven main categories subdivided into 44 'generic habitat types' and more than 1 200 detailed types, each with its own definition and references. Although this began as just one clement of the work alongside many others in the design of the data collection procedure, it became eventually a unique scientific piece of work in its own right, which is now accepted as a Western European standard by Commission services, the Council of Europe and various non-governmental bodies active in the field of nature conservation.

In compiling species lists team members could use work which had been undertaken by specialist taxonomists at a European level on threatened species and annexes relating to existing conventions and regulations. However, as well as the rare and endangered species present at a site, it was important to record the presence of other characteristic plants and animals. Many of these are endemic to a particular region, or are of local ecological significance, and therefore do not feature in the major international authority lists. It was therefore necessary to compile more comprehensive taxonomic lists and coding systems to allow validation of the complete species lists reported for sites in the biotopes inventory. For example, an extensive list of plant names and their synonyms has been established. Every species name recorded in each of the six taxonomic groups has been checked and allocated to the appropriate family. Conversely it is possible for a user of the database to search for sites important not only for a particular species but also for a particular family or even order (e.g. *Coleoptera* - beetles), in addition to searches based on other site characteristics such as location or habitat.

4.2. Coordination of activity

At the international level, working contacts with the Council of Europe and the IUCN in particular are permanent, so that not only could CORINE benefit from existing experience, but more important, at the end of the project, considerable progress has been made in the convergence of methodologies.

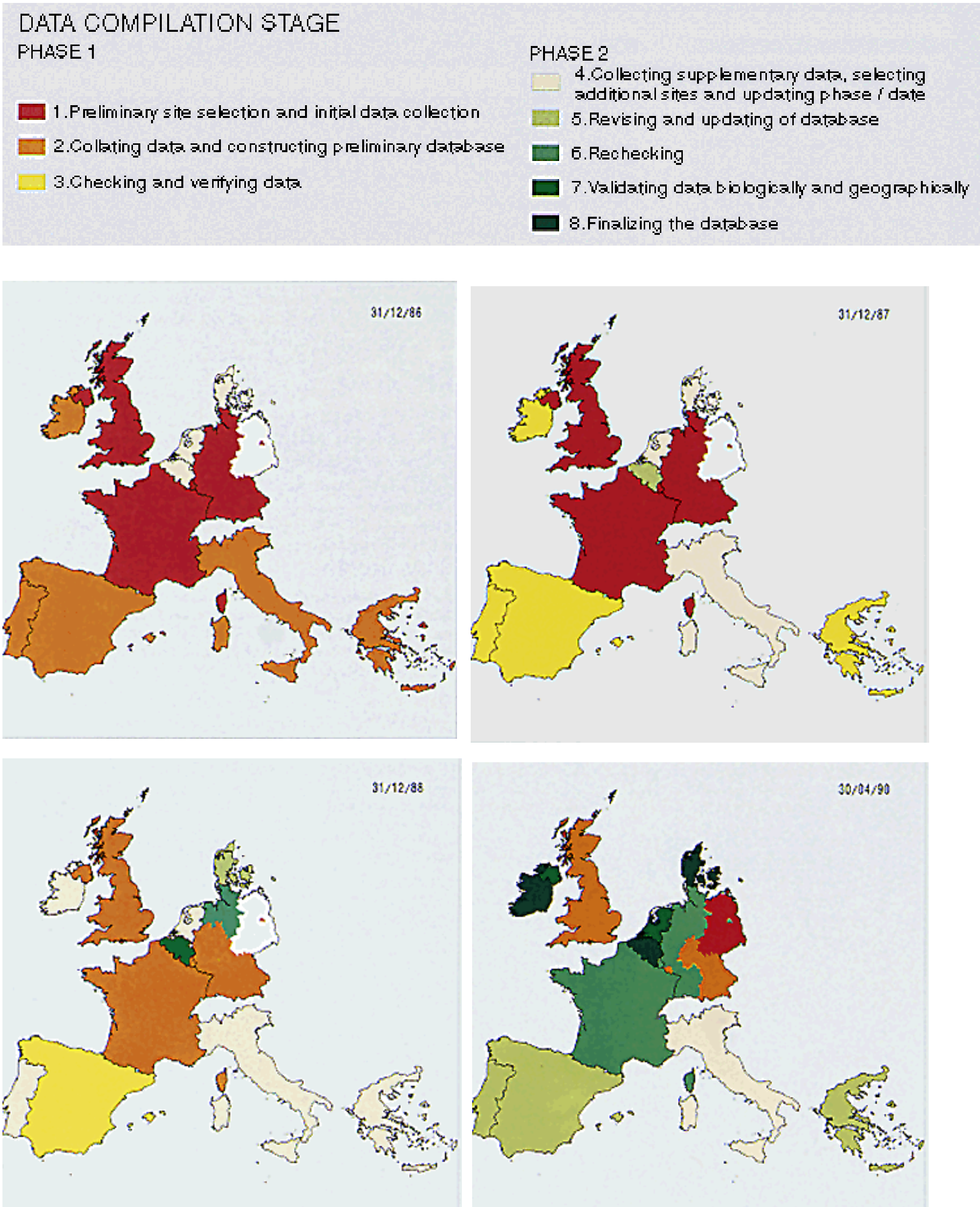
In several of the Member States, data compilation for the CORINE biotopes project has been the stimulus for setting up their own national databases to catalogue priority areas for nature conservation where these did not exist at a national level previously. This was especially the case in Member States with a regionalized structure such as Spain and the Federal Republic of Germany.

A further advantage which accrued in some Member States was that they were able to adopt the common methodology developed for the biotopes project 'off the shelf'. Having established the procedures to enable them to compile their contributions to the CORINE database, Member States realized that the methodology and impetus then existed to extend these databases to include sites of purely national interest, and that this could be achieved with relatively little additional effort. Such a process is under way in Ireland, Spain and Portugal, for example.

lt will be apparent from the diversity of data sources used in the compilation of the biotopes inventory (Section 3.4) that, over the course of five years, a considerable body of expertise has been built up in handling data originating from diverse sources and in melding these into a single consistent database. This integration has taken place at different levels in the organization of the project: at the Community level, in relation to the management of the central database; equally, at national levels, where central experts have been involved in synthesizing data collected by regional authorities, or by experts in the study and recording of different species groups or habitat types.

The existence of this shared pool of know-how is most evident in the performance of the biotopes team, who, irrespective of the status of its members (independent experts, officials from national or international institutes or administrations, etc.), have put together their knowledge and learned to work together. Bringing together these experts and persuading them to speak the same technical language is an important achievement of the project which needed time and patience to accomplish.

Figure 4.1 -Chronological development of the CORINE biotopes inventory



4.3.1. General evaluation

In the biotopes database, CORINE has created one Community database and stimulated a whole range of national databases which did not exist prior to the programme. The two are complementary in the sense that data from national databases can now easily be transferred to the Community database. National databases can be placed in their Community context. In addition, the CORINE initiative has succeeded in broadening the coverage and the information content of individual national systems. For example, in Greece, the CORINE database formed the basis for a detailed inventory in the framework of the Medspa funding programme. This provides information on many new sites of national and regional importance and will record previously unavailable information, such as statements of the relative importance of different areas for nature conservation.

4.3.2. The evolution of the database

The rates at which data were compiled into the database differed nationally and regionally, depending upon the resources available such as previous existence of information, how readily this could be accessed, and not least organizational constraints. The initial sources of information for the 10 Member States prior to 1986 included the results of the pilot study on biotopes (Wyatt, 1982) and the *Inventory of important bird areas* (Osieck and Bruyns, 1981). These two data-sets were merged by the project leader in 1986, when additional data were included from Council of Europe listings of biogenetic reserves.

These initial data sources were eventually augmented or completely replaced by data supplied as part of the CORINE project. Any overlaps between data collected from different sources, such as the biotopes pilot study and the important bird areas inventory, were eliminated by the compilers of the data-sets working at national level.

The processes of data compilation can be related to the two broad phases outlined in Figure 2.2, and comprise eight stages. These are listed in the legend to Figure 4.1 together with the chronological development of the database with respect to these activities.

A convenient way in which to assess the completeness of the database is to record the percentage of sites for which the various data fields have been recorded. It has been the practice to compile these statistics after each revision of a Member State's data holding, and at intervals for the database as a whole. Figure 4.2 shows how the completeness of the data record has increased over the period since such statistics were first extracted. The examples illustrate the provision of data on a basic geographical field (surface area), on 'generic' habitat and 'detailed' habitat, and on species.

Figure 4.2. Development of data-recording of selected fields

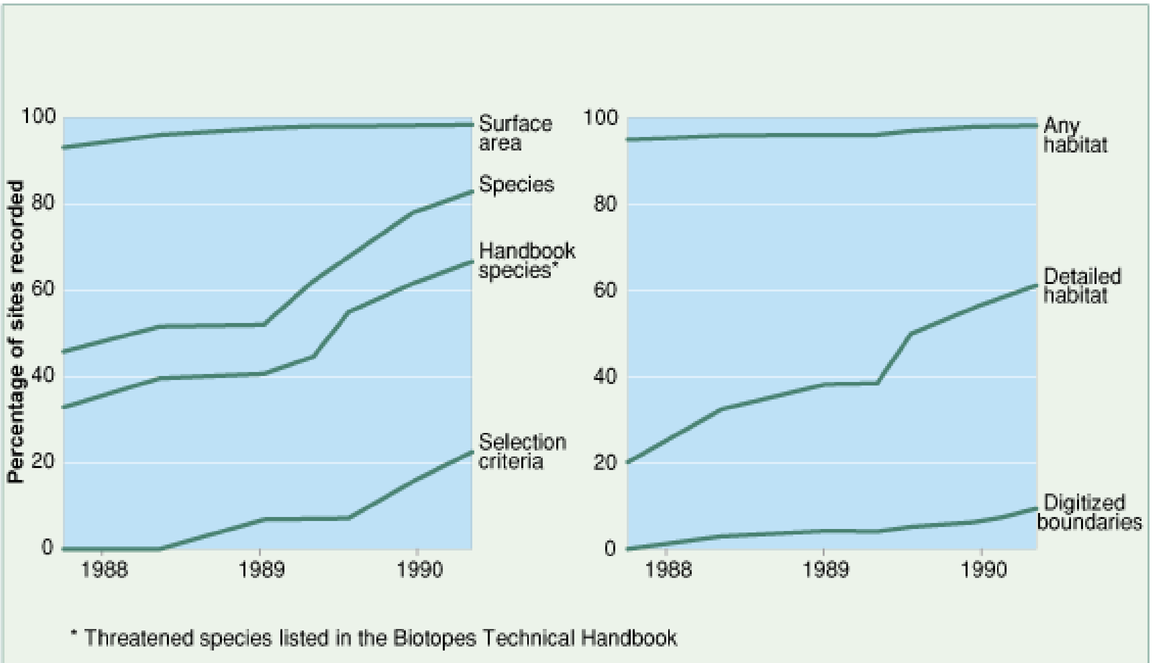
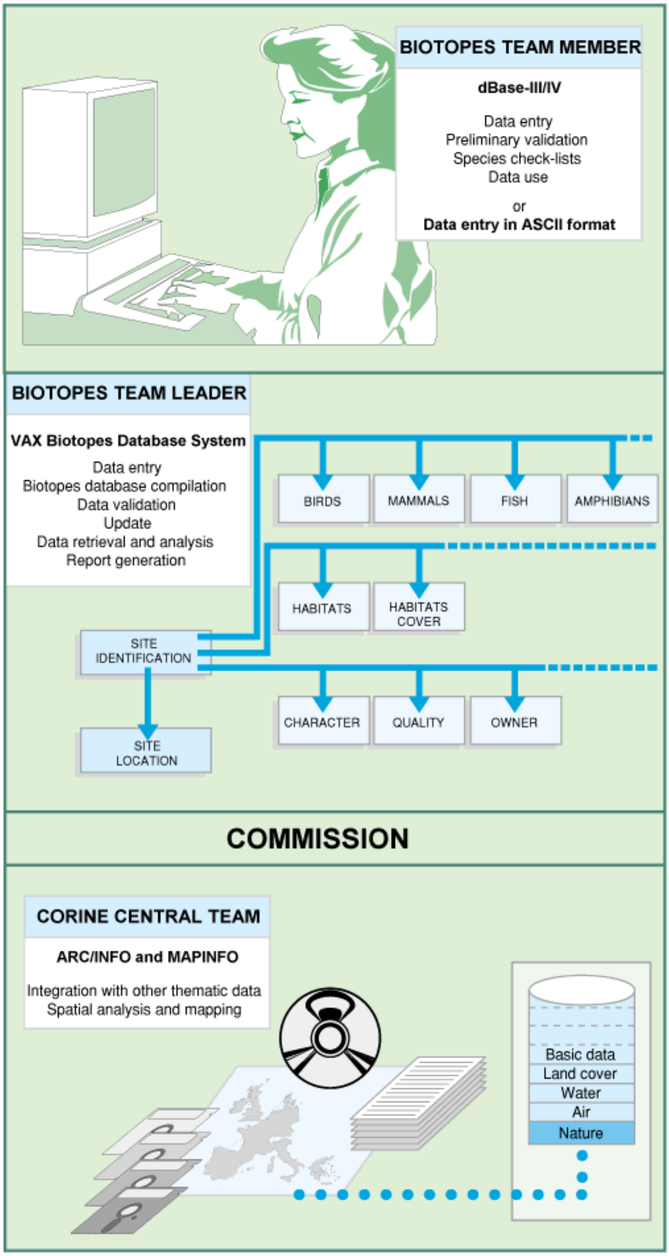


Figure 4.3 -The functions of each module in the application of computers to the CORINE biotopes inventory



The percentage of sites whose inclusion has been explicitly justified on the basis of the presence of threatened species or sensitive habitats (Section 3.2) is also plotted. (It should be noted that the appropriate coding for indicating these criteria was not agreed by the biotopes team until autumn 1987.)

From Figure 4.2 it is apparent that surface area and generic habitat, two basic data fields included in phase I of the project, were substantially complete in the initial data, but that phase 11 data such as detailed habitat and species have mainly been added with subsequent revisions. The boundary digitization started in 1988 in Portugal and up to now some 450 sites have been digitized and incorporated in the central database in Brussels for Portugal, Belgium and Luxembourg.

4.3.3. Software for the construction and use of the database

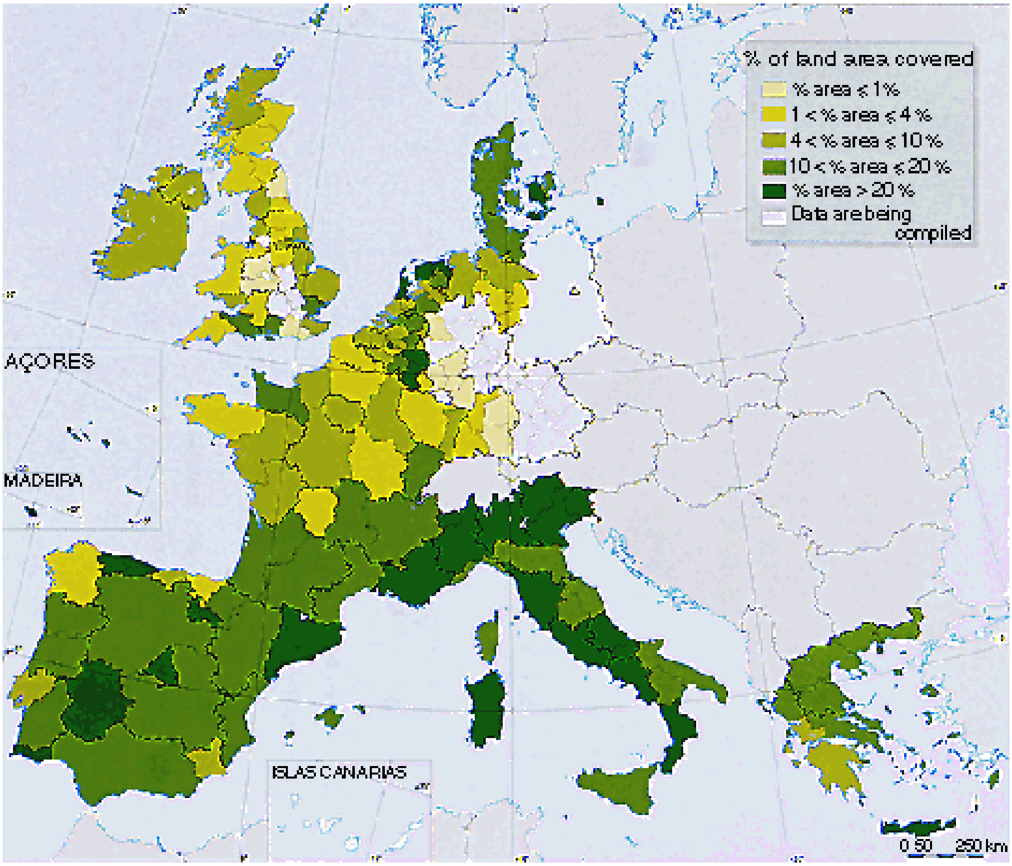
The project imposed obvious requirements to store the data as they were compiled, to validate the data prior to their use, and to provide facilities to allow retrieval and analysis of data. In response to these requirements, a number of linked computer systems were used, for each of which was developed software relevant to its function and the means to transfer data from one system to another. Figure 4.3 summarizes the functions of each module. Examples of programs developed under VAX/VMS were those to handle data received in the CORINE standard site record format as

Ascii text files, or to allow a typist with no previous knowledge of the project to enter data into that format from standard paper forms. In parallel, programs were written to convert data submitted to the database through the personal computer dBase-III system to the main data archive on the VAX.

Once data were stored on the VAX in standard site record format, programs were required to cheek their formats and the validity of coding and species nomenclature, and to convert the data to the biotopes internal database structure and to agreed exchange formats for transmission to the CORINE system. Further suites of programs were written to undertake routine data analysis, for example, to assess the completeness of the data holdings following each successive update, or the distribution by geographical region of site areas or habitat types.

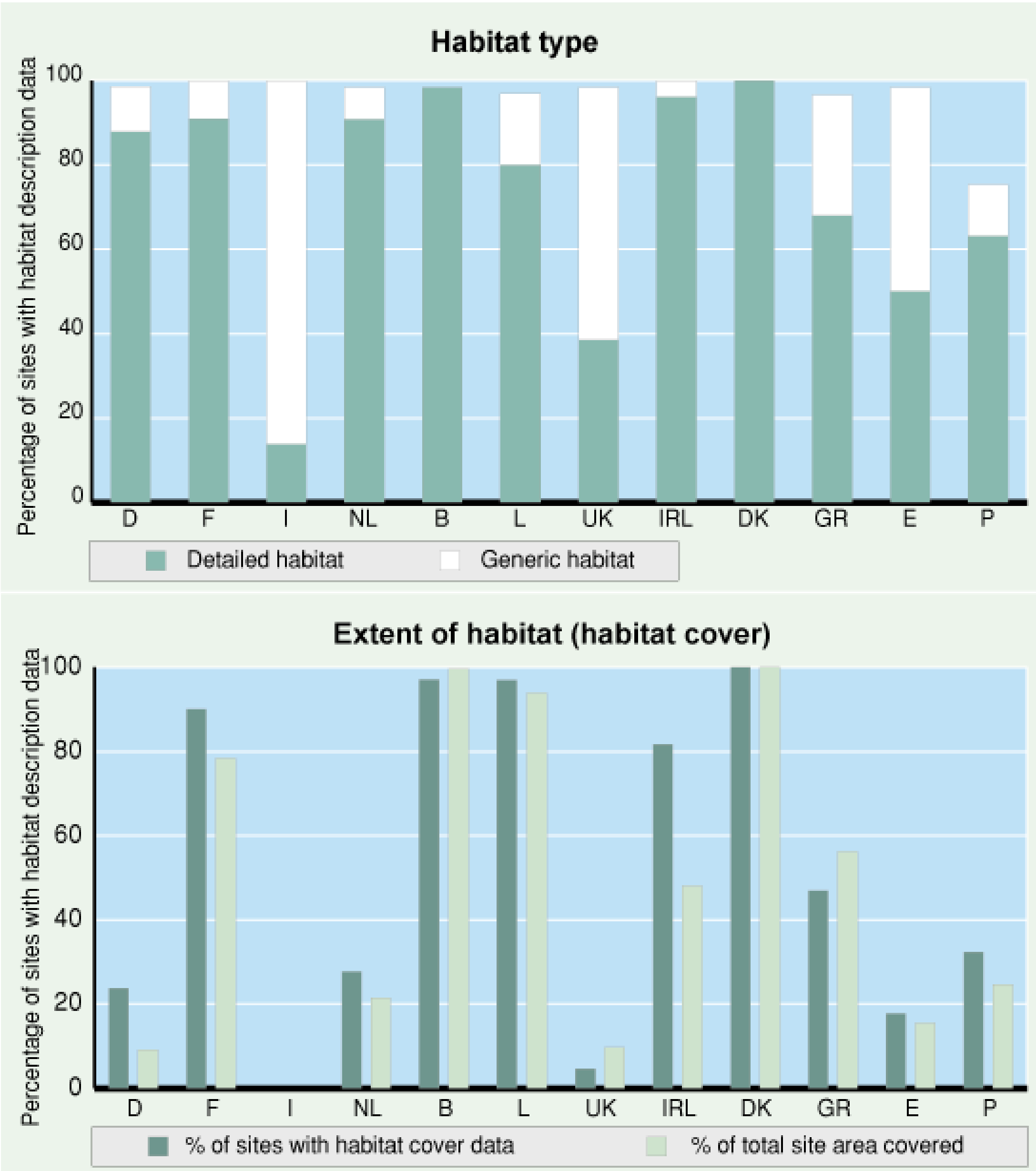
In Brussels, ARC/INFO and the Mapinfo desktop mapping system were used for data analysis and mapping, both of biotopes data alone and in association with data from other CORINE projects, as part of the single CORINE integrated GIS. Illustrations of the outputs from analytical programs run both on the VAX and the ARC/INFO systems will be found in Section 4.5.

Figure 4.4. Percentage of the land surface covered by sites in the CORINE biotopes database



The PC dBase-III system has hitherto been used mainly for data compilation in the Member States, several of which have adopted the system for this purpose. Programs have been supplied to users of this system to enable them to compile their data in machine-readable form, and also to pre-cheek their species data against the existing species reference lists. In response to interest expressed in Member States, the Commission and Parliament in accessing the biotopes database, a suite of dBase-111 procedures for data retrieval and analysis is being developed. It is planned to disseminate subsets of the biotopes database through this medium.

Figure 4.5. Completeness of CORINE biotopes data for habitat description and for the extent of cover by different habitats



4.4. Summary of the contents of the CORINE biotopes database

All data received by ITE from the biotopes team by 30 April 1990 have been processed and are included in these results. (Several of the biotopes team are still engaged in data compilation or revision, and the final database is expected to grow significantly.)

4.4.1. Surface area

Site surface area is known for between 92% and 100% of the sites per Member State (98% of the database as a whole). Sites recorded in the database cover a total of 283 694 k M2 or 12.6% of the land surface area of the Community. Figure 4.4 shows how this percentage varies between the different regions of the Community, some of which inevitably contain a greater concentration of important sites of high nature conservation interest than others, depending upon their landforms and the ways in which they have been modified by man over the centuries. In some of the Member States with lower percentage coverage, the data are still incomplete and the percentages can be expected to increase in the future (for example the UK, Luxembourg and parts of Germany). Conversely, in a few cases where the coverage is high at present (for example Italy), site numbers may decrease when the selection criteria have been more rigorously applied and certain candidate sites may no longer qualify for inclusion.

4.4.2. Altitude

Altitude is usually recorded either as a mean value or as minimum and maximum over a site. An altitude value has been entered for between 52% and 100% of the sites per Member State (94% of the database as a whole). Little use has been made of this parameter in data analyses to date, except in the identification of low-altitude sites liable to be affected by a possible rise in sea levels (Section 5.1 and Hollis *et al.,* 1989).

4.4.3. Habitat

Habitat description has been given major emphasis during data collection because one aim of the biotopes project is to identify important Community habitats. This has frequently proved one of the most difficult tasks for data compilers, who often must work from written descriptions of the sites. It is therefore a considerable achievement that habitats have been recorded for 98% of all sites, at least at the more generic level of the classification, and that the percentage of sites with the more detailed description has reached 61 %. The generic coding covers 44 broad habitat types (e.g. broad-leaved deciduous woodland, water-fringe vegetation), while detailed coding includes over 1 200 types described to date (e.g. Pyrenean beech forest; tall reed-bed dominated by *Scirpus).*

As well as a qualitative description of the types of habitats present at a site, the inventory also records a quantitative estimate of the extent of each habitat type, as a proportion of the site covered. This information is less readily available and, at present, it is reported for only 37% of the sites in the inventory. These percentages of completeness of the habitat data vary on a national basis (Figure 4.5), with five Member States having achieved over 90% completeness in detailed habitat coding, and four having reached that level for extent of habitat cover (which is collected at the generic level only). The less complete data-sets shown in Figure 4.5 indicate the Member States where further work in data compilation is still in progress.

The number of different habitat codes used averages nearly six per site over the whole database, with numbers of detailed and generic codes being approximately equal. The national differences shown (Figure 4.6) reflect completeness of the data compilation (e.g. low numbers of detailed codes in Italy, the UK and Spain), or the diversity of habitat types found on large sites, coupled with great detail in describing the habitats, exemplified in Belgium. The numbers of codes reported in the remaining Member States are close to the overall averages.

4.4.4. Motivation, designation and human activities

These remaining coded data fields are almost complete with only a few exceptions (Figure 4.7), overall mean percentages of sites with these types of data being 99%, 83% and 80% respectively. In the case of the 'Motivation' field, the mean number of codes per site varies from 2.1 (the Netherlands) to 7.7 (Denmark), and averages 3.6 overall, depending partly on whether the compilers have noted all the reasons for the importance of a site or only the principal ones.

The number of 'Designation' codes varies from 1.1 (Spain) to 3.3 (Denmark), with an overall mean of 1.6. Most sites cover only one or two designation types.

The numbers of different human activities which might affect the value of a site for nature conservation recorded per site varies between 2 and 4 (mean 2.6).

Figure 4.6. Number of habitat codes per site

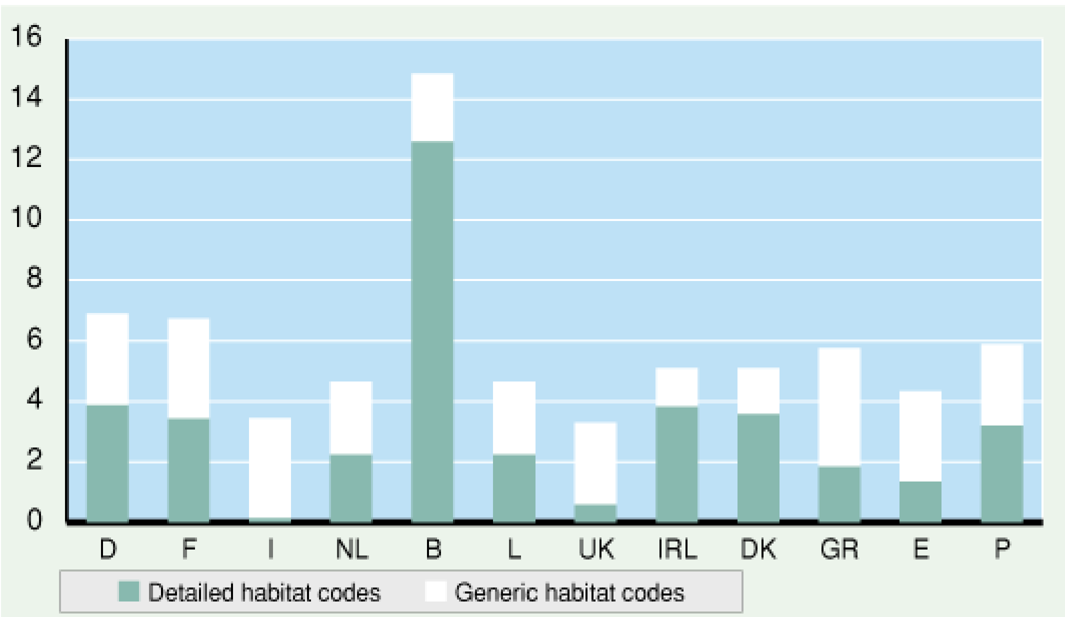


Figure 4.7. Completeness of motivation designation and human activities data in the CORINE biotopes database

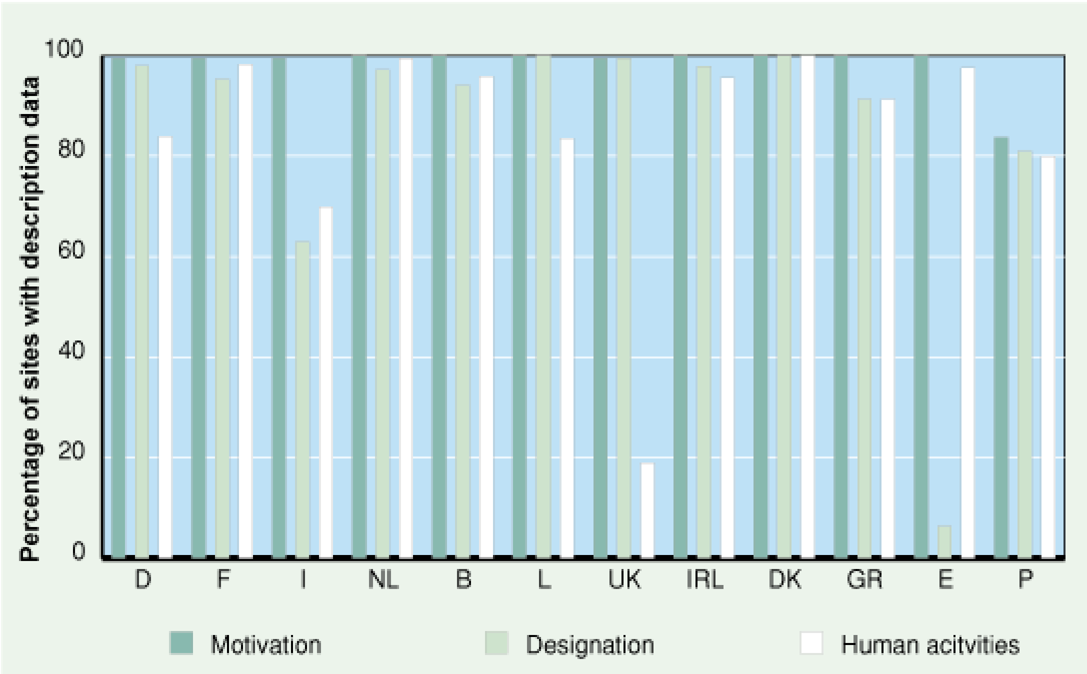
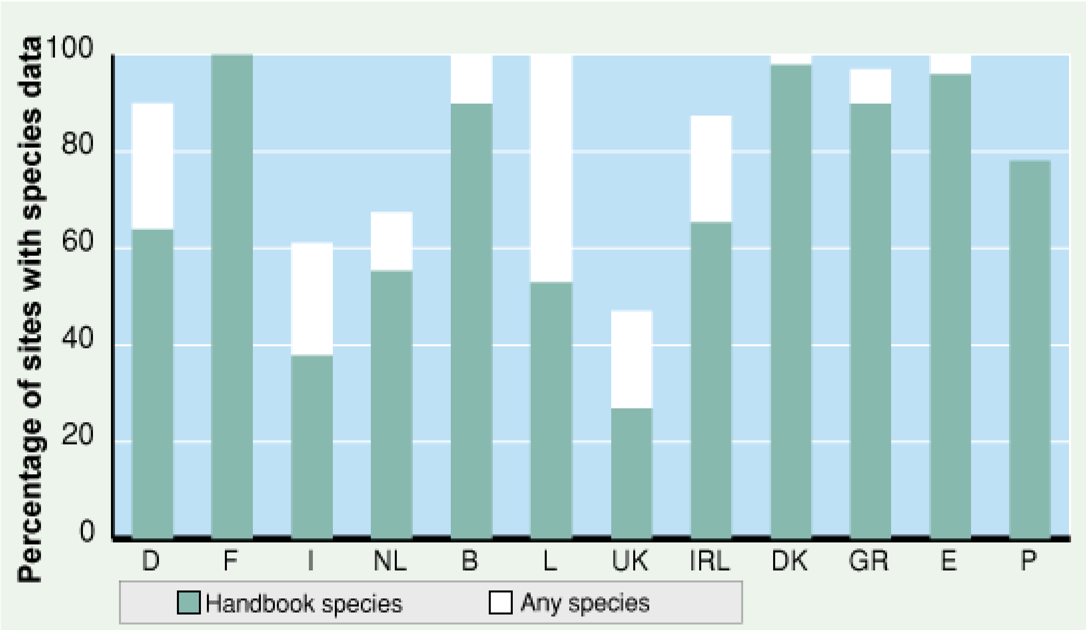


Figure 4.8. Completeness of species data in the CORINE biotopes database



4.4.5. Species

Species data have been recorded for 83% of all sites. Compilers were asked particularly to report the vulnerable and endangered species listed in the biotopes technical handbook. (These arc referred to as 'handbook species', and their presence is one criterion for determining the importance of a site at the Community level.) Sixty-six per cent of sites hold at least one species from these lists, indicated by heavy shading in Figure 4.8. Species have been recorded at every site in five Member States, and handbook species at over 90% of sites in four States.

Total numbers of species records held give another indication of the scope of the database (Table 4.1) and show that although the sites were originally based on inventories of important bird areas, there are now also major holdings of data for groups other than birds.

Table 4.1. Total number of species records in the CORINE biotopes database

Taxonomic group	All species	Handbook species
Mammals	5 889	3 227
Birds	39 332	18 814
Amphibians and reptiles	7 625	5 468
Fish	735	188
Invertebrates	3 080	1 203
Plants	24 428	1 304

4.4.6. Site boundaries and digitization

In Portugal, the most important sites have been digitized in relation with the land cover project. Later, an update was performed in close cooperation with the CORINE central team. The original data, stored in the Portuguese Bonne projection were subsequently reprojected to the CORINE Lambert azimuthal equal area projection in the central geographical information system. An example of the use of the results can be found in Figure 5.3, where the boundaries were brought in overlay with the results of the land cover project.

Belgium was taken as a case study for the joint digitization of the biotope sites in direct connection with the designated areas. All sites, biotopes as well as designated areas, were drawn by the relevant responsible persons on original topographical maps with a scale of 1:50 000.

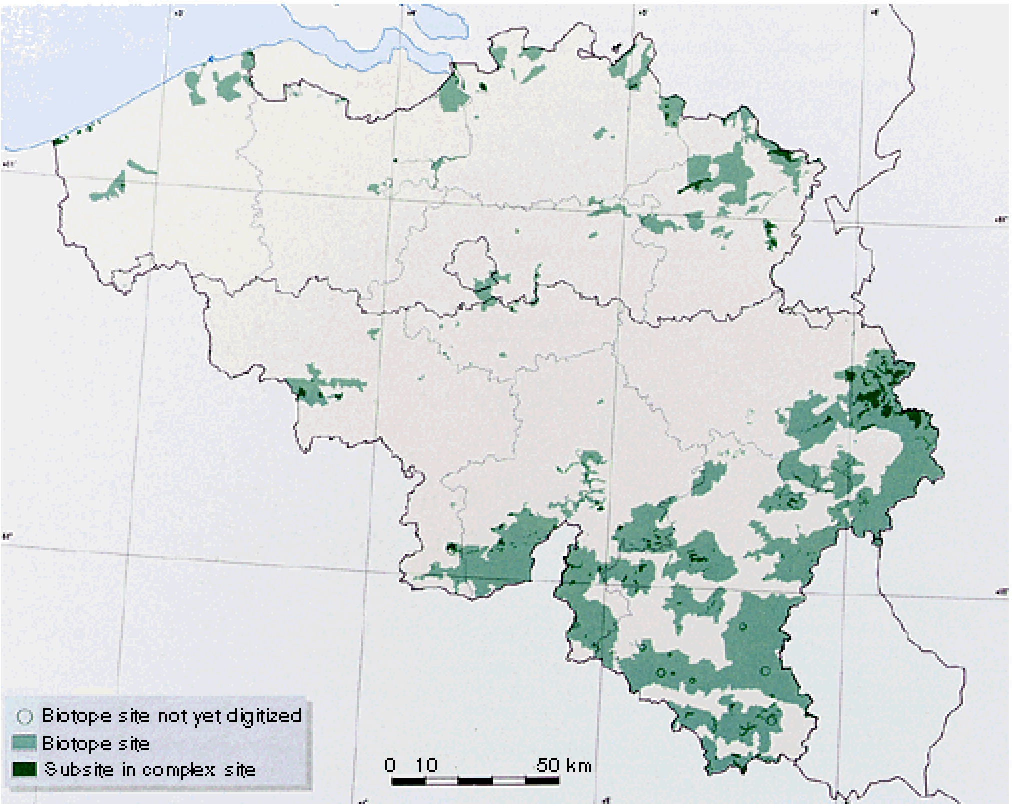
Common boundaries were indicated and digitized only once. Boundaries which correspond with an administrative boundary were also coded accordingly for later integration in mapping procedures. Each polygon was subsequently coded with respect to its status no matter how many different designations the site has. Figure 4.9 shows the results for the biotope sites. In total 18% of the land surface (565 660 ha) is covered with biotope sites of which 82% is designate in application of the Directive on the conservation of wild birds. Only 1.5% is designated under national or regional laws.

In Greece, Luxembourg and Denmark, work is under way to delineate the boundaries on maps.

For other countries, like France, Germany and the United Kingdom, sites have been or are being digitized in the framework of national or regional inventories. Here, the correlation with the CORINE biotope sites has to be established and the selected polygons must be transmitted to the central database.

Finally, in Italy, Ireland, Spain and the Netherlands work programmes are being discussed to delineate and digitize natural sites.

Figure 4.9 -Digitized boundaries for CORINE biotopes sites in Belgium



4.5. Interpretation and analysis of the data

4.5.1. Site area

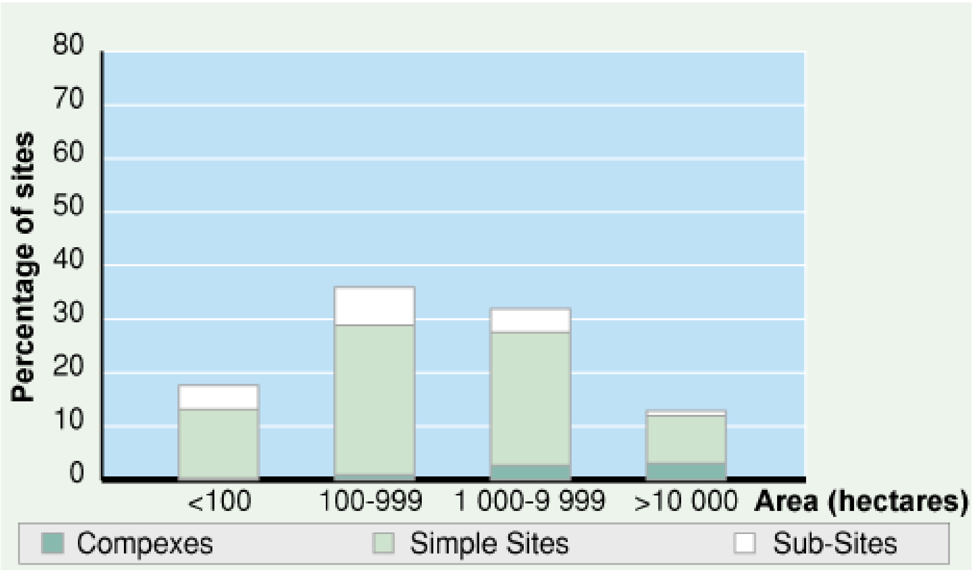
In considering the areas of sites, it is helpful to distinguish between site-complexes (i.e. those which contain smaller sub-sites), the corresponding sub-sites of these complexes, and single sites without any such hierarchical relationship to other sites. Over the whole Community, site-complexes are mostly over 1 000 hectares, sub-sites below 1000 ha, and single sites within the range 100 to 10 000 ha.

Differences exist between Member States in the statistical distribution of the areas of sites recorded (Figure 4.10), reflecting differences in the landscapes of their countries. Most of the very large sites (100 000 ha or more) are mountain ranges or estuarine complexes, the former being found particularly in Spain, Italy and Greece and the latter in the Netherlands. The extent to which the smaller sites, especially those of 100 ha or less, have been recorded reflects in part how fragmented the landscape has become as, for example, woodlands have been felled or wetlands drained during centuries of human activity.

Some of the differences in site area between Member States also depend on the extent to which compilers have made use of the site-complex field, since in some cases (e.g. Belgium) it was convenient to consider a series of large sites which are themselves important ecological entities and which consist of a number of ecologically distinct and important sub-sites. In others (e.g. Denmark), this approach was not adopted.

One particular use of the site-complex field has been to cross-reference larger areas, often with little or no statutory protection, with smaller protected areas occurring within them, for example nature reserves within national parks or extensive upland areas.

Figure 4.10 -Distribution of site surface areas in the CORINE biotopes database



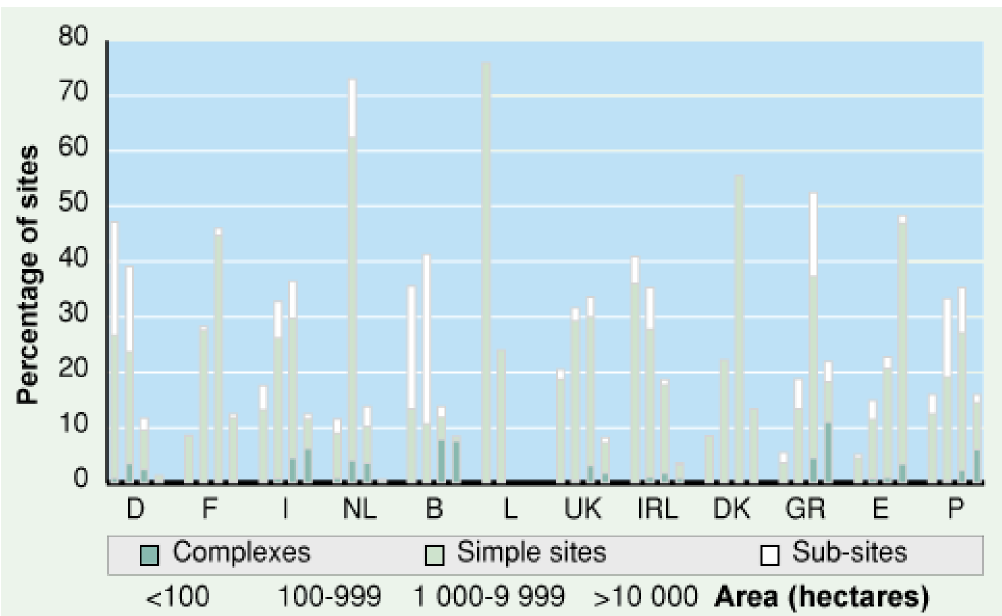
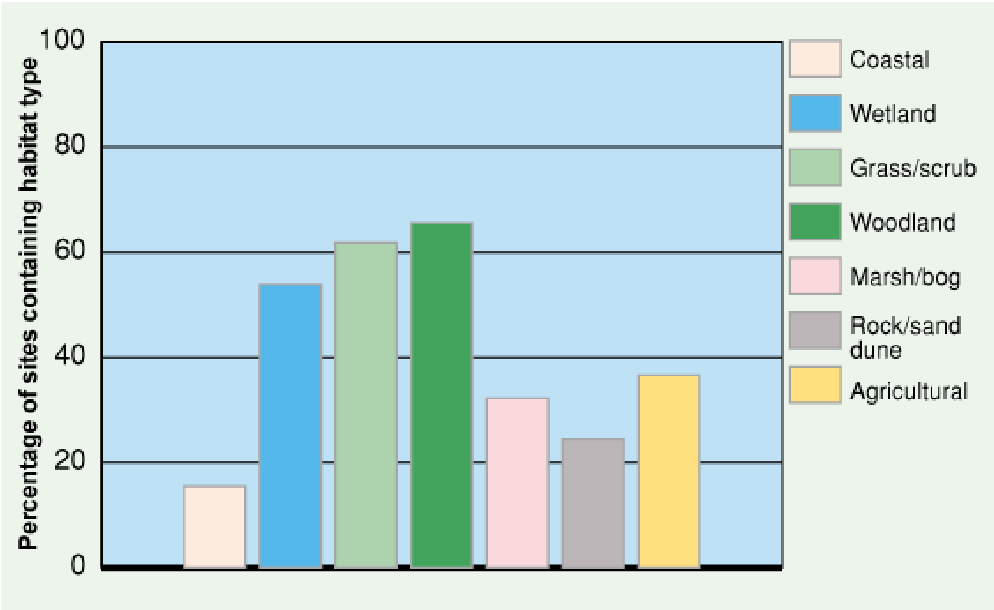
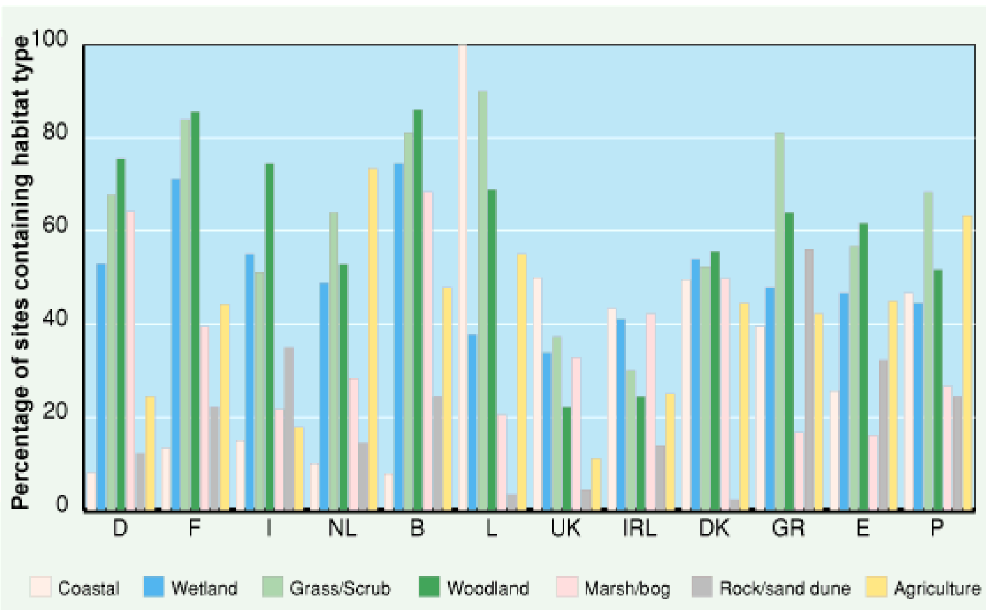


Figure 4.11 -Distribution of main habitat types in the CORINE biotopes database





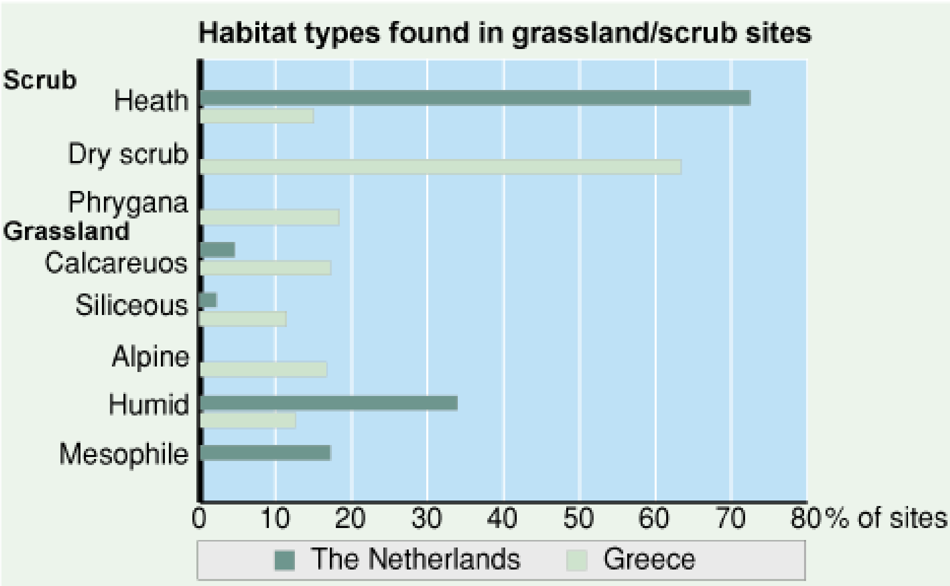
4.5.2. Habitat description

The database contains over 30 000 records in the habitat type field, which uses the hierarchical habitat classification system described in Section 3.3. At the simplest level in the hierarchy, these records can be analysed to derive the distribution of the major habitat divisions in each Member State (Figure 4.11). The dominance of three categories, wetlands, grasslands (including heaths and scrub), and woodlands, is consistent throughout all Member States except for four with high proportions of coastal sites: the UK, Ireland, Denmark and Portugal. Some other features are apparent, for example marshes and bogs are found on a high proportion of sites in Ireland but are rare in the Mediterranean countries; rocky habitats are frequent in Greece, as are agricultural sites in the Netherlands. These examples confirm the expected contrasts between members of a Community which stretches from the predominantly hot and dry Mediterranean regions to the cooler and damper north-west Atlantic seaboard.

The types of habitats in these broad categories show further contrasts when more detail in the descriptions is analysed. For example, a comparison of coastal types between the UK and Denmark reveals much greater variety in such habitats in the UK where many more cliffs and inter-tidal areas are found than in Denmark, where sea inlets and saltmarshes are the most frequent features (Figure 4.12). Grassland, scrub and heath types also vary greatly across Europe, as shown by the comparison between the Netherlands and Greece. In the Netherlands, such sites are dominated by heaths and humid grasslands, and in Greece by sclerophyllous (dry) scrubs (Figure 4.12).

The more detailed habitat codes are valuable as a source of information about the distribution across the Community of many characteristic habitat types. An example of the use of such data is given in Figure 4.13, showing how, as the habitat description narrows from the generic (broad-leaved woodland), first to beech forest, and then to ecologically different types of beech forests, the maps pinpoint the locations of such forests, some of which (e.g. Pyrenean and Hellenic types) are separated geographically, and others by edaphic factors such as the acidity of the soils upon which they grow.

Figure 4.12 -Examples of comparisons of habitat types



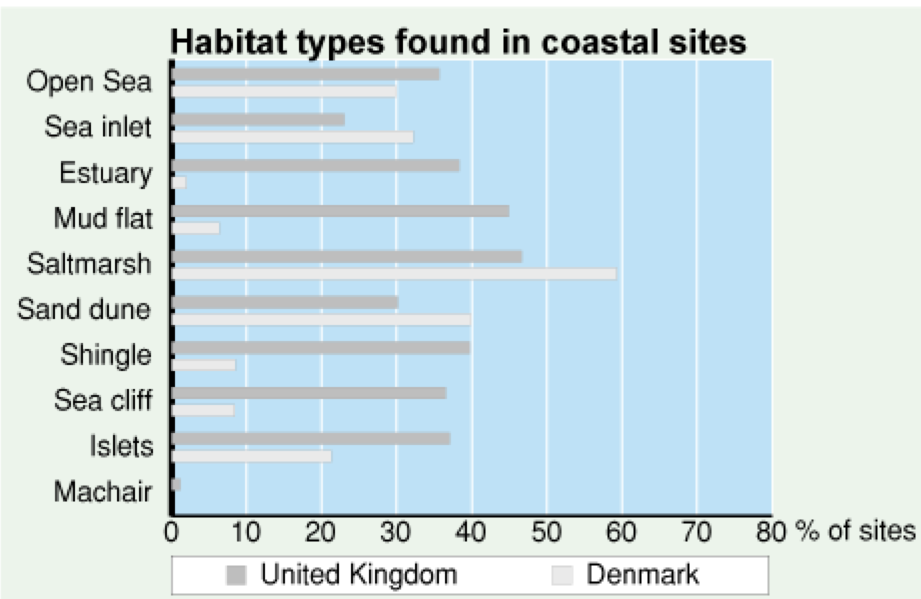
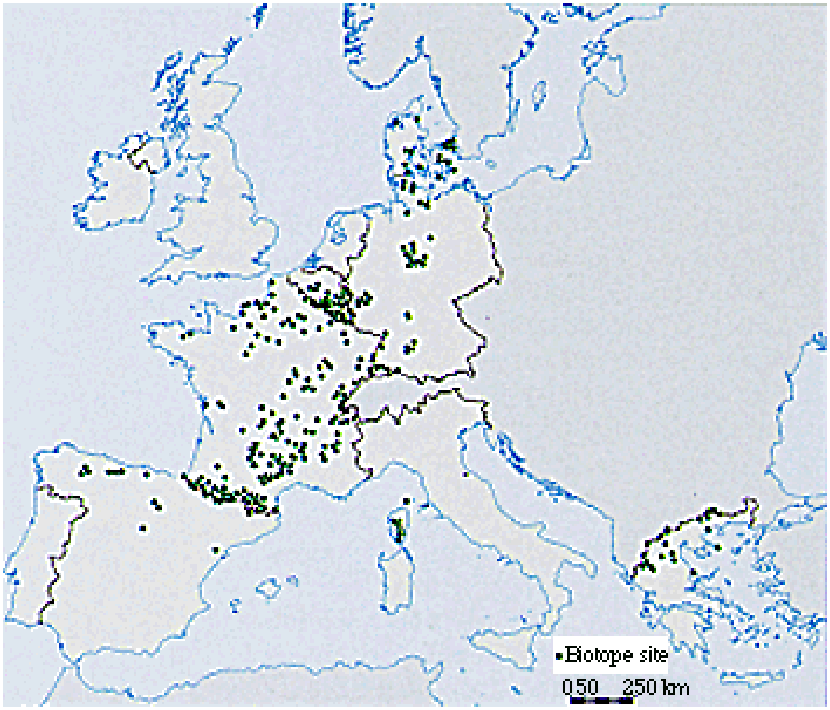


Figure 4.13 -An illustration of the CORINE habitat classification system



Beech forests

Beech forests occur everywhere in Europe in those regions where rainfall and the water balance of the soil can provide enough water for their transpiration needs. This general pattern conceals a diversified picture. In west and central Europe beech forests are dominated by*Fagus sylvatica,* in Greece by *Fagus orientalis* or *Fagus moesica*. The occurrence of other tree species and flora depends on the region and forest management practices. Many montane formations are beech-fir or beech-fir-spruce forests.

The map, derived from the CORINE biotopes inventory , shows the distribution of beech forests in general (476 sites) and of its sub-types (below).

Figure 4.13 -An illustration of the CORINE habitat classification system (continued)

Central European acidophilous beech forests with woodrush
Luzulo - Fagenion

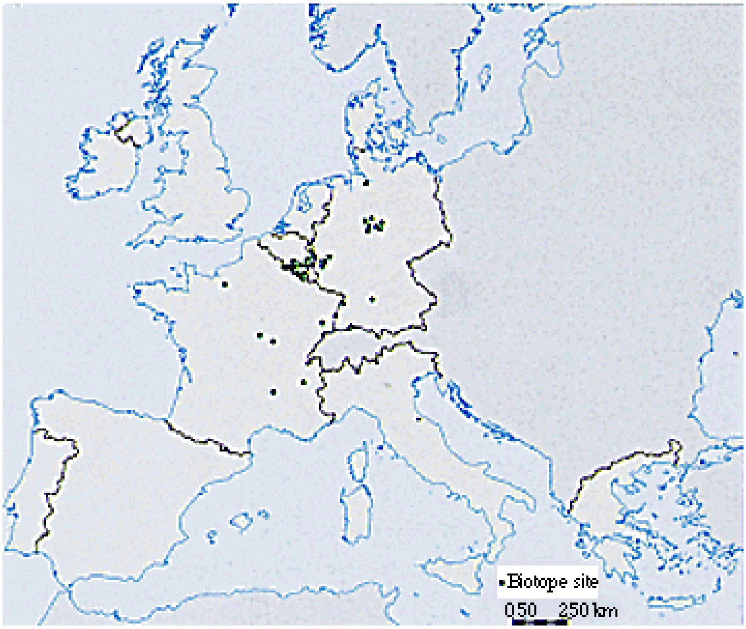


Figure 4.13 -An illustration of the CORINE habitat classification system (continued)

Pyreneo - Cantabrian neutrophile beech forests
Scillo - Fagenion

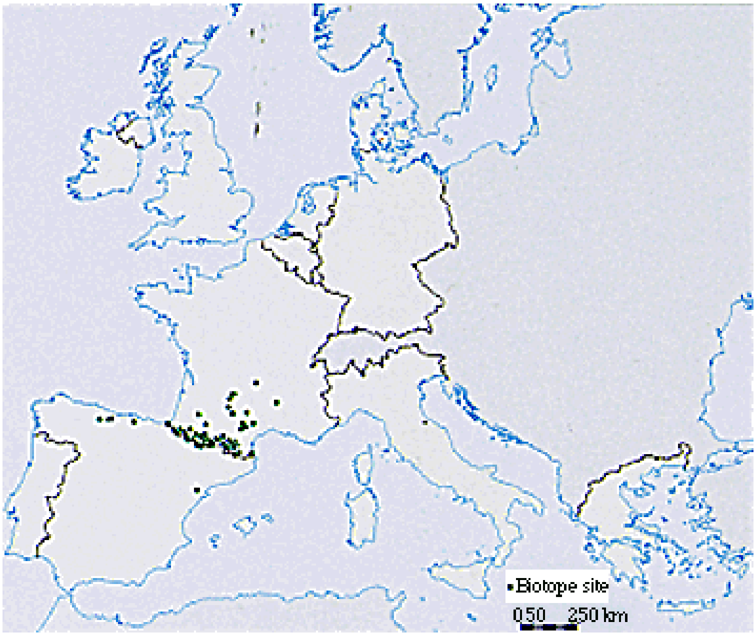


Figure 4.13 -An illustration of the CORINE habitat classification system (continued)

Subalpine beech woods
Aceri - Fagenion

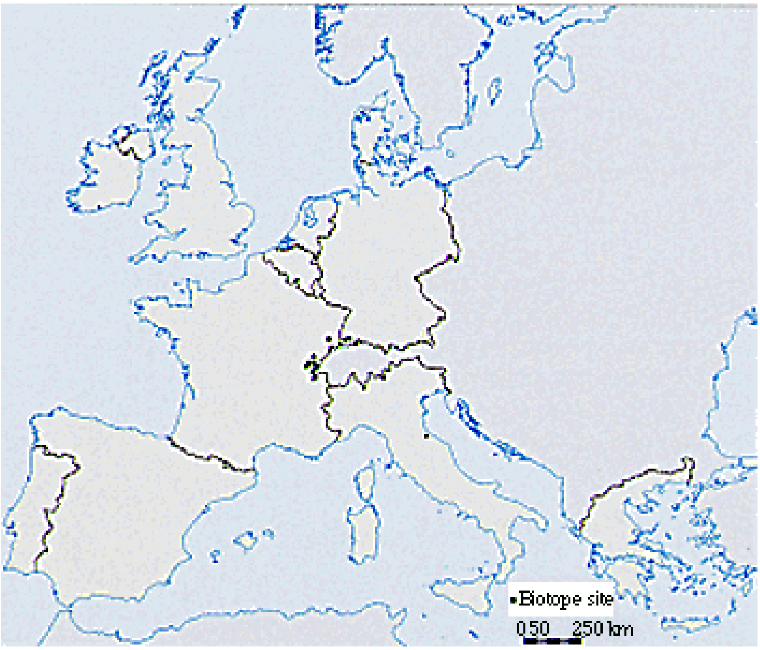


Figure 4.13 -An illustration of the CORINE habitat classification system (continued)

Southern medio-European beech forests
Fagion sylvaticae

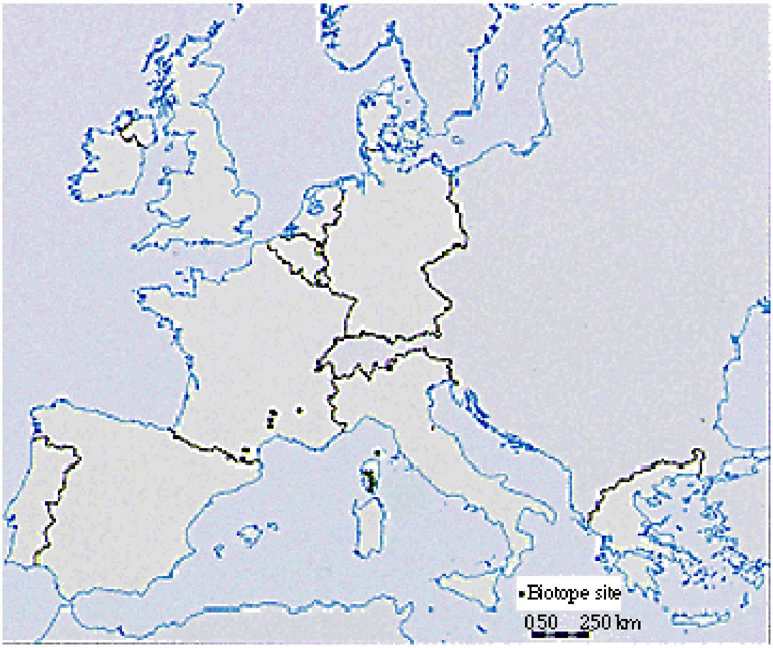
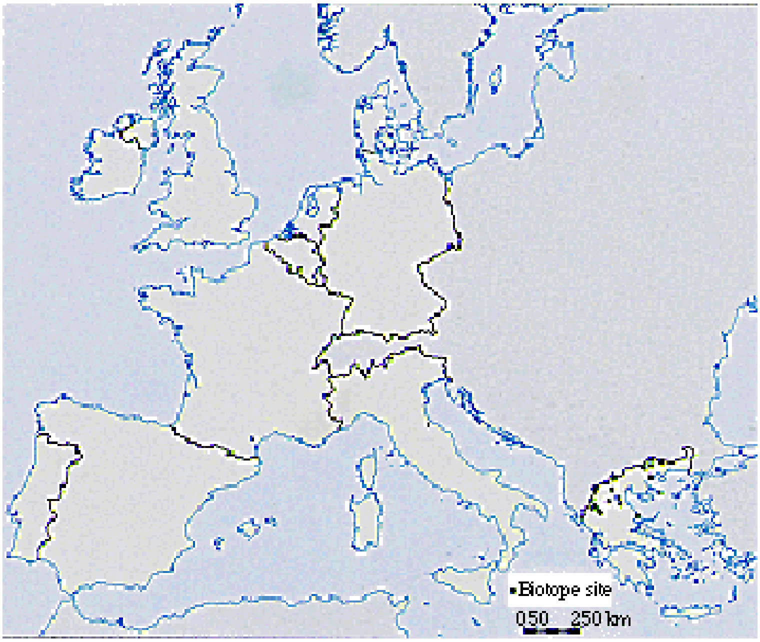


Figure 4.13 -An illustration of the CORINE habitat classification system (continued)

Hellenic beech forests
Fagion hellenicum



4.5.3. Habitat cover

Compilers were requested to estimate the percentage of each site which was occupied by each of the 44 generic habitat types. Almost complete data are available for analysis for four Member States and sufficient partial data, covering at least 20% of the total area recorded, to consider a further four. For this analysis (Figure 4.14) the area of each individual habitat type was calculated using the site area and percentage of the site covered by that type, and such areas were summed. Since the data are incomplete, Figure 4.14 should be regarded as an interim statement of the percentage of the total area of sites in those Member States whose habitat cover has been recorded to date. For this presentation, only the seven major habitat divisions were considered, although more detailed examination is also of interest (for example, the types of coastal habitats in Denmark (Figure 4.15).

It is useful and interesting to compare estimates of cover reported in the biotopes data with estimates derived from independent sources. The CORINE land cover project is generating from remotely-sensed imagery a digital map of land cover, using a hierarchical typology based on 44 broad categories. Although remote sensing is not capable of distinguishing the degree of detail recorded in the biotopes database, some categories are directly comparable (Table 4.2). Figure 4.16 illustrates how the boundaries of a site from the biotopes inventory can be digitally overlain on the land cover map in order to estimate the real extent of the various mapped categories, at the generic level.

Figure 4.14 -Distribution of areas covered by each major habitat type in the CORINE biotopes database

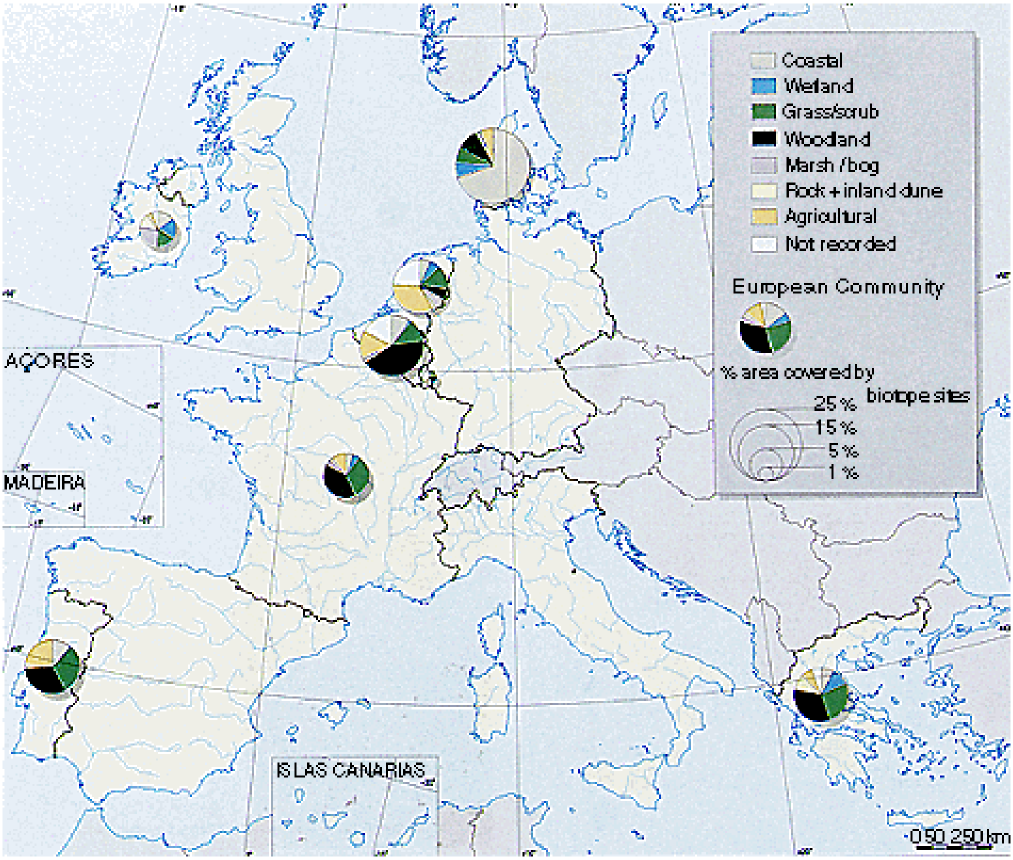


Figure 4.15 -An example of habitat cover at the second level of the CORINE habitat classification (Denmark)

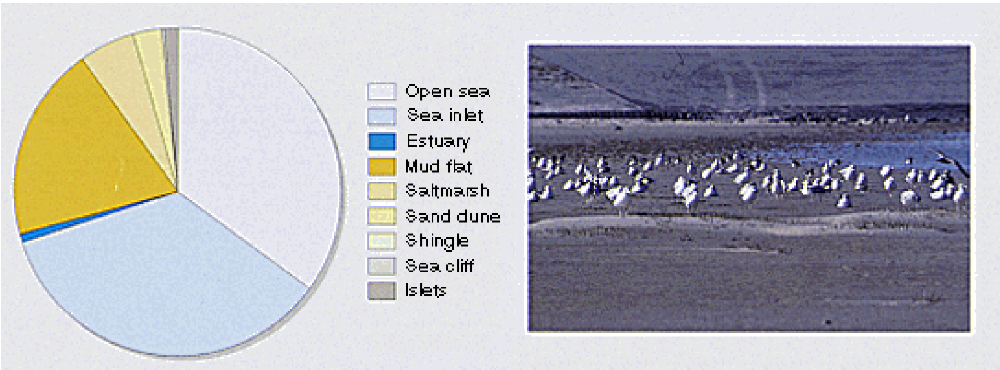


Figure 4.16 -Estimate of habitat cover from the CORINE land cover map

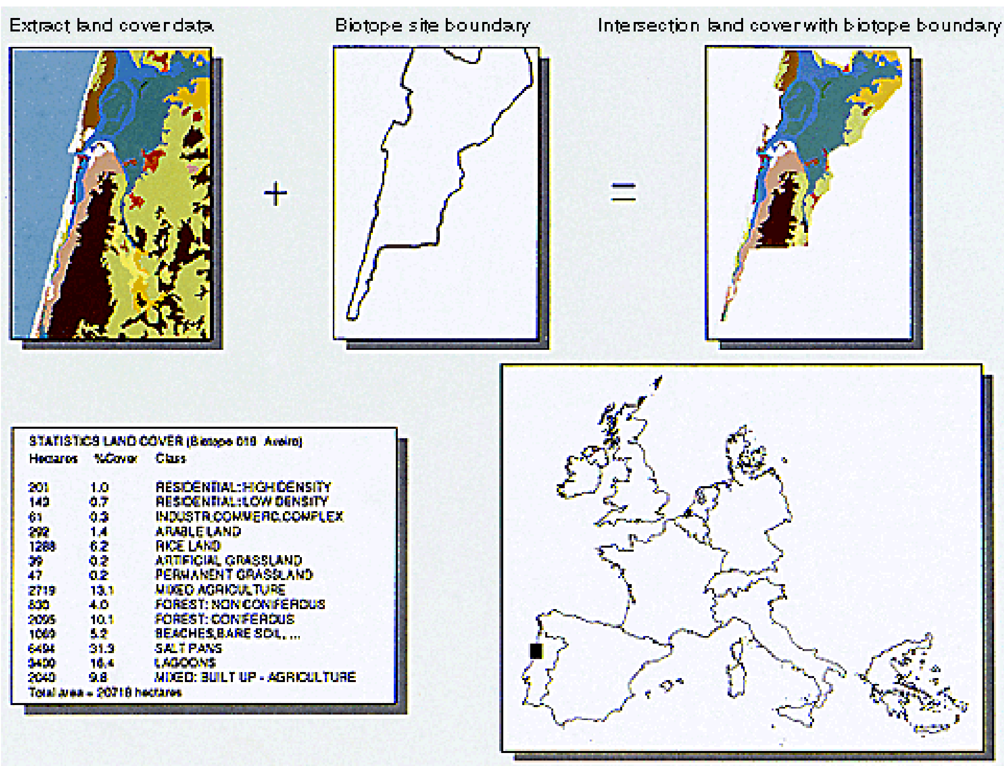


Table 4.2. Relationship between the habitat nomenclature and the CORINE land cover classification

	Artificial Surfaces	Agricultural Areas	Forest/semi-natural areas	Wetlands	Water Bodies
Coastal and halophytic communities			+	+	+
Non-marine waters					+
Scrub and grasslands		+	+		
Woodland			+		
Bogs and marshes				+	
Rocky habitats			+		
Agricultural land and highly artificial landscapes	+	+	+		

Table 4.2. Relationship between the habitat nomenclature and the CORINE land cover classification (continued)

Coastal and halophytic communities	Broad-leaved forest 311	Coniferous forest 312	Mixed forest 313	Natural grassland 321	Moors and heathland 322	Sclerophyllous vegetation 323	Transitional woodland-scrub 324	Beaches, dunes, sands 331	Bare rocks 332	Sparsely vegetated areas 333	Burnt areas 334	Glaciers and perpetual snow 335
11 Open sea												
12 Sea inlets												
13 Tidal rivers and estuaries												
14 Mud flats and sand flats												
15 Salt marshes, salt pastures, salt steppes												
16 Coastal sand dunes and sand beaches								●				
17 Shingle or stony beaches								●				
18 Sea cliffs									●			
19 Islets and rock stacks									●			
1A Machair (1)												

)

Table 4.2. Relationship between the habitat nomenclature and the CORINE land cover classification (continued)

Coastal and halophytic communities	Inland marshes 411	Peat bogs 412	Salt marshes 421	Salines 422	Intertidal flats 423	
11 Open sea						
12 Sea inlets						
13 Tidal rivers and estuaries						
14 Mud flats and sand flats					○	
15 Salt marshes, salt pastures, salt steppes			○	○		
16 Coastal sand dunes and sand beaches						
17 Shingle or stony beaches						
18 Sea cliffs						
19 Islets and rock stacks						
1A Machair (1)						

Table 4.2. Relationship between the habitat nomenclature and the CORINE land cover classification (continued)

Coastal and halophytic communities	Water courses 511	Water bodies 512	Coastal lagoons 521	Estuaries 522	Sea and ocean 523	
11 Open sea					○	
12 Sea inlets					○	
13 Tidal rivers and estuaries				○		
14 Mud flats and sand flats						
15 Salt marshes, salt pastures, salt steppes						
16 Coastal sand dunes and sand beaches						
17 Shingle or stony beaches						
18 Sea cliffs						
19 Islets and rock stacks						
1A Machair (1)						

Table 4.2. Relationship between the habitat nomenclature and the CORINE land cover classification (continued)

Non-marine waters	Water courses 511	Water bodies 512	Coastal lagoons 521	Estuaries 522	Sea and ocean 523
21 Lagoons			●		
22 Standing water (fresh)		●			
23 Standing water (brackish)		●			
24 Running water	●				

Table 4.2. Relationship between the habitat nomenclature and the CORINE land cover classification (continued)

Srub and grassland	Non-irrigated arable land 211	Permanently irrigated land 212	Rice fields 213	Vineyards 221	Fruit trees and berry plantations 222	Olive groves 223	Pastures 231	Annual crops associated with permanent crops 241	Complex cultivation patterns 242	Land principally occupied by agriculture 243	Agro-forestry areas 244
31 Heath and scrub											
32 Sclerophyllous scrub, garrigue and maquis											
33 Phrygana											
34 Dry calcareous grassland and pseudosteppes											
35 Dry siliceous grassland											
36 Alpine and boreal grassland											
37 Humid grassland and tall herb communities							○				
38 Mesophile grassland							○				

Table 4.2. Relationship between the habitat nomenclature and the CORINE land cover classification (continued)

Srub and grassland	Broad-leaved forest 311	Coniferous forest 312	Mixed forest 313	Natural grassland 321	Moors and heathland 322	Sclerophyllous vegetation 323	Transitional woodland-scrub 324	Beaches, dunes, sands 331	Bare rocks 332	Sparsely vegetated areas 333	Burnt areas 334	Glaciers and perpetual snow 335
31 Heath and scrub					●							
32 Sclerophyllous scrub, garrigue and maquis						●						
33 Phrygana						●						
34 Dry calcareous grassland and pseudosteppes				●								
35 Dry siliceous grassland				●								
36 Alpine and boreal grassland				●								
37 Humid grassland and tall herb communities				●								
38 Mesophile grassland				●								

Table 4.2. Relationship between the habitat nomenclature and the CORINE land cover classification (continued)

Woodland	Coniferous forest	Mixed forest	Natural grassland	Moors and heathland	Sclerophyllous vegetation	Transitional woodland-scrub	Beaches, dunes, sands	Bare rocks	Sparsely vegetated areas	Burnt areas	Glaciers and perpetual snow	
41 Broadleaved deciduous woodland	●											
42 Native coniferous woodland		●										
43 Mixed woodland			●									
44 Alluvial and very wet forest and brush	●	●	●									
45 Broadleaved evergreen woodland	●											

Table 4.2. Relationship between the habitat nomenclature and the CORINE land cover classification (continued)

Bogs and marshes	Inland marshes 411	Peat bogs 412	Salt marshes 421	Salines 422	Intertidal flats 423	
51 Raised bogs		●				
52 Blanket bogs		●				
53 Water-fringe vegetation	●					
54 Other bogs and mires	●					

Table 4.2. Relationship between the habitat nomenclature and the CORINE land cover classification (continued)

Rocky habitats	Broad-leaved forest 311	Coniferous forest 312	Mixed forest 313	Natural grassland 321	Moors and heathland 322	Sclerophyllous vegetation 323	Transitional woodland-scrub 324	Beaches, dunes, sands 331	Bare rocks 332	Sparsely vegetated areas 333	Burnt areas 334	Glaciers and perpetual snow 335
61 Scree								●				
62 Exposed bedrock, inland cliffs								●				
63 Permanent snow and ice												●
64 Inland sand dunes							●					
65 Caves (1)												

Table 4.2. Relationship between the habitat nomenclature and the CORINE land cover classification (continued)

Agricultural land and highly artificial landscape	Continous sur-faces urban fabric 111	Discontinous urban fabric 112	Industrial or commercial units 121	Road and rail networks and associated land 122	Port areas 123	Airports 124	Mineral extraction sites 131	Dump sites 132	Construction sites 133	Green urban areas 141	Sport and leisure vegetated sites facilities 143
81 Heavily fertilized, reseeded and improved grassland											
82 Crops											
83 Orchards, groves and planttation of poplars											
84 Tree lines, hedges,small woods, bocage and parkland											
85 Urban parks and large gardens										●	●
86 Urban and industrial areas (2)	●	●	●	●	●	●	●	●	●		
87 Fallow, ruderal and distributed land (1)											
88 Mine galleries and other artificiel underground habitats (1)											

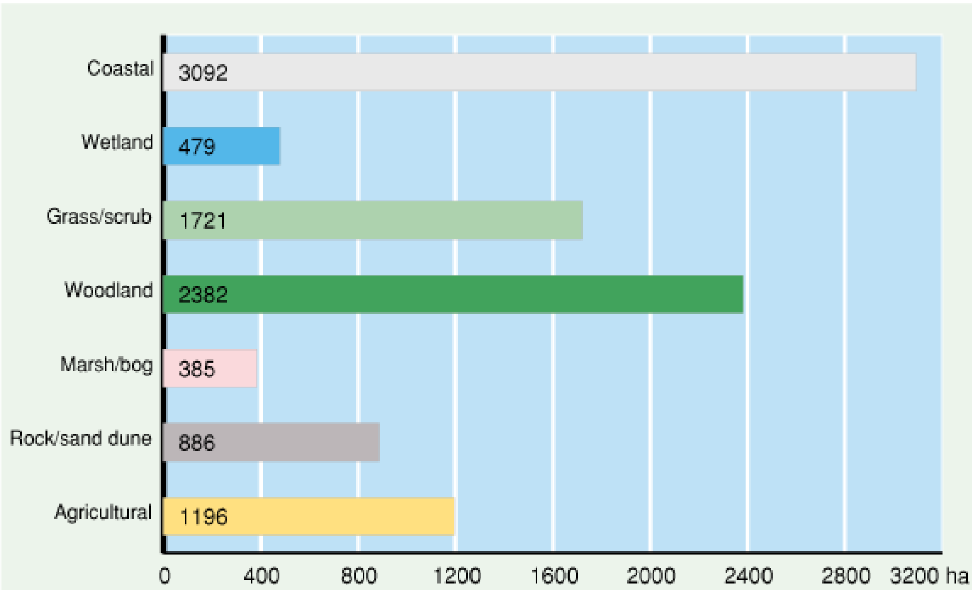
Table 4.2. Relationship between the habitat nomenclature and the CORINE land cover classification (continued)

Agricultural land and highly artificial landscape	Non-irrigated arable land 211	Permanently irrigated land 212	Rice fields 213	Vineyards 221	Fruit trees and berry plantations 222	Olive groves 223	Pastures 231	Annual crops associated with permanent crops 241	Complex culti-vation patterns 242	Land principally occupied by agriculture 243	Agro-forestry areas 244
81 Heavily fertilized, reseeded and improved grassland							●				
82 Crops	●	●	●					●	●	●	
83 Orchards, groves and plantation of poplars				●	●	●				●	
84 Tree lines, hedges,small woods, bocage and parkland											
85 Urban parks and large gardens											
86 Urban and industrial areas (2)											
87 Fallow, ruderal and distributed land (1)											
88 Mine galleries and other artificiel underground habitats (1)											

Table 4.2. Relationship between the habitat nomenclature and the CORINE land cover classification (continued)

Agricultural land and highly artificial landscapes	Broad-leaved forest 311	Coniferous forest 312	Mixed forest 313	Natural grassland 321	Moors and heathland 322	Sclerophyllous vegetation 323	Transitional woodland-scrub 324	Beaches, dunes, sands 331	Bare rocks 332	Sparsely vegetated areas 333	Burnt areas 334	Glaciers and perpetual snow 335
81 Heavily fertilized, reseeded and improved grassland												
82 Crops												
83 Orchards, groves and plantation	○	○										
84 Tree lines, hedges, small woods, bocage and parkland												
85 Urban parks and large gardens												
86 Urban and industrial areas (2)												
87 Fallow, ruderal and distributed land (1)												
88 Mine galleries and other artificiel underground habitats (1)												

Figure 4.17 -Mean areas per site of each major habitat type in the CORINE biotopes database



For a particular habitat type, a comparison between its frequency (the proportion of sites at which it occurs) and its extent (the proportion of the total area of all habitats which it covers) shows that many habitat types which are found on high proportions of sites actually occupy only small proportions of the total surface. For example, wetland habitats (including running water) are recorded on 75% of sites in Belgium but only occupy 1.2% of the surface area; woodlands are recorded for 56% of sites in Denmark but cover 9.3% of the area. At Community level, these comparisons are explained by an analysis of the mean areas per site for each habitat type (Figure 4.17). This shows that coastal and woodland sites tend to occur as much larger units than wetlands and marshes, due to the extensive and continuous nature of the former and prevalence amongst the latter of discrete units.

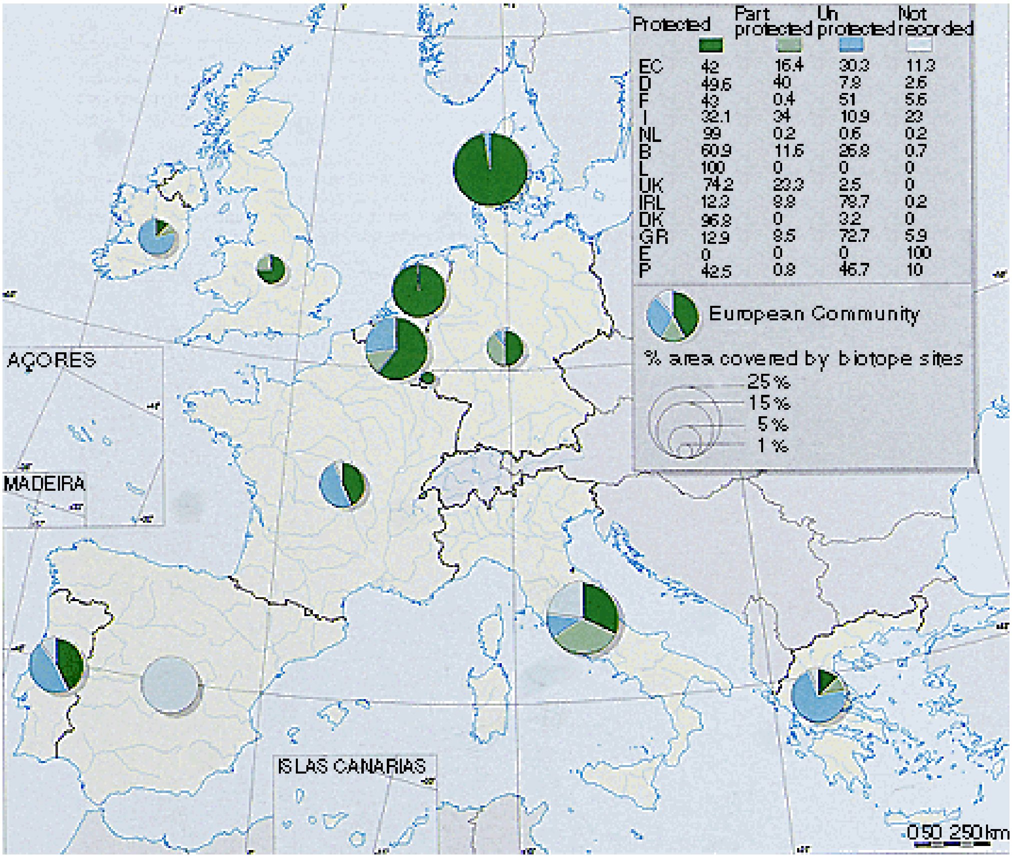
Even small areas of vulnerable habitats can be very important for nature conservation and so judgments on the value of sites should not be based only on area data. Indeed it is often those habitats which are rare on a regional or national basis which in turn support similarly rare species and which it is most vital to include in an information system such as CORINE. To this end, considerable emphasis has been placed in the biotopes project on the development of the classification system, and its application in the collection and analysis of this body of habitat data.

4.5.4. Designation data

At the time of writing, at Community level no consistent standards of legislation exist which are applicable to the designation of natural areas, with the exception of special protection areas under the EC Directive on the protection of wild birds (European Communities, 1979). Therefore early attempts in the biotopes project to set up a coding system which implied equivalence in each Member State of a particular code have been set aside. For example, the term 'national park' does not imply the same degree of protection in each State, although every State has areas designated under such a title. Until such equivalence can be established, it is preferable to analyse designation data State by State rather than across the whole database. However it is possible to distinguish broad categories, that is, whether a site (or part of it) is protected by legislation or unprotected, and the area of each site in each of these categories (Figure 4.18). The category 'part protected' is used exclusively to describe those sites whose codes indicate that they contain both protected and unprotected zones, but for which the percentage of the site covered by each designation type has not been given.

This analysis reveals major differences between Member States. These can have one of three origins or their combination: differences in the degree of protection afforded to reported sites, incomplete reporting of designation, or differences in the implementation of selection criteria. Further analysis on this question is clearly important.

Figure 4.18 -Protection status of CORINE biotopes sites



4.5.5. Motivation categories

Data compilers were requested to indicate which of 22 possible categories were motivating factors for the notification of each site. Some of these are broad categories, for example general ecological, botanical or zoological value, whilst others are more specialized, for example, the presence of endemic species or their value for fish or insects. A summary for the whole database (Figure 4.19) reveals that two categories apply to more than 50% of sites: those important botanically and for birds. These trends, which do not differ overwhelmingly between Member States, reflect the fact that plants and birds are on the whole more widely known and valued than other species groups. Of the botanical sites, in relatively few cases has the distinction been made between their value for vascular plants or lower plants. Conversely, a greater proportion of sites of zoological importance has been categorized according to more specific subdivisions.

Significant numbers of sites are noted as important for endangered, threatened, rare or endemic species, and for habitats or communities. However it is possible to give a more precise indication of the importance of a site for individual species or habitats by noting the particular criteria which governed its selection. When data specifying such criteria have been completed for a larger percentage of the sites than at present, these will form a more detailed and reliable information source than the motivation field. A preliminary analysis of the selection criteria notified to date is given in Section 4.5.8 below. In many cases the 'quality' text field in the database supplements motivation data.

The motivation categories 'landscape, geology or geomorphology' and 'general natural interest' cover over 25% of sites, but do not constitute reasons for site selection in the absence of important species or habitats. Note also that the cross-reference to the EC important bird areas register is made using the motivation field.

4.5.6. Human activities data

As in the case of the motivation field, the results are shown as a single histogram for the whole database (Figure 4.20) since there are no great differences between Member States. Almost half of all sites are affected (not necessarily detrimentally) by tourism and leisure activities. Around 30% of sites support stock or arable farming, which is consistent with almost 40% of sites containing agricultural habitats (Figure 4.11), while forestry forms a further widespread land use. Of the human activities which can be said to exploit wildlife, hunting and shooting occur on over one-third of sites, and fishing on about one-fifth.

The three categories of residential activity occur in the proportions which one might have predicted, since scattered settlement is complementary to the agricultural activities, while town centres are rarely likely to support important nature conservation sites. The remaining forms of human development, apart from major roads, affect only small numbers of sites. However under 10% of all sites enjoy human activities described as 'negligible or nil'.

The threats posed to sites by human activities are documented more fully where appropriate using the 'vulnerability' text field.

Figure 4.19 -Motivation categories in the CORINE biotopes database

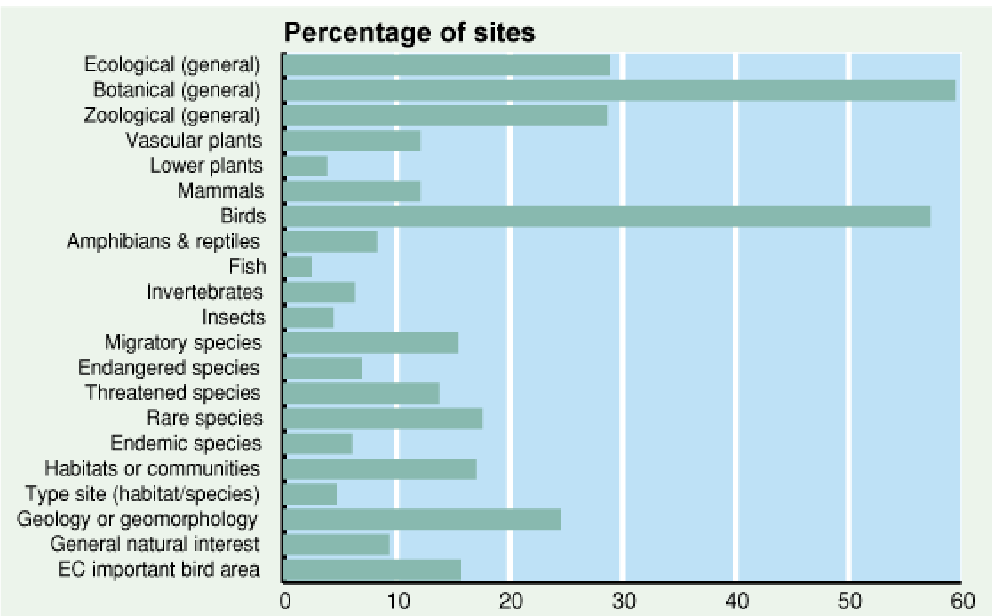
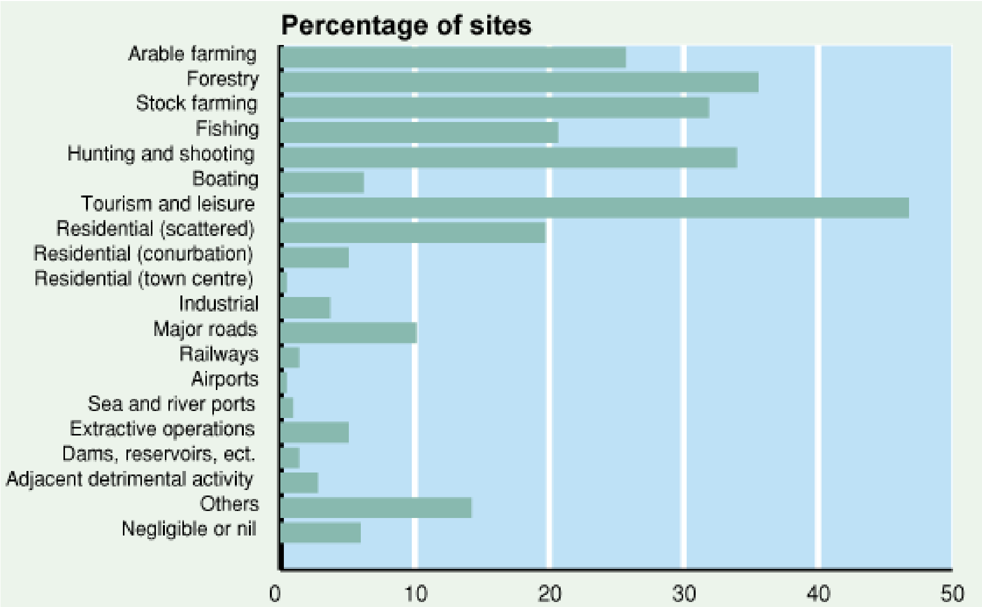


Figure 4.20 - Human activity categories in the CORINE biotopes database



4.5.7. Species data

The initial priority in recording important species of animals and plants occurring at each site was to concentrate on those species which are listed in the technical handbook because their populations in Western Europe were considered by such bodies as the Council of Europe and the International Union for the Conservation of Nature to be threatened. These are referred to here as 'handbook species'. With the exception of a small number of confidential records, or of species widespread in one region although considered threatened on a European scale, all such species were to be reported where they were known to be present. Data compilers were also asked to record other important, characteristic or interesting species, whether or not they are critical in influencing the selection of the site. In this Section, species records are generally separated into 'handbook species' and 'other species', and are also divided into the six broad taxonomic groups in the biotopes standard record format (mammals, birds, amphibians and reptiles, fish, invertebrates and plants).

The percentages of sites with species records, and the numbers of species recorded per site are recorded in Figure 4.21. Both values vary greatly between taxonomic groups and between Member States. Overall, birds are recorded from most sites, the great majority of which hold at least one handbook species. This reflects the better state of knowledge which generally prevails for ornithological sites, and the more comprehensive list of handbook species, derived from Annex I of the EC Directive on the protection of wild birds. Plants are the next most widely recorded, but little over one-quarter of sites with plant records support any handbook species. Many of the handbook plants are localized species, and over large parts of the Community area none of them occur.

Of the other groups, invertebrates and especially fish are very poorly recorded. Neither group has received sufficient attention for comprehensive records to have been collected, and amongst invertebrates, the most abundant of the six groups, recording has focused on a few well-studied orders. Most mammal and amphibian or reptile records pertain to handbook species.

Figure 4.21 also shows, for sites with species records, how many handbook species and how many species in total are recorded. This shows that over the database as a whole, many more birds and plants are recorded per site than members of the other groups. Again there are relatively few records of handbook plants. The comparison of these data for individual Member States shows some departures from the overall averages. For example, there are few records other than of handbook species for France, and very few plant records there. The species data for the UK are as yet incomplete. Very few amphibians and reptiles occur in Ireland, but this group and fish are strongly represented in the data for Denmark. In Greece and Spain the very rich invertebrate fauna have yet to be documented adequately, apart from a small number of sites in Spain with very large numbers of invertebrate records.

Figure 4.21 -Number of species records in the CORINE biotopes database

European Community

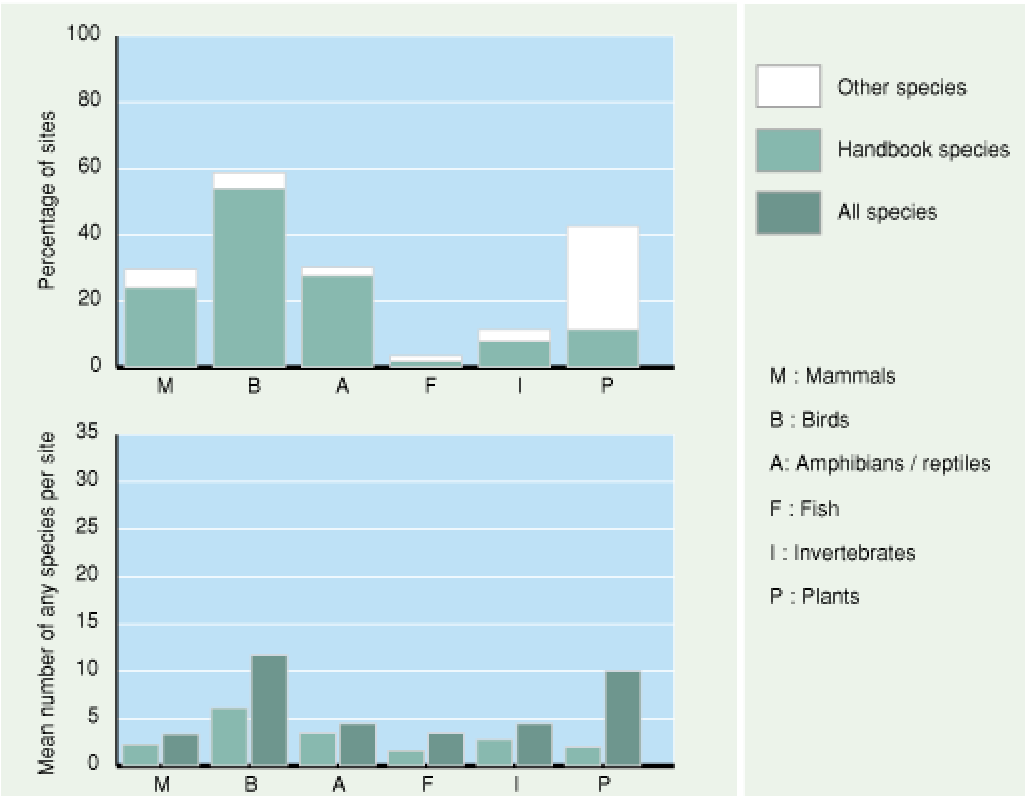


Figure 4.21 -Number of species records in the CORINE biotopes database (continued)

Germany

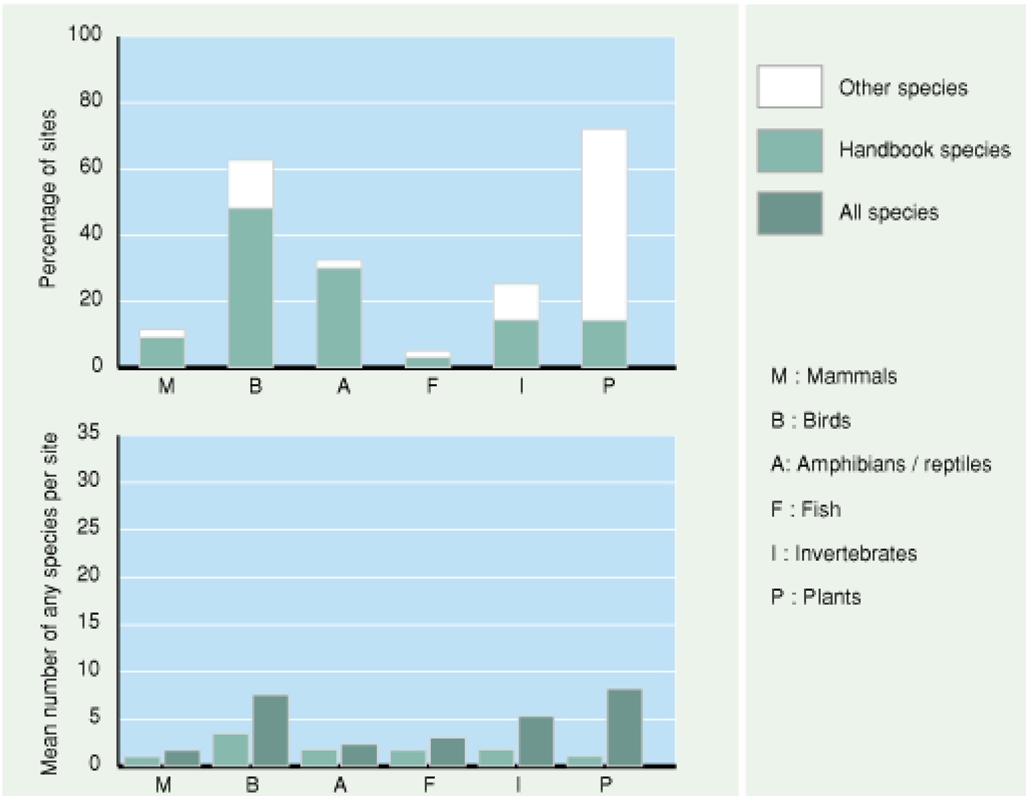


Figure 4.21 -Number of species records in the CORINE biotopes database (continued)

France

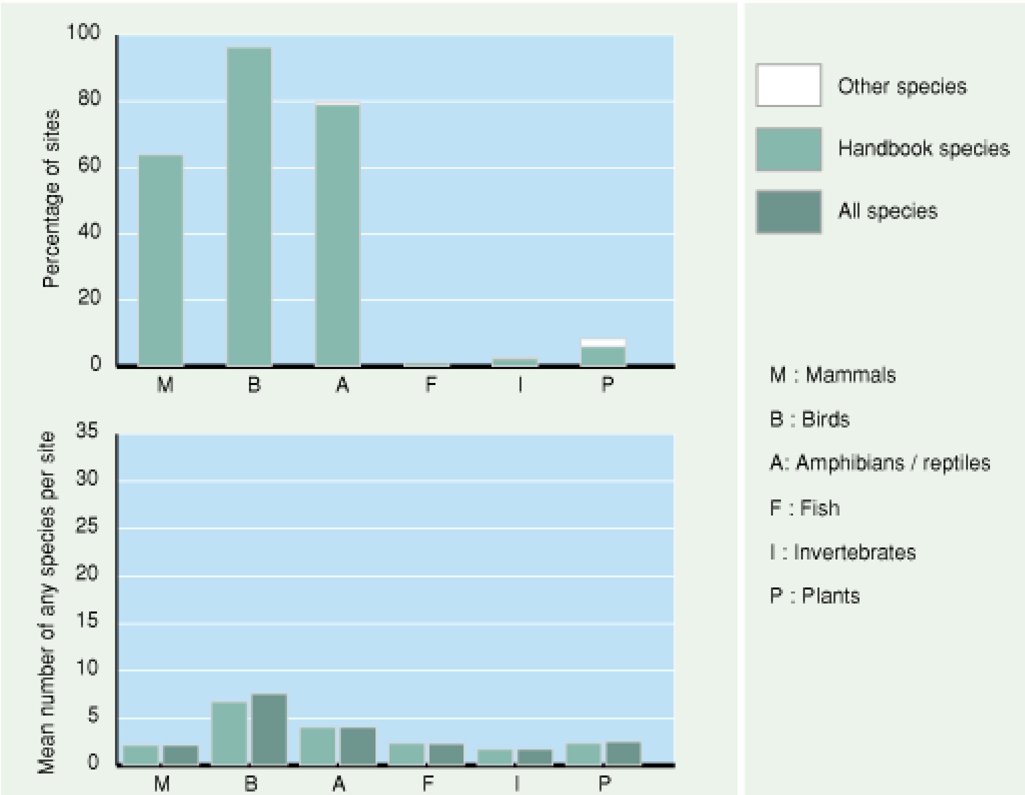


Figure 4.21 -Number of species records in the CORINE biotopes database (continued)

Italy

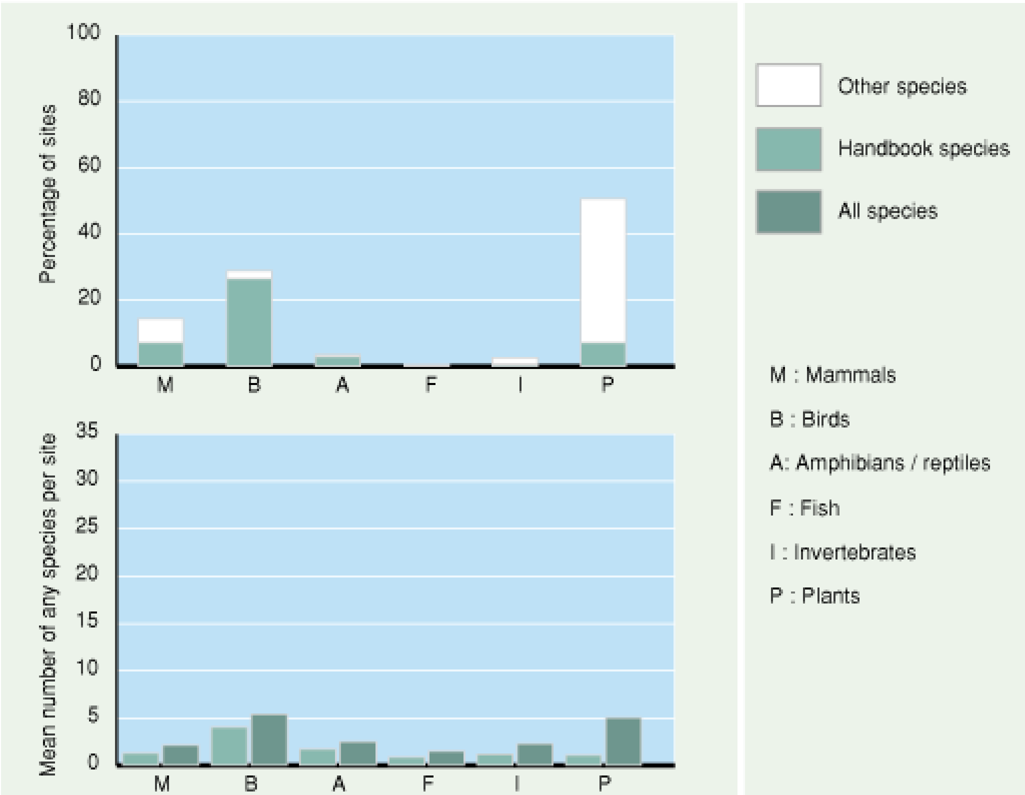


Figure 4.21 -Number of species records in the CORINE biotopes database (continued)

The Netherlands

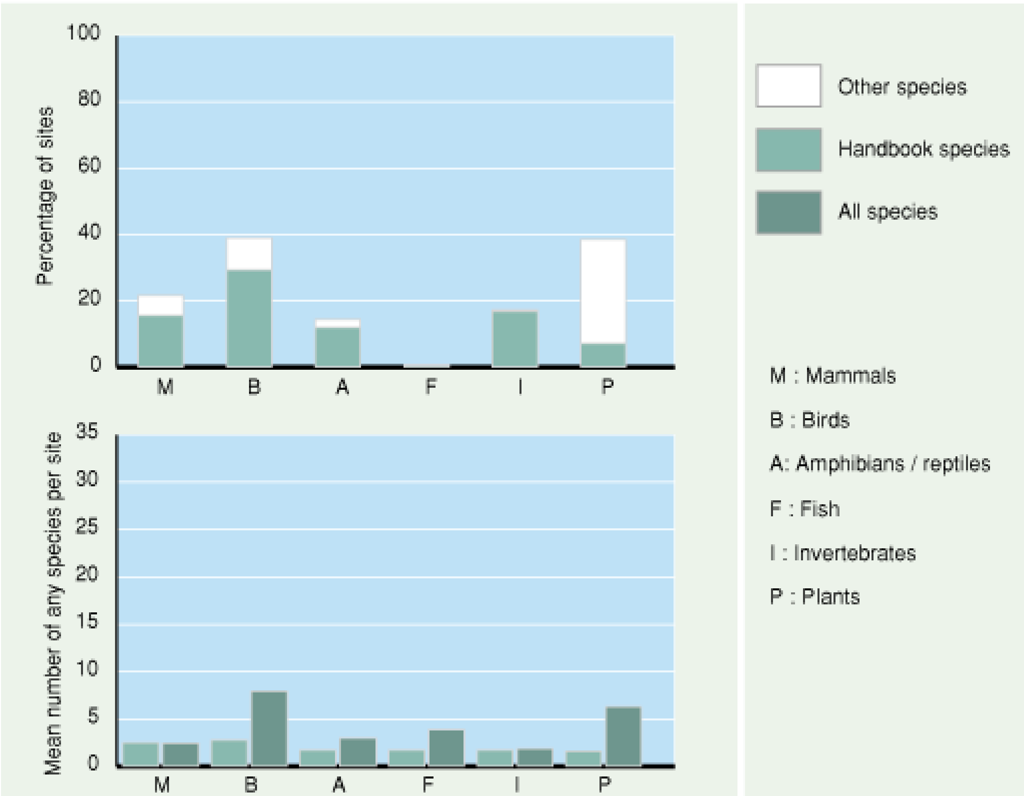


Figure 4.21 -Number of species records in the CORINE biotopes database (continued)

Belgium

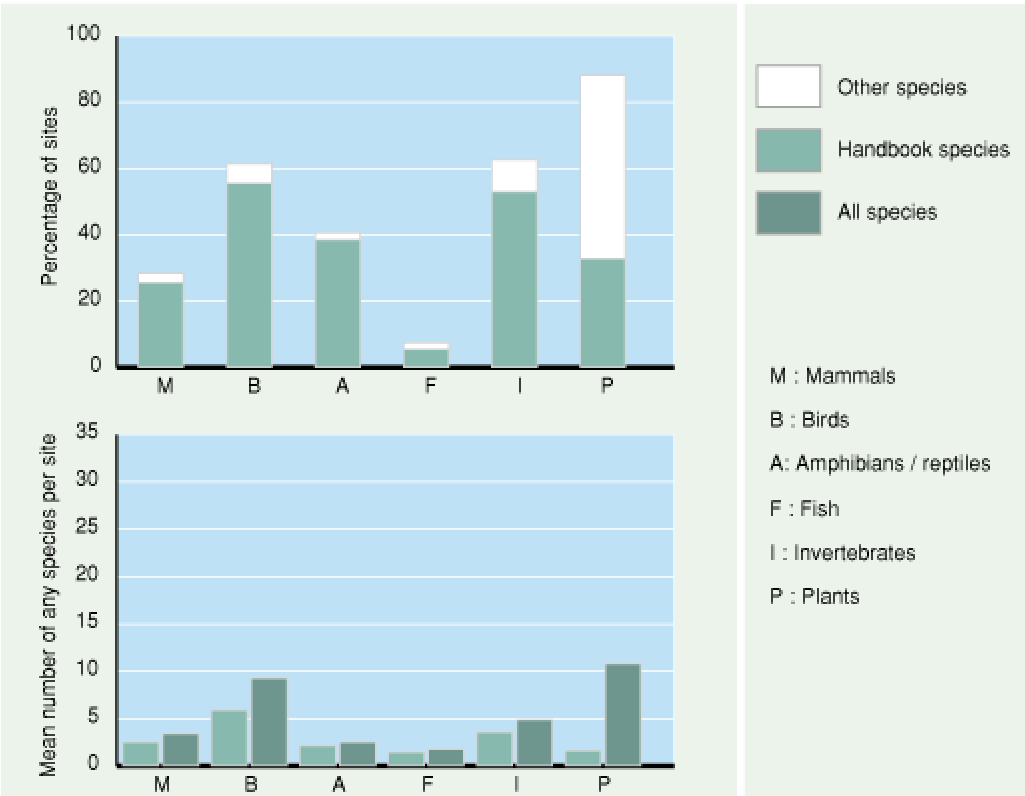


Figure 4.21 -Number of species records in the CORINE biotopes database (continued)

Luxembourg

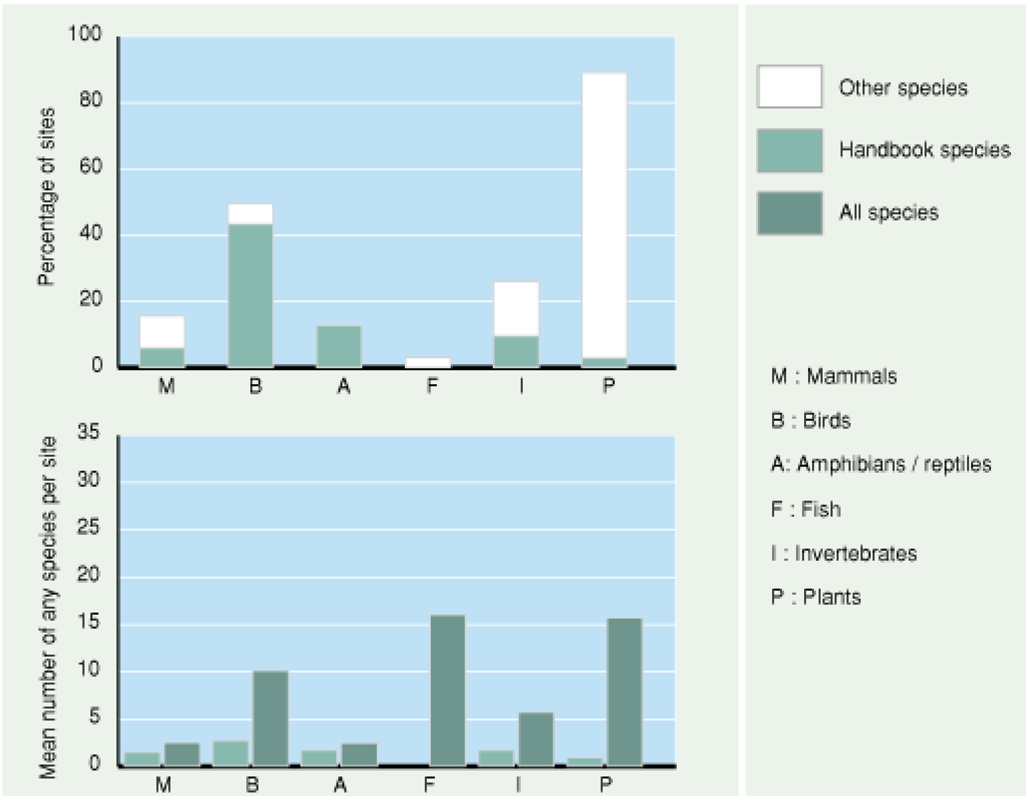


Figure 4.21 -Number of species records in the CORINE biotopes database (continued)

United Kingdom

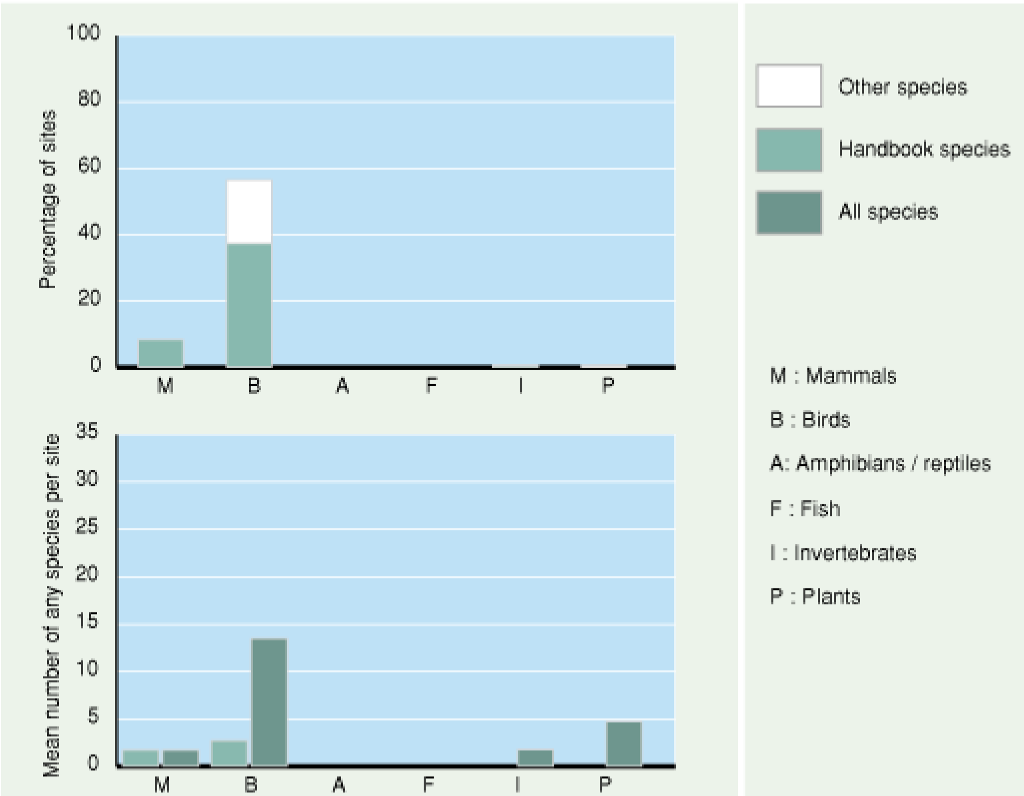


Figure 4.21 -Number of species records in the CORINE biotopes database (continued)

Ireland

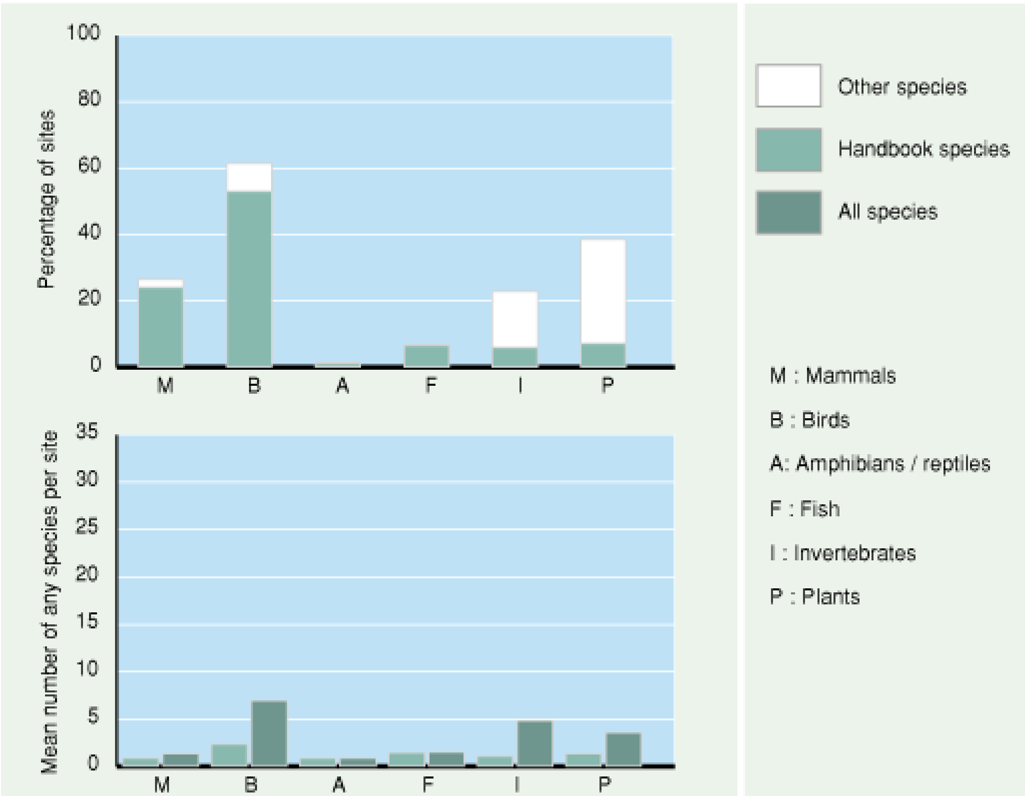


Figure 4.21 -Number of species records in the CORINE biotopes database (continued)

Denmark

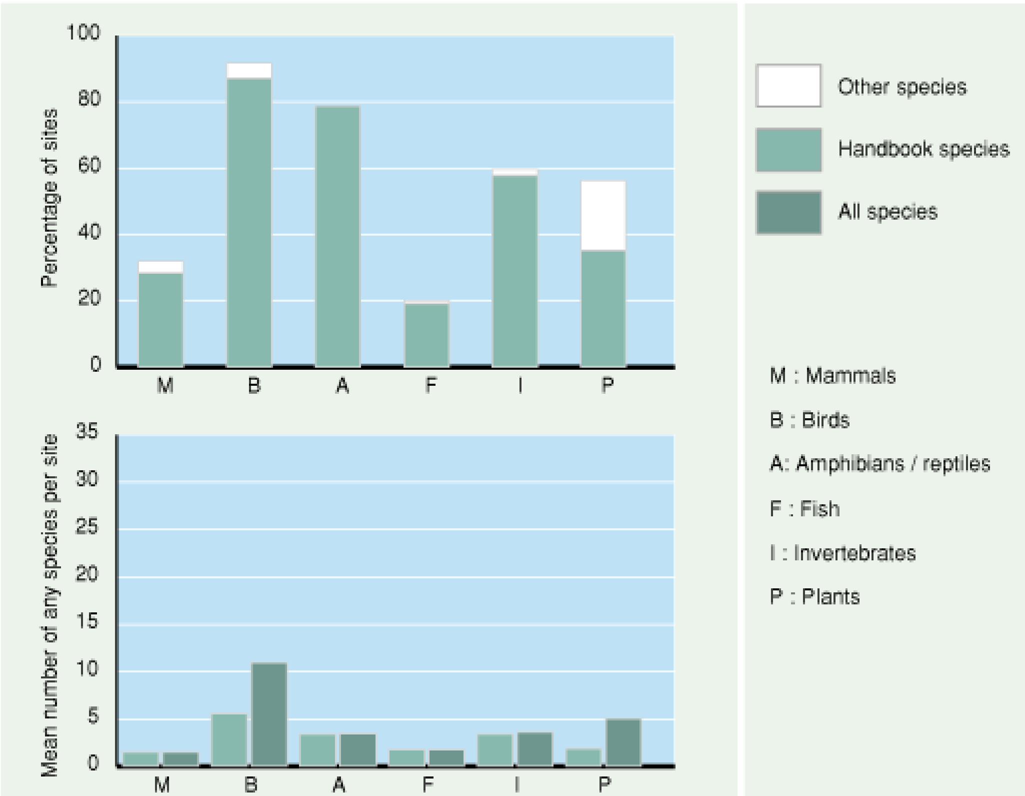


Figure 4.21 -Number of species records in the CORINE biotopes database (continued)

Greece

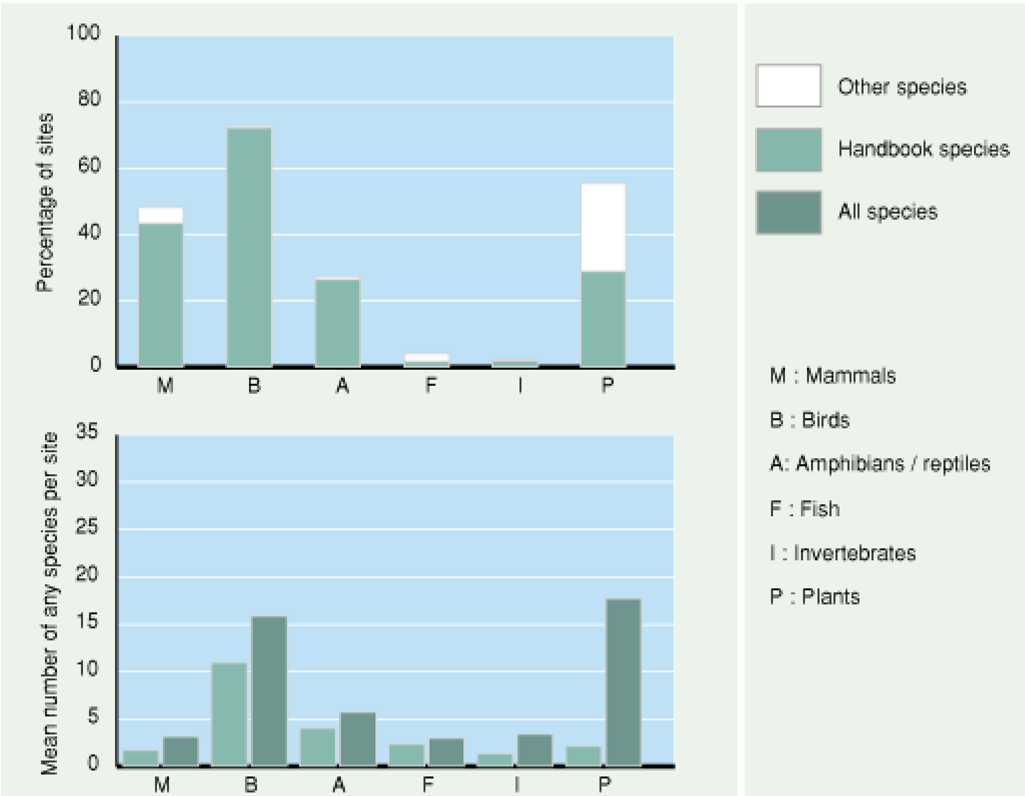


Figure 4.21 -Number of species records in the CORINE biotopes database (continued)

Spain

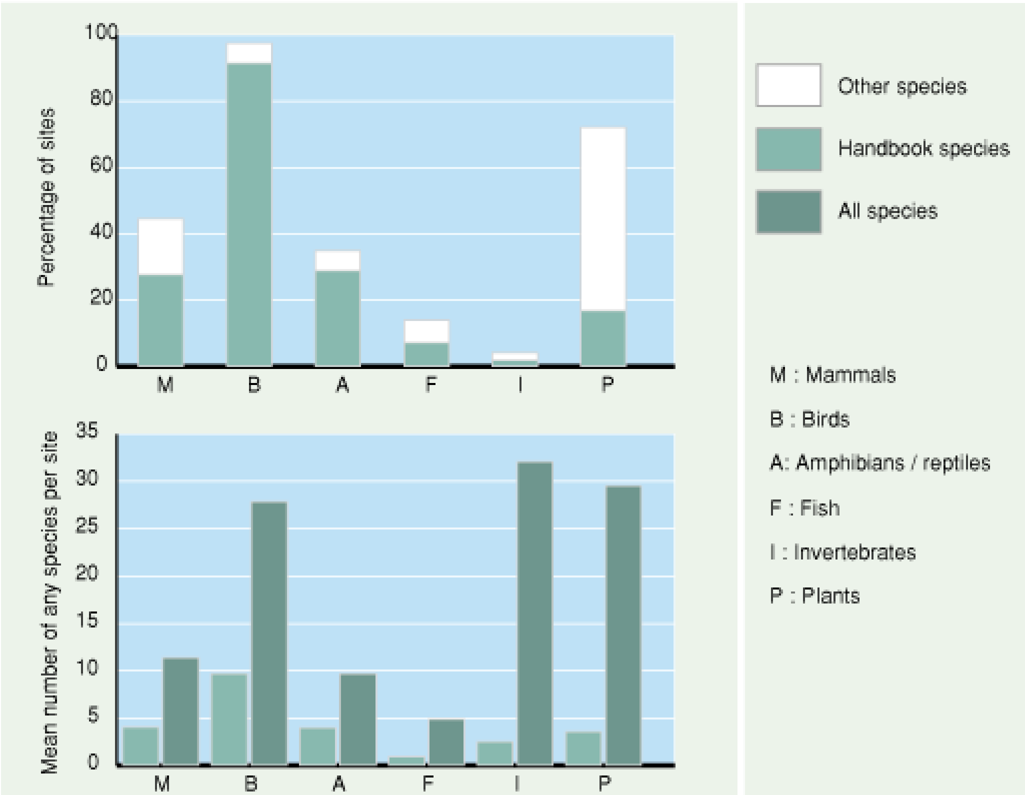


Figure 4.21 -Number of species records in the CORINE biotopes database (continued)

Portugal

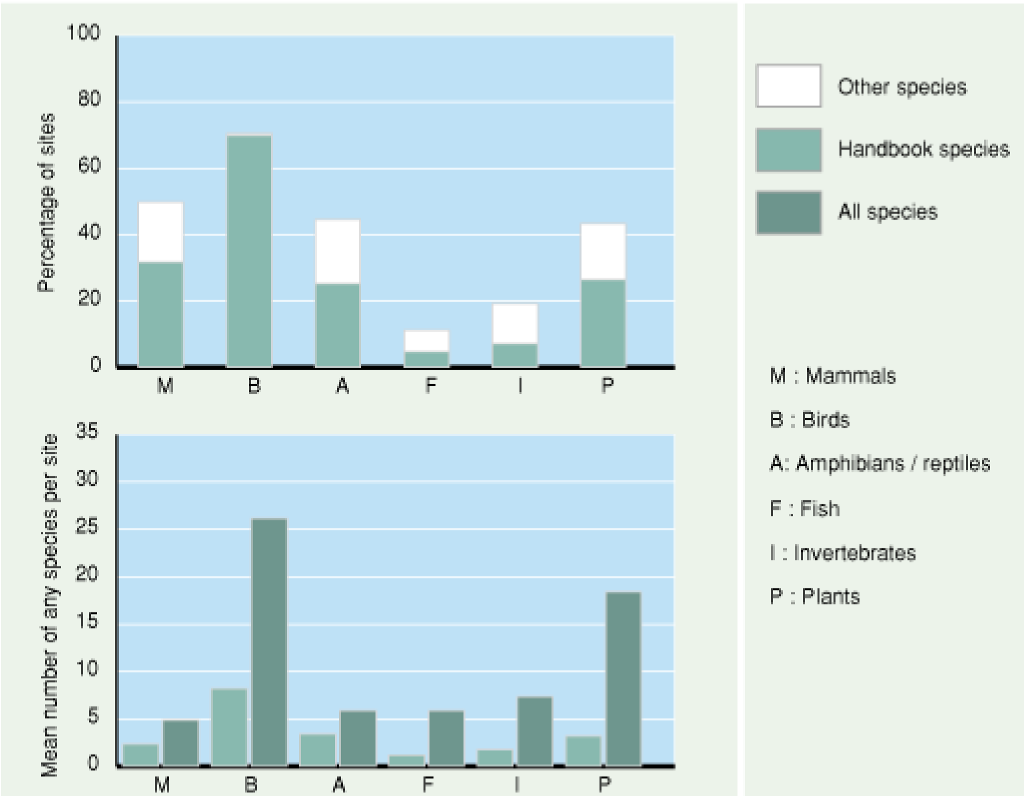
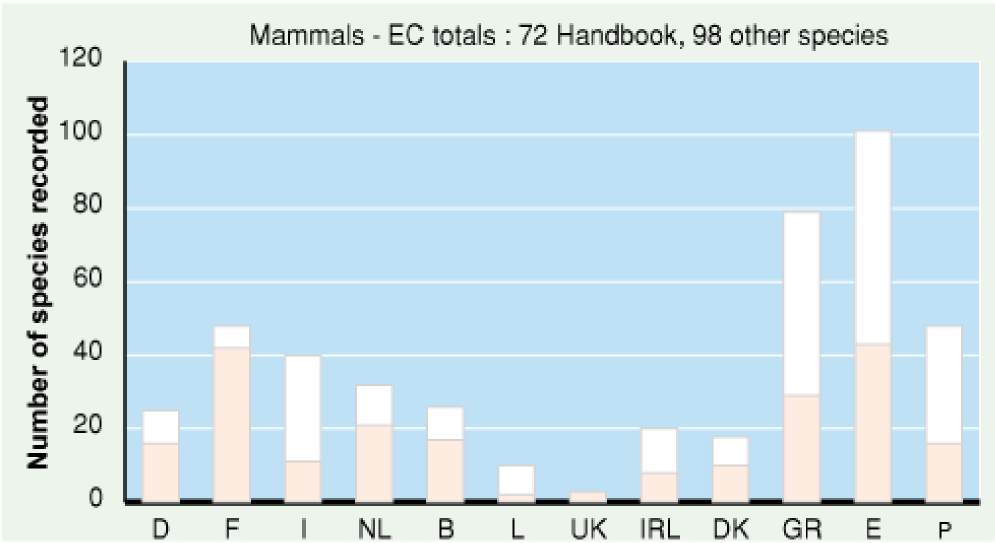


Figure 4.22 -Number of species recorded per Member State in each species group



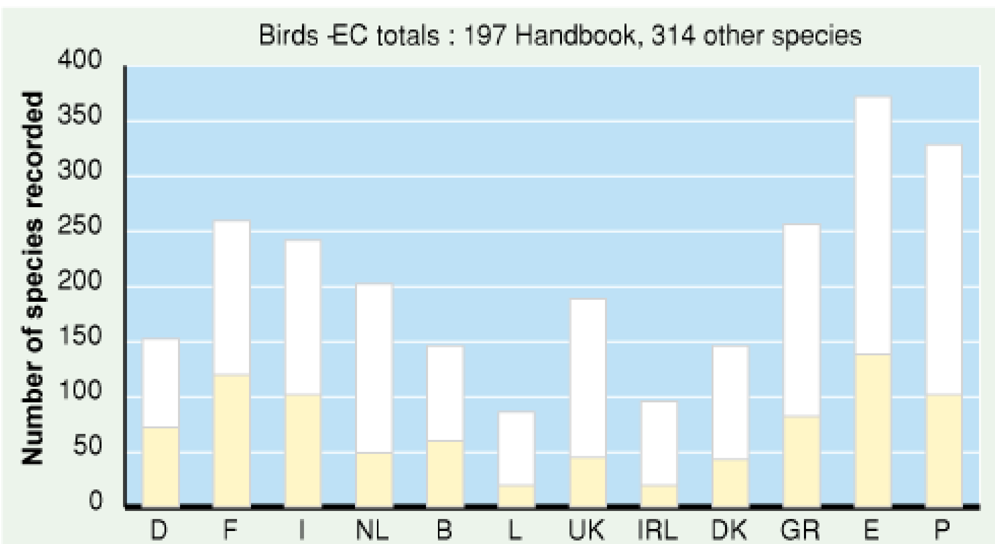


Figure 4.22 -Number of species recorded per Member State in each species group (continued)

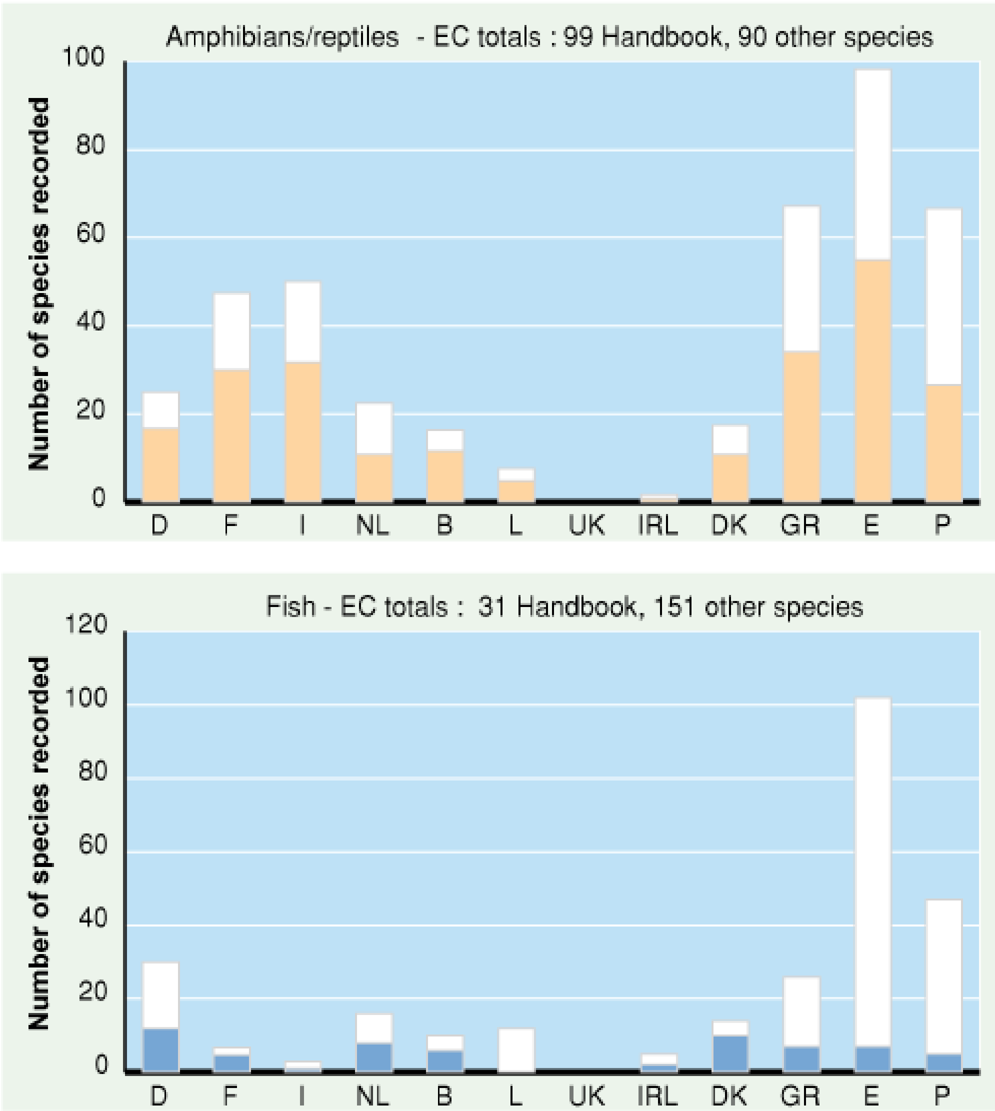
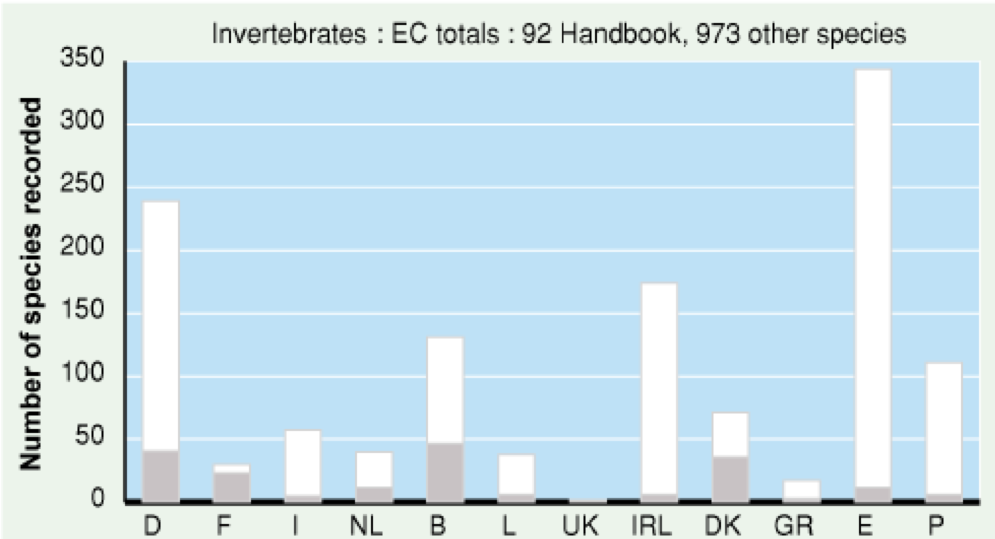
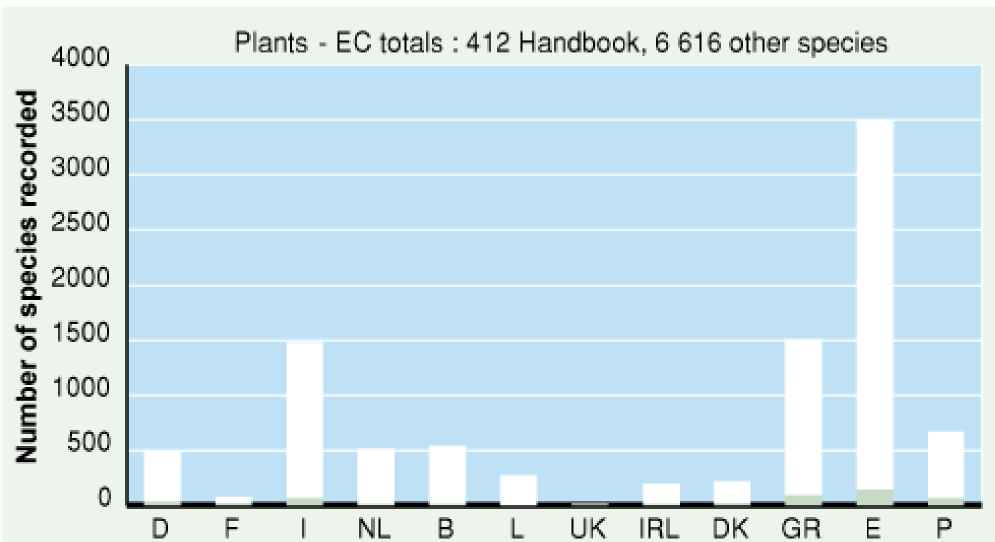


Figure 4.22 -Number of species recorded per Member State in each species group (continued)

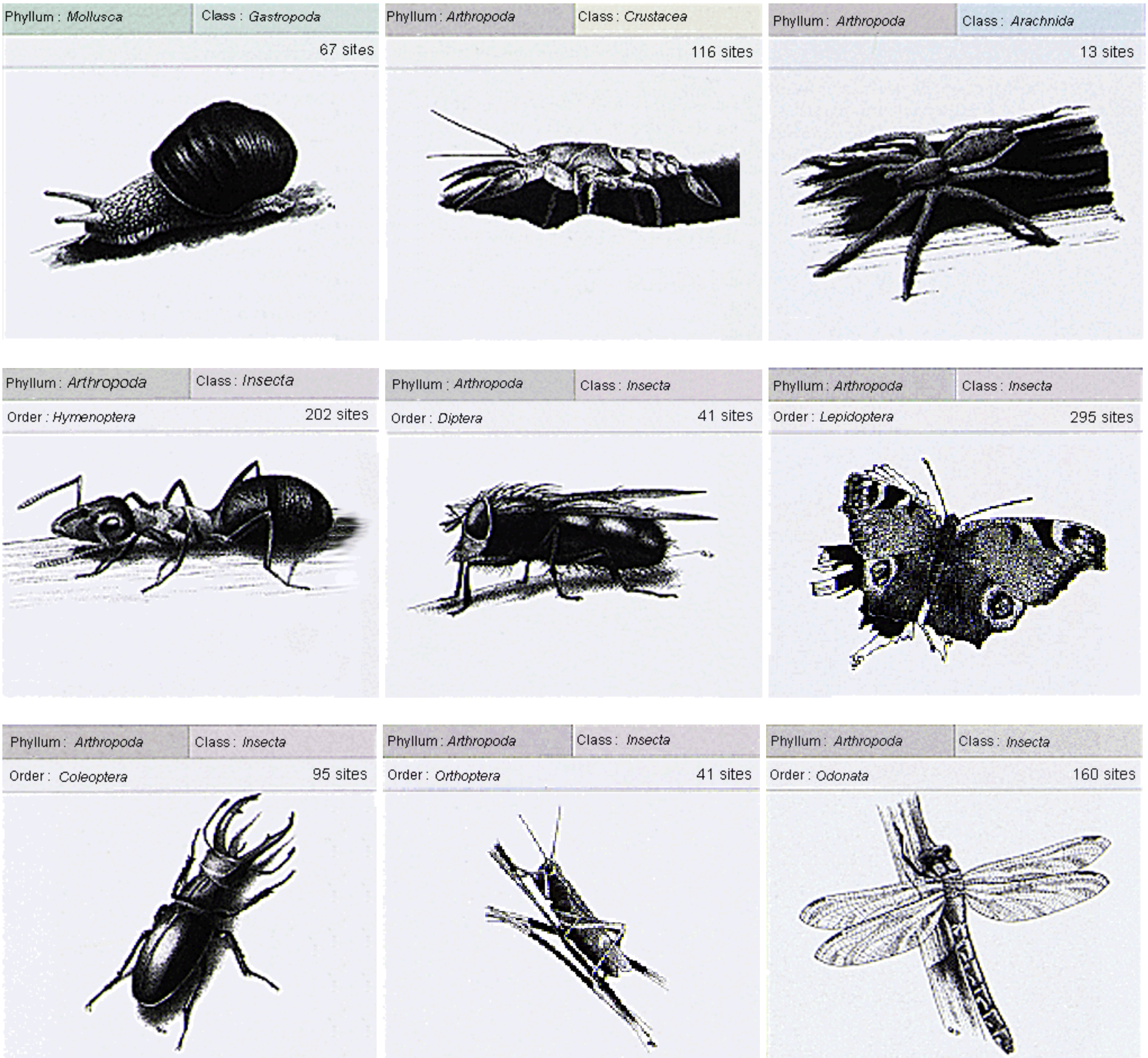




An alternative comparison can be made between total numbers of species of each group recorded per Member State and in the database as a whole (Figure 4.22). For mammals, and also amphibians and reptiles, the Mediterranean countries have many more species than the more northerly ones, but in the former area there is a lower proportion of handbook species amongst the fauna. The numbers of bird species as recorded are probably almost complete, with greatest numbers in the Mediterranean and least in Ireland (due to its isolation) and Luxembourg (probably due to lack of a sea coast). The numbers of species recorded for the three remaining groups are not complete, and non-handbook species outnumber those listed in the handbook by factors of 5 for fish, 10 for invertebrates and 15 for plants. The impressive totals of around 1 500 plant species in the data for Greece and Italy are eclipsed by over 3 500 for Spain. It is possible to put forward some suggestions concerning the selection of Red Data Book species lists from these comparisons: typically Mediterranean mammal, amphibian and reptile species may be under-represented in these lists; the lists for fish, invertebrates and plants are apparently much more selective than those for birds.

In order to validate the species nomenclature, and especially the plant names, extensive checking using taxonomic works of reference and species checklists was undertaken. This was particularly important so as to standardize on species nomenclature, since there was otherwise the risk that a species would be recorded under one name in one Member State, and a different name in another State, and it would be impossible to gain a Community-wide view of that species' distribution. In view of the very large numbers of plant species recorded as mentioned above, this problem was by far the most intractable for 'plants', which include in the source data undifferentiated lists of vascular plants, lower plants, fungi, lichens and algae. A subcontract was let to the Department of Botany of the Natural History Museum, London, so as to validate the 7 000 plant names which have been supplied.

Figure 4.23 -Number of sites in the CORINE biotopes database where various groups of invertebrates are recorded



In order to make use of these extensive species data, a hierarchical coding system has been developed so that every species record also carries a family code (Section 3.6). This makes it possible to analyse the species data at whatever taxonomic level is appropriate to an individual group. Figure 4.23 illustrates this principle with reference to the most frequently recorded invertebrate groups, which are either treated at the taxonomic level of class, or orders of insects. The most widely covered groups are *Lepidoptera and Odonata,* both of which are more readily studied than other invertebrate taxa. The large number of sites for *Hymenoptera* are disproportionately weighted towards the Netherlands.

As a further example of the use of the species coding system, sites containing records of birds of the families Falcon*idae* (falcons) and *Anatidae* (ducks, geese and swans) in Greece show the most important regions for these two groups (Figure 4.24). Such analyses of the potential of the species data are in addition to simple plots of the recorded sites for individual species, such as *Lutra lutra* (the otter). Figure 4.25 shows sites in the Community where otters have been recorded.

The capability exists within the data to combine species and habitat data, for example to assess where, within sites for which its known habitat preferences are found, a particular species of interest is recorded. For example, Figure 4.26 shows the distribution of the marsh orchid *Dactylorhiza sphagnicola,* in Belgium, together with the distribution of its habitat type (poor fens, coded 54.4 in the habitat classification).

A valuable use of the records of handbook species is in locating the sites or regions of greatest diversity for threatened species of particular groups. This can be achieved simply by counting the numbers of handbook species for a given taxonomic group over a particular geographical area. For example, in the Iberian peninsula sites with many threatened amphibian and reptile species are concentrated in the main mountain ranges (Figure 4.27).

Figure 4.24 -CORINE biotopes sites Greece where birds of the families Falconidae and Anatidae are recorded

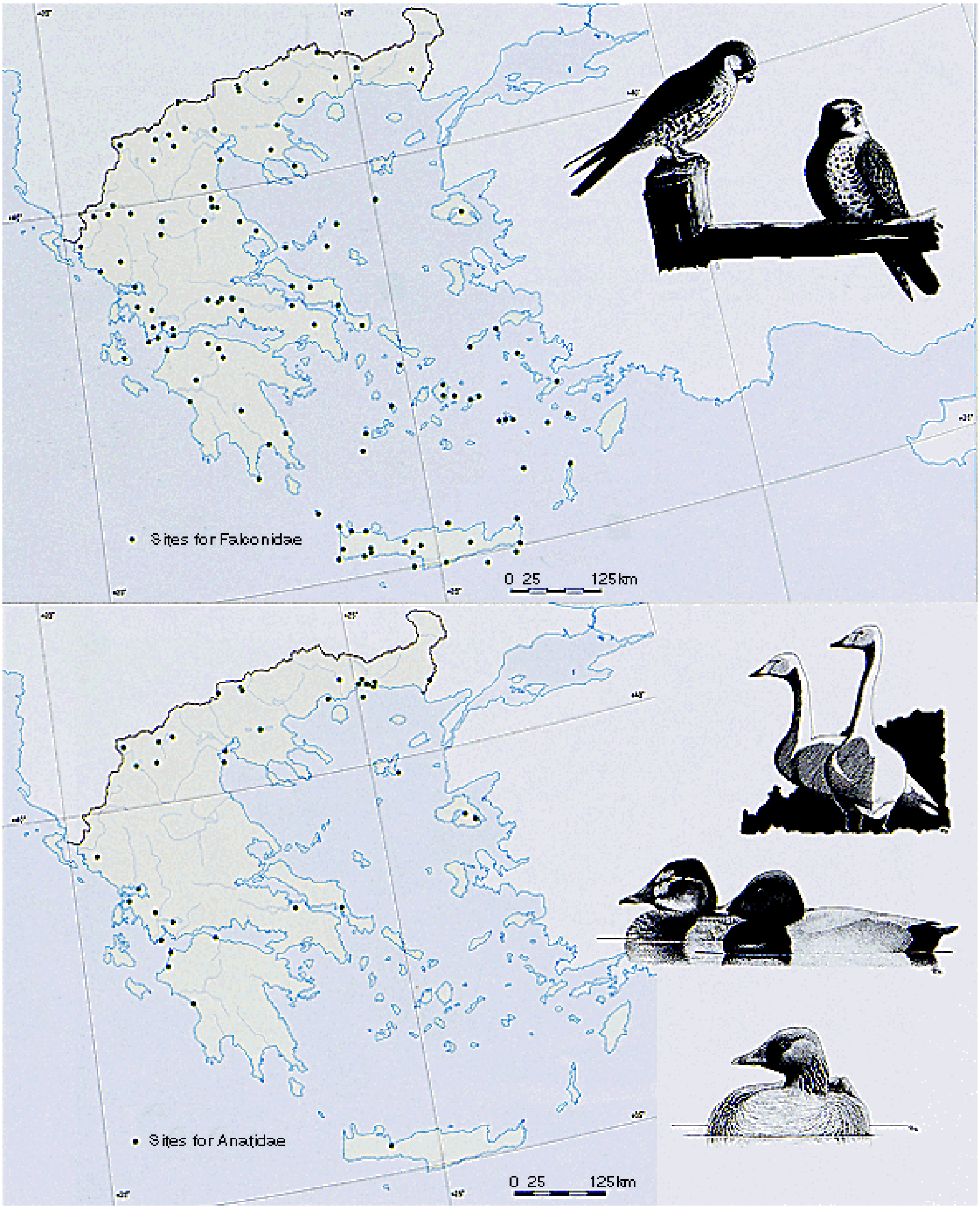


Figure 4.25 -CORINE biotopes sites where Lutra lutra (the otter) is recorded

Otter - *Lutra lutra* (Family : Mustelidae)

The otter was formerly found throughout Europe, but in many regions it has become very rare or even extinct. Although a terrestrial mammal, the otter requires aquatic habitats such as slow-running rivers with rushy and wooded banks, lakes, marshes and rocky seashores. Extremely well adapted to the aquatic environment, its menu is mainly fish, but also includes crustaceans, amphibians and a few waterfowl and small mammals. It breeds and rests underground by rivers, lakes or seashores in 'holts').

Although the map shows 394 sites where the otter has been reported in CORINE biotopes, it is a species in retreat almost everywhere in Europe. Moreover, population densities are sometimes very low and, in places, no longer sustainable. Its natural habitats have been under continuous pressure : marshes have been drained, river banks cleared and treated with herbicides, rivers and lakes polluted, and the sea coast developed for building and disturbed by tourists. Hunting, trapping and poisoning have also been common.

Conservation of the otter therefore requires strengthening of legal protection prevention of further destruction of otter habitats, and the establishment of more sanctuaries where otter populations are known to survive.

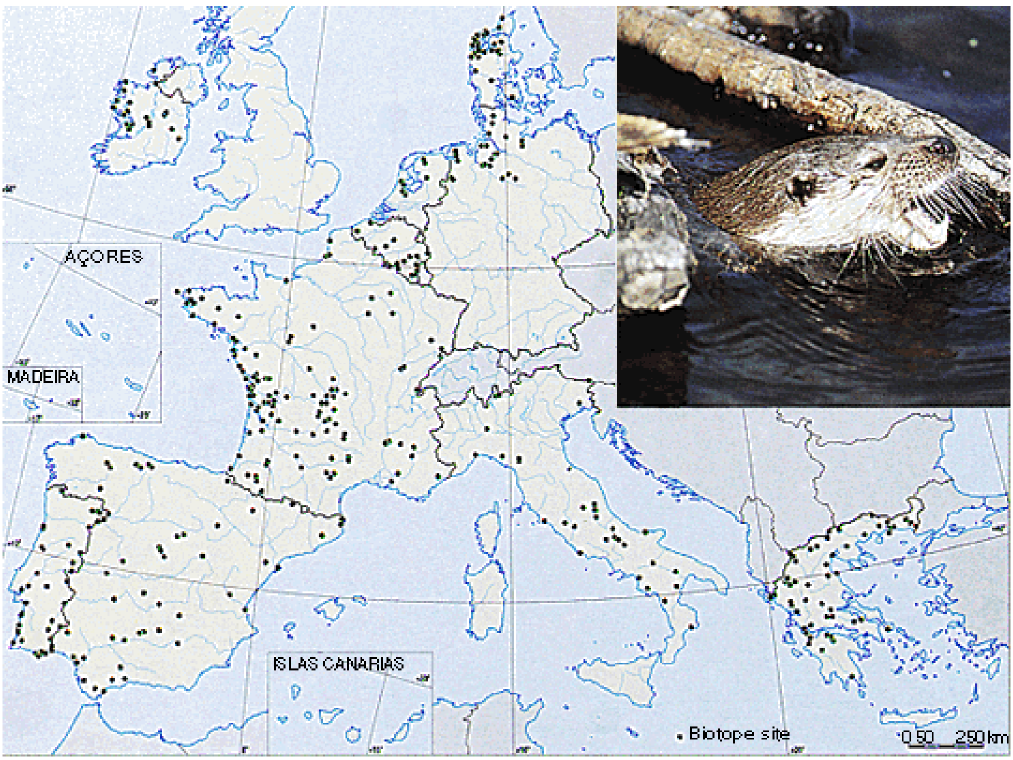
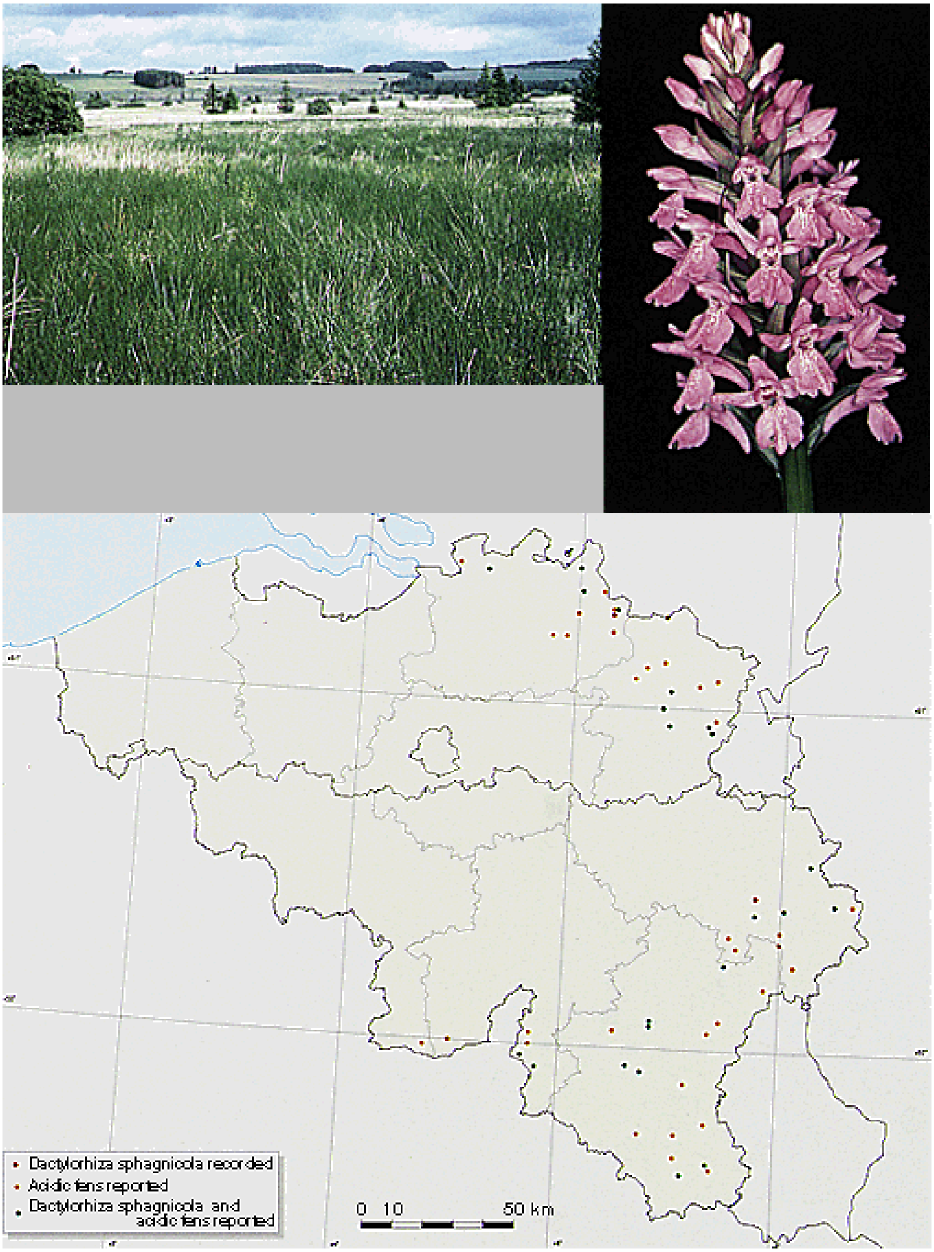


Figure 4.26 -CORINE biotopes sites in Belgium for Dactylorhiza sphagnicola and its habitat type



4.5.8. Site selection criteria

At the time of writing, the data documenting the use of the site selection criteria are available for 23 % of the sites in the database, and the present analysis has been restricted to an evaluation of the major habitat types and species groups used in each Member State (Figure 4.28)

Only for two Member States, Ireland and Denmark, have significant numbers of habitats amongst the 100 most important of their types in the Community been indicated. These results re-emphasize the European importance of the marshes and bogs of Ireland and the coasts of Denmark. At the regional level, the distribution of habitat types used in the selection criteria in each Member State is similar to the habitats of that State as a whole recorded in the habitat type field and illustrated in Figure 4.11, with the exception that man-made or agricultural habitats, as might be expected, rarely qualify a site for selection.

Concerning species, the large number of sites in Greece with populations of mammals birds and plants of Community significance is particularly notable. There are also many sites especially noted for invertebrates (an otherwise underrecorded group) in Belgium, the Netherlands and Ireland.

Figure 4.27 -Numbers of ‘handbook’ species of amphibians and reptiles per site in the Iberian peninsula

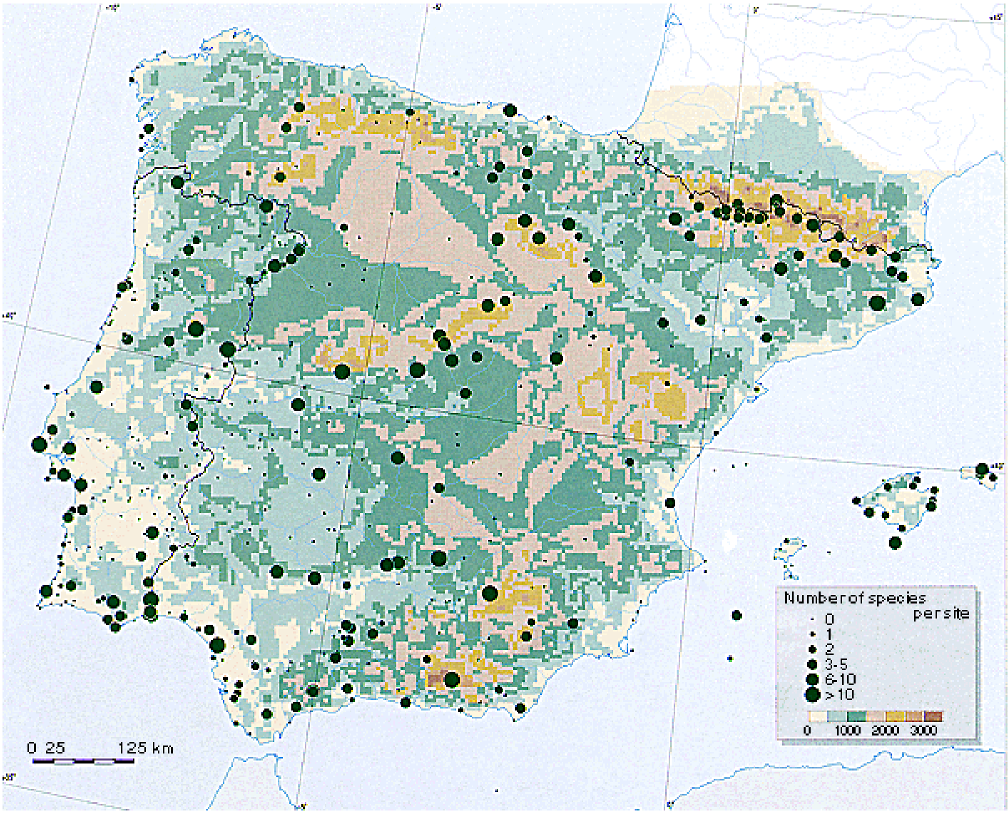
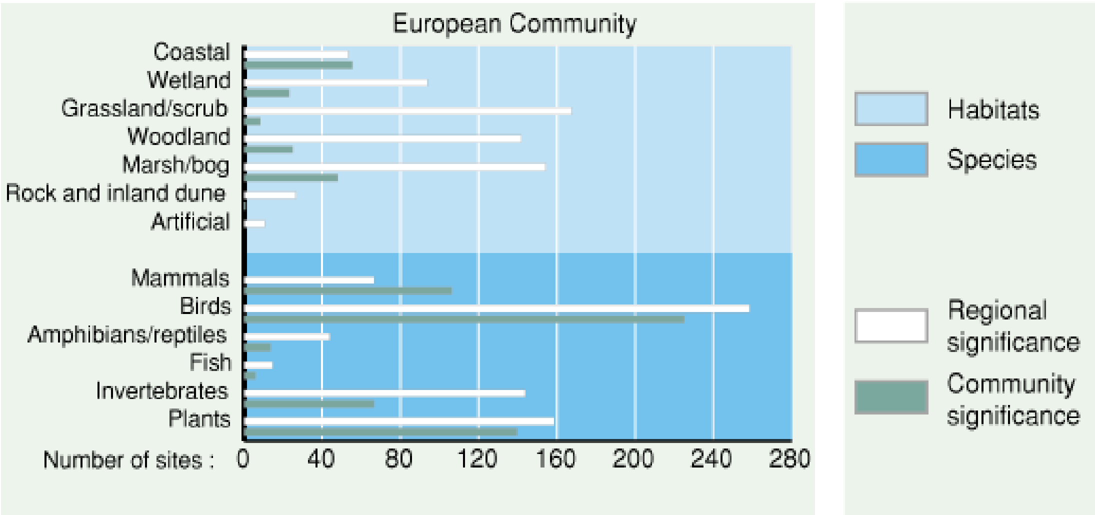


Figure 4.28 -Number of CORINE biotopes sites for each selection criterion specified

European Community



Belgium

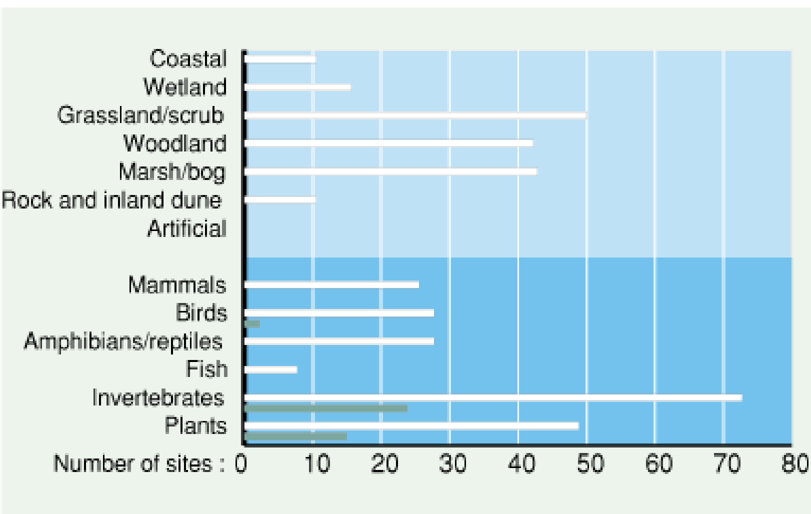
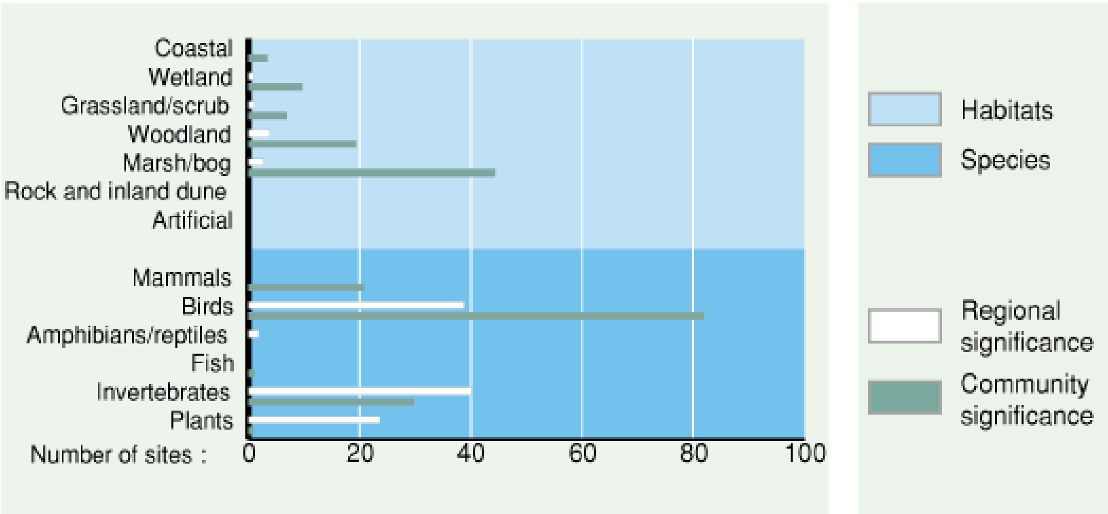


Figure 4.28 -Number of CORINE biotopes sites for each selection criterion specified (continued)

Ireland



Denmark

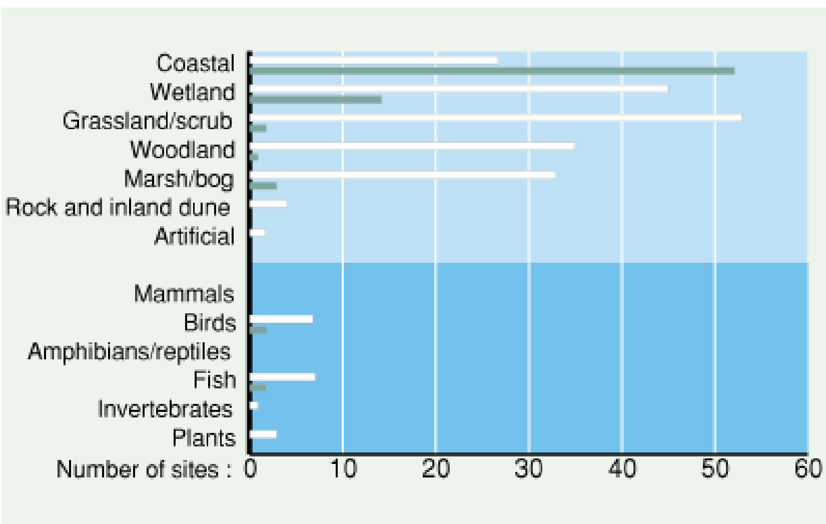
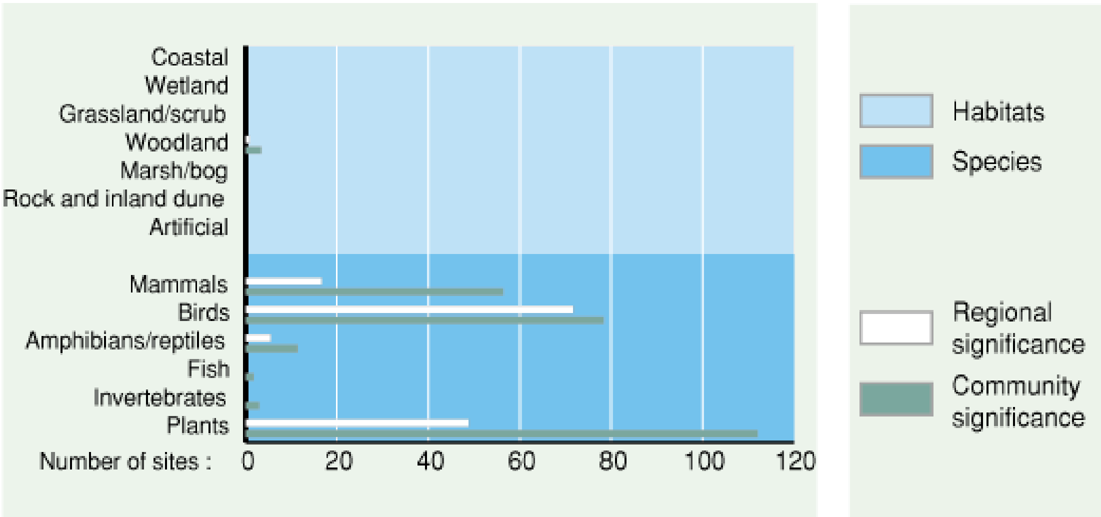


Figure 4.28 -Number of CORINE biotopes sites for each selection criterion specified

Greece



4.6. Conclusion

The task of building the biotopes database has entailed the gathering together of a team of experts with experience of the natural history of each of the Member States, as well as experts whose interests are represented internationally. This *modus operandi* has provided a model for assembling dispersed data-sets concerning various other thematic interests in the CORINE programme and will be a valuable contribution to the construction of the information networks needed for the European Agency. This biotopes team now forms a network of expertise across the Community, the existence of which is one of the most important outcomes of the project. In addition to the body of information which they have already contributed to the database, this network will be available for consultation whenever problems within their area of competence, such as updating or extending the scope of the biotopes database, may arise in the future.

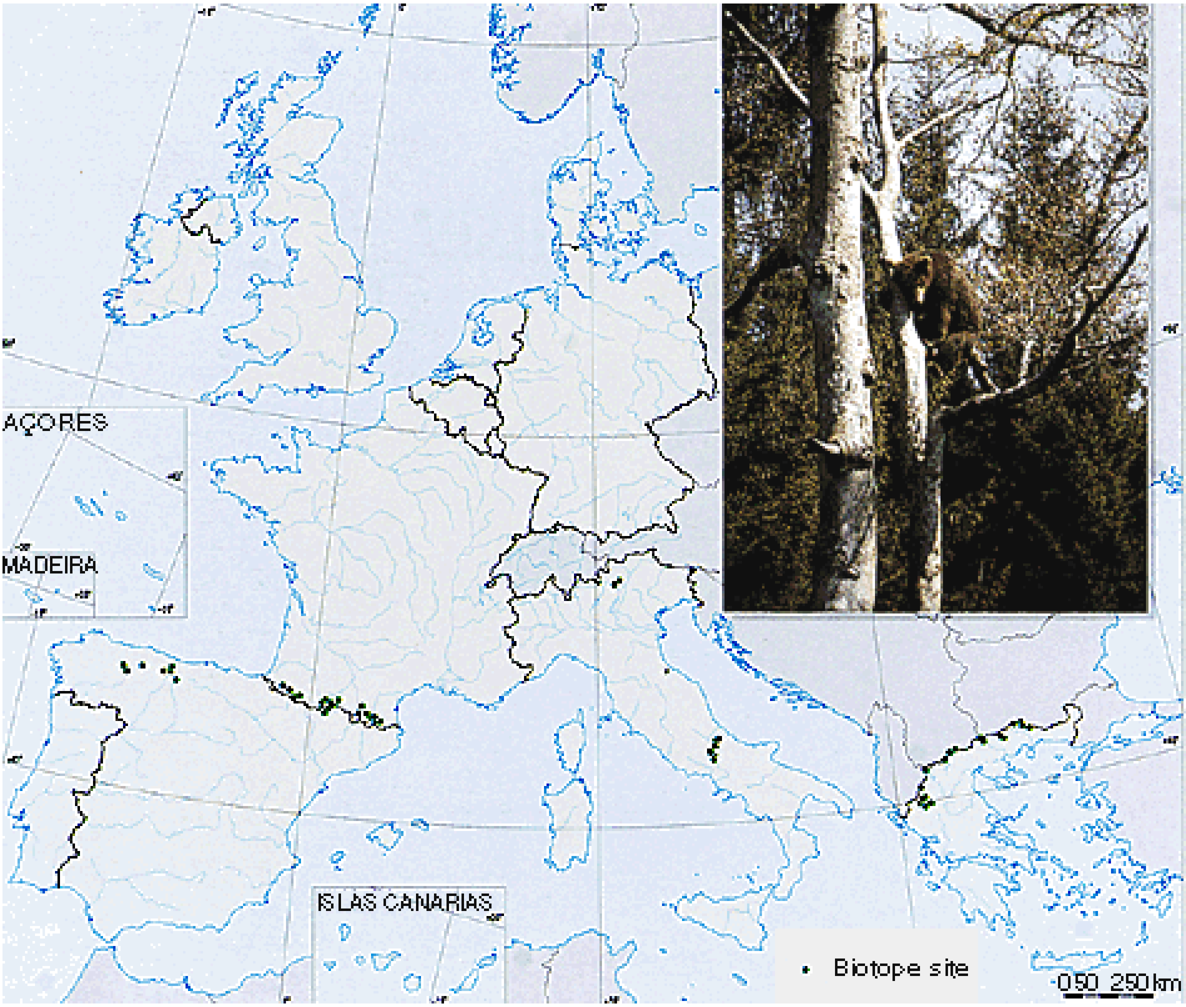
5. Data use

Figure 5.1 -CORINE biotopes sites where Ursus arctos has been recorded

The largest terrestrial mammal of the European Community, the brown bear, occurred in the past all over the Eurasian continent. While the present range remains broadly unchanged on a worldwide scale, the area of distribution has become fragmented, and population numbers are still in decline, particularly in western Europe. The most important threats are poaching and the loss of habitat.

Although a number of areas of importance for the bear are protected, there are problems for the survival of several populations. In February 1989 the European Parliament adopted a resolution on the protection of the brown bear in the European Community. This calls on the Commission, among other things, to give priority to schemes to prevent damage caused by bears or to compensate those affected by it, and to focus its efforts on setting up consistent networks of reserves and of special protection zones in the areas occupied by bears.

On the map, derived from the CORINE biotopes inventory, all the areas still occupied by brown bears in the European Community are shown. The range is subdivided into six separate populations: in Greece the Pindus mountains (c. 150 individuals) and Rhodopi mountains (c. 20); in Italy the Abruzzi (c. 50) and Trentino Alps (c. 15); the Pyrenees (c. 25) of France and Spain; and the Cantabrian mountains (c. 60) in Spain.


AÇORES
MADEIRA
ISLAS CANARIAS
Biotope site
0 50 250 km

5.1. Evaluation and illustration of potential uses of the data

The biotopes database is unique in the breadth of its geographic and subject coverage and is attracting attention as a valuable source of information on the environment in the Community for applications in both scientific research and environmental protection. Moreover, in addition to the uses to which the data held in the biotopes database have been put, the methodology has attracted widespread attention from bodies both within and beyond the European Community. Copies of either the biotopes technical handbook or the habitat classification (or both) have been distributed widely on request, for example to specialist groups with an interest in recording information about particular types of sites, or to bodies in countries outside the Community (for example, in Scandinavia or Eastern Europe) who are concerned with initiating similar databases.

Commensurate with the wide range of information recorded in the biotopes files is the range of individual applications of the data. These fall into a number of categories according to user: the CORINE central team in DG XI; other divisions in DG XI (notably the division which is responsible for drafting and effecting Community directives on species and habitat protection); other Directorates-General of the CEC; other European institutions, and other organizations. Users of the data outside the European Commission are requested to complete a simple form of agreement specifying the task for which they are using the data and asking for their help in validation of the data which they receive. For some complex analyses it proved necessary for users to discuss their requirements in detail so as to ensure that the present state of the database would be appropriate for their needs.

Typical questions put to the database include requests from DG XI for mapping of specific areas; from DG VI (Directorate-General for Agriculture) for agricultural policy-making, using the land cover biotopes study of Portugal; from the European Investment Bank for mapping in connection with physical planning of infrastructure development (for example, new road schemes). External organizations have included the North Sea Task Force (mapping of marine and coastal biotopes sites), the University College, London, study of the effects of sea-level rise on coastal sites (se below), and a variety of more specific applications, concerning individual localities or species. One such example is the monk seal *(Monachus monachus),* a mammal whose status gives rise to particular concern.

Mediterranean monk seal *(Monachus monachus)*

The family Phocidae comprises 1 9 species of seals worldwide, which mostly inhabit arctic and sub-arctic seas of both polar regions. The monk seals (genus *Monachus)* are the only exception, being resident in sub-tropical and tropical seas. In the past the Mediterranean monk seal occurred throughout the Mediterranean and on the North African Atlantic coast, reaching as far as the Black Sea and Sea of Marmara. However, it has now disappeared entirely from the coasts of Spain and France, and the total world population is estimated to be less than 1 000. About half this population is thought to occur in the European Community, mostly in Greece, and other major populations are off the coasts of Turkey and Morocco.

The reasons for the monk seal's decline are thought to include persecution by fishermen, disturbance by tourists, loss of habitat and pollution by organochlorine compounds. Inbreeding as a result of the smallness of surviving populations may now also be a factor. Deliberate killing was widespread in the past and is reported to continue illegally on occasion, but accidental drowning in nylon fishing nets, especially of pups, is possibly the greatest threat now.

The photograph illustrates a programme partly funded by the European Commission to develop a register of monk seals in the European Community. Individuals can be identified by the white spots in their fur.

The monk seal has been reported in 35 CORINE biotope sites (listed beside), of which 30 are in Greece.

Costa Da Cala Gonone
A Capo Monte Santo (Golfo Di Orosei Eentroterra)
Golfo Di Orosei
Nissos Dia
Nissi Dionissiades
Voria Syros
Nissi Kira-Panaghia, Piperi, Ghioura (Vorii Sporades)
Nissi Fourni
Nissos Tilos
Nissi Ananes
Nissos Skantzoura
Vorios Sifnos
Akrotirio Akritas;
Nisos Sapientza/Nisos Skhiza
Ditika Kai Notia Kithira
Nissi Paxi and Andipaxi
Nissi Strofades
Nissi Arki Kai Lipsi
Nissos Saria
Ormos Kai Akres Laganas Zakynthos
Elaphonissi
Nissos Aghiou Efstratios
Nissos Kassos
Nissi Meghisti, Ro, Stronghili (Kastelloriso)
Periochi Plagias Ikaria
Mikro Kai Megalo Seitani, Samos
Nissos Nikouria (Amorgos)
Nissides Koufonissia
Nissides Paximadia
Nissos Astipalea (Stampalia)
Nissos Ofidoussa
Fanari Ikarias
Nissos Ghioura
Islas Chafar nas
Ilhas Desertas
Ponta De S. Lourenco

Figure 5.2 -Comparison between CORINE biotopes sites where Gypaetus barbatus has been recorded and sites designated by the Member States as special protection areas (Directive 79/409/EEC)

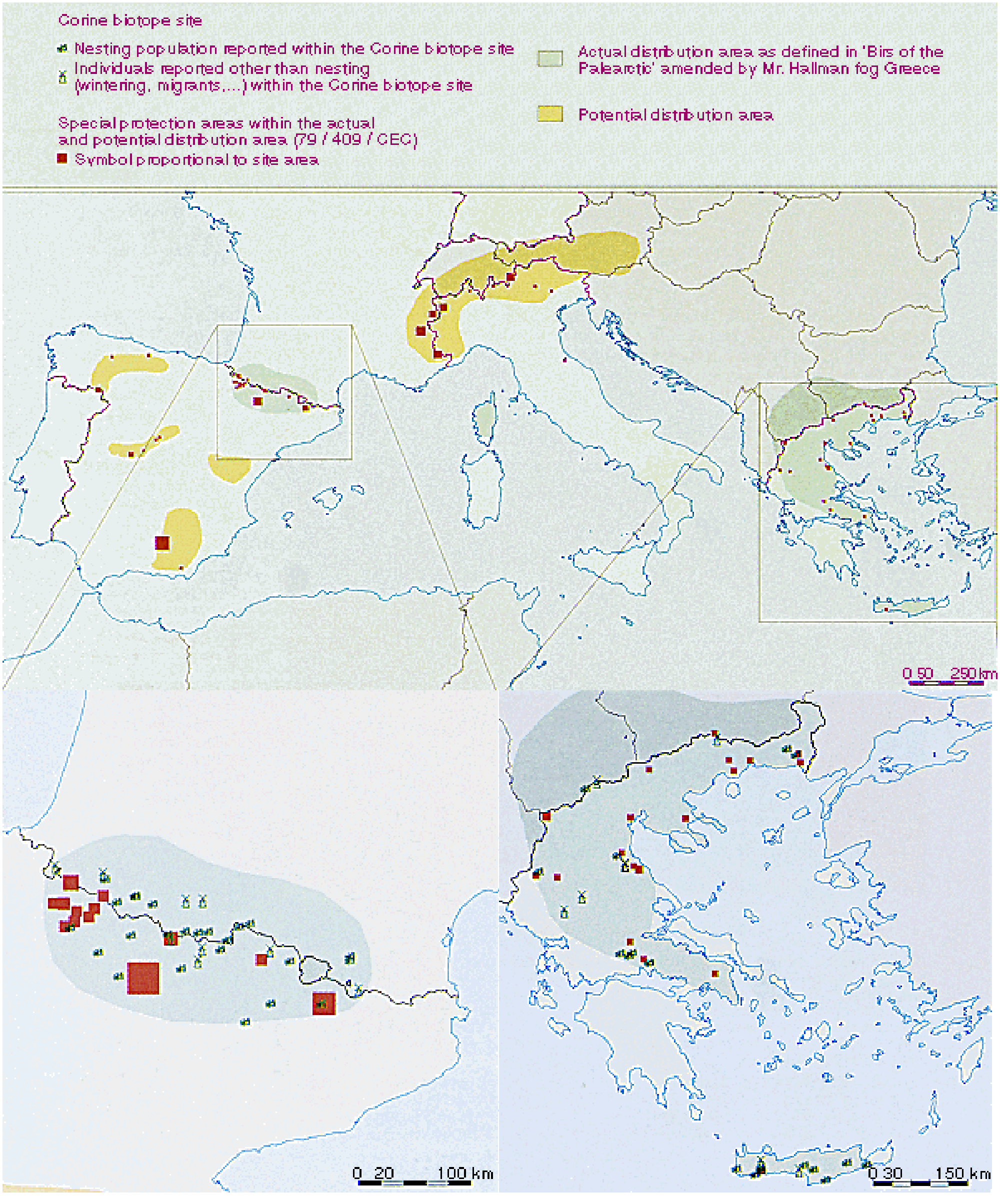
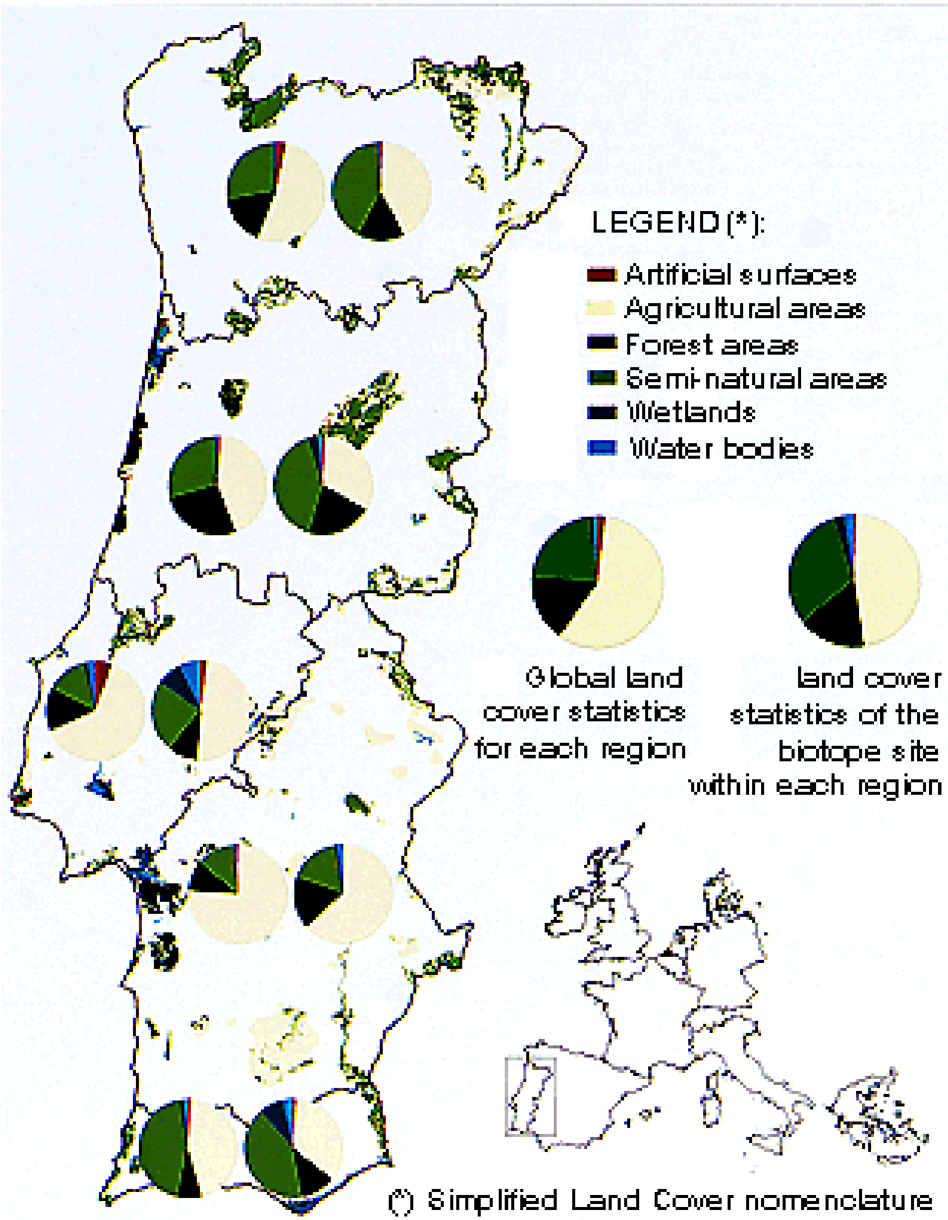


Figure 5.3 -Estimate of the extent of agricultural areas within the CORINE biotopes sites, ,using the CORINE land cover map in Portugal

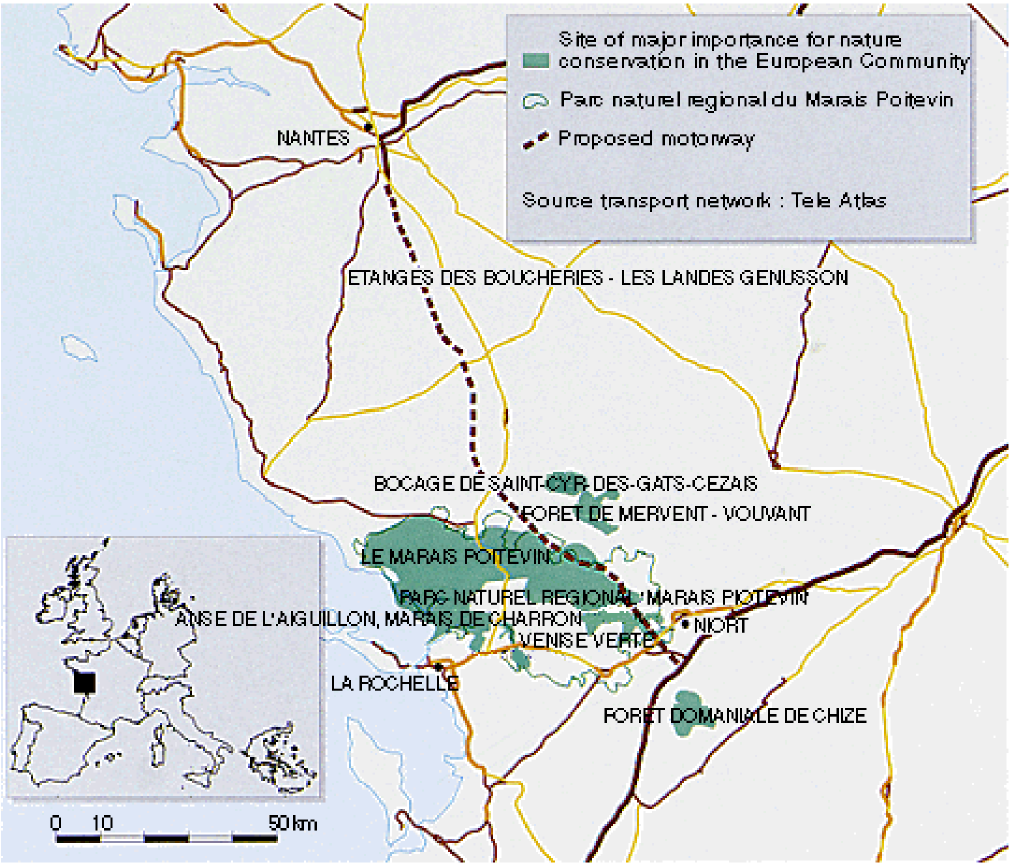


In order to make the database accessible to potential users, the data retrieval program on the ITE VAX computer system was written (Section 3.6.5). Using this program it is possible to respond to data requests involving the selection of sites on the basis of geographic area (NUTS region or coordinates); site, region or district name, respondent name; habitat, designation, motivation or human activity type; or species recorded. This retrieval program is also available to users via international computer networks. Data have been used for information from DG XI needed to implement Directive 79/409/EEC (the 'Birds Directive') and to draft the new Directive on the protection of natural and semi-natural habitats and of wild fauna and flora (the 'Habitats Directive'). Other uses include data gathering for replies to many Parliamentary Questions and to written requests for information, DG XI opinions on regional or agricultural policy, and special missions to Member States or regions. The VAX system has been used for tabulations and statistical summaries to answer complex questions, for example concerning site characteristics or species distribution.

The copy of the database mounted on an ARC/INFO geographic information system by the CORINE central team in Brussels, together with the digitized boundaries of biotopes in Portugal and Belgium, is used for the production of a wide variety of maps and other graphical material for dissemination of biotopes information in displays at meetings and for publications using CORINE biotopes data. In addition to these elaborate products, data have frequently been distributed in the form of listings or diskettes.

A few specific examples of the use of the database demonstrate its versatility and its potential value for the assessment and management of natural resources.

Figure 5.4 -CORINE biotopes sites in the neighbourhood of the proposed road track



The proposed Community Directive on the conservation of fauna, flora and habitats (the 'Habitats Directive'): the design and implementation of this programme to establish a European network of special protection areas requires sitebased information on the distribution of such species and habitats. The data held in the biotopes database have enabled the participants in the preparatory discussions to assess the consequences of the inclusion of certain endangered or vulnerable species in the annexes to the Directive, for example, in terms of the extent of areas which would need to be designated. Figure 5.1 maps sites where the brown bear, *Ursus arctos,* an endangered species, has been recorded.

The habitats to be designated are described in an annex to the draft Directive. This uses the CORINE habitat classification, including the hierarchical typology of that classification. Data from the biotopes inventory were used to map habitats nominated for inclusion in the annex (e.g. Figure 5.7) and, in combination with data from other sources, to assess the consequences of changing the composition of the annex, in terms of its effectiveness for nature conservation and its ease of implementation.

Implementation of the Community Directive on the conservation of wild birds: this Directive (European Commission, 1979) calls on Member States to classify in particular the most suitable territories in number and size as special protection areas for the conservation of the species of Annex I to the Directive.

Using the CORINE biotopes inventory it is possible to identify sites of importance for ` bird species in the Community. By overlaying them with the CORINE designated areas database, which includes the special protection areas, the extent to which these measures have been implemented can be indicated, and how complete the protection

Figure 5.5 -EC structural Funds regions and CORINE biotopes sites

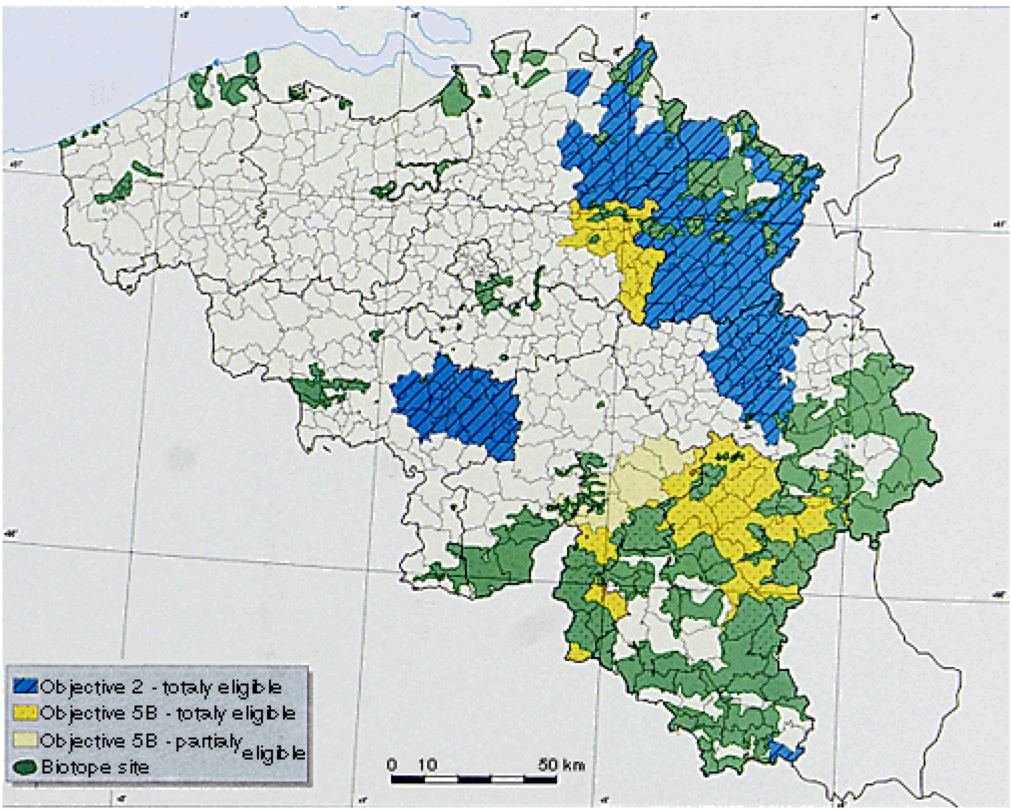


Figure 5.6 -Atlantic sites at risk to flooding if sea level rises

is that they offer at a particular moment in time, within the actual or potential distribution area of the species. Figure 5.2 shows for example that *Gypaetus barbatus* has been reported in 20 CORINE biotope sites within the Pyrenees. Only some of them, as a whole or partly, have been communicated to the Commission as special protection areas, and these are all in Spain.

By repeating this exercise for all Annex I species of the Directive, one can help to reach the final objective of the Directive in collaboration with the Member States.

Relationships between agriculture and conservation of natural habitats: as part of the preparation of the Directive on the protection of natural and semi-natural habitats of the Community (mentioned above), the Directorate-General for Agriculture requested an estimate of the extent of agricultural areas which would be affected by implementing the Directive. The results showed that in Portugal, for example, agriculture occupies a proportionately smaller area of the biotopes sites than of the national territory as a whole, and furthermore that these areas are generally characterized by low intensity agriculture, suitable for the promotion of environmentally friendly agricultural practices (Figure 5.3).

Impact assessment in relationship with European regional Funds: nature conservation is confronted almost daily with regional development programmes. The potential impact of such programmes on natural sites can be tested if sites of major importance for nature conservation arc digitally recorded.

For example, the European Investment Bank (EIB) systematically evaluates the environmental aspects of proposed projects. A standard procedure has been established for the EIB consultation of the CORINE database. The request illustrated here concerns the risk of damage to important biotopes by the planned construction of a new highway between Nantes and Niort in south-west France (Figure 5.4). The i-nap, together with the descriptive file of the site, was transmitted to the competent division in the EIB.

In a more general way the regions eligible for support from the structural Funds can be brought in overlay with the biotopes sites or, for example, sites communicated in application of the Directive on the conservation of wild birds as illustrated by Figure 5.5. In this way, projects applying for financial support from the EC structural Funds can be evaluated for their influence on natural sites.

Environmental models: areas of importance for nature conservation threatened by changes in sea level. There is considerable world interest in the possibility of climate change and in its consequences. Recently a research team from London University, under contract to the World-Wide Fund for Nature, studied the effects of increases in mean global temperatures (the 'greenhouse effect') on natural systems (Hollis *et al.,* 1989). One possible effect is a rise in mean sea level, and the WWF project assumed a scenario which led to a rise of 2 to 3 metres. Many important low-lying coastal ecosystems would be affected in such a scenario. The CORINE biotopes inventory was the only readily available source of information on important habitats at a European level, and the biotopes retrieval system was used to locate coastal sites in which a significant proportion of their surface lies below 3 metres. On the Atlantic coasts of the Community, more than 700 sites were identified, spread along the coastlines of its Member States, though with a particularly high density of threatened sites in the Low Countries in northern Europe. Figure 5.6 plots the locations of these sites.

Cross-fertilization with other CORINE projects: there are many instances where data collected by the biotopes project can be of value to other projects, and vice versa. For example, habitat cover data were used in conjunction with the land cover project to aid interpretation of the vegetation of particular areas in Portugal, and it is envisaged that such a procedure will be used widely in future work. There are also obvious cases where it would be desirable to combine information with the designated areas database, to confirm common boundaries between sites in the two databases where these are coincident, and to automate the completion of the designated areas cross-reference field in the biotopes database.

The CORINE biotopes database is a powerful tool for use in implementing or orientating European Community policy. However it is important to note that:

(i) it is not an all purpose 'magic box' and cannot answer everything;

(ii) it will give its full potential when used in conjunction with other information;

(iii) it will give best results when used by expert researchers.

A typical possible use can be illustrated by the information analysis to follow up the European Parliament Resolution on the establishment and conservation of Community nature reserves (European Communities, 1987). This Resolution 'draws attention ... to the exceptional importance of wetlands as breeding grounds and hatcheries for all types of saltwater and freshwater organisms and as areas where migratory birds feed, break their journey, moult and rest'. It points out, however, that these wetlands have become extremely rare throughout Europe ...' and 'therefore takes the view that a chain of biogenetic wetlands should be set up in Europe to act as a genetic reservoir

CORINE can contribute to the identification of such a biogenetic network. The working procedure would start with the generation of maps and lists from the CORINE biotopes database to immediately show the locations of important wetlands in general and of specific types. For example, Figure 5.7 and Figure 5.8 show sites where 'raised bogs' and 'wet heaths' are reported, in their potential distribution area in Europe.

Figure 5.7 -CORINE biotopes sites where the habitat ‘raised bogs’ has been reported

Raised bogs

Raised bogs are widespread in the cold humid regions of Europe. They originate generally in level flood-plain marshes of river systems, and their centres are slightly raised above the general level of the surroundings

The peat of raised bogs is very acid and poor in nutrients and oxygen. The microtopography is characterized by a mosaic of pools and hummocks, on which grow peal-forming mosses of the genus *Sphagnum.* The bog surface is found above the influence of ground-water so that plant nutrition depends largely on rainfall.

Bogs are of great biological interest: both flora and fauna are highly specialized. The most important threats are peat-cutting for fuel and compost production, atmospheric pollution (causing eutrophication), fires and drainage for afforestation and pasture.

The habitat has been reported at 362 sites in the CORINE biotopes inventory. This map together with a site listing can now serve as a basic document for discussion and contribution to the identification of a biogenetic network as proposed by the European Parliament resolution on the establishment and conservation of Community nature reserves (European Communities, 1987).

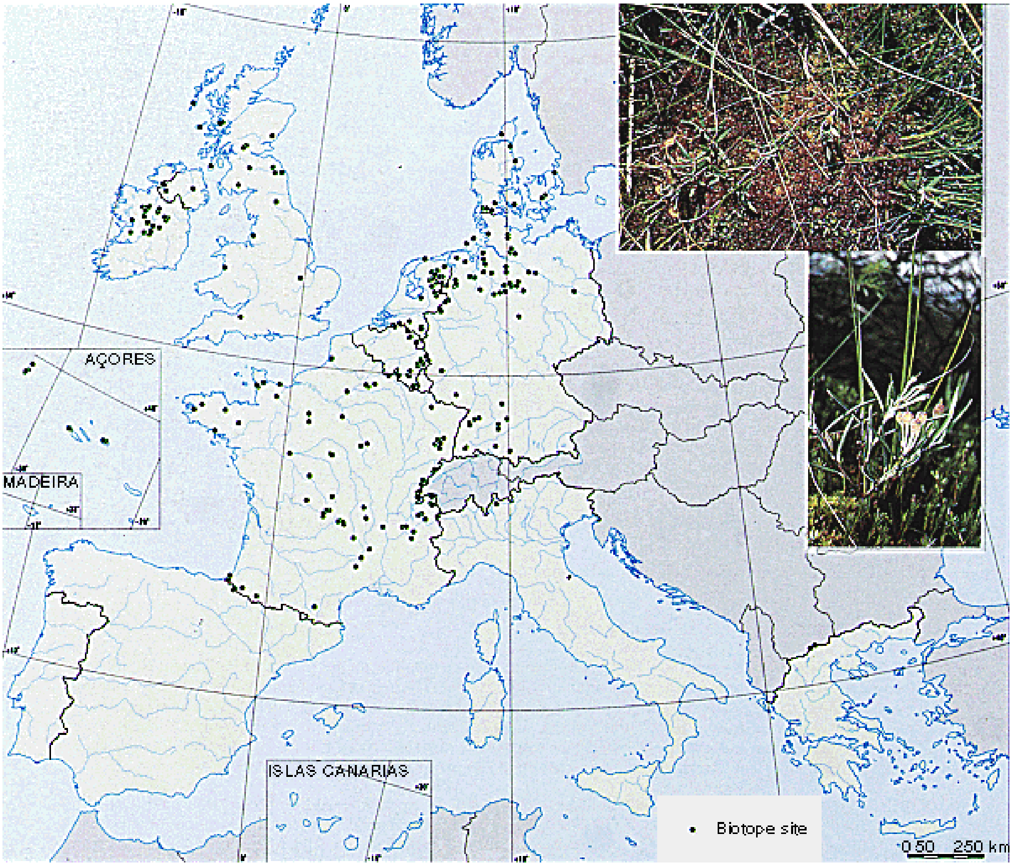

AÇORES
MADEIRA
ISLAS CANARIAS
Biotope site
0 50 250 km

Figure 5.8 -CORINE biotopes sites where the habitat ‘wet heaths’ has been reported

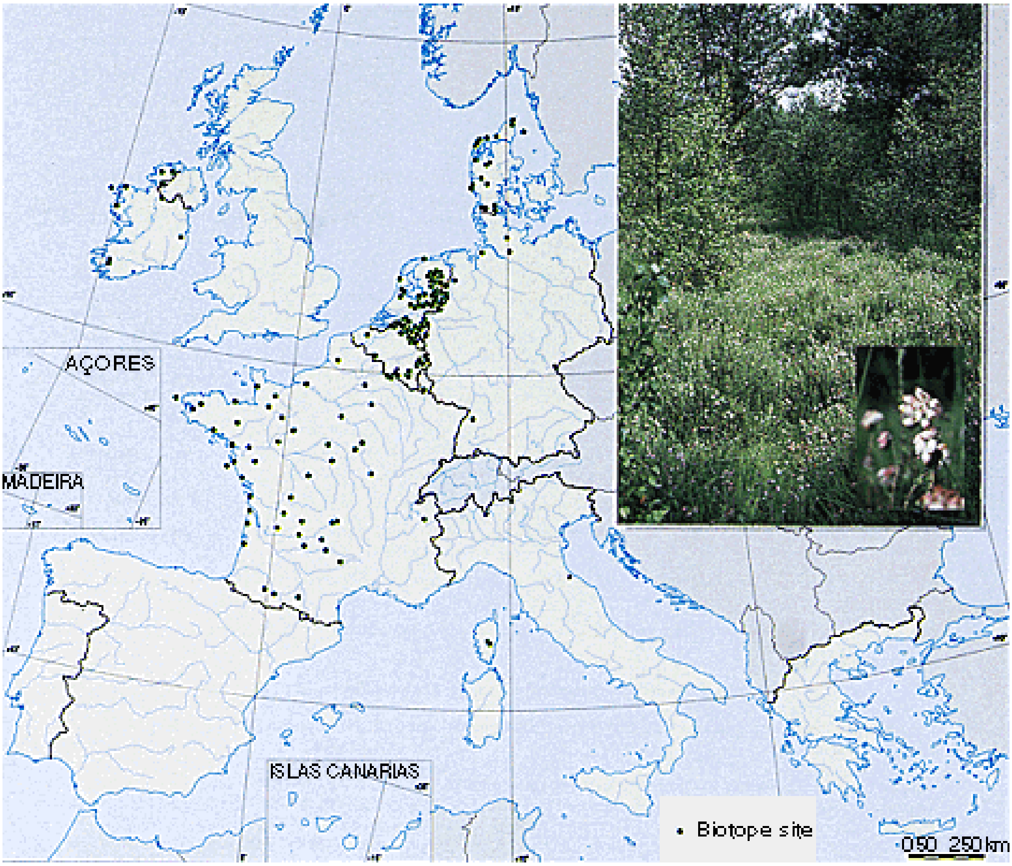
Heathlands

Heathlands are among the most remarkable semi-natural landscapes of Western Europe. The formation occurs in the north-west of Europe where the atlantic oceanic climate prevails. Heathland occupies mostly poor, acid, sandy soils (podsol).

The heathlands in the lowlands are a semi-natural landscape, a result of human activity in forest clearings used to pasture cattle and sheep. It was therefore grazing that created and maintained the heathlands. They are composed of a low, dense thicket of thorny shrubs with a scattering of junipers and stunted trees.

The current decline of heathlands is due to many factors. One main reason is the cessation of open grazing, allowing the heath to be spontaneously recolonized by birch and pine. Reafforestation and reclamation for agricultural purposes are other important factors. Moreover, the heathlands are favoured sites for military camps and air fields, and in recent decades they have also been developed for industry and housing.

Wet heath, the humid, peaty or semi-peaty variant (with *Erica tetralix and Sphagnum)* develops on poorly drained sandy soils. Presently, 261 wet heath sites are reported in the CORINE biotopes database. These data represent a good basis for the setting up of a coherent European network of areas for the conservation of the wet heath habitat.



This material would he submitted to experts on wetlands who would supplement data, check with other sources of information and identify wetlands of each type in sufficient numbers and appropriate locations for them to constitute, once protected, a viable basis for these habitats. The benefit is that work could begin immediately. Without CORINE many months of delay would be necessary before technical discussions could start. This type of working procedure will be extremely useful, for example, in the implementation of the 'Habitat Directive' once it has been adopted, since the type of procedure sketched out above will have to be repeated for many threatened habitat types.

Examples of other projects which have used CORINE biotopes data or methodology include:

(i) an exhibition of wetlands in Spain organized as part of the European Year of the Environment (Casa de Velasquez, Madrid);

(ii) a study of change in the landscape of the flood plains of Central Europe (Technische Universitat, Berlin);

(iii) production of an inventory of sand dune ecosystems in Europe (European Union for Dune Conservation);

(iv) production of conservation summaries on threatened plants in Greece (World Conservation Monitoring Centre);

(v) methodology for monitoring the environment of the Baltic Sea (Gothenburg University for Technology, for WWF-Sweden);

(vi) a survey of sites for important habitats in the EC, so as to estimate the cost of maintaining them (Nature Conservation Bureau, UK, for RSPB);

(vi i) research by the Environmental Studies Centre of the University of' Leiden to identify important nature conservation sites along 10-km-wide corridors bordering five major rivers in the Community;

(viii) mapping of selected habitat types within the Alpine region in preparation for the Alpine convention;

(ix) a study on the protection of sites of major importance for nature conservation in Europe (Landbouwuniversiteit, Wageningen, the Netherlands).

5.2. Dissemination of information

It is one of the guiding principles of the CORINE programme that the results collected should he made available as widely as possible. The means by which data have been supplied to satisfy individual requests have been described and exemplified in Section 5.1 above. Further valuable opportunities to increase awareness of the project have arisen from exhibitions, scientific meetings and published articles.

In view of the support given to CORINE by the European Parliament and by its Environment Committee, exhibitions mounted to inform Parliamentarians have been particularly relevant. For example, at a relatively early stage in the project, in March 1987, an exhibition featuring on-line retrieval facilities and static displays was mounted to coincide with a meeting of the Environment Committee held in Brussels. A permanent exhibition was later set up in the offices of the CORINE central team for the benefit of visitors. Similarly, displays were mounted at the project leader's institute, first at Bangor and later when the project moved to the Environmental Information Centre at Monks Wood. Such displays publicized CORINE to numerous visitors, especially at events such as the official opening of the Environmental Information Centre in July 1989.

The biotopes project has been presented at a number of scientific meetings, whether organized as presentations of the CORINE programme or on a wider basis. For example, papers were given at:

(I) the third Council of Europe Colloquy on computers in nature conservation, Strasbourg, November 1986;

(ii) the International Geographical Union Workshop on the global database planning project, England, May 1988 (Wyatt *et al.,* 1988);

(iii) the European Environmental Bureau Seminar on nature conservation and sustainable development: the role of Europe, Seville, February 1989;

(iv) the International Symposium on biological diversity, Madrid, November 1989 (Moss, in press); and even outside Europe:

(v) the Workshop to plan a biodiversity database for Uganda, Kampala, September 1990.

Papers and informal presentations have also been given at the national CORINE seminars in Lisbon, Madrid, Rome and Copenhagen.

Articles have been published to inform the scientific community of the work of the CORINE biotopes project, for example in *NERC News,* March 1987; the *Threatened Plants Newsletter* (published by the World Conservation Monitoring Centre), December 1988; the Institute of Terrestrial Ecology annual reports for 1985-86 and for 1988-89; *NERC Computing News,* March 1990. A number of publicity brochures have been produced by the CORINE central team in which the biotopes project has been featured.

In addition to such presentations of the database or of its results, a further requirement of the principle of dissemination of information is the availability of the actual data. In order to fulfill this aim, the data must be made accessible to potential users, whether they be in the European Commission, European Parliament, government or non-governmental organizations, or private individuals. Recommendations as to how this may be achieved are contained in Section 6.2.

5.3. Constraints on use

Given a database with such a wide specification as the biotopes database, there is always the temptation to attempt to use it to answer questions beyond its intended scope, or to use parts of the database which are as yet incomplete.

For example, the only species data which it is obligatory to record concern those species listed in the biotopes handbook. However respondents have also recorded many other species, and there is a danger that a user whose interest is in the distribution of a species outside the handbook lists may retrieve lists of sites for such a species which would not be complete. An example of the second type of misuse is to attempt a complete mapping of a detailed habitat type, when not every Member State in which the habitat occurs has completed detailed habitat coding (for example the map of beech forests coded 41.1, Figure 4.13).

Both the database manager and users must be aware of such limitations and avoid drawing false conclusions due to incorrect application of the data. The problems of incompleteness will eventually be overcome, but the temptation will remain to use the database for purposes beyond its scope. It is therefore necessary for intending users to take note of the scope and specifications of the database, outlined in this report and the technical handbook, before drawing their conclusions from it.

6. Conclusions and recommendations

6.1. Lessons which have been learned: problems and solutions

Needless to say, many problems have been met during the realization of the CORINE biotopes project, and solutions have been devised and implemented. However, it is worth noting that the problems with which the project was faced were not only those which might have been expected at the outset. Indeed, the more intractable problems had nothing to do with lack of data or methodological shortcomings, but were related to the management of human resources. This is a challenge in any major endeavor, but here it was further complicated by the fact that management was operated from a distance, using different languages, and depended on a variety of organizations and individuals, more or less closely interested in the project. In general, scientists are largely self-motivated, so that sensitive, persuasive management is needed to ensure that each of a team of individual scientists follows common goals.

In this section, three broad categories of problems which have been encountered during the biotopes project will he described, and the solutions implemented will be discussed. These categories concern data collection, methodological aspects, and project management.

6.1.1. Data collection problems

6.1.2. Methodological problems

6.1.3. Project management

6.1.1. Data collection problems

Problem 1: *The prior existence of data relevant to the requirements of the CORINE biotopes database did not automatically make compilation of the database easy.*

In general, where reliable information on nature conservation sites existed, efforts were made to subsume these sources into CORINE, since this avoided the need for primary data compilation and ensured a degree of consistency between CORINE and national or thematic data-sets. The forms in which data were available to biotopes team members were extremely varied, ranging from complete databases to dispersed publications requiring a considerable amount of searching, checking and updating. Whatever the starting points, the work was never straightforward, as there was always the requirement to understand completely what information was required, and to work to tailor the existing knowledge to the needs of a common inventory.

Translating and transposing data collected in diverse formats from different data sources was one of the most timeconsuming problems. This was encountered in all countries, and increased as the number of individual data sources increased. For example, in the Federal Republic of Germany, each *Land* had an independent system for the recording of nature conservation sites with its own specifications of the data to be collected. Although these were comparable in some respects, there were nevertheless important differences.

Assimilation of data from several different sources, including data which were not site-based, into a site inventory entailed allocation of records to the appropriate sites. This problem was encountered, for example, in the extraction of species records in the Netherlands and their assignment to CORINE biotopes sites. Such a problem is likely to occur whenever species data are recorded on a grid square framework, as is the common practice.

However curious it might seem at first, problems also arose when data had to be selected and sifted from sources more comprehensive than required for use at the Community level (for example, the selection of under 1 000 sites from 13 000 in the ZNIEFF database in France). Each site had to be checked individually against the Community criteria.

Data coding and format conversion from existing conventions could also be a complex problem, since automatic data transfer either was not possible or required as great an effort as manual recompilation. For example, there was not a simple 1: 1 equivalence between the habitat coding system used in the UK by the Nature Conservancy Council and the CORINE habitat nomenclature. Conversion therefore demanded considerable intellectual input.

Solution: These difficulties were all facets of the more general problem of reconciling the form, content and structure of various independent existing data sources with the different objectives of a Communitywide information system. Their solution determined much of the work of those members of the biotopes team who made use of existing data sources. Because of the diversity of the source data, no generalized solution is possible. It was necessary for each team member who was faced with such a problem to arrive at a suitable solution, in consultation with the biotopes project leader. Some of the approaches which have been adopted have been described in individual reports on the compilation of data, for example in France (Maurin *et al.,* 1989), and in Ireland (Wymer, 1989).

Common to all these solutions were three steps:

1. Biotopes team members, working together with the project leader, had to understand very clearly the data requirement.

2. They then had to organize the translation or transposition of original data to the CORINE specification, which necessitated a considerable knowledge of natural science.

3. They then had to put in considerable hard and meticulous work.

Problem 2: *It is often easier to start to build a new database afresh than to adapt an existing one, but this can lead to duplication of effort.*

Problem I above described some of the difficulties encountered in building upon existing databases outside the CORINE project. However in some instances, interim data held in the biotopes database proved to be radically different from what was required, and it was more effective to start to build the database afresh. This situation arose in a number of countries when the initial data were found to be out of date, or failed to meet the site selection criteria. In other cases, the use of data from several sources had introduced duplication of sites (see Problem 4).

However rebuilding a database afresh should only be considered if the earlier data can be demonstrated to be wholly inadequate, since there is no virtue in recompiling data without valid reason.

Solution: Each case must be considered individually, but every encouragement should be given to refining existing data rather than starting data compilation afresh. This should automatically be the option with current and future work, since the use of CORINE methodology will mean that data have only to be refined, not replaced. For example, a major update of the data held for Greece is now being prepared by the National Technical University of Athens and the Ministry of the Environment, but the existing data are being retained, and the two contributors of those data are part of the team working on the update. A similar process is under way in Spain.

Problem 3: *Members of the biotopes team did not have access to the necessary data.*

It was essential that an individual (or the organization which he represented) should have access to the information needed to build the database. If that information was not held by the organization for which the biotopes team member worked, he should have been able to identify alternative data sources. Without access to full data, incomplete recording of certain data fields is inevitable.

Solution: Biotopes team members were selected initially because they, or the organizations to which they belong, had the best possible access to the data required. However in some cases the necessary information just does not exist, and then the project leader and individual team members must be prepared to face problems of lack of suitable data at an early stage and try to overcome them. If there is no alternative, resources should he made available to collect the types of information which are lacking.

6.1.2. Methodological problems

Problem 4: *Data combined from different sources led to duplication i the recording of the same site.*

Early in the development of the biotopes database, data were collected from a variety of sources, particularly the 1982 biotopes pilot study, the 1981 important bird areas database, and Council of Europe data on biogenetic reserves. Although every attempt was made in combining these data to avoid duplication of site recording, it was inevitable that, due to a lack of knowledge of the actual areas described, the same site was included more than once. For example, one site may be described under different names by different authors, who may delimit the boundaries of the site differently, and so result in different surface areas or coordinates. This problem arose especially with the data for France, Italy and Denmark. Similar difficulties may arise in the cross-referencing of biotopes sites with designated areas either due to lack of concordance of site names or of boundaries.

Solution: A useful tool was the ability to plot sites on maps, and to distinguish the different sources by use of colour or symbols. This helped in the elimination of this problem from earlier data. A similar approach is helpful in cross-referencing biotopes and designated areas sites.

Since no one person or organization knows everything about a country's nature conservation sites, CORINE must continue to allow for data to be supplied from different sources. However, it was agreed that, from the 1989 biotopes team meeting onwards, data describing new sites are only added after approval by the appropriate member of the biotopes team, who is responsible for checking new sites against the selection criteria, and for avoiding overlaps with existing sites. This cannot be undertaken by the project leader, who does not know the ecological or geographical situation in sufficient detail to make these judgments.

This procedure of verification by the biotopes team member is being followed, for example, in the updating of information in the biotopes database on sites listed as 'important bird areas', using the inventory revised by the International Council for Bird Preservation (Grimmett and Jones, 1989).

Problem 5: *Improvements in the methodology during the course of the project's development led to supplementary work for biotopes team members*

The basic methodology for the project was agreed in its first year of development and circulated in the technical handbook, as described in Section 2.1. However, since CORINE was an experimental programme, it was inevitable that during construction of the database, various detailed aspects of its specification bad evolved as needs had arisen which

were not apparent at the outset. For example, the habitat classification has undergone expansion as experts in several Member States have reported additional detailed habitat types which had not previously been described, and additional codes have been added to the 'motivation' and 'human activities' fields. The most fundamental change in the methodology during the project was the introduction of a coding system to record the criteria used for site selection explicitly. This entailed additional work for biotopes team members when they were asked to add these indications to their existing data.

Solution: In a dynamic situation, where a database as large, complex and extensive as the biotopes inventory is being built for the first time, it would have been impossible to have arrived at a perfect final format and methodology for site recording at the outset of the project. Further changes may well be desirable in the future (Section 6.2).

Changes were made during the project in response to needs which arose as data were being compiled. This is therefore a problem which has to be accepted, but any changes which are made to data specifications should aim to minimize the extent to which alterations to the data already collected are necessary. For example, the provision of additional habitat codes have not invalidated preexisting codes, and recording of selection criteria data has not necessitated other changes to habitat and species data.

Problem 6: *The criteria for site selection were initially inadequately specified and so could not be applied consistently.*

The site selection criteria agreed at the outset of the project were stated only in general terms which left too much interpretation to users, in the sense that the wording used in the technical handbook did not convey a precise meaning as to how the criteria should be applied. The framework was given, should someone have discovered an appropriate procedure, but no procedure was available initially because there were no data.

Solution: The biotopes team, at its fourth meeting, agreed a precise definition for the criteria of importance at a Community or regional level for threatened species or habitats, and defined the geographical framework within which these criteria should be applied (see Section 3.2). A notation was also adopted so that these criteria could be explicitly recorded in the data.

Problem 7: *The need for a consistent nomenclature for species names.*

Species data were received from a number of national sources based on a variety of different taxonomic authorities. This led to multiple recording of some species (e.g. the ground squirrel *Citellus citellus,* which was also registered under its former name *Spermophilus citellus)* and to difficulties in identifying mistakes in nomenclature (see Section 3.7). Unless consistent taxonomic standards are adopted, retrieval of species information is difficult and prone to error.

Solution: The problem was addressed by the project leader using standard reference works (e.g. *Flora Europaea* (Tutin *et al, 1964-80); The mammals of the Palaearctic region* (Corbet, 1978)). Lists of accepted species names and their synonyms are now available both in hard-copy and machine-readable form, together with a dBase-

III program to check newly reported species names against the standard reference lists used for validating biotopes data. Mistakes and non-preferred synonyms can then be substituted by the preferred nomenclature. New names which are taxonomically valid are added to the authority lists.

Problem 8: *The database is concerned with recording a dynamic situation. Some types of sites evolve rapidly or even disappear,. populations fluctuate; available information improves.*

Changes in the database may be due to one of a number of factors:

(i) new data become available to describe a site better, and this may necessitate additions or corrections;

(ii) further previously unrecorded sites may need to be added;

(iii) sites may need to be omitted because they no longer meet the selection criteria;

(iv) sites may need to be omitted because the ecosystem has been destroyed.

Some sites may naturally be subject to change since they are dominated by successional ecosystems, for example accreting sand dunes. Many more sites change their character due to man-made influences, such as drainage of marshes or woodland clearance, while species distribution varies and numbers (especially of birds) also fluctuate. As an example of the most extreme type of change, since the project began the disappearance of two sites has been recorded (Irish peatlands exploited for peat extraction).

Solution: Updating procedures must be sufficient to keep the database accurate. A general updating frequency of five years has been agreed by the biotopes team, except for sites where rapid change is occurring, which need more frequent updating.

6.1.3. Project management

Problem 9: *The need to convince data holders that they have a shared interest in the results of the project.*

It was quite understandable that organizations who held data needed for the biotopes database, and who were not directly involved with the CORINE project, needed reassurance concerning the uses and value of the exercise. This observation applied equally to the members of the biotopes team at the outset. However, it gave rise to difficulties when a large number of individuals were simultaneously requiring individual responses to a similar set of questions. Time had to be invested in making a convincing case for the release of information held by such organizations. This could be especially difficult when those data were still undergoing completion or validation.

It was essential that all parties involved should understand the potential value of the work being undertaken. The problem was clearly evident within the biotopes team itself; some members started work very quickly because they clearly realized the value for their country, while others needed more persuasion.

Solution: The Commission and biotopes team members invested considerable effort in visiting the relevant authorities to explain the motivation behind the collection of data for CORINE. For example, officials of the Commission made three visits to Germany and received a delegation from the regional authorities; it was necessary in the UK to explain the value of CORINE at a senior level to the Nature Conservancy Council; and several meetings were held in Spain to promote CORINE to regional authorities. Sometimes these negotiations stretched over a longer period of time than the physical task of processing the data.

In some cases it was necessary to pay fees for access to data, for example to databases in the Netherlands.

Fortunately, the task of presenting the case for CORINE has become easier as further progress has been made in developing and publicizing the biotopes project and the many other component projects of the CORINE programme. A much more powerful case can be made by demonstrating an existing database into which the required data would fit to fill a gap, than in putting forward the abstract idea of a database which is yet to be built. The full potential of CORINE could be realized only when it became possible to interrelate different data-sets. With the publication of the current series of reports on CORINE, the project should gain such a high profile that the rationale for filling any remaining gaps in the database and for maintaining its accuracy become self-evident.

Problem 10: *Human factors: the difference between what biotopes team members thought was required from them, and what was actually required.*

Of all people, we expect scientific experts to behave rationally. Perhaps we should be reassured to discover that such experts still exhibit human characteristics, in that they make errors and depart from agreed procedures. However reassuring this discovery, these traits were very bad for the progress of the work!

For example, those compiling the biotopes data almost without exception failed to keep exactly to the format of the standard site record which had been agreed and specified in detail in the technical handbook: there were many departures from the specifications either in field titles or formats of individual data fields. The work of correcting these errors was made greater when they were not even consistent within a data-set. These problems could all be rectified, but they entailed extra work for the project leader.

A further problem was that selection of sites was justified by the presence of species other than those in the lists of threatened species contained in the technical handbook (see Section 3.2). This arose partly because of the natural desire to report species which were considered to be threatened at a national or regional level, but which are not threatened at the Community level. Alternatively, some sites were judged to be important because they held more than 1% of the Community population of a species which was not one of the threatened species listed in the technical handbook.

Some members of the biotopes team adopted their own interpretations of various data fields which diverged from those which were specified in the technical handbook. For example, the site complex name was used to describe relationships to other site inventories and to adjacent sites (Denmark); the region name given was not at the most specific NUTS level (Italy); district names were given in coded form (Denmark). However none of these fields was essential to the operation of the database, and the converse should also be reported: that the great majority of data compilers were able to report these data fields as they had been instructed.

Solution: The specifications for the data - formats and contents - were set out in detail in the technical handbook and explained at meetings: these actions were necessary preconditions to achieve consistency, but alone were not sufficient. Frequent regulation of the work, by letting only a small part of the work be done before examining the results and discussing them, then modifying any errors before proceeding, was very helpful. Direct contact between the project leader and individual contributors was indispensable, so that the team members' problems could be understood, and interpretation made easier for them.

Problem 11: *The members of the biotopes team sometimes took a long time to coordinate their data collection work.*

This was a widespread problem since there was a common tendency to underestimate the time and work which were involved. Some members of the biotopes team took months or even years to coordinate the data-gathering work in their countries, and timetables which had been agreed for the completion of' certain stages of database compilation were not adhered to, as deadlines were frequently broken. There were also long delays in responding to queries following data compilation, for example on species names for which confirmation or correction was sought, or requests for additional information missing from an initial data-set.

Few of the people involved were able to devote themselves entirely to the work required because, in general, CORINE formed a very small part of their professional work. They are busy people with many other responsibilities. Even when formal contracts were made for the tasks, there were sometimes problems because insufficient resources were made available to the biotopes team member by the organization for which he worked.

Solution: More frequent communication between team members and especially with the project leader through visits and telephone conversations gave team members extra encouragement and spurred them on to make greater progress. It was also necessary to adopt more realistic timetabling in planning the work, in the light of experience gained concerning the time which would be required to complete certain tasks.

6.2. Recommendations for future data collection and development of the project

Amongst the tasks which will be tackled by the European Environment Agency will he the continuing development of CORINE (Article 2 of the Council Regulation on the establishment of the European Environment Agency (European Communities, 1990b)). Another task will be to disseminate the information more widely, by the most appropriate methods for information exchange within a Community-wide network of data sources and users.

Our recommendations are grouped under the broad areas of data collection, development of methodology, database use, and research needs.

6.2.1. Data collection

6.2.2. Development of methodology

6.2.3. Use of the database

6.2.4. Research needs

6.2.1. Data collection

Recommendation 1: **Encourage the formation of further national and local databases.**

The CORINE biotopes methodology constitutes a flexible framework. This should be used to generate interest in the establishment of more detailed local inventories of sites of national or regional importance, which would be compatible with the biotopes database and which might form part of the national environmental information networks envisaged in the Regulation concerning the European Environmental Agency (European Communities, 1990b). Such local inventories already exist in some Member States, for example Germany, and are being established in Spain and Ireland, but this is not generally the rule. Such inventories can, in certain cases or regions foreseen in the relevant regulations, be supported by Community funds.

Recommendation 2: **Fill the gaps in the data which remain.**

The immediate priority is to complete the existing database to the standards required for phase 11 of the project. The most important gaps in the data concern the indication of criteria for site selection, the digitization of site boundaries, the detailed description of habitat and the provision of information on the proportions of sites covered by each habitat type. Data on the presence and abundance of species are still inadequate in the case of certain Member States. Work is currently under way to fill these gaps in a number of Member States, notably Spain, Greece and the UK. Cross-reference to the designated areas project awaits progress on the designated areas database.

Recommendation 3: **Improve the representation of inshore marine sites.**

Although they are allowed for in the habitat coding, there are few records of inshore marine areas in the biotopes database: only in the case of Danish waters is coverage adequate. This reflects the relative specialization in terrestrial ecosystems of most of the present biotopes team members. Contacts are required with marine biological institutes so that littoral and sub~littoral communities can be included, where these can be described for discrete geographic areas. This is becoming increasingly urgent, given the increased interest and activity in Community and international programmes such as the work of the North Sea Task Force.

Recommendation 4: **Digitize site boundaries.**

lt has been recognized since early in the biotopes project that maps showing site boundaries are an essential complement to the data collected in the biotopes database. There is clearly an advantage in the digitization of these boundaries, so that in future it will be possible to undertake spatial analysis and overlay operations, for example to determine whether proposed developments fall within or beyond their boundaries. This work has already been completed for

Portugal and Belgium, and in several countries work has been done at a national level or is currently in progress. There is a continuing need to ensure consistency in the methodology being used, to extend this work to the rest of the Community as soon as possible and to ensure the data are kept up to date. The smallest sites cannot adequately be digitized at an appropriate scale for a Community database, so there will continue to be a lower limit for the surface area of sites to be digitized; the current proposal is to digitize all sites larger than 100 ha, an area which is sufficiently large to be represented on a scale of 1: I 00 000.

Recommendation 5: **Update the database so as to keep it accurate.**

Since the biotopes which are the subject of the database, and the species which occur on them, are constantly undergoing changes as a result both of natural processes and man-made causes, it is essential that the database is updated at regular intervals. It has been agreed within the biotopes team that the database should be entirely updated at fiveyearly intervals, but that rapid changes to individual sites should be recorded as soon as possible.

Recommendation 6: **Build databases of species and habitat distributions across the Community.**

Species mapping in connection with the proposed 'Habitats Directive' has shown a requirement for data meeting a consistent standard on the distribution of plants and animals on a Community scale. Part of the future aim should be to provide for this requirement. Priority in the first instance should be accorded to the threatened species listed in directives and the biotopes technical handbook. For certain taxonomic groups the basis for this work already exists. Clearly, future initiatives should build on this expertise and information base. Such a major undertaking should be considered as complementary to the biotopes project rather than part of it, but close liaison between the two projects would be essential. Similarly, a database on the occurrence of habitats should be undertaken, drawing extensively on existing literature sources and scientific databases.

6.2.2. Development of methodology

Recommendation 7: **Adopt a definition for threatened habitats.**

Although 'threatened habitats' are used in the definition of the selection criteria (Section 3.2), these have never been formally defined and in the past were implicitly taken to include all natural and semi-natural habitats listed in the technical handbook. There would be the opportunity once the 'Habitats Directive' is operative to use the list of threatened habitats which will form Annex 4 to that Directive.

A threatened habitat is defined in the draft 'Habitats Directive' as: a habitat exposed to the risk of disappearance or degradation because of:

(i) its scarcity; or

(ii) the fragility of its ecological conditions; or

(iii) the fragility of its more specialized and characteristic species; or

(iv) its tendency to rarification.

Recommendation 8: **Improve some aspects of the coding system.**

Some improvements might usefully be made to the codings available for the fields 'motivation' and 'human activities'. These would take into account the hierarchical nature of several of the 'motivation' codes (for example there are codes for ecological and for zoological importance, and for sites significant for mammals, each of which includes the following category). The 'human activities' field could be directed more towards actual or potentially damaging operations, so giving a more structured way of recording the types of information now recorded using the 'vulnerability' text field. However, care must be taken not to introduce changes which require existing data to be modified retrospectively. In any case, many of the idiosyncrasies of the present system were introduced from a desire to achieve compatibility with other systems. This objective often inhibited the design of an optimal structure.

Recommendation 9: **Make the use of personal computer software the standard method for the supply of data to the project.**

Much extra work was generated during the project due to problems which data compilers experienced in following the data specifications correctly (Problem 10). Many of these problems can be avoided when data are entered using software specially written for this purpose. For example programs in the dBase-111 system supplied by the project leader have been used for data entry by a number of contributors, and simple data validation programs are also now available. These procedures considerably reduced the effort of data entry both at source and at the stage of merging data into the Community database.

6.2.3. Use of the database

Recommendation 10: **Make the CORINE biotopes data more readily accessible.**

As the information available in the CORINE programme as a whole, and in particular in the biotopes database, has become more complete, an increasing demand has arisen for its wider dissemination, so that more interested parties could now have access to the data. For example, several Member State governments and international non-governmental organizations throughout the Community are active in pressing for better environmental protection measures. They would welcome the opportunity to use data gathered by CORINE. Data have already been exchanged with the Council of Europe, the World Conservation Monitoring Centre, and the International Council for Bird Preservation, as well as national administrations, and such applications are likely to become more frequent. The most convenient means to achieve greater accessibility to the biotopes data in the short term would probably be through the distribution of digital versions of the database for use on personal computers, together with a sophisticated data retrieval package (such as the one which is now being written). Linked to that, measures have to be taken to ensure that the various users are routinely provided with updated information and software.

Recommendation 11: **Use the biotopes database to safeguard threatened sites.**

The biotopes database demonstrates that there are many important nature conservation sites throughout the Community which lack any statutory protection through designation by national or local governments (Figure 4.18). Now that these sites have been identified, there is the opportunity to prepare appropriate protective measures or management guidelines for them, whether this be through Community directives or national designations. The type of measure which would be appropriate will vary greatly, ranging from strict protection to general landscape management measures, depending on the characteristics of the site, and the threats upon it.

Furthermore, if the database is well publicized, its use might prevent actual site losses. Examples have already proven that when an unprotected site is recorded in the biotopes database, this is taken into account in the development processes, especially where Community policies are involved.

Recommendation 12: **Use the database to monitor and guide implementation of the 'Habitats Directive'.**

The biotopes database has already been extremely useful in the drafting of the annexes to the 'Habitats Directive' concerning species and habitats to be listed in the annexes. In future it could provide a valuable tool for the Community and for the Member States to monitor the success of the implementation of the Directive and to guide further developments in this field.

6.2.4. Research needs

Recommendation 13: **Develop the criteria for site selection on the basis of richness and representativeness.**

Some of the site selection criteria defined in the technical handbook could not readily be applied systematically. This was especially true in the case of those which take account of richness for taxonomic groups or assemblages of habitats. In the past, users who wished to evaluate sites on the basis of richness of a particular taxonomic group were referred to the method proposed by Bezzel (1980), but none of the data contributors reported that they had applied this method, and it is clear that the method is not generally feasible because of constraints on data availability and the effort needed to apply it. The application of these criteria therefore requires review involving more expertise and information. If appropriate, an extension of the coding to allow for explicit recording of criteria to include these types should be adopted.

Recommendation 14: **Research the sensitivity of different types of sites to change through human or natural processes.**

There is currently greatly increased awareness of the acceleration of global environmental change, in particular due to the phenomenon of climatic change. The effects on ecosystems as well as individual species require research for which the CORINE biotopes database would be able to provide baseline data. Similarly, the database could be used in studies of the effects of changes in land use on fauna, flora and habitats.

Recommendation 15: **Use of the database for research problems on nature conservation on a Community scale.**

The existence of the biotopes database and its use, particularly in combination with other environmental data offers immense possibilities for further research on nature conservation. Some applications have been explored in previous sections of this report (Chapter 5), but the full range of possible uses will only become apparent when the database is made generally available to the research community. An attractive possibility would be for the Commission to fund post-graduate research bursaries.

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This report details the CORINE biotopes project: its rationale and its aims; how those aims have been fulfilled during the period 1985-90; the working procedures and scientific methodologies which have been adopted for the selection and description of sites of Community importance for nature conservation. It also identifies the various outputs that have been incorporated into the CORINE geographic information system. The report describes lessons learned in compiling the database and some uses which have already been made of the data, evaluates future needs in the Community for information on nature and the environment and recommends further actions required.