Indicative map of the Pan-European Ecological Network in Western Europe

Technical background document

Rob H.G. Jongman
Irene M. Bouwma
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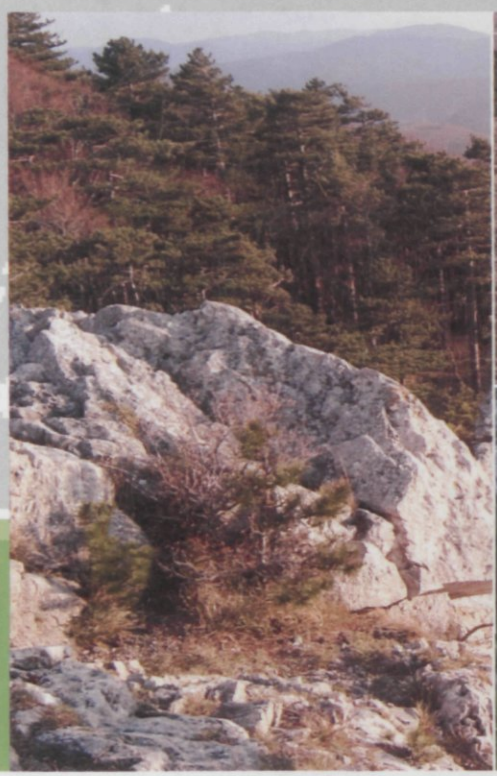

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The indicative map of the Pan-European Ecological Network in Western Europe

Technical background Report

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Alterra-rapport 1429

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ABSTRACT

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The Pan European Ecological Network for Western Europe is the third project in developing the Pan European Ecological Network The objective of the Pan-European Ecological Network is to develop a vision for a coherent network of high value areas for biodiversity, as internationally and nationally protected areas in combination with other suitable habitat areas for long term favourable conservation of Europe's key ecosystems, habitats and species. In the European strategy to reach the goals of the Convention on Biological Diversity, the establishment of the Pan-European Ecological Network (PEEN) is one of the priority issues since 1995 as formulated in the Pan-European Biological and Landscape Diversity Strategy (PEBLDS). This report presents the methodology used for the development of the Ecological map for Western Europe, the background of planning of ecological networks and the consultation process that has been carried out.

Keywords: Biodiversity Conservation, Ecological Corridors, Ecological network, Europe, Habitat fragmentation

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Preface

This report on Western Europe, together with the other two reports on Central and Eastern Europe and on South-eastern Europe, contributes to the implementation of the Kyiv targets on the realisation of the Pan European Ecological Network (PEEN), and in particular the target to identify the location of PEEN.

As in the case of the other two projects, the work for this report has been carried out in consultation with the Committee of Experts for the Establishment of the Pan European Ecological Network. The final version of the Western European Map will be available after a final review and the approval of the Committee of Experts.

The present report presents a draft version of the map of Western Europe as the full consultation on the map can only be finalised in 2007. The reason to publish the draft version now is that this allows the draft map to be included in the reports for the Ministerial 'Environment for Europe' Conference in Belgrade in October 2007.

The project for Western European Ecological Network (PEEN-WE) has been carried out by Alterra, Wageningen UR in cooperation with the European Centre for Nature Conservation (ECNC), which coordinated the development of the indicatives maps for East and Central Europe and South-East Europe. Cooperation between Alterra and ECNC in development of the three maps ensures consistency in methodology and consultations as regards the three maps.

Data have been provided by many researchers, agencies and NGO's. The map has already been discussed with experts from nearly all countries involved; discussions have been carried out by e-mail, telephone and in personal engagements.

Their valuable comments have been taken into account and have improved the map. We thank them all for their cooperation. The GIS work and the map design has been done by Arjan Griffioen from Alterra. He was a key person in this project. We also thank him for his contribution and cooperation. This report builds on the two previous reports on the PEEN Central and Eastern Europe (Bouwma et al, 2002) and PEEN South Eastern Europe (Bíro et al 2006). For reasons of comparability we followed as much as possible the procedures and approaches used there.

In the coming months more detailed consultations will take place with governments and experts as represented in the Expert Committee of the Pan-European Ecological Network, resulting in a final indicative map for the European Ecological Network for Western-Europe.

Rob Jongman, project leader PEEN-WE, Alterra
Rob Wolters, Executive Director ECNC

Excutive summary

The objective of the Pan-European Ecological Network is to develop a vision for a coherent network of internationally and nationally protected areas in combination with other suitable habitat areas for long term favourable conservation of Europe's key ecosystems, habitats and species. In the European strategy to reach the goals of the Convention on Biological Diversity, the establishment of the Pan-European Ecological Network (PEEN) is one of the priority issues since 1995 as formulated in the Pan-European Biological and Landscape Diversity Strategy (PEBLDS). In recent years, the political interest in the concept of ecological connectivity in general, and ecological networks in particular, has increased considerably because of the growing concern about the ongoing decline of biodiversity and the potential impacts of climate change on Europe's biodiversity. In ecological networks scientific insights have now been translated into policy and planning.

The project has resulted in an indicative map of PEEN which identifies the core nature areas of European importance, existing corridors between these areas, and search areas where new corridors could and should be established to meet the connectivity requirements of key species.

The map illustrates the relevance of national and regional biodiversity within a European context; it communicates the concept of nature as a coherent entity, rather than an agglomerate of individual sites and species. The map also draws attention to the changes in land use and infrastructure development that have an impact on biodiversity, even when core nature areas are not directly affected. As such, the indicative map of the Pan-European Ecological Network in Western Europe is a powerful communication and education instrument. It shows the highly fragmented character of natural and semi natural areas in urbanised North-western Europe. More than in other parts of Europe mitigation of fragmentation is a key issue here for the survival of natural species and the maintenance of natural and semi-natural habitats.

The indicative map of the Pan-European Ecological Network for Western Europe highlights the areas vital for biodiversity in this part of Europe. It indicates possibilities to reinforce the long term existence and possible return of internationally important species following the strategy of a coherent and robust network. It summarises insights and data in a way that is readily understandable, useful and inspiring for policy makers responsible for nature protection and land use planning.

The map is strictly *indicative*, i.e. it gives a *tentative indication* of the possible or likely location of core areas for biodiversity and ecological corridors of Pan-European importance at a scale of 1: 3,000,000. Therefore, the map cannot and should not be used to draw conclusions concerning the exact location and boundaries of core areas and ecological corridors of the Pan-European Ecological Network. The map does not suggest that the identified areas should be designated under international or national protection instruments, nor does it wish to comment on or influence the

way in which national governments apply their sovereign rights to designate areas for nature conservation purposes.

The map is also not a blueprint for decision making and implementation; it indicates important areas where further investigations, arguments for concrete decisions could lead to more concrete and balanced plans taking into account interests of different stakeholders. The indicative map is based upon many ecological and land cover data, insights of experts, assumptions and targets, which are explained in the following chapters. The map can be used together with other maps presenting underlying and more detailed data on habitat types or designated areas with an international status.

One of the main conclusions of the project is that due to the high degree of fragmentation there is a huge task in Western Europe for reconstructing coherence in nature. It is a challenge for European regional and national governments as well as the NGOs to restore this coherence in biodiversity to enlarge the populations of natural species to be sustained in Western Europe.

1 Introduction

In the early 1990s the idea of developing an ecological network at a European scale was developed on the basis of the concepts developed in several European countries both in east and west Europe (Jongman, 1995, Bennet, 1991, Bischoff and Jongman 1993). In the European strategy to reach the goals of the Convention on Biological Diversity the establishment of the Pan-European Ecological Network (PEEN) has been one of the priority issues for nature conservation in Europe since 1995 as formulated in the Pan-European Biological and Landscape Diversity Strategy (PEBLDS). This approach was endorsed by the Third Ministerial Conference 'Environment for Europe' (EfE) in Sofia. In recent years interest in the concept of ecological connectivity in general, and ecological networks in particular, has increased considerably, partly because of the growing concern about the impacts of climate change on Europe's biodiversity, partly because the scientific insights have now been translated into policy and planning (Burkhardt et al, 2003)

The underlying philosophy of the establishment of the PEEN is to counteract the fragmentation of natural habitats and valuable landscapes and to promote synergy between the existing nature policies, land use planning and rural and urban development.

In 2000 the European Centre for Nature Conservation (ECNC) was requested by the Committee of Experts for the Establishment of the PEEN to start developing the 'Indicative map for the Pan-European Ecological Network'. As a first step, an indicative map for 12 Central and Eastern European countries has been developed, outlining the indicative location of core-areas and search areas for corridors of Pan-European importance (Bouwma et al 2002). The indicative map of Pan-European Ecological Network in Central and Eastern Europe (PEEN CEE) was presented at the meeting of the Expert Committee on the establishment of the Pan-European Ecological Network in Riga, in October 2003.

After this project the Expert Committee prioritized the development of indicative PEEN maps for the South-eastern European region and the Newly Independent States (NIS) that has been presented to the Committee of Experts in 2006 (Biró et al 2006).

In 2005 Alterra and ECNC have been requested by the Dutch Ministry of Agriculture, Nature management and Food Quality and its representatives in the Committee of Experts of PEEN to follow up the process of the Pan European Ecological Network with a proposal for the structure of the Network in Western Europe (the former EU 15, Norway and Switzerland). The project has been carried out under the auspices of the Committee of Experts for the development of PEEN. Alterra has executed the project on the Indicative Map of the PEEN Western Europe in close cooperation with ECNC and with support of several data providing NGO's. The project includes Western Europe from the Polar Circle in Norway onto

Sicily and Gibraltar. At present Iceland, the Canary Islands and Madeira have been left out. The indicative map covers therefore the following countries in Europe:

- EU countries: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, Malta, Netherlands, Portugal, Spain, Sweden, United Kingdom
- Non EU-countries: Switzerland, Norway, Andorra, Monaco, San Marino, Liechtenstein

2 Scientific background of the PEEN concept

2.1 Ecological Networks, nature in the wider countryside

It has become clear that there are large parts of the land in Europe where nature cannot survive in designated land set apart. We have to accept, that birds, mammals, insects and plants move through the countryside and that they need space to move. During many centuries this already was common practice: both man and animal crossed the landscapes of Europe and exchanged individuals, species and genetic information between populations and regions. The Spanish cañadas are a clear example of this principle in Western Europe (Bunce et al 2006).

In a planned and intensively used land as is known in many parts of Europe natural processes and species and genetic exchange through landscapes has to be one of the backbones of spatial planning: it makes spatial planning the director of environmental conservation. It means concretely that in addition to official site protection through national parks and nature reserves multifunctional zones should be developed and maintained: ecological corridors, greenways and landscape linkages that have aesthetic functions, contribute to an attractive living environment, have an educational function, a recreational function and last but not least an ecological function (Jongman 2004). Actually, the tradition for greening the landscape has already existed for a longer period in many countries in Europe as a tool to prevent and guide urban sprawl with a - not always recognised – side product of ecological coherence (Von Haaren and Reich 2006)

Ecological networks are the result of science based nature conservation, of nature conservation planning. Its basis is founded in biogeography, population dynamics, landscape ecology and land use science. The planning process contains ecological elements, but requires also political, land use planning and awareness components. Without the incorporation of these aspects ecological networks cannot survive as a concept and cannot be realised in practice. This means that they should be based on science based models, on tested scenarios and on participative planning procedures.

2.2 Modelling ecological networks

Many natural species can migrate over long distances and many also move through the landscape in search of food, shelter and new breeding sites. They travel at different scale levels constructing their own pathways and their own network. In the present day landscapes with road traffic and intensive land use they have become vulnerable. They cannot be identified as being present at every moment of the year and they often compete with human land use. In Europe many species are adapted to the cultural landscapes as accessible and non-hostile land with food and shelter. The role of ecological networks will be to maintain and where needed to restore these functions of migration, food supply and shelter in the landscape.

An ecological network should be geared towards ecosystem functioning (forest, marshland, moors) or a key species. A strategic choice of such a focal species benefits many more species than an arbitrary species in the network design. Some focal species have broad-scale effects at the ecosystem level (Dale *et al.* 2000): turnstone species (top predators, such as the wolf, brown bear, otter) ecological engineers (beaver) and umbrella species (red deer). These can be used at the larger continental level, while species with local abundance and dispersal better function for local and regional networks.

The concept that can be used for assessments in man-dominated landscape in general and for designing ecological networks is the metapopulation concept (Levins 1970, Opdam 1988, Hanski & Gilpin 1997). A metapopulation is a set of populations in a habitat network connected by inter-patch dispersal. A habitat network is a set of habitat patches close enough to have a reasonable level of inter-patch dispersal. Habitat is a species-specific term for the set of conditions a species needs to feed, survive and reproduce.

In highly fragmented landscapes, the occurrence of a species at a certain moment in time does not necessarily mean that the species is part of a sustainable population. The reason is that metapopulation dynamics, such as local extinctions and recolonization processes are taking place constantly and reduce the value of single observations. In conservation planning for metapopulations of more than one and mostly many species, it would not be a sound strategy to conserve all the patches where a species is found at a certain moment in time and neglect others patches. Moreover, what we see as distribution patterns of species is the result of historical developments in land use and populations can be in a process of adapting to the present day landscape. Probably, the populations are lagging behind the landscape changes (Tilman et al. 1994). Therefore ecological networks cannot be based entirely upon species distribution data but have to be based on a more general long-term strategy.

To be effective in conservation planning ecological knowledge and modelling results must be translated into policy and technical solutions. Design and management of linkages for conservation can be viewed in a biological way, a socio-political way and as a design problem (Bennet 1999).

An analysis of the benefits for flora and fauna is an important step and an essential basis for evaluating design and management of the landscape and of ecological networks. Within an ecological network corridors can be designed species specific or group specific, but they also can have a variety of functions. Knowledge of the ecological structure and processes in the landscape, combined with the behaviour and ecology of species is of utmost importance in the design of ecological networks and corridors. In all cases the landscape has to be able to fulfil its ecological function by using forests, hedgerows, streams and small forests for guidance and shelter.

2.3 Connectivity and connectedness

Migrating species are vulnerable in their lifecycle. They are not all year available to signal the importance of a site as a temporary habitat. European storks (*Ciconia ciconia*) for instance breed in large parts of Europe and they winter in Africa, migrating 10,000 km each season. Species have adapted to the cultural landscapes of Europe, because they were accessible and not hostile. Large areas with good living conditions that are always inhabited are defined as core areas for populations. In good reproductive years species will move from these areas into other – even marginal - sites (Verboom et al, 1991). Area reduction will cause a reduction of the populations that can survive and in this way an increased risk of extinction, because dispersal between habitats decreases, causing less exchange of genetic information and less colonisation of empty habitats.

Increasing traffic and intensifying agriculture made the European cultural landscape more open on the one hand and more difficult access on the other. Forests and hedgerows disappeared in intensively used agricultural land, forests became uniform production forests, streams have been straightened and the road-network became asphalted, denser and more intensively used. Last but not least many large and important wetlands have been drained.

Plants and animals both disperse by wind, water, with help of other species or by own movements. Migration is a specification of dispersal, while it is directed to a certain site. Dispersal is essential in population survival and the functioning of biotopes. However, dispersal can only function if there are 1) sites to disperse from and to 2) means for dispersal. On the one hand animal species will leave a population if living conditions cannot support all individuals and on the other hand species will fill in gaps in populations or sites that are empty. Fluctuations in populations can cause changes in species abundance and species composition of a site. Birth, death, immigration and emigration are the main processes to regulate fluctuations at the population level. Plants depend on other species for their dispersal. However, plant strategies for dispersal are the least known and difficult to detect in practice. Restriction of species dispersal increases the chance of species extinction.

The main functional aspect of in the landscape of importance for dispersal and persistence of populations is connectivity and connectedness. According to Baudry and Merriam (1988) connectivity is a parameter of landscape function, which measures the processes by which sub-populations of organisms are interconnected into a functional demographic unit. Connectedness refers to the structural links between elements of the spatial structure of a landscape and can be described from mappable elements.

Structural elements are different from functional parameters. For some species connectivity is measured in the distance between sites, for other species the structure of the landscape. The connectedness through hedgerows represents the presence of corridors and barriers. Area reduction will cause a reduction of the populations that

can survive and in this way an increased risk of extinction. It also will increase the need for species to disperse between sites through a more or less hostile landscape.

Routes for species migration consist of zones that are accessible for the species to move from one site to another and back. Due to differences in needs migration and dispersal routes can be manifold, from single wooded banks to small-scale landscapes and from river shores to whole rivers and coastlines. For fish it means that rivers are not blocked by dams and of good water quality. For mammals and amphibians it means that routes are available and that man-made barriers can be crossed.

Amphibians and mammals are able to disperse over distances from several metres to hundreds of kilometres. For small mammals ecological corridors can be hedgerows, brooks and all kind of other natural features that offer shelter. Migration is important for grazing animals like red deer (*Cervus elaphus*) and roe deer (*Capreolus capreolus*), for predators like the golden eagle (*Aquila chrysaetos*), the lynx (*Lynx lynx* and *L. pardina*) and the wolf (*Canis lupus,* Figure 1) but also for most birds from northern and eastern Europe.

Figure 1. The wolf (Canis lupus) is a species that migrates over long distances in forested and open landscapes from eastern to Western Europe (Photo Saxifraga-Jan van der Straaten).

For many species, (mammals, birds and fish) rivers are important corridors. A river is therefore more than the sum of its parts and it is not a static body of water, but rather a continuum with a changing ecological structure and function. According to Jungwirth (1998) modern ecology recognises them as complex systems. The links according to Townsend and Riley (1999) operate in three spatial dimensions:

- Longitudinal links along the length of the river system, such as the river continuum (Vannote et al 1980), downstream barriers to migration
- Lateral links with the adjacent terrestrial system, such as the flood pulse concept (Junk et al 1989).
- Vertical links with and through the riverbed.

In general running waters constitute a vector for the transfer of material from elevated reaches to the bottom of a drainage basin. Fish, mammals and plants move along their corridor in different speed and with different steps. The strong interaction between the stream and its riparian ecosystems in its ecotone provide a huge exchange of energy, matter and nutrients that attracts all kind of natural species. The transport of matter and nutrients is restrained by all kind of natural and man-made retention devices and in this way the river is an important mechanism for reconstruction of landscapes and for species, linking reproduction sites and populations. The way matter, energy and species move through a river system can be well described with the spiralling concept , based on the explain the behaviour of species along rivers.

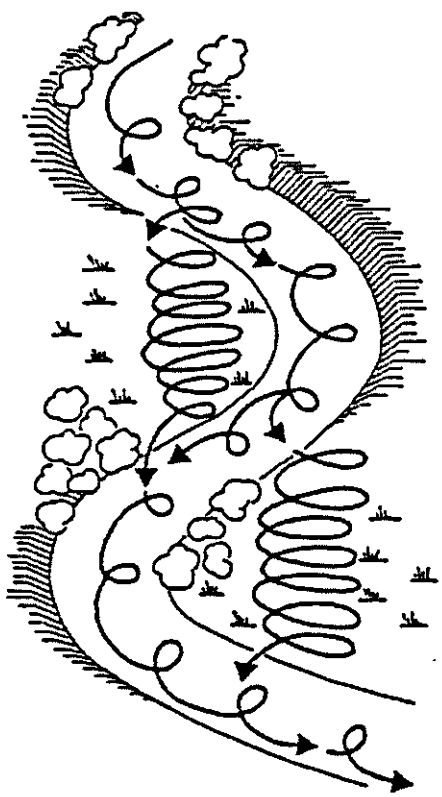

Figure 2. The spiralling concept for river system (Pinay et al 1990). Strong interaction between the stream and the riparian systems in the ecotone represent important exchange of nutrients, matter and species.

2.4 The Structure of Ecological Networks

Ecological networks can be defined as systems of areas of high biodiversity value and their interconnections that make a fragmented natural system coherent to support more biological diversity than in non-connected form. An ecological network is composed of core areas, (usually protected by) buffer zones and (connected through) ecological corridors (Bischoff and Jongman 1993). Core areas have mostly been

identified by traditional nature conservation policies as National Parks or Nature reserves. The insight gained from recent geographical and ecological concepts link this traditional conservation strategy with other land use and integrate nature conservation in general land use policy and spatial planning. In this way ecological corridors and buffer zones are becoming key elements in nature conservation strategy, but also highly discussed elements as they are the landscape elements where many functions coincide.

In Western Europe many, but not all, important natural areas are protected. Differences in definitions used by countries in Europe can be big and lead to confusion (Jongman 2004). Agriculture, forestry and recreation are in some cases allowed, in other cases integral part of the protected area. Traditional land use or land use techniques, especially extensive exploitation of grassland such as transhumance can be a method of management of semi-natural areas. Other categories of protected areas are areas for landscape conservation, nature parks, areas of outstanding natural beauty, etc. These areas can include protected areas for nature conservation. Agriculture, forestry and recreation are more or less limited by rules concerning land use, buildings and environmental protection. Public access is regulated differently. Now through the EU-Species and Habitats Directive (92/43/EEC) brings some coherency into these developments in Europe. However, national differences will maintain to exist and be taken into account when designing and implementing ecological networks.

IUCN defines a buffer zone as: a zone peripheral to a national park/reserve where restrictions are placed upon resource use or special development measures are undertaken to enhance the conservation value of the area (Oldfield 1988). The more socio-economic approach is expressed by the World Bank definition: a social agreement or contract between the protected area and the surrounding community, where size, position and type of buffer zone is defined by the conditions of this agreement.

Landscape change outside the boundaries of a core area generally causes important biotic changes within it. By creating environmental gradients, buffer zones maintain landscape processes and elements around the natural remnant to avoid abrupt changes. Common sense and practical experience make us realise that the fundamental role of protected areas would not be achieved if the controlling of adjacent human activities is not accomplished. Buffer zones may be viewed as a shield around the core area against the direct impact of human activities or as the ecotone between protected and economically used land (Jongman and Troumbis 1995).

Connectivity and connectedness come together in the concept of ecological corridors. Ecological corridors can be defined functionally to indicate connectivity and as physical structures to indicate connectedness. They can be defined as functional connections enabling dipersal and migration of species that could be subject to local extinction (Bouwma et al 2002). As physical structures they also can be defined as various landscape structures, other than core areas, in size and shape

varying from wide to narrow and from meandering to straight structures, which represent links that permeate the landscape, maintaining or re-establishing natural connectivity (Jongman & Troumbis 1995).
In addition to the above classification and according to functionality, corridors can be classified into three or four classes according to the (physiognomic) shape that they have: linear, stepping stone and landscape corridors (see Figure 3).

As physical structures within an ecological network ecological corridors are multifunctional landscape structures. In Europe ecological corridors are often the result of human intervention in nature: hedgerows, stonewalls, landscapes with small forests, canals and rivers. Others such as coastlines and watercourses are predominantly natural. The nature of ecological corridors and their efficiency in interconnecting remnants and in permeating the landscape depend on the habitat site they originate from and the land use mosaic within which they are embedded in and of which they consist. Their density and spatial arrangement change according to the type of land use. Their connectivity function varies from high to low depending on their spatial arrangement, internal structure and management. Ecological corridors are multifunctional by definition; they have functions for:
- *Aesthetics*: it makes an area characteristic
- *Social-psychological well being*: they make an attractive living environment
- *Education*: they help to understand and experience nature
- *Recreation*: nature close to housing
- *Ecology*: temporal and permanent habitat and pathways for species.

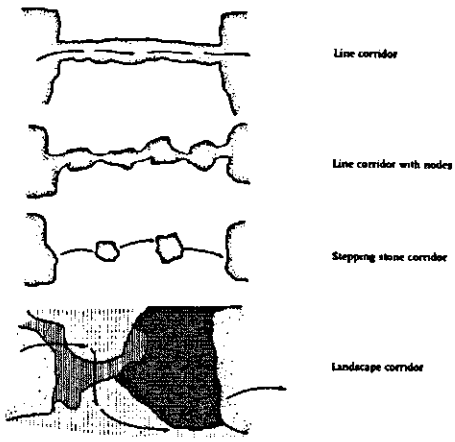

Figure 3. Different shapes of corridors (Bloemmen et al, 2004)

Ecological corridors are multifunctional in both ecological and societal sense, because they are not the core areas of a nature conservation system but function in the wider landscape. They are also part of 'greenways' that exist in many parts of Europe, sometimes under different names (Von Haaren and Reich, 2006, Machado et al 1997). They can be as wide as a watershed or as narrow as a trail. They can encompass natural landscape features as well as a variety of human landscape features and are from more natural to more cultural classified as (Florida Greenways Commission, 1994):

- landscape linkages, large linear protected areas between large ecosystems including undisturbed rivers;
- conservation corridors, less protected and in many cases with recreational functions, often along rivers;
- greenbelts, protected natural lands surrounding cities to balance urban and suburban growth;
- recreational corridors, linear open spaces with intensive recreational use;
- scenic corridors, primarily protected for its scenic quality;
- utilitarian corridors, canals, powerlines that have an utilitarian function but serve natural and recreational functions as well;
- trails, designated routes for hikers and outdoor recreation having a function as natural corridor as well.

This overview shows the multifunctionality and morphological diversity of greenways and ecological corridors. The more complex a corridor is, the better it can function for different species groups and the more it is multifunctional in an ecological sense.

It must be stated, that corridors also can have negative influence such as the breaking of isolation that is needed for certain species, exposing populations to more competitive species, the possibility of spreading of diseases, exotic species, and weeds, disrupting local adaptations, facilitating spread of fire and abiotic disturbances and disruption of local adaptations (Noss, 1987). Beier and Noss (1998) stipulate that based on empirical research ecological corridors to maintain biodiversity are valuable conservation tools. Not maintaining or re-establishing ecological corridors would mean that mankind neglects the last remnants of natural connectivity and in this way could harm its own nature conservation objectives (Beier and Noss, 1998). Moreover, nowadays practice shows that transport by man are much more important for spreading species and diseases.

Finally a network can be hampered by all kind of barriers. Natural barriers do exist at all levels. The Atlantic Ocean is a barrier between America and Europe for most plant and animal species. Mountains and rivers can be barriers for mammals and agricultural roads can already be barriers for insects and spiders. However, much more important are modern barriers for nature, as modern society develops new mechanisms and structures that cannot easily be adapted to by natural species. Canalisation of waterways and the building of motorways however did disturb both the habitat of species as well as their possibility to disperse. Ecoducts and fish ladders can mitigate these barriers (Figure 4).

Figure 4. Fish ladder in one of the headwaters of the Tweed (Scotland) for migration of Salmon. (Photo Rob Jongman)

2.5 Hierarchy of ecological networks

Ecological networks are effectively implemented at the landscape level; they reflect the complexity of pattern and processes in the landscape. This means that between the Pan European Ecological network and its application several levels of plans can be developed aiming at decisions and applications for different purposes.

The size of network components serves as a criterion of the network hierarchy with four levels (Mander et al, 2003):

(a) mega-scale: very large natural core areas (>10000 km^2),
(b) macro-scale: large natural core areas (>1000 km^2) connected with wide corridors or stepping stone elements (width >10 km);
(c) meso-scale: medium size core areas (10-1000 km^2) and connecting corridors between these areas (width 0,1-10 km);
(d) micro-scale: small protected habitats, woodlots, wetlands, grassland patches, ponds (<10 km^2) and connecting corridors (width <0,1 km).

Mega-scale ecological networks can be considered at global level. The Human Footprint Map can serve as a base for determining global ecological networks. The macro-scale of ecological networks is represented by macro-regional-level plans such as PEEN, the wildlands project (Noss 1992), or national-level projects within larger countries such as Russia (Sobolev et al. 1995). Most of the projects at this level are used as guiding principles or visions for the future. This macro level can be defined as the (sub) continental level without taking administrative boundaries into account.

The landscape-level ecological networks are designed or implemented in a wide spatial scale range, from macro- and meso- to micro-scale projects. At the meso-scalemost significant planning of ecological networks has been carried out (Figure 5).

Figure 5. The ecological network of Bitburg-Prüm (Burckhart et al, 1995)

Likewise, the most detailed analysis and implementation schemes have been established at micro-scale (Figure 6, 7).

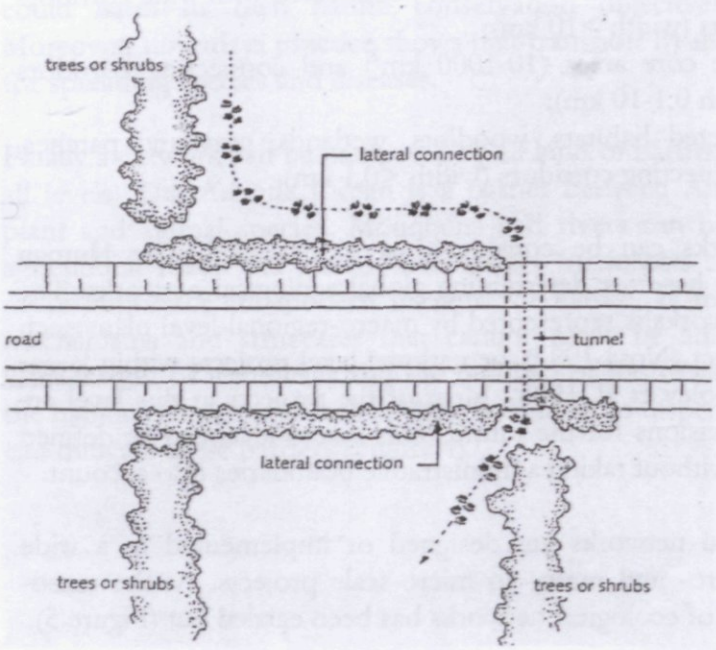

Figure 6. Design of a road crossing and landscape structure for a badger (Meles meles).

Figure 7. Badger tunnel realized in a road project (Photo Rob Jongman)

The challnge of the ecological network approach is to integrate ecological principles, biodiversity, and landscape conservation requirements into spatial planning as well as into implementation.

At the European level Natura 2000 develops a coherent European Network of Special Areas of Conservation (SAC) in each of the EU Member States (as defined in Habitats Directive (92/43/EEC Article 3). The network consists of Special Protection Areas (SPA – not to be mistaken with the SPA under the Barcelona Convention) and Sites of Community Interest (SCIs). This network, composed of designated sites hosting the natural habitat types and species listed in the Habitats Directive Annex I and II, aims to enable the natural habitat types and the species populations to be maintained or restored at a favourable conservation status. The PEEN concept also covers large undisturbed areas and their connecting corridors outside of protected or designated areas and is an indicative map for developing visions for the future.

3 Approaches for ecological networks in Western Europe

3.1 Introduction

In spite of the good intentions within the field of nature conservation, the industrialization of agriculture, restructuring of land use, the development of transport networks and metropolitan areas has caused a serious fragmentation of natural areas, deterioration of ecosystems, loss of natural habitats and habitat structures, and extinction of species. This is especially the case in the most densely populated areas of Europe. Novel ideas about ecological networks have developed into various concepts and plans for terrestrial systems of ecological stability, or networks of linear habitats connecting habitat islands on different geographical and administrative levels.

Ecological networks are proclaimed to be a leading objective in the Pan-European Biological and Landscape Diversity Strategy (Council of Europe et al., 1996). The importance of a wider landscape for nature conservation has been recognised in the European Union's Habitat Directive (EC92/43), when referring to the importance of landscape elements and structures for the favourable conservation status of habitats and species. However, also at the national and regional level initiatives are developed for Ecological networks, leading to real implementation on the ground.

The approaches show varieties in concepts, criteria, legislation and implementation. Variations reflect the cultural differences between countries in Europe as well as the need for Ecological Networks. The idea of green networks was already developed in urban planning in the beginning of the 20th century. In the great metropolitan areas of Europe, systems of Green Corridors were developed: London, Moscow, Berlin, Prague Budapest and Copenhagen (Forchammer, 1939, Kavaliauskas, 1995).

3.2 Stakeholders in nature conservation planning at the European level

A brief overview is needed on policy stakeholders related to the field of ecological network development in Europe as this is a fast developing area. Moreover, controversies exist around the topic of ecological networks and corridors, both on a political level as well as in research.

The aim of the overview is to:
- To provide insight in the relevant policy arenas concerning ecological networks;
- Identify the main group of stakeholders who now are involved in the development of ecological networks in Europe;
- Form a basis for consultation of experts and policy makers involved and a communication strategy for the results of the project towards other sectors.

Figure 8. Wienerwald, an area with high biodiversity, traditionally an important area for recreation (rock climbing) for inhabitants of Vienna (Photo Rob Jongman)

SBSSTA- national representatives

COP- national representatives

PF: CBD

Committee of Experts

Council of Europe

ECNC

PF: PEBLDS process

European Commission

EEA (incl. ETC-NC, ETC-C, ETC-TE)

Habitats Committee

Participants VILM workshop

PF : Natura 2000

Policymakers

Scientific researchers

PF: national or regional networks

International NGO's

WWF

IUCN

ECNC

Wetlands International

Birdlife International

PF: all

Figure 9. Main policy arenas and main stakeholders. PF: Policy field

Figure 9 outlines the main stakeholder groups and their related policy fields. Looking at the attitude of the 5 major groups towards ecological networks the following can be noticed.

At the European level there are at present four main policy arenas which are concerned with the development of ecological networks as well as a number of NGOs. These are:

Convention on Biological Diversity (CBD)

At the global level of policy making the issue of ecological networks and connectivity is discussed in two UN -fora. At the World Summit on Sustainable Development (WSSD) in Johannesburg the importance of the development of regional and national ecological networks also as a way to achieve sustainable development was reaffirmed. During the 7th Conference of Parties of the Convention on Biological Diversity the relationship between ecological networks and protected areas has been discussed. In the declaration it was stated that the COP invites Parties to consider options, in the context of implementing the programme of work of protected areas, such as ecological networks, ecological corridors, buffer zones and other related approaches in order to follow up the WSSD Plan of Implementation and the conclusions of Inter-Sessional Meeting on the Multi-Year Programme of Work of the Conference of the Parties up to 2010.

The most tangible result so far is that one of the indicators developed to monitor progress regarding the implementation of the CBD is 'fragmentation'. Within the framework of the CBD this indicator has been defined as 'the area of unfragmented land'

Natura 2000 and Habitats Directive (EU)

Under the Birds and Habitats Directive the Natura 2000 network will be established that is considered as a European Ecological Network. In article 10 of the Directive the importance of connectivity between the areas is indicated. In the EU until now most attention has been paid to the identification and designation of the Natura 2000 sites itself. In May 2004 Ireland as chair of the EU organised the Malahide Conference. In the recommendations of this conference (1.8) it is stated that:

> *"1.8 Protected areas integrated into broader landscapes and seascapes by applying the ecosystem approach, and where appropriate, developing tools for ecological connectivity, such as ecological corridors".*

As a result the EEA has indicated that it will incorporate the research on connectivity between Natura 2000 sites in their work program of 2005. Also in 2004 Germany and the Netherlands, on the request of the head of the department responsible for the implementation of the Birds and Habitats Directive of the European Commission have been asked to start developing ideas regarding connectivity for Natura 2000 areas and develop an advice for the Scientific Committee responsible for the Habitats Directive. In May 2005 a symposium has been organised to review this issue with a broad range of stakeholders.

In June 2005 the need to review the issue of connectivity for Natura 2000 sites was also discussed in the Habitats Committee. The Committee decided that it was too

early to discuss this issue and decided that it was a matter that first needed to be reviewed by the Scientific Working Group of the Habitats Directive.

Policy process of the Pan-European Ecological Network (under PEBLDS, Council of Europe)

In 1995, 55 countries endorsed the establishment of the Pan-European Ecological Network (PEEN) as one of the activities to be undertaken within the framework of the Pan-European Biological and Landscape Diversity Strategy (PEBLDS). In order to facilitate the development of the Pan-European Ecological Network a committee of Experts has been established under the auspices of the Council of Europe and ECNC. This Committee meets annually.

The stakeholders involved in the PEBLDS process are in general in favour of ecological networks and the concepts behind them. In the policy field "Natura 2000" the situation is dual in nature. Recently the EC as well as the EEA have expressed their interest to work on this topic. However in the Habitats Committee several country representatives have raised objections to pursuing the issue of connectivity between Natura 2000 areas. They foresee more difficulties in the realisation of ecological corridors than in the designation of Natura2000 sites.

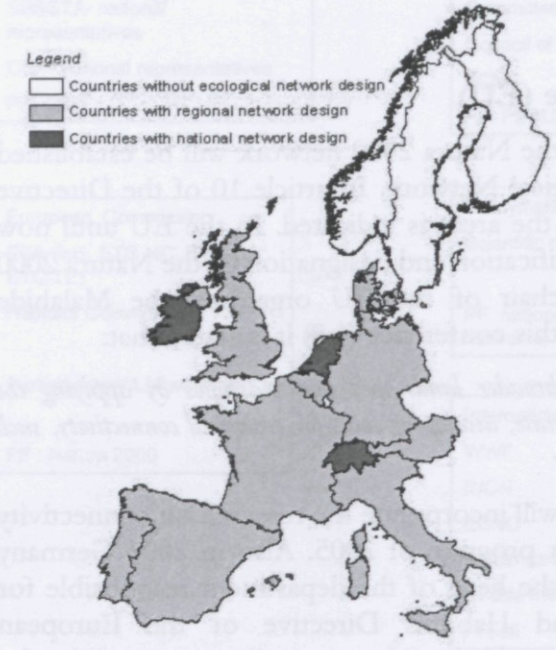

Figure 10. Countries in Western Europe with national and regional networks, mostly as part of policy documents or legal obligations. If is indicated that regional networks are developed, then this can vary between one region and all regions within the country (for details see Table 1).

Alpine Convention

Article 12 of the Alpine Convention underlines the need for connectivity. Four organisations are leading in implementing the Alpine Convention: WWF, ALPARC, CIPRA and ISCAR. In September 2005 a joint workshop was organised to identify the connection areas between the Priority Conservation Areas in the Alps.

3.3 Stakeholders in conservation planning at national and regional level

Besides the international processes also at national and regional level several countries in Western Europe have developed national or regional networks (Table 1, Figure 10). However the actual implementation of the networks can vary widely. in some cases it is only a paper plan in other cases official government policy with substantial funding.

Table 1 Germany status of network development areas of ecological coherence

Country	Status of network development
Andorra	-
Austria	Several regions have developed networks, a national network for large carnivores exist
Belgium - Flanders	Network developed/implementation under development
Belgium- Waloon	Networks under development at the local level
Denmark -	Networks developed at the regional level (within spatial planning context)
Finland	No network exists- -the National Forest Service has started studies to review connectivity between their areas
France	A national network has been drafted in the framework of a spatial development plan. It does not have an official status. Recently the directors of national parks have gathered together discuss the need for connectivity between National Parks, local initiatives in Calais/Pas du Nord
Germany	Most Länder have developed networks, a new law adopted in 2003 obliges all Länder to de so; first coordination meeting in Vilm October 2004 with Bundesländer and neighbouring countries. At present the sketch of areas of ecological cohernece of Germany (as a basis for linkage between the Ecological Networks of the Länder has been produced in 2006
Ireland	Network developed at the national level as part of spatial planning process
Italy	Several regions have developed networks
Luxembourg	-
Malta	-
Monaco	-
Netherlands	Network on national and elaboration at the regional level
Norway	-
Portugal	At the regional level activities are undertaken, plans have been developed in Alentejo and especially Greenway plans around Lisbon, Coimbra and Porto and Algarve Cordão verde
San Marino	-
Spain	Several regions have developed networks, but there is no coordination between them
Sweden	-
Switzerland	Network developed and national level and some Kantons
United Kingdom	Scotland has developed a forest network, Some regions in England have developed ecological networks (Cheshire); Wales has developed a national woodland network

3.4 Planning Approaches for Ecological Networks

In several countries in Western Europe ecological networks are being planned as part of a legislative task or as a regional or national planning strategy. In a number of countries in Europe legislation has included ecological networks. However in most countries the planning policy or nature conservation/biodiversity policy is leading the development of ecological networks. Moreover federalisation and decentralisation has led to a great variety in approaches. When regional governments have the lead in nature conservation and land management, then usually differences occur within countries (Table 2). This means that also coordination between networks is a huge task as there are many approaches and interests.

Table 2. Legislation, planning and responsibility for development and implementation of ecological networks.

Name of the network	Embedded in legislation	Regional Policy Plan	Nature Plan	Decentralisation, Federalisation
Ecological Network, Flanders, Belgium	X		X	X
Ecological networks Walloon, Belgium	-		X	X
Ecological Network, Denmark	-	X		X
Vernetzter Biotopsysteme Germany	X		X	X
Reti ecologiche, Italy	-		X	X
Ecological Network, The Netherlands	-		X	X
Greenways Systems Portugal	-	X		X
Ecological Networks, Spain	-		X	X
Ecological Networks, United Kingdom	-		X	X
Ecological Network Ireland	-	X		
Ecological Network Switzerland (REN)	X		X	X

Despite the many authorities and stakeholders involved in the development of Ecological networks at the national and regional level, the approaches and objectives are rather comparable (Table 3). There are big differences in the level of detail between plans; but in general most regional plans are well sustained by data and monitoring of change and development. National plans are usually made to develop planning strategies while regional and local plans are often focussing on implementation on the ground. In some regions implementation is well on its way such as in Cheshire County, UK (see: http://www.lifeeconet.com and http://www.cheshire.gov.uk/srep).

Table 3. Functions and approaches for Ecological networks

Name of the network	Main functions	Approaches, concepts and aims
Ecological Networks, Flanders, Belgium	Ecological	Coherent structure of areas in which nature conservation policy is the main objective, according to Flemish law
Ecological networks, Walloon, Belgium	Ecological	Local structures at community level based on regional guidelines
Ecological Networks, Denmark	Ecological	Core areas and ecological corridors developed as part of the counties multi functional planning. Aiming at the creation of a coherent structure to facilitate dispersal of species.
Vernetzter Biotopsysteme, All Bundesländer, Germany	Eco-ecological, Landscape Management	Planning concept for conservation of nature and natural communities, development of core areas and corridors and to conserve species according to the Federal Nature Conservation law.
Reti ecologiche, Italy (Bologna, Modena, Umbria)	Ecological	Projects at local and sub-regional level partly under EU-Life funding to create potentially useful for establishing ecological network. Criteria are under development.
National Ecological Network, The Netherlands	Ecological	Policy document aiming at conservation of species in a coherent area structure at the regional level
Greenways system of the Lisbon, Coimbra and Porto, Portugal	Ecological, Recreational	Gap analysis of protected areas and areas to be protected for both nature conservation and cultural and recreational values.
PEIN system Catalunya , Spain	Ecological	As a consequence of Catalan strategy for biodiversity some projects try to connect the PEIN natural protected areas by rural areas into what might be considered an Ecological Network
Ecological Network Bask Country, Spain	Ecological	
Ecological Network Madrid, Spain	Ecological	
Ecological Network, Cheshire County United Kingdom	Ecological	Regional project aiming at its implementation at a regional level carried out under Life funding. The project is being implemented by Cheshire County Council.
Forest Network Scotland	Ecological	
REN Ecological Network Switzerland	Ecological	National Plan for Nature conservation

4 Methodology for Development of the Map

4.1 Introduction

While developing the methodology for the indicative map of the Pan-European Ecological Network it is relevant to consider the aim of the Pan-European Ecological Network (Council of Europe et al, 1995):

> *'The Pan-European Ecological Network addresses the development of an ecological network at a European level. It will consist of core areas, corridors and buffer zones. Restoration areas will be identified where they are considered necessary. The Pan-European Ecological Network aims to conserve the full range of ecosystems, habitats, species and landscapes of European importance and to counteract the main causes for decline by creating the right spatial and environmental conditions'.*

The map for Western Europe is developed at a scale of 1:3 million (1 mm = 3 km). For the design of the map only data that are European wide available and consistent can be used. Data that are only available for a part of Europe although the species or habitat is present in other parts contort the reliability of the results. They could be confused with species or habitats with a regionally specific distribution. The map has to take into account the work already carried out at a European level regarding the identification of core areas for biodiversity. Therefore the map includes the current existing international protected areas (Natura 2000), the nationally protected areas in Norway and Switzerland, as well as important areas identified by international organisations and NGO's, such as Birdlife International, the Ramsar Convention and The European Butterfly Organisation (through de Vlinderstichting).

Figure 12. Waddensee near Schiermonnikoog (The Netherlands), Natura 2000 Area (Photo Saxifaga Foundation-Jan van der Straaten)

The Pan-European Ecological Network is a vision for development of coherency in ecological networks throughout Europe and its implementation by national and regional governments. Therefore a method needs to be used that also takes into consideration the national ecological networks or if applicable a coherent set of regional networks developed in the countries depicted on the map.

4.2 Identification of the PEEN in Western Europe

Two other projects have been carried out in which an indicative map of PEEN for two different regions has been developed: Central and Eastern Europe (CEE, Bouwma et al 2002) and South Eastern Europe (SEE, Biró et al 2006). The maps developed for CEE & SEE are available now as database and poster size maps.

These maps of the indicative Pan-European Ecological Network consists of two elements being core-areas and search areas for corridors. Buffer zones have not been identified, because they are site specific and depend on local socio-economic circumstances. Restoration or nature development areas neither have been incorporated in the design, due to the lack of information on such areas. The methodology for this project will be based on the methodologies developed in these projects with additions that can be used for EU15.

The aim of the present project was to produce an easily readable indicative map according to a consistent and transparent methodology.
The map shows in first place the indicative location of

i) core areas in several different habitat types of the Western Europe, which are distinguished by different colours
ii) corridors along forested areas and along rivers.

4.3 Datasets for identification of core areas

The identification of core areas for the Pan-European Ecological Network in the present project is based on spatial information and datasets (Table 4). In the previous projects some shortcomings of the methodology were observed by the experts working in the project or by people reviewing the results. These were mainly that the current method might underestimate the ecological value of small-scale (hedgerows, small forests) landscapes - only large unfragmented landscapes are identified. Also in this project the same shortcoming exists. Small scale landscapes are not identified as core areas (Figure 13). However, they are identified as potential corridor landscapes. At this level the small scale agricultural landscapes have been only included as corridor landscapes as they do not provide large habitats for species; they always contain fragmented populations.

Figure 13. Small scale farming landscape in the Lake District, England, identified as corridor landscape (Photo Rob Jongman)

Table 4. Data used in the project PEEN-WE

Dataset	Source	Used for	Coverage
Topographical information			
Digital elevation model	USGS Data Centre	Background, habitat types	All
Hydrology (rivers, lakes)	ESRI, WDBII, Bartholemew	Background, corridors	All
National borders	ESRI, WDBII	Background	All
Towns and cities	GEOnet Names Server	Background	All
Roads	ESRI	Counterchecking corridors	All
Rivers	Bartholemew	River corridors	All
Internationally protected areas			
Ramsar sites	UNEP-WCMC	Protected areas	All
World Heritage sites	UNEP-WCMC	Protected areas	All
Man and Biosphere Reserve sites	UNEP-WCMC	Protected areas	All
Natura 2000	European Environmental Agency	Protected areas	EU15
Protected Areas Norway	UNEP On Line GIS and Map Database	Protected areas	Norway
Internationally acknowledged areas			
Important Bird Areas	BirdLife	Protected areas	All
Prime Butterfly Areas	De Vlinderstichting	Protected areas	All
Landcover information			
Corine Land Cover (CLC2000)	European Environment Agency	Habitat types	EU15
LC Database Norway	Nijos	Habitat types	Norway
LC database Switzerland	WSL	Habitat Types	Switzerland
Others			
Biogeographical regions	European Environment Agency	Habitat types	All
Potential natural vegetation	Alterra	Habitat types	All
Soil map	FAO-Unesco Soil Database	Habitat types	All
European Environmental Stratification	Wageningen UR	Habitat types	All

The basis of the PEEN are habitat maps showing existing non-fragmented natural and semi-natural areas considered large enough to sustain viable populations of large species and species of European importance requiring large areas. The project includes Western Europe from the Polar Circle in Norway onto Sicily and Gibraltar. As the area needed for survival of species differ largely between these areas due to climatic conditions use has been made of the Environmental Stratification of Europe (Figure 15, Metzger et al 2005, Jongman et al 2006) to identify habitats in different regions. Use has also been made of a Digital Elevation Model (DEM) of Europe to diversify between high mountains and lowlands. Further use has been made of the following datasets.

Figure 14. Elk (Alces alces) is a large animal used as an indicator for the size of habitat areas (Photo Saxifraga Foundation-Janus Verkerk)

Digital Elevation Model (DEM)

The Unites States Geological Survey GTOPO30 is a global digital elevation model by the USGS EROS Data Centre with a horizontal grid spacing of 30 arc seconds (approximately 1 km^2). GTOPO30 was derived from several raster and vector sources of topographic information. DEM was used directly on one hand in the background layer for an easy topographic identification of the region, and again indirectly in the habitat layer.

Rivers and lakes

The Bartolemew database was used for this layer together with the Environmental Systems Research Institute's (ESRI) World Basemap. The project team decided to indicate the three highest levels of the Bartolemew map to avoid overcrowding of the map. Rivers on one hand represent topographic data on the map; however, data on their quality have been used for the identification of the corridors.

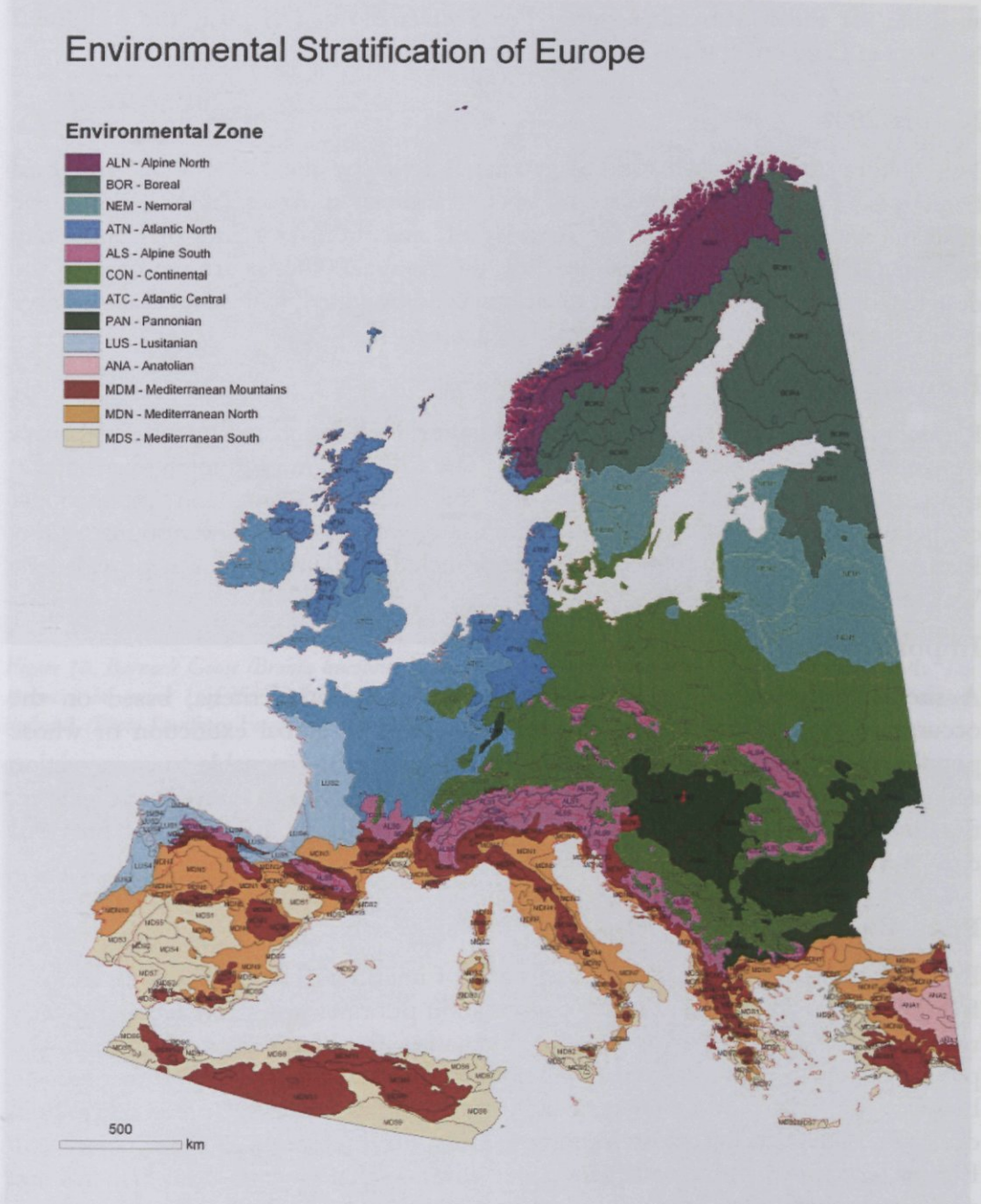

Figure 15. Environmental stratification of Europe; the Zones are Alpine North: ALN, Alpine South: ALS, Atlantic North: ATN, Atlantic Central: ATC, Lusitanian: LUS, Boreal: BOR, Nemoral, NEM, Continental: CON, Pannonian: PAN, Mediterranean North: MDN, Mediterranean Mountains: MDM, Mediterranean South: MDS.

Corine Land Cover 2000 (CLC2000)

The CLC2000 database provides a Pan-European inventory of biophysical land cover, using a 44-class nomenclature. It is made available on a 250m by 250m grid database, which has been aggregated from the original vector data at 1:100 000. CLC is a key database for integrated environmental assessment. The CLC2000 database is

available for the EU member states. For Switzerland and Norway the Swiss and Norwegian Land cover maps have been used.

Natura 2000

The Natura 2000 is a network of protected areas by the EU Habitat and Bird Directives. The network consists of Special Protection Areas (SPA – not to be mistaken with the SPA under the Barcelona Convention) and Sites of Community Interest (SCIs). It has been assumed that the Natura2000 sites are the core of the designated areas in PEEN WE. It must however, be stated, that national differences in designation do exists and can be easily detected.

Ramsar sites

Ramsar sites are wetlands of international importance designated under the Ramsar Convention, the Convention on Wetlands. The Convention is an intergovernmental treaty, which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. Only Ramsar site larger than 1000 ha have been included. Data have been provided by Wetlands International.

Important Bird Areas (IBA)

A site is recognised as an IBA only if it meets certain criteria, based on the occurrence of key bird species that are vulnerable to global extinction or whose populations are otherwise irreplaceable. An IBA must be amenable to conservation action and management. The IBA criteria are internationally agreed, standardized, they are quantitative and scientifically defensible. BirdLife International provided data on IBAs.

Prime Butterfly Areas (PBA)

Prime Butterfly Areas are an initial selection of important butterfly areas in Europe, focusing on target species that are conservation priorities across a large and diverse region. Prime butterfly areas indicate core areas for biodiversity. Protection and proper management of these areas will not only help to conserve these target species, but also the many other characteristic species they contain. Criteria have been devised to identify the most important areas for the specified target species in Europe, combined with a wide geographic coverage that includes both marginal and core populations. Data were provided by "De Vlinderstichting' in the form of an excel table with coordinates and size of the areas.

Soil map

The FAO-Unesco Soil Map of the world was published between 1974 and 1978 at 1 : 5.000.000 scale (*FAO, 1991*). The legend comprises an estimated 1650 different map units, which consist of soil units or associations of soil units. The soil units are grouped in 26 major soil groupings. The soil map was used to identify some habitats that have specific soil requirements like moist grasslands.

Figure 16. Barnacle Goose (Branta leucopsis) is one of the bird that makes use of Ramsar sites and IBAs. The species is in annex 1 of the Birds Directive, but not included as a key species because its habitat is already included. (Photo Saxifraga Foundation-Jan van der Straaten)

Figure 17. The spoonbill (Platalea leucorodia) is one of the species included as indicator species (Photo Saxifraga Foundation-Jan van der Straaten)

4.4 Identification of Core Areas

In order to identify existing non-fragmented natural and semi-natural areas considered large enough to sustain viable populations of species of European importance the following steps are being conducted:

- Development of a combined land cover map for the entire region (CORINE, Switzerland and Norway)
- Development of an ecologically interpreted habitat classification map;
- Identification of habitats of sufficient size according to the working scale of the map according to identified size classes.
- Identification of NATURA2000 sites
- Identification of Ramsar sites, IBAs and Prime Butterfly Areas.
- Identification and linking indicator species to the identified habitats;
- Estimation of the required area size for sustainable populations of the indicator species.

Table 5. Simplified habitat classification for wet habitats of Western Europe based on CORINE 2000, Norwegian Land Cover and the Swiss land cover.

Water & wetlands			
PEEN legenda	**land cover database**	**Habitat**	**Environmental Zone**
Fens and bogs	CORINE	Peat bogs	all
	CORINE	Inland marshes	all
	Switzerland		all
	Norway		all
Salt marsh, saline areas, beaches	CORINE	Salt marshes	all
	CORINE	Salines	all
	CORINE	Intertidal flats	all
	CORINE	Beaches, dunes, sands	all
	Switzerland		all
	Norway		all
Inland water/ wetlands	CORINE	Water bodies	all
	CORINE	Coastal lagoons	all
	CORINE		all
	CORINE	Estuaries	all
	Switzerland	Inland waters	all
	Norway	Water	all

Figure 18 Boreal Coniferous Forest Dalarna, Fulufjälet (Photo Saxifarga Foundation, Willem van Kruijsbergen)

Figure 19 Mediterranean Shrub, near Cadiz (Photo Saxifraga Foundation, Jan van der Straten)

Figure 20. Southern Atlantic Heath (Tras-os-Montes Portugal, Photo Rob Jongman)

Figure 21. Alpine shrub vegetation in the Appenines, Mont S.Michel, Salerno Italy (Photo Saxifraga Foundation, Marijke Verhagen)

Figure 22. Lozère-Meyruais, Massif Central, France; alpine grasslands and scarsely vegetated areas (Photo Saxifraga Foundation-Jan van der Straten)

Figure 23 The Apollo butterfly (Parnassius Apollo) is an indicator of Prime butterfly areas (Photo Saxifraga Foundation-Marijke Verhagen).

Table 6. Simplified habitat classification for natural grasslands habitats of Western Europe based on CORINE 2000, Norwegian Land Cover and the Swiss land cover. The codes of the Environmental zones are as in Figure 15.

Grasslands			
PEEN legenda	**land cover database**	**Habitat**	**Environmental Zone**
Alpine grasslands/shrubs/open areas etc.	CORINE	Glaciers and perpetual snow	ALN, ALS
	CORINE	Sparsely vegetated areas	ALN, ALS
	CORINE	Sparsely vegetated areas	CON, ATN
	CORINE	Bare rocks	ALN, ALS,
	CORINE	Bare rocks	CON, ATN
	CORINE	Natural grasslands	ALN, ALS
	CORINE	Moors and heathland	ALN, ALS,
	CORINE	Sclerophyllous vegetation	ALN, ALS,
	CORINE	Sclerophyllous vegetation	ATN, LUS
	CORINE	Sparsely vegetated areas	MDM, MDN, MDS
	CORINE	Bare rocks	MDM, MDN, MDS
	CORINE	Natural grasslands	MDM, MDN, MDS
	CORINE	Sclerophyllous vegetation	MDM, MDN, MDS
	Switzerland	Open spaces with little or no vegetation	ALS
	Switzerland	Scrub and/or herbaceous vegetation associations	ALS
	Norway	Glacier	ALN
	Norway	Other land without vegetation cover	ALN
Calcareous grassland (dry)	CORINE	Natural grasslands	All
Moist grassland	CORINE	Natural grasslands	All

The first step was to develop a combined land cover map for the project region based on the existing land cover data (CORINE, Norwegian land cover map, Swiss land cover map) making use of BioHab categories (Bunce et al 2005). Based on the compiled land cover map of the region, habitats were identified by combining various land cover classes with additional information on Environmental zones of Europe (Metzger et al 2006), altitude and soil information (wet soils, calcareous soils). Selections are presented in Table 5, 6 and 7. The complete overview of the Land cover categories that have been used is presented in Annex 1. The Habitat categories developed on the basis of the land cover maps for the different Environmental Zones of Europe are presented in Appendix 2. Examples are given in Figures 16-22. The following habitat selection criteria have been used:

1. Size
2. Naturalness for the biogeographic region / Environmental zone; this means that most conifer forests in the Boreal, Continental and Atlantic zones have not been included as they their function is predominantly for wood production while the conifer forests in the high Alpine region have been included;
3. Importance for natural species

The next step in the identification of large non-fragmented areas was the selection of indicator species and linking them to the identified habitats. This was done by analysis of existing population data and confirmed by expert judgement. Experts have been consulted in various countries and on various species types. Given the scale of the map and the grain of the land cover information it was decided to consider only larger mammal and bird species as possible indicator species.

Table 7. Simplified habitat classification for forest habitats of Western Europe based on CORINE 2000, Norwegian Land Cover and the Swiss land cover. The codes of the Environmental zones are as in Figure 15.

Forest			
PEEN legenda	**land cover database**	**Habitat**	**Environmental Zone**
Forest - Scandinavia	CORINE	Broad-leaved forest	ALN, BOR, ATN
	CORINE	Coniferous forest	ALN, ATN
	CORINE	Mixed forest	ALN, NEM, BOR, ATN
	Norway	Non-productive forest. A lot of mountainous forest	ALN, BOR, NEM
	CORINE	Transitional woodland-shrub	ALN, BOR, NEM
Forest- Others	CORINE	Broad-leaved forest	ATC, ATN, LUS, MDM, MDN, MDS, PAN, CON, ALS
	CORINE	Coniferous forest	ATC, ATN, MDM, MDN, MDS, PAN, ALS
	CORINE	Mixed forest	ATC, ATN, LUS,MDM, MDN, MDS, PAN, ALS, CON
	CORINE	Burnt areas	MDM, MDN, MDS, ALS, LUS
	Switzerland	Forests	ALS,MDM, CON
	CORINE	Transitional woodland-shrub	ATC, ATN, LUS,MDM, MDN, MDS, PAN, ALS
	Switzerland	Scrub and/or herbaceous vegetation associations	CON

Mammal and bird species were selected based on their existing international protection status: species occurring on the Habitats and Birds Directives, cross checked with the Bern-Annex II and vulnerable-extinct status according to EBBC or IUCN. A total of 15 mammal species (Table 8, Annex 2) and 84 bird species (Annex 3) were selected for the Europe-WE region. For Europe SEE 90 bird species and 20 mammal species have been selected and for the CEE region 115 bird species and 19 mammal species. Species have been linked to habitats and the minimum size of the habitats has been calculated on the basis of the area of habitat required by the selected species. The required minimum area sizes (considered being sub-optimal for the various habitats) range from 50 km^2 for wetlands, peat lands and grasslands to 300 km^2 for different types of forests.

The size thresholds for different habitat areas were determined to support sustainable populations in a number of steps:

- Linking species to the identified habitat type – habitat types were identified for each ecological region;
- Assessing standards (for different species) for the minimum population size considered large enough to be sustainable in the long term;

– Estimating the minimum size of the areas needed to support viable populations of all selected species, per habitat type.

Table 8 Mammal species mammal species selected for PEEN Western Europe. In Annex 1 a table is presented that presents in which Environmental zones these species have bee used.

Latin name	English name	Selected Habitat
Castor fiber	Beaver	Water, Rivers, Wetlands
Alopex lagopus	polar fox	Bogs, low shrubs, arctic vegetation, Boreal zone, Northern Alpine zone
Lutra lutra	Otter	Waters, wetlands
Mustela lutreola	European mink	Marshes, grasslands
Canis lupus	Wolf	Forests, shrubs, grasslands
Gulo gulo	Wolverine	Forests, shrubs, sparsely vegetated areas Boreal zone
Lynx lynx	Lynx	Forests, shrubs, low vegetation
Lynx pardina	pardel lynx	Forests, shrubs, wetlands, Iberian peninsula
Rupicapra rupicapra	Chamois	Alpine grasslands, alpine shrub, Southern Alpine Zone
Capra hircus (aegagrus)	Ibex	Alpine grasslands, alpine shrub Southern Alpine zone
Ursus arctos	brown bear	Forests, shrubs
Cervus elaphus corsicanus	Red deer	Mixed landscapes, only in Corsica
Alces alces	Moose	Forests, marshes in Boreal and nemoral zones
Rangifer tarandus fennicus	Reindeer	Tundra vegetation, low shrubs, Boreal zone

Figure 24. Wolverine (Alopex lagopus) is a species characteristic of Boreal mountain habitats (Photo Saxifraga Foundation, Jan Van Der Straaten)

Figure 25. Otter (Lutra lutra), a species of rivers and wetland migrating long distances (Photo Saxifraga Foundtion, Mark Zekhuis)

For determining the different thresholds in area size per habitat type the following thresholds were set (Table 9):

- Very large areas (>5 x the minimum area size): long-term survival of all populations of the selected species is quite probable (size class III);
- Large areas (2 x the minimum area size): 100 % of the selected species can occur here. However, when isolated, these areas may suffer some loss of species and some immigration is required; connection or area enlargement is recommended (size class II);
- Areas with a sub-optimal size: maximum 70% of the selected species maintain viable populations; the most demanding species can only be maintained or restored by enlarging habitat size and/or making connections with comparable habitats by corridors to areas of class I, II and III.

The spatial patterns of habitat types that exceed each of the thresholds were assessed in a GIS analysis. Fish species are not included as indicator species. They were substituted by occurrence of natural, non-regulated larger rivers that are considered as a proxy for migrating fish.

Table 9. Tresholds for habitat types in the PEEN WE project (in km²).

Thresholds PEEN-WE	T1	T2	T3
Mediterranean heath and shrubs	300	2000	10000
Atlantic heath	10	300	1500
Alpine grasslands/shrubs/open areas etc.	150	2000	10000
Other shrub	600	2000	10000
Fens and bogs	50	2000	10000
Salt marsh, saline areas, beaches	150	300	1500
Inland water/ wetlands	50	1000	5000
Forest – Scandinavia	600	2000	10000
Forest- Other parts of W. Europe	300	2000	10000
Calcareous grassland (dry)	150	2000	10000
Moist grasslands	150	1000	5000

Figure 26 Montado of Cork oak (Quercus suber) and Holm oak (Quercus ilex) near Évora, Portugal (Photo Anne van Doorn)

The Environmental Stratification has been used to select different habitat sizes for species in different parts of Europe. For instance, the potential density of wolf and brown bear is lower in Scandinavia than in the Iberian peninsula. Moreover habitats do differ between different altitudinal bands. That means that for identification of habitats within the Environmental Stratification substrata have been identified (Altitudinal Environmental Zones, AEnZ) based on the DEM for Europe. Grasslands on higher altitudes have been identified as Alpine grasslands. In Mediterranean North (MDN) the natural high altitude forests are Beech forests, while the low altitude forests are broadleaved evergreen forests or Dehesas and Montados. This includes Eucalypt forests as with the data available they cannot be

excluded. Wet and calcareous grasslands are identified with help of the DEM (low grasslands) and the European soil map.

Species have been selected based on their occurrence in the habitats selected. Species have been linked to the Environmental zones in Europe and within these zones to the various habitat types (see Figure 27). All threshold areas have been identified for the Environmental zones and later merged into the joint legend for European habitats.

4.5 Identification of search areas for corridors

At the European level ecological corridors are indicative.When they are being translated into implementation the corridor at the European level is only a search area, because the actual implementation will have to be carried out in consulation with other fields of land use and policy The identification of search areas for ecological corridors for the Pan-European Ecological Network for Western Europe is based on the following information:

- Bird migration routes
- The need for connectivity between core areas based on their size, namely, if they are not big enough to support the connectivity needs of mobile species;
  - o Relative forest density per km^2 in areas between large habitat blocks and smallr areas and between small habitat blocks:
  - o Location of hedgerow landscapes (small scale farming areas, based on expert information): CORINE classes 20, 21, 22; these areas can be used as corridors if they are situated between identified core areas or if they are identified as such in national/regional ecological networks.
  - o Location of mountain ranges (part of Habitat classes)
- Location of natural, semi-natural and artificial rivers (Table 10);
  1. *All large rivers*
  2. *Cat 1:Natural Rivers*
     a. *Natural rivers* with vegetation along the banks, large floodplain, no regulation (no dikes, no dams). No restriction for aquatic species (fish migration)
     b. *Natural rivers* with vegetation along the banks, large floodplain, limited regulation. Restrictions for aquatic species (dams).
  3. *Cat 2: Semi-natural rivers* Vegetation along the banks, limited floodplain, medium regulation (low dikes, weirs, dams)
  4. *Cat 3: Artificial Rivers.* Artificial/highighly regulated: no natural vegetation along the banks, (agricultural areas/cities), no or small floodplain, highly regulated with dikes, dams, canals.
     - Expert judgment (project members and consulted experts);
     - Visual comparison with existing national networks (core-areas and corridors)

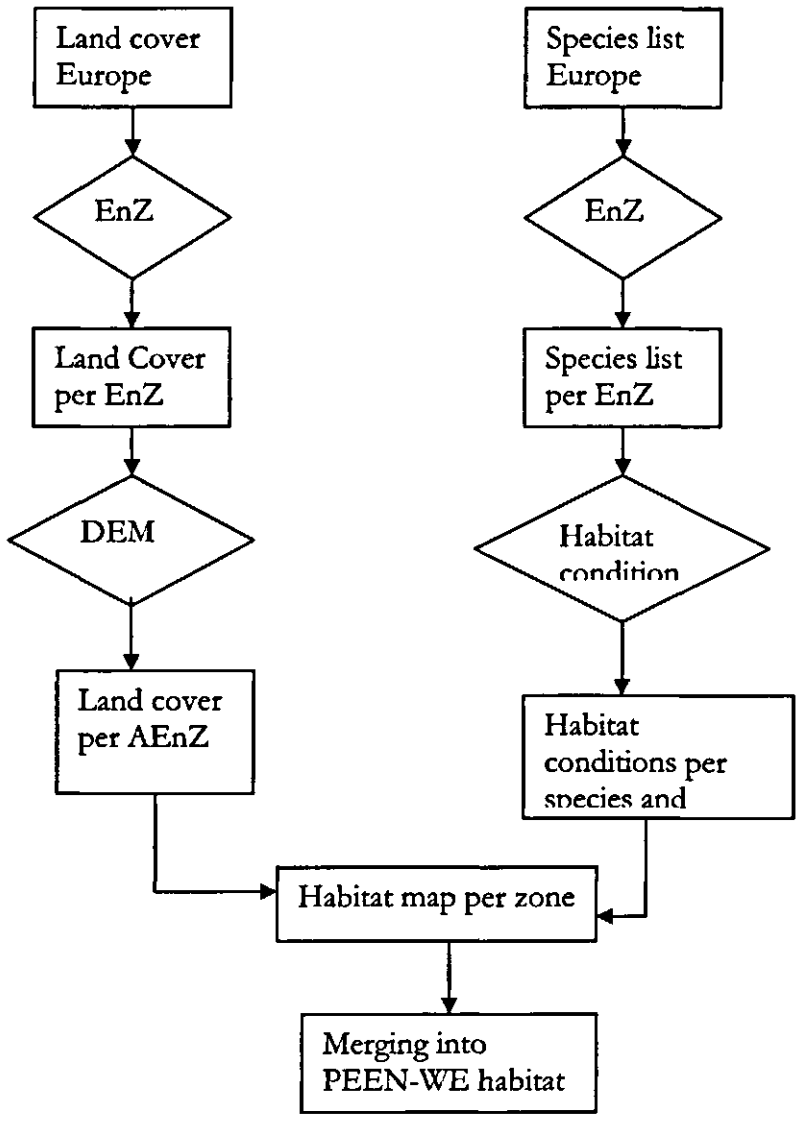

Figure 27. Procedure for identifying core areas for the PEEN-WE region; AEnZ: Altitudinal Environmental Zone (low/ high).

The connectivity function of rivers is assessed through experts. In the previous projects experts were asked to divide rivers in 3 categories. Rivers or section of rivers with a naturalness categorised as 1A, 1B and 2 were considered as corridors. Category 3 rivers do not fulfil a corridor function.

In this project rivers are identified using Bartholemew maps of Europe that recognises rivers in six categories as well as canals and other artificial waterways. Barriers in rivers will have to be selected when analysis rivers for fish connectivity. The report of the Commission on Dams will be used as well as expert judgement. Categories 1, 2 3 from the Bartholemew database have been included. Barriers in rivers will have to be selected when analysis rivers for fish connectivity.

Table 10. Classification of selected rivers in Western Europe in natural, semi-natural and artificial.

1. Natural Rivers	2. Semi natural Rivers	3. Artificial Rivers
Loire	*Rhine*	*Meuse*
Drau	*Marne/Seine*	*Douro*
Garonne	*Thames*	*Po*
Shannon	*Elbe*	*Scheldt*
Tweed	*Weser*	*IJzer*
Oder	*Tiber*	*Mosel*
Guadiana	*Arno*	
Minho	*Sem*	
March	*Danube*	
Guadalquivir	*Neckar*	
	Ahr	
	Tajo/Tejo	
	Ebro	

4.6 Identification of restoration areas

As in the two preceding project no method has been developed yet. It has been decided not to include this category. The participants in the methodology workshop in Wageningen, November 2005 advised not to define restoration areas as they are small and maybe concentrated in the Netherlands and systematic information is probably not available.

4.7 Consultation process

In line with the preceding projects PEEN-CEE and SEE, a broad consultation process for PEEN-WE was organized. The consultation process aimed at reviewing the draft version of the technical report and the draft version of the indicative map. A further political consultation will take place in the Meeting of the Committee of Experts of the PEEN in 2007.

One of the aims of consultation process was to refine the proposed PEEN structure through discussion with experts, policy makers and organizations involved in the establishments of the PEEN-WE. During the consultation process several issues were raised that clearly demonstrate the different views that exist on the PEEN. An important benefit of the consultation process was that it provided the opportunity to incorporate additional knowledge in the project and to agree with national and regional experts on the data to be included or excluded.

The consultation process started the beginning of October 2006. A questionnaire was developed to facilitate the processing of the comments. The questionnaire consisted of 13 questions concerning the concepts and methodologies used, the legibility and correctness of the draft map displaying the core areas and corridors and the possibilities of what can happen with the outcome of the project. All questions from the questionnaire are discussed below. In italics it is explained what has been done regarding the remarks.

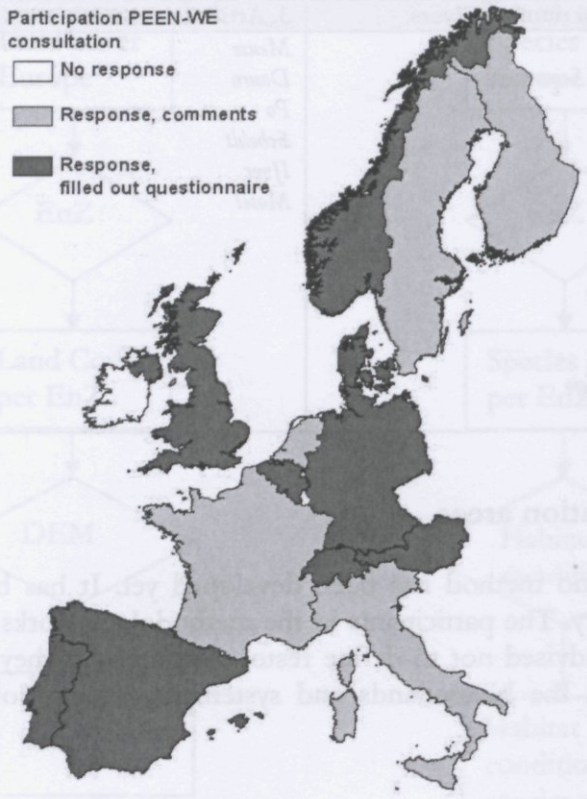

Figure 28. Countries involved in the consultation process. Replies have been received from the countries in grey (comments) and dark grey (questionnaire returned)

The questionnaire with a request for comments was sent out on the 4th of November to 110 policy makers, organizations and individual experts. The following organizations received a questionnaire (Annex 3):

- Members of the committee of Experts of the development of the PEEN;
- Ministries of Environment of the following countries: Austria, Belgium, Denmark, Finland, France, Germany, Italy, Malta, Norway, Portugal, Spain, Sweden, Switzerland, The Netherlands, UK;
- Intergovernmental organizations: European commission, Secretariat of the Bern convention, Secretariat of the Bonn convention, Secretariat of the Ramsar convention, Secretariat of the Helsinki convention, Secretariat of the Barcelona convention, Committee of the regions;
- Non-governmental organizations: IUCN, WWF, UNEP, Plantlife International.

From the 4th of November to the 10th of December 2006 the questionnaires could be sent to Alterra. In total 22 questionnaires returned and a further 8 reactions were received (see figure 28). In a number of cases combined reactions have been received. Representatives or experts working for the ministry that is responsible for nature of the following countries have sent a reaction: Austria, Belgium, Denmark, Germany, Italy, Norway, Switzerland and The Netherlands. All comments were reviewed and as far as possible included in the technical report and the indicative map. Meetings have been held with experts from Spain, Denmark, Germany, The

Netherlands and UK. Extensive e-mail discussion has been used with Finnish and Swiss representatives.

General remarks

One of the most often mentioned comment on PEEN is that not only large unfragmented landscapes should be used, but also cultural landscapes with a small-scale patch framework of semi-natural habitats.
As for the technical document, one comment was made about the consultation process itself. According to one respondent the choice of stakeholders is very narrow as one has to think beyond the nature conservation arena.

The issue of the inclusion of small scale cultural landscapes has been discussed in meetings with several stakeholders and a workshop held in November 2005 in Wageningen. Conclusion from these discussions for this project was that these landscapes are especially for Western Europe very important, but that they at the level of the European continent (Macro scale network, see 2.5) only can be included as corridor landscapes.

Concerning the consultation of other parties than policy makers and experts on biodiversity it has been considered that in this stage consultation with other sectors not yet relevant is as this is the stage of construction of a vision on Biodiversity priorities. After finalisation of the maps consultation and discussion with other sectors should take place.

Implementation of PEEN

A very important challenge that was mentioned a couple of times is to make clear the relationship between PEEN and regional and sub-regional ecological networks: ecological networks function at different scales and that they are interdependent and complement one another. Downscaling to regional level scales should be possible.

Concepts used

Ecological networks should be defined as "systems of high biodiversity value", rather than nature reserves. Core areas for nature can be highly fragmented themselves how to expand and link within and between core areas.
Naturalness, biodiversity and connectivity are chosen as central concepts in developing the Pan European Ecological Network. Most of the respondents agreed with these, about half of the respondents missed some additional concepts:

- hydrology (DK)
- landscape potential (Ch)
- ecosystems (functioning) (NO)
- habitat requirements and cultural landscapes (Be, De)
- valuable habitats (De)
- hot spots for biodiversity (De)
- protected areas and sustainable use (Pt)

The term "systems of high biodiversity value" has been used now in the report. The other concepts have bee considered, but some could not well be included at this level such as hydrology, landscape potential, habitat requirements and cultural landscape. The concepts of Valuable habitats, hotspots

for biodiversity have been included through naturalness and biodiversity. Protected areas and sustainable use are included through the inclusion of Natura2000 and nationally protected areas in Norway and Switzerland.

Construction of indicative map: 3 layers

While it is clear for most respondents that the indicative map is based on three layers, some issues remain unclear:

- The meaning of 3 thresholds is not clear (NO)
- There is a bias towards naturalness (De)
- Unclear which species are used for layer 2 (De)
- No indication which kind of national designated areas except Natura 2000-sites have been chosen. In Germany there are 8 different kinds of designated areas for nature protection (De)

The paragraph on thresholds has been expanded and the species lists are included in Annex xx. The bias towards naturalness seems to be existing; this is because at this level large species have been used for selection of habitats. However, through the IBA's, Ramsar sites and Natura 2000 also grasslands and wetlands have been included that mostly are not natural but managed.

Species selection

Most respondents agreed to base the species selection on the migrating and wide ranging species of the Habitats Directive, but missed a species list as annex in the technical report. Some suggestions were made to include certain groups of species, these are showed in table 11. Another comment was that this species selection is too much biased towards animals. For some respondents it remained unclear how the different remaining species in Natura 2000 sites will be taken into account when identifying core areas of PEEN.

Table 11. Species groups suggested to be included as focal species

Migrating fish (De)
Typical representative species for major habitats (UK)
Indicator species with zonal distribution (Es)
Specific rare species of cultural landscapes (Be)
Typical metapopulation species (De)
Species of national interest too (De)
Species under Berne Convention (De)
Include threatened animals and plants (Pt)

All habitat types of Europe have been considered; this means that most important Plant areas are included as well. The animal species list has been added in Annex xx. The selection has been done in a rather pragmatic way. Species have been analysed on their range, habitat type and the knowledge about their activities. They include species with zonal distribution such as Lynx pardina.

Figure 29. European Eagle owl (Bubo bubo) is a wide ranging species that occurs in Central Europe, the Alps, the Iberian Peninsula and Scandinavia (Photo Saxifraga Foundation, Jan van der Straaten).

Small Natura 2000 sites, artificial lakes and river stretches, how to deal with it?

Many respondents had suggestions how to deal with the small Natura 2000 sites the small artificial lakes and the river stretches that often coincide with hotspots for the species groups. People agreed on including smaller sites as well in PEEN-WE. Some argued to make them part of core areas (of a specific category), corridors or buffer zones; others prefer to just mark them as point-data on the map. Another approach what was mentioned is to choose a bottom up-approach for the identification of important areas and corridors between them. That means the necessary work has to be done by the respective countries and regions. Finally some methodological doubts were raised, e.g. it was not clear how the species information is overlaid with the landscape info.

Small Natura 2000 sites have been used to help identifying ecological corridors, but they have not been included as core areas. As there are large differences between countries in the identification of Natura 2000 sites, the smallr sites (<25km²) have been excluded. This has been done in consultation with the Bundesamt für Naturschutz in Bonn. This does not mean that these are not valuable, but that their size fits better to the meso-scale networks.

Small lakes as important Ramsar sites are included through the Ramsar classification.

Use of data sources and quality of land cover information

Among the respondents many question were raised concerning the Ramsar sites and Prime Butterfly Areas. It appears that many Ramsar sites are missing, especially in the UK or not well reflected (Lake Åsnen, Sweden).
The inclusion of PBAs raised doubts: important PBAs are missing (F), butterflies are seen as not relevant at this European scale (Ch), the data source was seen as non-officially validated and non-homogeneous information (Pt) or respondents are just not familiar with the information (No).
In general there were not many doubts about the quality of the land cover data for the countries in the European Union (CORINE) although several times the uncapability of CORINE to identify valuable small scale habitats was mentioned. This could be solved to validate the land cover information with national information sources.
Most of the comments concerned the in- or exclusions of some land cover classes (table 12).

Use has been made of the database of Wetlands International on Ramsar sites. The butterfly organization provided the list of PBAs. These have been included because they are considered representative by the European Butterfly organizations. Most butterflies do not migrate, but they can be important to indicate other than forest habitats, such as species rich grasslands and landscapes with high diversity in habitats.

The land cover classes suggested to be included have been added. An e-mil discussion with experts from Scandinavia made clear that most of the mentioned forests are valuable and can be included. Small habitats could not be included as there is not a complete European database on these. Inclusion of some regions or countries would introduce bias. New inventories can in a later phase be used to update the network.

Table 12. Land cover classes suggested to be included or excluded

Land cover classes to be included	Land cover classes to be excluded
Large unfragmented areas in Finland	Mediterranean Eucalyptus
Coniferous forest below 800m in Scandinavia	
Broad-leafed forests in Sweden.	
Areas for timber production can serve as a corridor.	
Heath lands	
Small habitats and grassland habitats (not identified by Corine).	
Montados / dehesas	
Chalk grasslands	

Small national/regional core areas become European corridors

Small core areas of regional and national networks have been linked as corridors at the European level. Most of the respondents agreed to this approach, but some noticed differences with national maps (e.g. Germany) or missed important areas on the map. Areas and national data sources suggested to be included are shown in table 13.

Missing ecological corridors

Many respondents think corridors are missing. Denmark, Austria and Germany have sent maps displaying the main national ecological corridors. Norway recommends a comprehensive update based on the national ecological map. Other remarks concern the inclusion of large rivers and coastal dunes and the low number of corridors in England.

Table 13. Areas and database for ecological corridors suggested to be included

River stretches and small NATURA2000 sites
Cheshire ECOnet
Spanish Cañadas

The differences with national maps and regional databases are caused by the generalisations that are required at this level. The Cheshire ECOnet is a regional plan that is being implemented. There is of course a link with PEEN, but the details cannot be included. With the Bundesamt für Naturschutz it has been agreed to include a number of ecological corridors based on nationally important areas.

For Spain the Cañadas have not been included as corridors. However there role in connectivity has been recognised through a special study on the connectivity function of Cañadas in cooperation with the Complutense University of Madrid.

Figure 30. Cañada Real de Segovia, Spain. Cañadas have been important livestock corridors and can be important ecological corridors in the future (Photo Rob Jongman)

Validation corridor selection

The validation of the outcome of the corridor selection is based on a comparison with national ecological networks and areas with a high density of small landscape elements. Most of the respondents agreed to this approach (as far as a national network has been developed, which is not the case for the UK and Switzerland), but some missed the output of the validation and wondered whether any changes have been made. For others it was unclear which data base has been used or noticed important differences with the national ecological network map. For some it is unclear how the concept of corridors will be used. It remains unclear whether corridors are only indicated between similar habitats and whether no corridors mean they are non-existing. Validation of search areas for corridors is seen as an important next step in the process (Table 14).

Table 14. Recommendations to validate corridor selection

Include HNV farming areas
Use the 1st indicative map of the German Habitat Corridor Network
Use the simplified map of the Swiss REN for comparison

Explanation on the use of corridors is given in the text now. At the level of the PEEN they link larger areas through zones with dense patterns of habitats and protected areas. For implementation they are broad zones indicating search areas for implementation of ecological corridors. Ecological corridors at the European map are at regional and local level search areas for implementation of ecological corridors as their realization depends on the existing land use and other claims on the land.

Missing data sources

The far majority of the respondents did not know whether any European wide data sources are overlooked, Only two missing data sources are mentioned: Emerald for non-EU countries and the Globcover maps of ESA for the Nordic countries.

Protected areas for Norway and Switzerland have now been included.

Legend of indicative map

The majority of the respondents did not find the legend of the map clear and a lot of suggestions for improvement were made (Table 15). Some respondents remained unclear what the differences in habitat sizes mean (different km^2 or maximum outstretch). Others wonder why the black arrows vary in length, if the grey colour of NATURA2000 sites means that these areas are not included in PEEN.

Table 15. Suggestions to improve the legend of the indicative map

Better distinction between colours
No dark colours for the polygons(orgWCMC)
Points on the map in better readable colours and placed on top (orgWCMC)
Provide more explanation about NATURA2000 sites, core areas, corridors, different lengths of black arrows and descriptions like >600km (UK)

Included areas not shown on indicative map

Due to technical limitations of the used resolution, some included areas are not shown on the map. This is well explained in the technical document according to the majority of the respondents, although some like to see a list of the not shown areas. From the indicative map itself it is not clear that some included areas are not shown and more explanation on the map is required and /or as a short comment when downloading from the internet.

The use of the map and its legend is explained in chapter 5 and Appendix 6.

Possibilities for the outcome of the Pan European Ecological map for Western Europe

The status of the Indicative Map is not binding, but only indicative. The Committee of Experts of PEBLDS might decide to forward the indicative map with a short report to the Council of PEBLDS for presentation at the next Ministerial meeting 'Environment for Europe' in Belgrade. There are several possibilities for the outcome of the project:

1) a scientific document (including the map) for the committee of experts,
2) a presentation of the indicative map with a short summary of the report as a policy relevant document for the PEBLDS council and Belgrade conference and
3) a presentation as an information document in Belgrade. None of these possibilities had a clear preference among the respondents, although the second options received most 'votes'.

Additionally, some other options were mentioned:

- A publication in a relevant scientific journal.
- A publication on the internet.
- The outcome serves as a basis for further action on the ground.
- Produce a CD-ROM with the GIS layers without copyright limits.

5 Interpretation of the map

5.1 Introduction

The Map of PEEN-WE is a generalisd map, that indicates potential core areas for an Ecological Network in Western Europe as part of the Pan EuropeanNetwork for all Europe. It is based on habitat information as well as on existing protected areas. Certain guidelines for the correct use and interpretation of this 'Indicative map of PEEN for Western Europe' should be considered:

- The indicative map of the Pan-European Ecological Network for Western Europe shows areas that are vital for biodiversity of international importance. It indicates possibilities to reinforce the safe and long term existence and possible return of internationally important species following the strategy of a coherent and robust network. It summarises insights and data in a manner that is meant to be readily understandable, useful and inspiring for policy makers responsible for nature protection and rehabilitation and for land use planning.
- The map is not a blueprint for decisions and implementation; it indicates important areas where considerations for protection measures, decisions and further investigations potentially leading to pros and cons for concrete decisions on protection or mitigation of fragmentation should lead to more concrete and balanced plans taking into account interests of different stakeholders.
- The indicative map is based upon many data, insights, assumptions and targets explained in the preceding chapters. The map can be used together with other maps at other planning levels presenting underlying and more detailed data on habitat types or designated areas with an international status.
- When using the indicative map one has to consider the scale and resolution of working maps that relate to original data (species distribution of different kinds, land cover, land use) in GIS and the scale and resolution on which the results are presented to the users/target groups.

The map shows i) core areas and ii) search areas for corridors. Regarding the core areas with an international status it is important to mention that the network explicitly was identified to include areas with a certain formal or semi-formal international status such as Sites of Community Interest (SCi): potential Sites of Community Interest (pSCI) (NATURA2000), Ramsar sites (Wetland Areas), Important Bird Areas, Primary Butterfly Areas. The NATURA2000 sites have been delineated and only sites smaller than 25ha have been excluded. The geographical position of the other areas is indicated on the map, but without specification.

The indicative map shows search areas where corridors could be located. Further analysis of possibilities is needed when actually corridors are designed e.g. suitability from an ecological viewpoint; their compatibility with other land uses and the optimal spatial position taking into account influences of urbanisation and infrastructure within which a further selection of narrower zones or stepping-stones could be based upon local or regional knowledge and plans. In the framework of the

project regional information was nor could be applied as the scale of the project is not aming at direct implementation available (see section 2.5). Therefore, search areas were indicated in order to inspire and invite regional or local experts and authorities to design more concrete plans taking into account local circumstances in terms of ecological potentials or a layout that is compatible with other land use.

Rivers in a natural state act as an important migration route for fishes and other species groups such as birds and river related mammals. Major rivers were indicated as important migratory routes as also the location of many IBAs shows as along the Rhine. Many rivers are strongly influenced by dams, weirs or other artificial obstructions for migratory fish species. However in several rivers mitigation measures have been carried out or are being planned.

Search areas for nature restoration have not been identified. However, they can be derived from the size indication of the core-areas where enlargement of core areas or connection via corridors is considered an effective contribution to a robust ecological network. Restoration areas can be specified for (groups of) habitat types or selected species or species groups as the area demand of the most demanding species do differ per habitat type. Also, when considering possibilities to enlarge or connect areas to facilitate viable populations, it is inevitable to select areas with the same habitat characteristics or at least the potential to develop such. In the Netherlands the National Ecological Network contains Nature Development areas, to be developed into areas with high nature values by regional authorities.

The map also contains basic topographical information such as: boundaries of countries, coastlines, major rivers, major urbanised areas

5.2 How to interpret and use the map?

Any map has its restrictions due to its scale and its contents as shown in the legend. The indicative character and the goal of the indicative map have been described earlier anis expressed in the simplified legend (sese Appendix 6). In addition, some recommendations on how to interpret the map and use it in the desired manner are given.

The classification of area sizes sustaining viable populations of different species was developed for identifying core areas. A recommendation for size class I, very large areas, is to respect or reinforce their internal coherence as much as possible: so that the internal coherence is safeguarded, as possible safeguarding the internal coherence no fragmentation occurs and that habitat characteristics and quality do not decrease. Size I areas can sustain less demanding secies and about 70-90% of the populations of the more demanding species identified. For a realistic approach connectivity measures are required.

Size class II and III are considered to include the more demanding species characteristic for that specific habitat type, pre-supposing that habitat quality can be

guaranteed and is maintained by adequate management and that some exchange between areas is made possible. Any fragmentation or further isolation of those core areas should be avoided; and if possible the exchange between areas should be facilitated.

Areas that are not indicated as part of the Pan-European Ecological Network are not large enough to maintain viable populations of 70% of those selected species belonging to the particular habitat types.

Ecological corridors are seen as zones or routes that facilitate dispersal and migration of fauna. They support small and vulnerable populations in isolated areas and allow species movements for fouraging and seasonalmigration (winter, summer and breeding habitat). Populations too small or prone to temporary or permanent extinction can be supplemented from other areas provided individuals can reach these areas. Corridors connecting areas, either in an uninterrupted or in an interrupted (stepping stone-like) form could fulfil this function.

6 Conclusions and recommendations

The Pan European ecological network in Western Europe continues from Central and South-eastern Europe into Scandinavia, the Alps towards the Apennines in Italy and through the Cevennes and the Massif Central into the Iberian Peninsula, where it is concentrated in the mostly east west situated mountain ranges (Cantabrian, Guaderrama-Gredos, Toledo and Morena). Also Scotland is a core area. Iceland would have been a core area as well, but it is not included yet. In the urbanised part of Europe, northern Germany, The Netherlands, Belgium, Northern France and Southern and Central England most areas of high nature value except coastal areas are too small and isolated to be included as core areas. Here high nature value landscapes act as corridor landscapes. They function as sinks for the core areas of central and southern Europe: species can reach these areas, but cannot survive in independent populations and remain metapopulations. Corridor areas increase here in number compared to south-eastern and eastern Europe. This trend could already be seen in the Czech Republic and in western Poland.

The map has been based on ecological information only. This means that land use data, agricultural developments, urbanisation trends and development of transport networks has not been taken into account. The development in these land use categories are the major counteract to the ecological network. The Pan European Ecological Network should be compared with scenarios of urbanisation and agricultural development to identify problem areas, competing processes and possibilities for mitigation and cooperation.

Western Europe is rich in landscape diversity; there are many valuable cultural landscapes. These landscapes are not included in this map as core areas as they cannot maintain populations of species that require habitat at the Continental: continental scale. These species mainly use these landscapes as temporary habitat or as a corridor. However, they contain many species that are important and are part of the Pan European flyways for songbirds, birds of prey, herons and storks. The fact that they only figure here as corridor landscapes, does not disqualify them.

Also within the core areas identified on the Western European map corridors and fragmentation problems might occur as WWF Austria has pointed out. Within the Alps and Apennines big fragmentation problems do exist due to road networks and ongoing urbanisation in the valleys. This leads to isolation of populations in parts of the Alps. Especially plant species and mammals are threatened by this.

In the Iberian Peninsula, but also in France, Italy, Switzerland Austria and southern Germany the last remnants of transhumance exist. It seems inevitably that this system will disappear due to the relatively high costs and socially unattractive life for the shepherds. However this seasonal grazing system maintained large parts of the Alpine grasslands, the lowland wetlands and steppe grasslands. These grasslands habitats are partly under the Natura2000 regime. The drove roads have always been

important pathways for seed and animal transport. They also can function as such in the future, but new ideas and incentives are needed to maintain this function.

Rivers can function as ecological corridors for fish, birds, mammals and plants. However, river regulation that is normal practice in Western Europe prevents this function to be fulfilled. Rivers are dammed; they mostly do not flood the river forelands; the river shore vegetation is often not natural and most river forests have disappeared.

Data that could be used differ between counties due several causes:
- There are differences in interpretation of land cover categories. The land cover map shows clear differences in habitat interpretation between Finland and Sweden and between Portugal and Spain. Here land cover categories change suddenly at the borders. This has been solved by expert judgement in this project, but makes the CLC2000 less useful for Europe covering projects.
- There are differences in the selection of NATURA 2000 sites. Spain has selected large sites covering extensive areas. France has selected smaller site mainly in the south-eastern and central part of the country, while Germany has selected predominantly smaller Natura2000 sites. The border between Germany and France can clearly be seen at the map of Natura2000, showing many small sites in Germany and nearly no sites in eastern France. Denmark has mainly coastal wetlands selected as NATURA2000 sites. This is caused by the tradition in Danish land use to protect small biotopes in agricultural landscapes. Larger terrestrial sites with (semi-)natural vegetation do not exist.

The many reactions from the countries involved and the active participation in the consultation phase shows that in many countries development of ecological networks is an issue of important and is taking place at national, regional and local level. Both authorities and civil society are active. The suggestions given and the proposals for adaptation were manifold and helpful. Most proposals were however at the level of national and regional level. This is especially promising for the implementation of ecological networks as the new strategy for nature conservation in an urbanising and globalising world.

Recommendations that can be made based on the project of PEEN-WE, are:
- The map can be used to promote the approach of Ecological networks in Europe and to show the coherence between the ecological structure of Europe;
- For European projects harmonisation of data is a point of great concern;
- In most countries the most important authorities in nature and biodiversity conservation are regional governments, which means that communication with the regions is of utmost importance;
- In Western Europe ecological corridors are of key importance in the functioning of PEEN and maintaining of biodiversity; therefore special attention is needed for the functioning and maintenance of linear structures such as drove roads (Cañadas) and rivers.

References

Baudry, J. & Merriam, H.G., 1988. Connectivity and connectedness: functional versus structural patterns in landscapes. In: K-F Schreiber (Ed.) *Connectivity in Landscape Ecology.* Proceedings of the 2nd International Seminar of the International Association for Landscape Ecology, pp. 23-28. Münsterische Geographische Arbeiten 29. Münster.

Beier, P. and R.F., Noss, 1998. Do Habitat Corridors provide Connectivity? *Conservation Biology* 12 (6):1241-1252

Bennett, A.F., 1999: *Linkages in the landscape. The role of corridors and connectivity in wildlife conservation.* IUCN, Gland, Switzerland and Cambridge, UK.

Bennet, G. (Ed), 1991. *Towards a European Ecological Network.* Institute for European Environmental Policy

Biró, E., I. Bouwma & Grobelnik, V., 2006. *Indicative Map of the Pan European Ecological Network in Southeastern Europe. Technical Background document,* Tilburg, ECNC-European Centre for Nature Conservation, ECNC Technical Report series. .

Bischoff N.T. & Jongman, R.H.G., 1993. *Development of rural areas in Europe: The claim for nature. Netherlands* Scientific Council for Government Policy, Preliminary and background studies, V79.

Bloemmen, M.H.I.; Sluis, T. van der; Baveco, H.; Bouwma, I.M.; Greft, J. van der; Groot Bruinderink, G.; Higler, B.; Kuipers, H.; Lammertsma, D.; Ottburg, F.G.W.A.; Smits, N.;Van Swaay, C. & Wingerden, W.K.R.E. van, 2004. *European corridors: example studies for the Pan-European Ecological Network : background document.* Alterra Report 1087, 103 pp.

Bolck, M., De Togni, G. Van der Sluis, Th & Jongman, R.H.G., 2004. From models to reality: design and implementation process. In R.H.G. Jongman and G. Pungetti (Eds): *Ecological networks and greenways, concept, design and implementation.* Cambridge University Press, pp 128-150.

Bouwma, I.M., Jongman, R.H.G. & Butovsky, R.O., 2002. *Indicative map of the Pan-European Ecological Network for central and Eastern Europe. Technical background document.* ECNC, Technical Report Series, Tilburg/Budapest, pp 101.

Bunce, R.G.H., Groom, G.B., Jongman R.H.G. & Padoa Schioppa, E.(Eds), 2005. *Handbook for Surveillance and Monitoring of European Habitats.* Alterra Report 1219, EU FP project EVK CT-2002-20018, pp107

Bunce,R.G.H., I. De Aranzabal, M.F. Schmitz & F.D. Pineda, 2006. A *review of the role of Drove Roads (Cañadas) as ecological corridors.* Alterra report 1428, 42 pp

Burkhardt, R, Jäger, E., Mirbach, E., Rothenberger, A. & Schwab, G., 1995. Planung Vernetzter Biotopsysteme. The Design of the habitat network of Rheinland-Pfalz (Germany). *Landschap* 12(3):99-110.

Burkhardt, R., Baier, H., Bendzko, U., et al., 2003. Naturschutzfachliche Kriterien zur Umsetzung des § 3 BNatSchG. *Natur und Landschaft* 78, 418–426.

Council of Europe, UNEP, European Centre for Nature Conservation, 1996. *The Pan-European Biological and Landscape Diversity Strategy: A Vision for Europe's Natural Heritage.*

Dale, V.H., 2000. ESA report, Ecological principles and guidelines for managing the use of land. *Ecological Applications,* 10: 639-670

Florida Greenway Commission, 1994. *Creating a state-wide Greenways system, for people...for wildlife....for Florida.* Report to the Governor. Tallahassee.

Forchammer, N.O., 1939. *Københavnegnens grønne områder.* Dansk Byplanlaboratorium.

Hanski, I.A, Gilpin, M.E., (Eds.), 1997. *Metapopulation biology.* Academic Press London.

Jongman, R.H.G., 1995. Nature Conservation Planning in Europe: Developing Ecological Networks. *Landscape and Urban Planning.* 32:169-183.

Jongman R.H.G. and Troumbis, A.Y., 1995: *The wider Landscape for Nature Conservation: ecological corridors and buffer zones.* MN2.7 Project-report 1995, submitted to the European Topic Centre for Nature Conservation in Fulfilment of the 1995 Work Programme. European Centre for Nature Conservation, pp 78.

Jongman, R.H.G., 2004. The context and concept of ecological networks. In: Jongman, R.H.G. and Pungetti, G.P. 2004. *Ecological networks and greenways, concept, design and implementation* pp 7-33. Cambridge University Press

Jongman, R.H.G., Bunce, R.G.H., Metzger, M.J., Mücher, C.A. & Howard, D.C. ,2006, A statistical Environmental Stratification of Europe: objectives and applications. *Landscape Ecology:* 21:409-419

Jungwirth M., Schmutz S. & S. Weiss (eds.), 1998: *River Continuum and Fish Migration - Going Beyond the Longitudinal River Corridor in Understanding Ecological Integrity.* Marston Book Services, Ltd.

Junk W.J., Bayley P.B. & R.E. Sparks, 1989: *The flood pulse concept in river-floodplain systems.* In Dodge, D.P. (ed.). Canadian Special Publication of Fisheries and Aquatic Sciences 106: 110-127

Kavaliauskas, P., 1995. The nature frame. *Landschap* 95 (3), 17–26 (Special issue on ecological networks).

Levins, R., 1970. Extinction. In: M. Gerstenhaber (ed.). *Some mathematical problems in biology.* American Mathematical Society, Providence; 77-107.

Machado, J.R., J. Ahern, G. G. Saraiva, E.A. da Silva, J. Rocha, J.C. Ferreira, P.M.Sousa & R. Roquette, 1997. Greenways Network for the Metropolitan are of Lisbon. In J.R. Machado and J. Ahern (Eds) *Environmental Challnges in an Expanding Urban World and the Role of Emerging Information Technology,* CNIG, Lisbon, pp 281-289

Mander, Ü, Külvik, M. & Jongman, R.H.G., 2003. Scaling in territorial ecological networks. *Landschap,* 20 (2): 113-127

Metzger, M.J., Bunce, R.G.H., Jongman, R.H.G., Mücher, C.A. & Watkins, J.W., 2005 A statistical stratification of the environment of Europe. *Journal of Global Ecology and Biogeography* 14: 549-563

Noss, R.F., 1987. Corridors in real landscapes: a reply to Simberloff and Cox. *Conservation Biology* 1:159-164

Noss, R.F., 1992. The wildlands project: land conservation strategy. *Wild Earth* (Special Issue): 10-25.

Oldfield, S., 1988: *Buffer zone management in tropical moist forest: Case studies and guidelines.* IUCN, Gland, Switzerland.

Opdam, P., 1991. Metapopulation theory and habitat fragmentation: a review of holarctic breeding bird studies. *Landscape Ecology* 5: 93-106

Pinay, G., Décamps, H., Chauvet, E. & Fustec, E., 1990: Functions of ecotones in fluvial systems. In In: R.J. Naiman and H. Décamps (Eds), *The Eclogy and management of aquatic-terrestrial ecotones.* pp 141-169. UNESCO, Man and Biosphere Series Volume 4.

Sobolev, N. A., Shvarts, E. A., Kreindlin, M.L., Mokievsky, V.O. & Zubakin, V.A., 1995. Russia's protected areas: a survey and identification of development problems. In: *Biodiversity and Conservation* Vol. 4, pp.: 964-83.

Tilman, D., May, R. M., Lehman, C. L., Nowak, M. A., 1994. Habitat destruction and the extinction debt. *Nature* 371, 65-66

Townsend, C.T. & R.H. Riley, 1999: *Assessment of river health: accounting for perturbation pathways in physical and ecological space.* Freshwater Biology 41, 393-405

Vannote, R.L., Minshall, G.W., Cummins, K.W., Sedell, J.R. & Cushing, C.E., 1980: The river continuum concept. *Can J. of Fish. and Aq. Sc.* 37:130-137.

Verboom, J., Schotman, A., Opdam, P. & Metz, J.A.J., 1991: European Nuthatch metapopulations in a fragmented agricultural landscape. *Oikos* 61: 149-156

Von Haaren, C and M. Reich, 2006. The German way to greenways and habitat networks. *Landscape and Urban Planning,* 76: 7-22

Appendix 1 Land cover types CORINE (CLC 2000), Norway and Switzerland

CORINE CLC2000

CODE	LABEL_LEVEL1	LABEL_LEVEL 2	LABEL_LEVEL 3
1	Artificial surfaces	Urban fabric	Continuous urban fabric
2	Artificial surfaces	Urban fabric	Discontinuous urban fabric
3	Artificial surfaces	Industrial, commercial and transport units	Industrial or commercial units
4	Artificial surfaces	Industrial, commercial and transport units	Road and rail networks and associated land
5	Artificial surfaces	Industrial, commercial and transport units	Port areas
6	Artificial surfaces	Industrial, commercial and transport units	Airports
7	Artificial surfaces	Mine, dump and construction sites	Mineral extraction sites
8	Artificial surfaces	Mine, dump and construction sites	Dump sites
9	Artificial surfaces	Mine, dump and construction sites	Construction sites
10	Artificial surfaces	Artificial, non-agricultural vegetated areas	Green urban areas
11	Artificial surfaces	Artificial, non-agricultural vegetated areas	Sport and leisure facilities
12	Agricultural areas	Arable land	Non-irrigated arable land
13	Agricultural areas	Arable land	Permanently irrigated land
14	Agricultural areas	Arable land	Rice fields
15	Agricultural areas	Permanent crops	Vineyards
16	Agricultural areas	Permanent crops	Fruit trees and berry plantations
17	Agricultural areas	Permanent crops	Olive groves
18	Agricultural areas	Pastures	Pastures
19	Agricultural areas	Heterogeneous agricultural areas	Annual crops associated with permanent crops
20	Agricultural areas	Heterogeneous agricultural areas	Complex cultivation patterns
21	Agricultural areas	Heterogeneous agricultural areas	Land principally occupied by agriculture, with significant areas of natural vegetation

CODE	LABEL_LEVEL1	LABEL_LEVEL 2	LABEL_LEVEL 3
22	Agricultural areas	Heterogeneous agricultural areas	Agro-forestry areas
23	Forest and semi natural areas	Forests	Broad-leaved forest
24	Forest and semi natural areas	Forests	Coniferous forest
25	Forest and semi natural areas	Forests	Mixed forest
26	Forest and semi natural areas	Scrub and/or herbaceous vegetation associations	Natural grasslands
27	Forest and semi natural areas	Scrub and/or herbaceous vegetation associations	Moors and heathland
28	Forest and semi natural areas	Scrub and/or herbaceous vegetation associations	Sclerophyllous vegetation
29	Forest and semi natural areas	Scrub and/or herbaceous vegetation associations	Transitional woodland-shrub
30	Forest and semi natural areas	Open spaces with little or no vegetation	Beaches, dunes, sands
31	Forest and semi natural areas	Open spaces with little or no vegetation	Bare rocks
32	Forest and semi natural areas	Open spaces with little or no vegetation	Sparsely vegetated areas
33	Forest and semi natural areas	Open spaces with little or no vegetation	Burnt areas
34	Forest and semi natural areas	Open spaces with little or no vegetation	Glaciers and perpetual snow
35	Wetlands	Inland wetlands	Inland marshes
36	Wetlands	Inland wetlands	Peat bogs
37	Wetlands	Maritime wetlands	Salt marshes
38	Wetlands	Maritime wetlands	Salines
39	Wetlands	Maritime wetlands	Intertidal flats
40	Water bodies	Inland waters	Water courses
41	Water bodies	Inland waters	Water bodies
42	Water bodies	Marine waters	Coastal lagoons
43	Water bodies	Marine waters	Estuaries

Norwegian Land Cover Categories:

CODE	Label level 1
1	productive forest
2	non-productive forest
3	agricultural land
4	other land with vegetation cover
5	other land without vegetation cover
6	urban and built up areas
7	glacier
8	water

Swiss Land Cover Categories

CODE	Label level 1	label level 2
11	artificial surfaces	urban fabric
12	artificial surfaces	industrial commercial and transport units
13	artificial surfaces	mine, dump and construction sites
14	artificial surfaces	artificial non-agricultural vegetated areas
21	agricultural areas	arable land
22	agricultural areas	permanent crops
23	agricultural areas	pastures
24	agricultural areas	heterogeneous agricultural areas
31	forest and seminatural areas	forests
32	forest and seminatural areas	scrub and or herbaceous vegetation
33	forest and seminatural areas	open spaces , sparsely vegetated
41	wetlands	inland wetlands
51	water bodies	inland waters

Appendix 2 Translation of CORINE Landcover in Habitat categories

The Land cover units of CLC2000, Norway and Switzerland are translated using BioHab categories (Column 6, Bunce et al 2005) for the Environmental Zones of Europe (Column 1, see Figure 15). These regionalised habitats have been the basis for estimation of the minimum habitat sizes required for PEEN WE. In a number of cases the Altitude has been used for differentiation.

Enz_Name	Enz_Code	Corine_name	Corine code	Altitude	Habitat name
ALN	1	Continuous urban fabric	1	not applicable	URB
ALN	1	Discontinuous urban fabric	2	not applicable	URB
ALN	1	Industrial or commercial units	3	not applicable	URB
ALN	1	Road and rail networks and associated land	4	not applicable	URB
ALN	1	Port areas	5	not applicable	URB
ALN	1	Airports	6	not applicable	URB
ALN	1	Mineral extraction sites	7	not applicable	URB
ALN	1	Dump sites	8	not applicable	URB
ALN	1	Construction sites	9	not applicable	URB
ALN	1	Green urban areas	10	not applicable	URB
ALN	1	Sport and leisure facilities	11	not applicable	URB
ALN	1	Non-irrigated arable land	12	not applicable	CRO
ALN	1	Permanently irrigated land	13	not applicable	CRO
ALN	1	Rice fields	14	not applicable	CRO
ALN	1	Vineyards	15	not applicable	CRO
ALN	1	Fruit trees and berry plantations	16	not applicable	CRO/WOC
ALN	1	Olive groves	17	not applicable	CRO/WOC
ALN	1	Pastures	18	not applicable	CHE
ALN	1	Annual crops associated with permanent crops	19	not applicable	CRO/WOC
ALN	1	Complex cultivation patterns	20	not applicable	CRO/WOC
ALN	1	Land principally occupied by agriculture, with significant areas of natural vegetation	21	not applicable	CRO/FPH/DEC
ALN	1	Agro-forestry areas	22	not applicable	CRO/FPH/DEC
ALN	1	Broad-leaved forest	23	not applicable	FPH/DEC
ALN	1	Coniferous forest	24	not applicable	FPH/CON
ALN	1	Mixed forest	25	not applicable	FPH/DEC/CON
ALN	1	Natural grasslands	26	not applicable	LHE/CHE
ALN	1	Moors and heathland	27	not applicable	DCH/EVR
ALN	1	Sclerophyllous vegetation	28	not applicable	DCH/EVR
ALN	1	Transitional woodland-shrub	29	not applicable	TPH/DEC
ALN	1	Beaches, dunes, sands	30	not applicable	TID
ALN	1	Bare rocks	31	not applicable	TER
ALN	1	Sparsely vegetated areas	32	not applicable	TER
ALN	1	Burnt areas	33	not applicable	FPH/BUR

Enz_Name	Enz_Code	Corine_name	Corine code	Altitude	Habitat name
ALN	1	Rice fields	34	not applicable	NVT
ALN	1	Vineyards	35	not applicable	HEL
ALN	1	Fruit trees and berry plantations	36	not applicable	CRY
ALN	1	Olive groves	37	not applicable	HEL/TID
ALN	1	Pastures	38	not applicable	TID
ALN	1	Annual crops associated with permanent crops	39	not applicable	SEA/TID
ALN	1	Complex cultivation patterns	40	not applicable	AQU
ALN	1	Land principally occupied by agriculture, with significant areas of natural vegetation	41	not applicable	AQU
ALN	1	Agro-forestry areas	42	not applicable	AQU
ALN	1	Broad-leaved forest	43	not applicable	SEA/TID
BOR	2	Continuous urban fabric	1	not applicable	URB
BOR	2	Discontinuous urban fabric	2	not applicable	URB
BOR	2	Industrial or commercial units	3	not applicable	URB
BOR	2	Road and rail networks and associated land	4	not applicable	URB
BOR	2	Port areas	5	not applicable	URB
BOR	2	Airports	6	not applicable	URB
BOR	2	Mineral extraction sites	7	not applicable	URB
BOR	2	Dump sites	8	not applicable	URB
BOR	2	Construction sites	9	not applicable	URB
BOR	2	Green urban areas	10	not applicable	URB
BOR	2	Sport and leisure facilities	11	not applicable	URB
BOR	2	Non-irrigated arable land	12	not applicable	CRO
BOR	2	Permanently irrigated land	13	not applicable	CRO
BOR	2	Rice fields	14	not applicable	CRO
BOR	2	Vineyards	15	not applicable	CRO
BOR	2	Fruit trees and berry plantations	16	not applicable	CRO/WOC
BOR	2	Olive groves	17	not applicable	CRO/WOC
BOR	2	Pastures	18	not applicable	CHE
BOR	2	Annual crops associated with permanent crops	19	not applicable	CRO/WOC
BOR	2	Complex cultivation patterns	20	not applicable	CRO/WOC
BOR	2	Land principally occupied by agriculture, with significant areas of natural vegetation	21	not applicable	CRO/FPH/DEC
BOR	2	Agro-forestry areas	22	not applicable	CRO/FPH/DEC
BOR	2	Broad-leaved forest	23	not applicable	FPH/DEC
BOR	2	Coniferous forest	24	not applicable	FPH/CON
BOR	2	Mixed forest	25	not applicable	FPH/DEC/CON
BOR	2	Natural grasslands	26	not applicable	LHE/CHE
BOR	2	Moors and heathland	27	not applicable	LPH/EVR
BOR	2	Sclerophyllous vegetation	28	not applicable	LPH/EVR
BOR	2	Transitional woodland-shrub	29	not applicable	TPH/DEC

Enz_Name	Enz_Code	Corine_name	Corine code	Altitude	Habitat name
BOR	2	Beaches, dunes, sands	30	not applicable	TID
BOR	2	Bare rocks	31	not applicable	TER
BOR	2	Sparsely vegetated areas	32	not applicable	TER
BOR	2	Burnt areas	33	not applicable	FPH/BUR
BOR	2	Glaciers and perpetual snow	34	not applicable	ICE
BOR	2	Inland marshes	35	not applicable	HEL
BOR	2	Peat bogs	36	not applicable	CRY
BOR	2	Salt marshes	37	not applicable	HEL/TID
BOR	2	Salines	38	not applicable	TID
BOR	2	Intertidal flats	39	not applicable	SEA/TID
BOR	2	Water courses	40	not applicable	AQU
BOR	2	Water bodies	41	not applicable	AQU
BOR	2	Coastal lagoons	42	not applicable	AQU
BOR	2	Estuaries	43	not applicable	SEA/TID
NEM	3	Continuous urban fabric	1	not applicable	URB
NEM	3	Discontinuous urban fabric	2	not applicable	URB
NEM	3	Industrial or commercial units	3	not applicable	URB
NEM	3	Road and rail networks and associated land	4	not applicable	URB
NEM	3	Port areas	5	not applicable	URB
NEM	3	Airports	6	not applicable	URB
NEM	3	Mineral extraction sites	7	not applicable	URB
NEM	3	Dump sites	8	not applicable	URB
NEM	3	Construction sites	9	not applicable	URB
NEM	3	Green urban areas	10	not applicable	URB
NEM	3	Sport and leisure facilities	11	not applicable	URB
NEM	3	Non-irrigated arable land	12	not applicable	CRO
NEM	3	Permanently irrigated land	13	not applicable	CRO
NEM	3	Rice fields	14	not applicable	CRO
NEM	3	Vineyards	15	not applicable	CRO
NEM	3	Fruit trees and berry plantations	16	not applicable	CRO/WOC
NEM	3	Olive groves	17	not applicable	CRO/WOC
NEM	3	Pastures	18	not applicable	CHE
NEM	3	Annual crops associated with permanent crops	19	not applicable	CRO/WOC
NEM	3	Complex cultivation patterns	20	not applicable	CRO/WOC
NEM	3	Land principally occupied by agriculture, with significant areas of natural vegetation	21	not applicable	CRO/FPH/DEC
NEM	3	Agro-forestry areas	22	not applicable	CRO/FPH/DEC
NEM	3	Broad-leaved forest	23	not applicable	FPH/DEC
NEM	3	Coniferous forest	24	not applicable	FPH/CON
NEM	3	Mixed forest	25	not applicable	FPH/DEC/CON
NEM	3	Natural grasslands	26	not applicable	LHE/CHE
NEM	3	Moors and heathland	27	not applicable	LPH/EVR
NEM	3	Sclerophyllous vegetation	28	not applicable	LPH/EVR

Enz_Name	Enz_Code	Corine_name	Corine code	Altitude	Habitat name
NEM	3	Transitional woodland-shrub	29	not applicable	TPH/DEC
NEM	3	Beaches, dunes, sands	30	not applicable	TID
NEM	3	Bare rocks	31	not applicable	TER
NEM	3	Sparsely vegetated areas	32	not applicable	TER
NEM	3	Burnt areas	33	not applicable	FPH/BUR
NEM	3	Glaciers and perpetual snow	34	not applicable	ICE
NEM	3	Inland marshes	35	not applicable	HEL
NEM	3	Peat bogs	36	not applicable	CRY
NEM	3	Salt marshes	37	not applicable	HEL/TID
NEM	3	Salines	38	not applicable	TID
NEM	3	Intertidal flats	39	not applicable	SEA/TID
NEM	3	Water courses	40	not applicable	AQU
NEM	3	Water bodies	41	not applicable	AQU
NEM	3	Coastal lagoons	42	not applicable	AQU
NEM	3	Estuaries	43	not applicable	SEA/TID
ATN	4	Continuous urban fabric	1	not applicable	URB
ATN	4	Discontinuous urban fabric	2	not applicable	URB
ATN	4	Industrial or commercial units	3	not applicable	URB
ATN	4	Road and rail networks and associated land	4	not applicable	URB
ATN	4	Port areas	5	not applicable	URB
ATN	4	Airports	6	not applicable	URB
ATN	4	Mineral extraction sites	7	not applicable	URB
ATN	4	Dump sites	8	not applicable	URB
ATN	4	Construction sites	9	not applicable	URB
ATN	4	Green urban areas	10	not applicable	URB
ATN	4	Sport and leisure facilities	11	not applicable	URB
ATN	4	Non-irrigated arable land	12	not applicable	CRO
ATN	4	Permanently irrigated land	13	not applicable	CRO
ATN	4	Rice fields	14	not applicable	CRO
ATN	4	Vineyards	15	not applicable	CRO
ATN	4	Fruit trees and berry plantations	16	not applicable	CRO/WOC
ATN	4	Olive groves	17	not applicable	CRO/WOC
ATN	4	Pastures	18	not applicable	CHE
ATN	4	Annual crops associated with permanent crops	19	not applicable	CRO/WOC
ATN	4	Complex cultivation patterns	20	not applicable	CRO/WOC
ATN	4	Land principally occupied by agriculture, with significant areas of natural vegetation	21	not applicable	CRO/FPH/DEC
ATN	4	Agro-forestry areas	22	not applicable	CRO/FPH/DEC
ATN	4	Broad-leaved forest	23	not applicable	FPH/DEC
ATN	4	Coniferous forest	24	not applicable	FPH/CON
ATN	4	Mixed forest	25	not applicable	FPH/DEC/CON
ATN	4	Natural grasslands	26	not applicable	LHE/CHE
ATN	4	Moors and heathland	27	not applicable	LPH/EVR

Enz_Name	Enz_Code	Corine_name	Corine code	Altitude	Habitat name
ATN	4	Sclerophyllous vegetation	28	not applicable	LPH/EVR
ATN	4	Transitional woodland-shrub	29	not applicable	TPH/DEC
ATN	4	Beaches, dunes, sands	30	not applicable	TID
ATN	4	Bare rocks	31	not applicable	TER
ATN	4	Sparsely vegetated areas	32	not applicable	TER
ATN	4	Burnt areas	33	not applicable	FPH/BUR
ATN	4	Glaciers and perpetual snow	34	not applicable	ICE
ATN	4	Inland marshes	35	not applicable	HEL
ATN	4	Peat bogs	36	not applicable	CRY
ATN	4	Salt marshes	37	not applicable	HEL/TID
ATN	4	Salines	38	not applicable	TID
ATN	4	Intertidal flats	39	not applicable	SEA/TID
ATN	4	Water courses	40	not applicable	AQU
ATN	4	Water bodies	41	not applicable	AQU
ATN	4	Coastal lagoons	42	not applicable	AQU
ATN	4	Estuaries	43	not applicable	SEA/TID
ALS	5	Continuous urban fabric	1	not applicable	URB
ALS	5	Discontinuous urban fabric	2	not applicable	URB
ALS	5	Industrial or commercial units	3	not applicable	URB
ALS	5	Road and rail networks and associated land	4	not applicable	URB
ALS	5	Port areas	5	not applicable	URB
ALS	5	Airports	6	not applicable	URB
ALS	5	Mineral extraction sites	7	not applicable	URB
ALS	5	Dump sites	8	not applicable	URB
ALS	5	Construction sites	9	not applicable	URB
ALS	5	Green urban areas	10	not applicable	URB
ALS	5	Sport and leisure facilities	11	not applicable	URB
ALS	5	Non-irrigated arable land	12	not applicable	CRO
ALS	5	Permanently irrigated land	13	not applicable	CRO
ALS	5	Rice fields	14	not applicable	CRO
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ALS	5	Broad-leaved forest	23	not applicable	FPH/DEC
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ALS	5	Mixed forest	25	not applicable	FPH/DEC/CON
ALS	5	Natural grasslands	26	not applicable	LHE/CHE
ALS	5	Moors and heathland	27	not applicable	SCH/EVR

Enz_Name	Enz_Code	Corine_name	Corine code	Altitude	Habitat name
ALS	5	Sclerophyllous vegetation	28	not applicable	SCH/EVR
ALS	5	Transitional woodland-shrub	29	not applicable	TPH/CON
ALS	5	Beaches, dunes, sands	30	not applicable	TID
ALS	5	Bare rocks	31	not applicable	TER
ALS	5	Sparsely vegetated areas	32	not applicable	TER
ALS	5	Burnt areas	33	not applicable	FPH/BUR
ALS	5	Glaciers and perpetual snow	34	not applicable	ICE
ALS	5	Inland marshes	35	not applicable	HEL
ALS	5	Peat bogs	36	not applicable	CRY
ALS	5	Salt marshes	37	not applicable	HEL/TID
ALS	5	Salines	38	not applicable	TID
ALS	5	Intertidal flats	39	not applicable	SEA/TID
ALS	5	Water courses	40	not applicable	AQU
ALS	5	Water bodies	41	not applicable	AQU
ALS	5	Coastal lagoons	42	not applicable	AQU
ALS	5	Estuaries	43	not applicable	SEA/TID
CON	6	Continuous urban fabric	1	not applicable	URB
CON	6	Discontinuous urban fabric	2	not applicable	URB
CON	6	Industrial or commercial units	3	not applicable	URB
CON	6	Road and rail networks and associated land	4	not applicable	URB
CON	6	Port areas	5	not applicable	URB
CON	6	Airports	6	not applicable	URB
CON	6	Mineral extraction sites	7	not applicable	URB
CON	6	Dump sites	8	not applicable	URB
CON	6	Construction sites	9	not applicable	URB
CON	6	Green urban areas	10	not applicable	URB
CON	6	Sport and leisure facilities	11	not applicable	URB
CON	6	Non-irrigated arable land	12	not applicable	CRO
CON	6	Permanently irrigated land	13	not applicable	CRO
CON	6	Rice fields	14	not applicable	CRO
CON	6	Vineyards	15	not applicable	CRO
CON	6	Fruit trees and berry plantations	16	not applicable	CRO/WOC
CON	6	Olive groves	17	not applicable	CRO/WOC
CON	6	Pastures	18	not applicable	CHE
CON	6	Annual crops associated with permanent crops	19	not applicable	CRO/WOC
CON	6	Complex cultivation patterns	20	not applicable	CRO/WOC
CON	6	Land principally occupied by agriculture, with significant areas of natural vegetation	21	not applicable	CRO/FPH/DEC
CON	6	Agro-forestry areas	22	not applicable	CRO/FPH/DEC
CON	6	Broad-leaved forest	23	not applicable	FPH/DEC
CON	6	Coniferous forest	24	not applicable	FPH/CON
CON	6	Mixed forest	25	not applicable	FPH/DEC/CON
CON	6	Natural grasslands	26	not applicable	LHE/CHE
CON	6	Moors and heathland	27	not applicable	LPH/EVR

Enz_Name	Enz_Code	Corine_name	Corine code	Altitude	Habitat name
CON	6	Sclerophyllous vegetation	28	not applicable	LPH/EVR
CON	6	Transitional woodland-shrub	29	not applicable	TPH/DEC
CON	6	Beaches, dunes, sands	30	not applicable	TID
CON	6	Bare rocks	31	not applicable	TER
CON	6	Sparsely vegetated areas	32	not applicable	TER
CON	6	Burnt areas	33	not applicable	FPH/BUR
CON	6	Glaciers and perpetual snow	34	not applicable	ICE
CON	6	Inland marshes	35	not applicable	HEL
CON	6	Peat bogs	36	not applicable	CRY
CON	6	Salt marshes	37	not applicable	HEL/TID
CON	6	Salines	38	not applicable	TID
CON	6	Intertidal flats	39	not applicable	SEA/TID
CON	6	Water courses	40	not applicable	AQU
CON	6	Water bodies	41	not applicable	AQU
CON	6	Coastal lagoons	42	not applicable	AQU
CON	6	Estuaries	43	not applicable	SEA/TID
ATC	7	Continuous urban fabric	1	not applicable	URB
ATC	7	Discontinuous urban fabric	2	not applicable	URB
ATC	7	Industrial or commercial units	3	not applicable	URB
ATC	7	Road and rail networks and associated land	4	not applicable	URB
ATC	7	Port areas	5	not applicable	URB
ATC	7	Airports	6	not applicable	URB
ATC	7	Mineral extraction sites	7	not applicable	URB
ATC	7	Dump sites	8	not applicable	URB
ATC	7	Construction sites	9	not applicable	URB
ATC	7	Green urban areas	10	not applicable	URB
ATC	7	Sport and leisure facilities	11	not applicable	URB
ATC	7	Non-irrigated arable land	12	not applicable	CRO
ATC	7	Permanently irrigated land	13	not applicable	CRO
ATC	7	Rice fields	14	not applicable	CRO
ATC	7	Vineyards	15	not applicable	CRO
ATC	7	Fruit trees and berry plantations	16	not applicable	CRO/WOC
ATC	7	Olive groves	17	not applicable	CRO/WOC
ATC	7	Pastures	18	not applicable	CHE
ATC	7	Annual crops associated with permanent crops	19	not applicable	CRO/WOC
ATC	7	Complex cultivation patterns	20	not applicable	CRO/WOC
ATC	7	Land principally occupied by agriculture, with significant areas of natural vegetation	21	not applicable	CRO/FPH/DEC
ATC	7	Agro-forestry areas	22	not applicable	CRO/FPH/DEC
ATC	7	Broad-leaved forest	23	not applicable	FPH/DEC
ATC	7	Coniferous forest	24	not applicable	FPH/CON
ATC	7	Mixed forest	25	not applicable	FPH/DEC/CON
ATC	7	Natural grasslands	26	not applicable	LHE/CHE

Enz_Name	Enz_Code	Corine_name	Corine code	Altitude	Habitat name
ATC	7	Moors and heathland	27	not applicable	LPH/EVR
ATC	7	Sclerophyllous vegetation	28	not applicable	LPH/EVR
ATC	7	Transitional woodland-shrub	29	not applicable	TPH/DEC
ATC	7	Beaches, dunes, sands	30	not applicable	TID
ATC	7	Bare rocks	31	not applicable	TER
ATC	7	Sparsely vegetated areas	32	not applicable	TER
ATC	7	Burnt areas	33	not applicable	FPH/BUR
ATC	7	Glaciers and perpetual snow	34	not applicable	ICE
ATC	7	Inland marshes	35	not applicable	HEL
ATC	7	Peat bogs	36	not applicable	CRY
ATC	7	Salt marshes	37	not applicable	HEL/TID
ATC	7	Salines	38	not applicable	TID
ATC	7	Intertidal flats	39	not applicable	SEA/TID
ATC	7	Water courses	40	not applicable	AQU
ATC	7	Water bodies	41	not applicable	AQU
ATC	7	Coastal lagoons	42	not applicable	AQU
ATC	7	Estuaries	43	not applicable	SEA/TID
PAN	8	Continuous urban fabric	1	not applicable	URB
PAN	8	Discontinuous urban fabric	2	not applicable	URB
PAN	8	Industrial or commercial units	3	not applicable	URB
PAN	8	Road and rail networks and associated land	4	not applicable	URB
PAN	8	Port areas	5	not applicable	URB
PAN	8	Airports	6	not applicable	URB
PAN	8	Mineral extraction sites	7	not applicable	URB
PAN	8	Dump sites	8	not applicable	URB
PAN	8	Construction sites	9	not applicable	URB
PAN	8	Green urban areas	10	not applicable	URB
PAN	8	Sport and leisure facilities	11	not applicable	URB
PAN	8	Non-irrigated arable land	12	not applicable	CRO
PAN	8	Permanently irrigated land	13	not applicable	CRO
PAN	8	Rice fields	14	not applicable	CRO
PAN	8	Vineyards	15	not applicable	CRO
PAN	8	Fruit trees and berry plantations	16	not applicable	CRO/WOC
PAN	8	Olive groves	17	not applicable	CRO/WOC
PAN	8	Pastures	18	not applicable	CHE
PAN	8	Annual crops associated with permanent crops	19	not applicable	CRO/WOC
PAN	8	Complex cultivation patterns	20	not applicable	CRO/WOC
PAN	8	Land principally occupied by agriculture, with significant areas of natural vegetation	21	not applicable	CRO/FPH/DEC
PAN	8	Agro-forestry areas	22	not applicable	CRO/FPH/DEC
PAN	8	Broad-leaved forest	23	not applicable	FPH/DEC
PAN	8	Coniferous forest	24	not applicable	FPH/CON
PAN	8	Mixed forest	25	not applicable	FPH/DEC/CON
PAN	8	Natural grasslands	26	not applicable	LHE/CHE

Enz_Name	Enz_Code	Corine_name	Corine code	Altitude	Habitat name
PAN	8	Moors and heathland	27	not applicable	LPH/EVR
PAN	8	Sclerophyllous vegetation	28	not applicable	LPH/EVR
PAN	8	Transitional woodland-shrub	29	not applicable	TPH/DEC
PAN	8	Beaches, dunes, sands	30	not applicable	TID
PAN	8	Bare rocks	31	not applicable	TER
PAN	8	Sparsely vegetated areas	32	not applicable	TER
PAN	8	Burnt areas	33	not applicable	FPH/BUR
PAN	8	Glaciers and perpetual snow	34	not applicable	ICE
PAN	8	Inland marshes	35	not applicable	HEL
PAN	8	Peat bogs	36	not applicable	CRY
PAN	8	Salt marshes	37	not applicable	HEL/TID
PAN	8	Salines	38	not applicable	TID
PAN	8	Intertidal flats	39	not applicable	SEA/TID
PAN	8	Water courses	40	not applicable	AQU
PAN	8	Water bodies	41	not applicable	AQU
PAN	8	Coastal lagoons	42	not applicable	AQU
PAN	8	Estuaries	43	not applicable	SEA/TID
LUS	9	Continuous urban fabric	1	not applicable	URB
LUS	9	Discontinuous urban fabric	2	not applicable	URB
LUS	9	Industrial or commercial units	3	not applicable	URB
LUS	9	Road and rail networks and associated land	4	not applicable	URB
LUS	9	Port areas	5	not applicable	URB
LUS	9	Airports	6	not applicable	URB
LUS	9	Mineral extraction sites	7	not applicable	URB
LUS	9	Dump sites	8	not applicable	URB
LUS	9	Construction sites	9	not applicable	URB
LUS	9	Green urban areas	10	not applicable	URB
LUS	9	Sport and leisure facilities	11	not applicable	URB
LUS	9	Non-irrigated arable land	12	not applicable	CRO
LUS	9	Permanently irrigated land	13	not applicable	CRO
LUS	9	Rice fields	14	not applicable	CRO
LUS	9	Vineyards	15	not applicable	CRO
LUS	9	Fruit trees and berry plantations	16	not applicable	CRO/WOC
LUS	9	Olive groves	17	not applicable	CRO/WOC
LUS	9	Pastures	18	not applicable	CHE
LUS	9	Annual crops associated with permanent crops	19	not applicable	CRO/WOC
LUS	9	Complex cultivation patterns	20	not applicable	CRO/WOC
LUS	9	Land principally occupied by agriculture, with significant areas of natural vegetation	21	not applicable	CRO/FPH/DEC
LUS	9	Agro-forestry areas	22	not applicable	CRO/FPH/DEC
LUS	9	Broad-leaved forest	23	not applicable	FPH/DEC
LUS	9	Coniferous forest	24	not applicable	FPH/CON
LUS	9	Mixed forest	25	not applicable	FPH/DEC/CON
LUS	9	Natural grasslands	26	not applicable	LHE/CHE

Enz_Name	Enz_Code	Corine_name	Corine code	Altitude	Habitat name
LUS	9	Moors and heathland	27	not applicable	MPH/EVR
LUS	9	Sclerophyllous vegetation	28	not applicable	MPH/EVR
LUS	9	Transitional woodland-shrub	29	not applicable	TPH/EVR
LUS	9	Beaches, dunes, sands	30	not applicable	TID
LUS	9	Bare rocks	31	not applicable	TER
LUS	9	Sparsely vegetated areas	32	not applicable	TER
LUS	9	Burnt areas	33	not applicable	FPH/BUR
LUS	9	Glaciers and perpetual snow	34	not applicable	ICE
LUS	9	Inland marshes	35	not applicable	HEL
LUS	9	Peat bogs	36	not applicable	CRY
LUS	9	Salt marshes	37	not applicable	HEL/TID
LUS	9	Salines	38	not applicable	TID
LUS	9	Intertidal flats	39	not applicable	SEA/TID
LUS	9	Water courses	40	not applicable	AQU
LUS	9	Water bodies	41	not applicable	AQU
LUS	9	Coastal lagoons	42	not applicable	AQU
LUS	9	Estuaries	43	not applicable	SEA/TID
MDM/low	11	Continuous urban fabric	1	< 1000	URB
MDM/high	11	Continuous urban fabric	1	> 1000	URB
MDM/low	11	Discontinuous urban fabric	2	< 1000	URB
MDM/high	11	Discontinuous urban fabric	2	> 1000	URB
MDM/low	11	Industrial or commercial units	3	< 1000	URB
MDM/high	11	Industrial or commercial units	3	> 1000	URB
MDM/low	11	Road and rail networks and associated land	4	< 1000	URB
MDM/high	11	Road and rail networks and associated land	4	> 1000	URB
MDM/low	11	Port areas	5	< 1000	URB
MDM/high	11	Port areas	5	> 1000	URB
MDM/low	11	Airports	6	< 1000	URB
MDM/high	11	Airports	6	> 1000	URB
MDM/low	11	Mineral extraction sites	7	< 1000	URB
MDM/high	11	Mineral extraction sites	7	> 1000	URB
MDM/low	11	Dump sites	8	< 1000	URB
MDM/high	11	Dump sites	8	> 1000	URB
MDM/low	11	Construction sites	9	< 1000	URB
MDM/high	11	Construction sites	9	> 1000	URB
MDM/low	11	Green urban areas	10	< 1000	URB
MDM/high	11	Green urban areas	10	> 1000	URB
MDM/low	11	Sport and leisure facilities	11	< 1000	URB
MDM/high	11	Sport and leisure facilities	11	> 1000	URB
MDM/low	11	Non-irrigated arable land	12	< 1000	CRO
MDM/high	11	Non-irrigated arable land	12	> 1000	CRO
MDM/low	11	Permanently irrigated land	13	< 1000	CRO
MDM/high	11	Permanently irrigated land	13	> 1000	CRO
MDM/low	11	Rice fields	14	< 1000	CRO
MDM/high	11	Rice fields	14	> 1000	CRO
MDM/low	11	Vineyards	15	< 1000	CRO

Enz_Name	Enz_Code	Corine_name	Corine code	Altitude	Habitat name
MDM/high	11	Vineyards	15	> 1000	CRO
MDM/low	11	Fruit trees and berry plantations	16	< 1000	CRO/WOC
MDM/high	11	Fruit trees and berry plantations	16	> 1000	CRO/WOC
MDM/low	11	Olive groves	17	< 1000	CRO/WOC
MDM/high	11	Olive groves	17	> 1000	CRO/WOC
MDM/low	11	Pastures	18	< 1000	CHE
MDM/high	11	Pastures	18	> 1000	CHE
MDM/low	11	Annual crops associated with permanent crops	19	< 1000	CRO/WOC
MDM/high	11	Annual crops associated with permanent crops	19	> 1000	CRO/WOC
MDM/low	11	Complex cultivation patterns	20	< 1000	CRO/WOC
MDM/high	11	Complex cultivation patterns	20	> 1000	CRO/WOC
MDM/low	11	Land principally occupied by agriculture, with significant areas of natural vegetation	21	< 1000	CRO/FPH/DEC
MDM/high	11	Land principally occupied by agriculture, with significant areas of natural vegetation	21	> 1000	CRO/FPH/DEC
MDM/high	11	Agro-forestry areas	22	> 1000	CRO/FPH/DEC
MDM/low	11	Agro-forestry areas	22	< 1000	CRO/FPH/EVR
MDM/high	11	Broad-leaved forest	23	> 1000	FPH/DEC
MDM/low	11	Broad-leaved forest	23	< 1000	FPH/EVR
MDM/low	11	Coniferous forest	24	< 1000	FPH/CON
MDM/high	11	Coniferous forest	24	> 1000	FPH/CON
MDM/low	11	Mixed forest	25	< 1000	FPH/DEC/CON
MDM/high	11	Mixed forest	25	> 1000	FPH/DEC/CON
MDM/low	11	Natural grasslands	26	< 1000	LHE/CHE
MDM/high	11	Natural grasslands	26	> 1000	LHE/CHE
MDM/low	11	Moors and heathland	27	< 1000	LPH/EVR
MDM/high	11	Moors and heathland	27	> 1000	LPH/EVR
MDM/low	11	Sclerophyllous vegetation	28	< 1000	LPH/EVR
MDM/high	11	Sclerophyllous vegetation	28	> 1000	LPH/EVR
MDM/high	11	Transitional woodland-shrub	29	> 1000	TPH/DEC
MDM/low	11	Transitional woodland-shrub	29	< 1000	TPH/EVR
MDM/low	11	Beaches, dunes, sands	30	< 1000	TID
MDM/high	11	Beaches, dunes, sands	30	> 1000	TID
MDM/low	11	Bare rocks	31	< 1000	TER
MDM/high	11	Bare rocks	31	> 1000	TER
MDM/low	11	Sparsely vegetated areas	32	< 1000	TER
MDM/high	11	Sparsely vegetated areas	32	> 1000	TER
MDM/low	11	Burnt areas	33	< 1000	FPH/BUR
MDM/high	11	Burnt areas	33	> 1000	FPH/BUR
MDM/low	11	Glaciers and perpetual snow	34	< 1000	ICE
MDM/high	11	Glaciers and perpetual snow	34	> 1000	ICE
MDM/low	11	Inland marshes	35	< 1000	HEL

Enz_Name	Enz_Code	Corine_name	Corine code	Altitude	Habitat name
MDM/high	11	Inland marshes	35	> 1000	HEL
MDM/low	11	Peat bogs	36	< 1000	CRY
MDM/high	11	Peat bogs	36	> 1000	CRY
MDM/low	11	Salt marshes	37	< 1000	HEL/TID
MDM/high	11	Salt marshes	37	> 1000	HEL/TID
MDM/low	11	Salines	38	< 1000	TID
MDM/high	11	Salines	38	> 1000	TID
MDM/low	11	Intertidal flats	39	< 1000	SEA/TID
MDM/high	11	Intertidal flats	39	> 1000	SEA/TID
MDM/low	11	Water courses	40	< 1000	AQU
MDM/high	11	Water courses	40	> 1000	AQU
MDM/low	11	Water bodies	41	< 1000	AQU
MDM/high	11	Water bodies	41	> 1000	AQU
MDM/low	11	Coastal lagoons	42	< 1000	AQU
MDM/high	11	Coastal lagoons	42	> 1000	AQU
MDM/low	11	Estuaries	43	< 1000	SEA/TID
MDM/high	11	Estuaries	43	> 1000	SEA/TID
MDN/low	12	Continuous urban fabric	1	< 1000	URB
MDN/high	12	Continuous urban fabric	1	> 1000	URB
MDN/low	12	Discontinuous urban fabric	2	< 1000	URB
MDN/high	12	Discontinuous urban fabric	2	> 1000	URB
MDN/low	12	Industrial or commercial units	3	< 1000	URB
MDN/high	12	Industrial or commercial units	3	> 1000	URB
MDN/low	12	Road and rail networks and associated land	4	< 1000	URB
MDN/high	12	Road and rail networks and associated land	4	> 1000	URB
MDN/low	12	Port areas	5	< 1000	URB
MDN/high	12	Port areas	5	> 1000	URB
MDN/low	12	Airports	6	< 1000	URB
MDN/high	12	Airports	6	> 1000	URB
MDN/low	12	Mineral extraction sites	7	< 1000	URB
MDN/high	12	Mineral extraction sites	7	> 1000	URB
MDN/low	12	Dump sites	8	< 1000	URB
MDN/high	12	Dump sites	8	> 1000	URB
MDN/low	12	Construction sites	9	< 1000	URB
MDN/high	12	Construction sites	9	> 1000	URB
MDN/low	12	Green urban areas	10	< 1000	URB
MDN/high	12	Green urban areas	10	> 1000	URB
MDN/low	12	Sport and leisure facilities	11	< 1000	URB
MDN/high	12	Sport and leisure facilities	11	> 1000	URB
MDN/low	12	Non-irrigated arable land	12	< 1000	CRO
MDN/high	12	Non-irrigated arable land	12	> 1000	CRO
MDN/low	12	Permanently irrigated land	13	< 1000	CRO
MDN/high	12	Permanently irrigated land	13	> 1000	CRO
MDN/low	12	Rice fields	14	< 1000	CRO
MDN/high	12	Rice fields	14	> 1000	CRO
MDN/low	12	Vineyards	15	< 1000	CRO

Enz_Name	Enz_Code	Corine_name	Corine code	Altitude	Habitat name
MDN/high	12	Vineyards	15	> 1000	CRO
MDN/low	12	Fruit trees and berry plantations	16	< 1000	CRO/WOC
MDN/high	12	Fruit trees and berry plantations	16	> 1000	CRO/WOC
MDN/low	12	Olive groves	17	< 1000	CRO/WOC
MDN/high	12	Olive groves	17	> 1000	CRO/WOC
MDN/low	12	Pastures	18	< 1000	CHE
MDN/high	12	Pastures	18	> 1000	CHE
MDN/low	12	Annual crops associated with permanent crops	19	< 1000	CRO/WOC
MDN/high	12	Annual crops associated with permanent crops	19	> 1000	CRO/WOC
MDN/low	12	Complex cultivation patterns	20	< 1000	CRO/WOC
MDN/high	12	Complex cultivation patterns	20	> 1000	CRO/WOC
MDN/low	12	Land principally occupied by agriculture, with significant areas of natural vegetation	21	< 1000	CRO/FPH/DEC
MDN/high	12	Land principally occupied by agriculture, with significant areas of natural vegetation	21	> 1000	CRO/FPH/DEC
MDN/high	12	Agro-forestry areas	22	> 1000	CRO/FPH/DEC
MDN/low	12	Agro-forestry areas	22	< 1000	CRO/FPH/EVR
MDN/high	12	Broad-leaved forest	23	> 1000	FPH/DEC
MDN/low	12	Broad-leaved forest	23	< 1000	FPH/EVR
MDN/low	12	Coniferous forest	24	< 1000	FPH/CON
MDN/high	12	Coniferous forest	24	> 1000	FPH/CON
MDN/low	12	Mixed forest	25	< 1000	FPH/DEC/CON
MDN/high	12	Mixed forest	25	> 1000	FPH/DEC/CON
MDN/low	12	Natural grasslands	26	< 1000	LHE/CHE
MDN/high	12	Natural grasslands	26	> 1000	LHE/CHE
MDN/low	12	Moors and heathland	27	< 1000	LPH/EVR
MDN/high	12	Moors and heathland	27	> 1000	LPH/EVR
MDN/low	12	Sclerophyllous vegetation	28	< 1000	LPH/EVR
MDN/high	12	Sclerophyllous vegetation	28	> 1000	LPH/EVR
MDN/high	12	Transitional woodland-shrub	29	> 1000	TPH/DEC
MDN/low	12	Transitional woodland-shrub	29	< 1000	TPH/EVR
MDN/low	12	Beaches, dunes, sands	30	< 1000	TID
MDN/high	12	Beaches, dunes, sands	30	> 1000	TID
MDN/low	12	Bare rocks	31	< 1000	TER
MDN/high	12	Bare rocks	31	> 1000	TER
MDN/low	12	Sparsely vegetated areas	32	< 1000	TER
MDN/high	12	Sparsely vegetated areas	32	> 1000	TER
MDN/low	12	Burnt areas	33	< 1000	FPH/BUR
MDN/high	12	Burnt areas	33	> 1000	FPH/BUR
MDN/low	12	Glaciers and perpetual snow	34	< 1000	ICE
MDN/high	12	Glaciers and perpetual snow	34	> 1000	ICE
MDN/low	12	Inland marshes	35	< 1000	HEL

Enz_Name	Enz_Code	Corine_name	Corine code	Altitude	Habitat name
MDN/high	12	Inland marshes	35	> 1000	HEL
MDN/low	12	Peat bogs	36	< 1000	CRY
MDN/high	12	Peat bogs	36	> 1000	CRY
MDN/low	12	Salt marshes	37	< 1000	HEL/TID
MDN/high	12	Salt marshes	37	> 1000	HEL/TID
MDN/low	12	Salines	38	< 1000	TID
MDN/high	12	Salines	38	> 1000	TID
MDN/low	12	Intertidal flats	39	< 1000	SEA/TID
MDN/high	12	Intertidal flats	39	> 1000	SEA/TID
MDN/low	12	Water courses	40	< 1000	AQU
MDN/high	12	Water courses	40	> 1000	AQU
MDN/low	12	Water bodies	41	< 1000	AQU
MDN/high	12	Water bodies	41	> 1000	AQU
MDN/low	12	Coastal lagoons	42	< 1000	AQU
MDN/high	12	Coastal lagoons	42	> 1000	AQU
MDN/low	12	Estuaries	43	< 1000	SEA/TID
MDN/high	12	Estuaries	43	> 1000	SEA/TID
MDS/low	13	Continuous urban fabric	1	< 1000	URB
MDS/high	13	Continuous urban fabric	1	> 1000	URB
MDS/low	13	Discontinuous urban fabric	2	< 1000	URB
MDS/high	13	Discontinuous urban fabric	2	> 1000	URB
MDS/low	13	Industrial or commercial units	3	< 1000	URB
MDS/high	13	Industrial or commercial units	3	> 1000	URB
MDS/low	13	Road and rail networks and associated land	4	< 1000	URB
MDS/high	13	Road and rail networks and associated land	4	> 1000	URB
MDS/low	13	Port areas	5	< 1000	URB
MDS/high	13	Port areas	5	> 1000	URB
MDS/low	13	Airports	6	< 1000	URB
MDS/high	13	Airports	6	> 1000	URB
MDS/low	13	Mineral extraction sites	7	< 1000	URB
MDS/high	13	Mineral extraction sites	7	> 1000	URB
MDS/low	13	Dump sites	8	< 1000	URB
MDS/high	13	Dump sites	8	> 1000	URB
MDS/low	13	Construction sites	9	< 1000	URB
MDS/high	13	Construction sites	9	> 1000	URB
MDS/low	13	Green urban areas	10	< 1000	URB
MDS/high	13	Green urban areas	10	> 1000	URB
MDS/low	13	Sport and leisure facilities	11	< 1000	URB
MDS/high	13	Sport and leisure facilities	11	> 1000	URB
MDS/low	13	Non-irrigated arable land	12	< 1000	CRO
MDS/high	13	Non-irrigated arable land	12	> 1000	CRO
MDS/low	13	Permanently irrigated land	13	< 1000	CRO
MDS/high	13	Permanently irrigated land	13	> 1000	CRO
MDS/low	13	Rice fields	14	< 1000	CRO
MDS/high	13	Rice fields	14	> 1000	CRO
MDS/low	13	Vineyards	15	< 1000	CRO

Enz_Name	Enz_Code	Corine_name	Corine code	Altitude	Habitat name
MDS/high	13	Vineyards	15	> 1000	CRO
MDS/low	13	Fruit trees and berry plantations	16	< 1000	CRO/WOC
MDS/high	13	Fruit trees and berry plantations	16	> 1000	CRO/WOC
MDS/low	13	Olive groves	17	< 1000	CRO/WOC
MDS/high	13	Olive groves	17	> 1000	CRO/WOC
MDS/low	13	Pastures	18	< 1000	CHE
MDS/high	13	Pastures	18	> 1000	CHE
MDS/low	13	Annual crops associated with permanent crops	19	< 1000	CRO/WOC
MDS/high	13	Annual crops associated with permanent crops	19	> 1000	CRO/WOC
MDS/low	13	Complex cultivation patterns	20	< 1000	CRO/WOC
MDS/high	13	Complex cultivation patterns	20	> 1000	CRO/WOC
MDS/low	13	Land principally occupied by agriculture, with significant areas of natural vegetation	21	< 1000	CRO/FPH/DEC
MDS/high	13	Land principally occupied by agriculture, with significant areas of natural vegetation	21	> 1000	CRO/FPH/DEC
MDS/high	13	Agro-forestry areas	22	> 1000	CRO/FPH/DEC
MDS/low	13	Agro-forestry areas	22	< 1000	CRO/FPH/EVR
MDS/high	13	Broad-leaved forest	23	> 1000	FPH/DEC
MDS/low	13	Broad-leaved forest	23	< 1000	FPH/EVR
MDS/low	13	Coniferous forest	24	< 1000	FPH/CON
MDS/high	13	Coniferous forest	24	> 1000	FPH/CON
MDS/low	13	Mixed forest	25	< 1000	FPH/DEC/CON
MDS/high	13	Mixed forest	25	> 1000	FPH/DEC/CON
MDS/low	13	Natural grasslands	26	< 1000	LHE/CHE
MDS/high	13	Natural grasslands	26	> 1000	LHE/CHE
MDS/low	13	Moors and heathland	27	< 1000	LPH/EVR
MDS/high	13	Moors and heathland	27	> 1000	LPH/EVR
MDS/low	13	Sclerophyllous vegetation	28	< 1000	LPH/EVR
MDS/high	13	Sclerophyllous vegetation	28	> 1000	LPH/EVR
MDS/high	13	Transitional woodland-shrub	29	> 1000	TPH/DEC
MDS/low	13	Transitional woodland-shrub	29	< 1000	TPH/EVR
MDS/low	13	Beaches, dunes, sands	30	< 1000	TID
MDS/high	13	Beaches, dunes, sands	30	> 1000	TID
MDS/low	13	Bare rocks	31	< 1000	TER
MDS/high	13	Bare rocks	31	> 1000	TER
MDS/low	13	Sparsely vegetated areas	32	< 1000	TER
MDS/high	13	Sparsely vegetated areas	32	> 1000	TER
MDS/low	13	Burnt areas	33	< 1000	FPH/BUR
MDS/high	13	Burnt areas	33	> 1000	FPH/BUR
MDS/low	13	Glaciers and perpetual snow	34	< 1000	ICE
MDS/high	13	Glaciers and perpetual snow	34	> 1000	ICE
MDS/low	13	Inland marshes	35	< 1000	HEL

Enz_Name	Enz_Code	Corine_name	Corine code	Altitude	Habitat name
MDS/high	13	Inland marshes	35	> 1000	HEL
MDS/low	13	Peat bogs	36	< 1000	CRY
MDS/high	13	Peat bogs	36	> 1000	CRY
MDS/low	13	Salt marshes	37	< 1000	HEL/TID
MDS/high	13	Salt marshes	37	> 1000	HEL/TID
MDS/low	13	Salines	38	< 1000	TID
MDS/high	13	Salines	38	> 1000	TID
MDS/low	13	Intertidal flats	39	< 1000	SEA/TID
MDS/high	13	Intertidal flats	39	> 1000	SEA/TID
MDS/low	13	Water courses	40	< 1000	AQU
MDS/high	13	Water courses	40	> 1000	AQU
MDS/low	13	Water bodies	41	< 1000	AQU
MDS/high	13	Water bodies	41	> 1000	AQU
MDS/low	13	Coastal lagoons	42	< 1000	AQU
MDS/high	13	Coastal lagoons	42	> 1000	AQU
MDS/low	13	Estuaries	43	< 1000	SEA/TID
MDS/high	13	Estuaries	43	> 1000	SEA/TID

Appendix 3 Mammals selected for habitat size selection

Species have been allocated to environmental zones, habitat types and a size of the required habitat has been indicated.

		ENZ	ALN	ALS	BOR	NEM	CON	ATN	ATC	LUS	PAN	MDN	MDM	MDS	
	Castor fiber	beaver	*4*	4	4	4	4	4	4						
	Alopex lagopus	polar fox	7												
	Lutra lutra	otter		4	4	4	4	4	4	4	4	4	4	4	
*	Mustela lutreola	European mink					5		5						Normandy, Brittany and Lunebürger Heide
*	Canis lupus	wolf	7	6	7					6		6	6	6	Except Finland
*	Gulo gulo	forest dormouse	*8*												
	Lynx lynx	lynx	*8*	8	8										Except Finland and Baltic states
*	Lynx pardina	pardel lynx		8								8	8	8	Iberian Peninsula
*	Marmota marmota latirostris	Tatra marmot		4											Carpathian subspecies
	Rupicapra rupicapra	gems/chamois		5											
	Capra hircus (aegagrus)	Ibex		5									5		
	Ursus arctos	brown bear	*8*	8	8								8		
	Cervus elaphus corsicanus	Red deer											6		only Corsica
	Alces alces	Moose			7	7									
	Rangifer tarandus fennicus	Reindeer	*8*												Finnish forest Reindeer

class	km2
1	<10
2	10-50
3	50-150
4	150-300
5	300-600
6	600-1000
7	1000-2000
8	>2000

zones to be included
excluded in Annex 1
not in EU-15

* priority species

Excluded: Monachus monachus
Phoca hispida (Botnica and saimensis)
Halichoerus grypus
Phoca vitulina

Appendix 4 Overview of bird species used in PEEN WE

Criteria for selection of bird species:
On Annex I of Birds Directive or in previous projects
Occurs in EU+ (excl Canary islands) as breeding bird
No colony breeder (some species of PEEN- SEE were excluded for this reason)
More then 100 breeding pairs in EU (unless also in PEEN-SEE)
Not restricted to islands in the Mediterranean
Not a limited distribution (only few localities)
Not spending large parts of life on open sea/ tidal areas/ highabitat preference open sea
Excluded if occurring frequently in other region and not selected there
Excluded is subspecies on Annex I of which species is abundant in Europe

	bird species:	Number of reproductive units
1	Gavia arctica	20
2	Gavia stellata	20
3	Podiceps auritus	40
4	Botaurus stellaris	20
5	Ixobrychus minutus	40
6	Nycticorax nycticorax	20
7	Ardeola ralloides	40
8	Ardea purpurea	20
9	Egretta alba	20
10	Egretta garzetta	40
11	Ciconia nigra	20
12	Platelea leucorodia	20
13	Phoenicopterus ruber	20
14	Cygnus cygnus	20
15	Aythya nyroca	20
16	Mergus albellus	20
17	Neophron percnopterus	20
18	Gyps fulvus	20
19	Aegypius monachus	20
20	Pernis apivorus	20
21	Milvus migrans	20
22	Milvus milvus	20
23	Haliaeetus albicilla	20
24	Circaetus gallicus	20
25	Circus cyaneus	20
26	Circus pygargus	20
27	Aquila pomarina	20
28	Aquila chrysaetos	20
29	Hieraeetus pennatus	20
30	Hieraaetus fasciatus	20

31	Pandion haliaeetus	20
32	Falco vespertinus	20
33	Falco columbarius	20
34	Falco naumanni	20
35	Falco rusticolus	20
36	Bonasa bonasia	40
37	Tetrao urogallus	20
38	Tetrao tetrix	20
39	Lagopus mutus (incl subsp pyrenaicus & helveticus)	20
40	Alectoris graeca	40
41	Porzana parva	40
42	Crex crex	40
43	Grus grus	20
44	Recurvirostra avosetta	20
45	Himantopus himantopus	20
46	Himantopus himantopus	20
47	Burhinus oedicnemus	20
48	Glareola pratincola	20
49	Charadrius morinellus	20
50	Pluvialis apricaria	20
51	Philomachus pugnax	20
52	Gallinago media	20
53	Calidris alpina	20
54	Phalaropus lobatus	20
55	Tringa glareola	20
56	Larus audouinii	20
57	Sterna albifrons	40
58	Chlidonias hybridus	40
59	Chlidonias leucopterus	40
60	Pterocles alchata	20
61	Bubo bubo	20
62	Nyctea scandiaca	20
63	Glaucidium passerinum	40
64	Strix uralensis	20
65	Strix nebulosa	20
66	Asio flammeus	20
67	Caprimulgus europaeus	20
68	Alcedo atthis	40
69	Coracias garrulus	40
70	Dendrocopos leucotos	40
71	Picoides tridactylus	40
72	Picus canus	20
73	Chersophilius duponti	40
74	Anthus campestris	100

75	Luscinia svecica	100
76	Sylvia undata	100
77	Ficedula albicollis	100
78	Lanius minor	40
79	Phasianus colchicus	40
80	Sitta europaea	40
81	Hippolais olivetorum	100
82	Drycopus martius	40
83	Eremophila alpestris	
84	Oxyura leucocephala	

Appendix 5 Experts and policy makers aproached for consultation

Country	First name	Last name	Institution
Austria	Alois	Posch	Ministry for Agriculture, Forestry, Environment, Water
Austria	Franz	Dollinger	Land Salzburg
Austria	Günter	Liebel	Land-und Forstwirtschaft,
Austria	Christian	Plössing	Amt der Tiroler Landesregierung, Abt. Umweltschutz
Austria	Michael	Proschek	WWF Austria
Austria	Maria	Tiefenbach	Umweltbundesamt
Belgium	Patrick	Dewolf	DGRNE
Belgium	Ilona	Jepsena	European Commission, DG Environment B2
Belgium	Marc	Dufrêne	
Belgium	Geert	De Blust	Institute of Nature Conservation INBO, Landscape Ecology and Nature Management
Belgium	Tim	Christophersen	IUCN
Belgium	Kris	Decleer	Institute of Nature Conservation, Head Nature Restoration and Nature
Belgium	Els	Martens	Afdeling Natuur, Ministerie van de Vlaamse Gemeenschap
Belgium	Mark	Roekaerts	
Belgium	Jacques	Stein	Ministère de l'Environnment
Denmark	Jörgen	Primdahl	KVL
Denmark	Jean Louis	Weber	European Environmental Agency
Denmark	Erik	Buchwald	Danish Forest and Nature Agency, Division of Sea and Habitats
Denmark	Jane	Feehan	EEA
Denmark	Peder	Agger	RUC
Denmark	Anni	Dalgas	The Danish Forest and Nature Agency
Denmark	Martin	Schneekloth	Danish Forest and Nature Management Agency
Finland	Jussi	Soramaki	Ministry of the Environment, Land Use Department
Finland	Heikki	Korpelainen	Ministry of the Environment
Finland	Sami	Niemi	Ministry of Agriculture & Forestry
Finland	Petri	Ahlroth	SYKE- Finnish Environment Institute, Nature Division
France	Isabelle	Combroux	Muséum National d`Histoire Naturelle
France	Francois	Bland	Ministère de l'Ecologie et du développement durable, Sous-direction des Espaces Naturels
France	Henri	Jaffeux	Ministère de écologie et du développement durable, Sous-direction des Espaces Naturels
France	Olivia	Delanoë	INEA
France	Sebastien	Moncorps	IUCN, Comité francaise
France	Dominique	Richard	Topic Centre Biodiversity and \nature Conservation

Country	First name	Last name	Institution
Germany	Franziska	Tanneberger	Universität Greifswald, Botanisches Institut
Germany	Andreas	Laudensack	Umweltministerium
Germany	Richard	Genkinger	Landesanstalt für Ökologie, Bodenordnung und Forsten NRW (LÖBF) Abt. 3- Ökologie, Naturschutz und Landschaftspflege, Dezernat 34
Germany	Karin	Ullrich,	Bundesamt für Naturschutz, Biotopschutz und Landschaftsökologie I 2.1
Germany	Julia	Raddatz	Landesanstalt für Umweltschutz Baden-Württemberg, Referat 25- Flächenschutz
Germany	Frank	Zimmermann	Landesumweltamt (LUA) Brandenburg, Abt. Ökologie, Naturschutz, Wasser- Referat Ö 2
Germany	Christof	Herrmann	Landesamt für Umwelt, Naturschutz und Geologie Mecklenburg- Vorpommern
Germany	Peter	Finck	Bundesanstalt für Naturschutz, Abt Biotopschutz und Landschaftökologie
Germany	Jens	Peterson	Landesamt für Umweltschutz Sachsen- Anhalt, FB 4 - Naturschutz
Germany	Detlef	Szymanski	Hessisches Ministerium für Umwelt, Landwirtschaft und Forsten
Germany	Barbara	von Kügelgen	Uni Hannover, , Inst. Für Klandschafstspflege und Naturschutz
Germany	Hans-Joachim	Augst	Landesamt für Natur und Umwelt Schleswig-Holstein, Abt. 3- Naturschutz und Landschaftspflege
Germany	Rüdiger	Burkhardt	Landesamt für Umwelt, Wasserwirtschaft und Gewerbeaufsicht Rheinland-Pfalz, Abt. 5 - Naturschutz und Landschaftspflege
Germany	Christian	Geske	Hessen Forst FIV- Forsteinrichtung, Information, Versuchswesen, Naturschutzdaten
Germany	Markus	Nipko	Naturschutzbund Deutschland e.V. (NABU), Naturschutz und Umweltpolitik
Germany	Olaf	Drachenfels, v.	Niedersächsischer Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz
Germany	Ronald	Fricke	Staatliches Museum für Naturkunde Stuttgart, Museum Schloss Rosenstein
Germany	Axel	Ssymank	Bundesamt für Naturschutz, Biotopschutz und Landschaftsökologie I 2.2
Germany	Martin	Dieterich	Institut für Landschaftsforschung und Naturschutz Singen (ILN), im NABU LV Baden Württemberg
Germany	Nicola	Breier	Nature Conservation and Nuclear Safety, Ministry for the Environment
Ireland	Mary	Tubridy	Compass Informatics Limited
Ireland	Colman	O Criodain	National Parks and Wildlife Service Department of the Environment, Heritage and Local Government
Italia	Emilio	Padoa Schioppa	Universitá degli Studi di Milano Bicocca, Dipartimento de Scienze dell'Ambiente e del Territorio
Italy	Eugenio	Dupré	Ministero dell´Ambiente e della Tutela del Territorio, Direzione Conservazione della Natura

Country	First name	Last name	Institution
Italy	Anna Maria	Maggiore	Nature Protection Directorate, Ministry for the Environment and Territory
Italy	Francesca	Pani	Nature Protection Directorate, Ministry for the Environment and Territory
Liechtenstein	Michael	Fasel	Amt fur Wald, Natur und Landschaft
Luxembourg	Claude	Origer	Ministère de l'Environnement
Malta	Marie Therese	Gambin	Malta Environment and Planning Authority
Malta	Alfred	Baldacchino	Environment Protection Directorate, Malta Environment and Planning Authority
Monaco	Patrick	Van Klaveren	Relations exterieures, Jardin de l'Unesco
Norway	Harald	Bratli	NIJOS
Norway	Wenche	Dramstad	NIJOS
Norway	Arild	Lindgaard	Directorate for Nature Management
Portugal	Teresa	Andresen	University of Porto
Portugal	Pedro	Arriegas	Instituti da Conservaçao da Natureza
Portugal	João	Machado	Universidade Tecnica de Lisboa
Portugal	Gloria	Araújo	Instituto de Conservação da Natureza
Portugal	Teresa	Avelar	Ministry of Agriculture, Rural development & fisheries, Environment Audit
Portugal	Carlos	Morais	Ministry of Agriculture, Rural development & fisheries, Forestry Directorate
Spain	Luis	Suąrez	WWF Spain
Spain	Rafael	Hidalgo	Ministry of the Environment, General-Directorate for Biodiversity
Spain	Roberto	Valljo Bombin	Spanish Nature Conservation
Spain	Mikel	Gurrutxaga	IKT, S.A. Department of the Natural Environment and Geographical Information Systems.
Spain	Teresa	Gil Gil	Environmental Research Centre of Madrid "Fernando Gonzáles Bernáldez"
Spain	Josep Maria	Mallarach Carrera	Fundacio Territori I Paissatge
Spain	Miguel	Aymerich	Dirección General de Conservación de la Naturaleza MIMAM
Sweden	Ola	Inghe	Swedish Environmental Protection Agency Environmental Monitoring
Sweden	Helene	Lindahl	Natura 2000-samordnare, Swedish Environment Protection Agency
Sweden	Torsten	Larsson	Swedish Environmental Protection Agency
Sweden	Nilla	Thomson	Ministry of Environment
Sweden	Margaretha	Ihse	Stockholms Universitet, Dept of Physical Geography and Quaternary Geology
Sweden	Anders	Glimskär	SLU, Dept for conservation Biology
Sweden	Ingrid	Sarlöv Herlin	SLU
Switzerland	Raymond Pierre	Lebeau	ivision Protection de la Nature, Office fédéral de l'environnement, des forêts et du paysage/ Bundesamt für Umwelt, Wald und Landschaft

Country	First name	Last name	Institution
			(BUWAL)
Switzerland	Raymond	Delarze	Office federal de l'Environnement, des forets et du Paysage
Switzerland	Guy	Berthoud	Bureau d'Études en écologie appliqué (ECONAT SA)
Switzerland	Erich	Kohli	Swiss Agency for the Ewnvironment, Forests and Landscape, Nature Division
Switzerland	Brigitte	Decrausaz	Ministry of Agriculture
The Netherlands	Bas	Roels	Ministry of Agriculture, Nature and Food Quality
The Netherlands	Hans	Kampf	Ministry of Agriculture, Nature and Food Quality, Department of Knowledge
The Netherlands	Peter	Bos	Directie Natuur, Ministerie van LNV
The Netherlands	Ben	Delbaere	
The Netherlands	Sander	van Opstal	Directie Kennis, locatie Ede
UK			Countryside Council for Wales
UK	Bob	Ford	Department for Environment, Food and Rural Affairs, Natura 2000 team
UK	Roger	Catchpole	English Nature
UK	Seona	Anderson	Plantlife International
UK	Andrew	Stott	DEFRA Zone 1/06, European Wildlife division
UK	David/ Phil	Mallon/ Alcock	Scottish Executive Environment & Rural Affairs Department , Protected Areas Team
UK	Wyn	Jones	Joint Nature Conservation Committee, Head of Habitats
UK	Ian	Marshall	Chester County Council
UK	Igor	Lysenko	UNEP World Conservation Monitoring Centre

Appendix 6 Legend of the Map of PEEN WE, habitat categories and tresholds

Legend Name	Categories of simplified habitat	Environmental Zone	Altitude	Soil Map	Threshold 1 (ha)	Threshold 2 (ha)	Threshold 3 (ha)
Fens and bogs	Peat bogs	all	-	-	50	2000	10000
	Inland marshes	all	-	-			
Salt marsh, saline areas, beaches	Salt marshes	all	-	-	150	300	1500
	Salines	all	-	-			
	Intertidal flats	all	-	-			
	Beaches, dunes, sands	all					
Inland water/ wetlands	Water bodies	all	-	-	50	1000	5000
	Coastal lagoons	all					
	Estuaries	all					
	Inland waters	all					
	Water	all					
Alpine grasslands/shrubs/open areas etc.	Glaciers and perpetual snow	ALN, ALS			150	2000	10000
	Sparsely vegetated areas	ALN, ALS					
	Sparsely vegetated areas	CON, ATN	> 800				
	Bare rocks	ALN, ALS,	> 800				
	Bare rocks	CON, ATN	> 800				
	Natural grasslands	ALN, ALS					
	Moors and heathland	ALN, ALS,	>800				
	Sclerophyllous vegetation	ALN, ALS,					
	Sclerophyllous vegetation	ATN, LUS	> 800				
	Sparsely vegetated areas	MDM, MDN, MDS	> 1800				

Legend Name	Categories of simplified habitat	Environmental Zone	Altitude	Soil Map	Threshold 1 (ha)	Threshold 2 (ha)	Threshold 3 (ha)
	Bare rocks	MDM, MDN, MDS	> 1800				
	Natural grasslands	MDM, MDN, MDS	> 1800				
	Sclerophyllous vegetation	MDM, MDN, MDS	> 1800				
	Open spaces with little or no vegetation	ALS					
	Scrub and/or herbaceous vegetation associations	ALS					
	Glacier	ALN					
	Other land without vegetation cover	ALN					
Calcareous grassland (dry)	Natural grasslands	All		From other documentation	150	2000	10000
Moist grassland	Natural grasslands	All		From other documentation	150	1000	5000
Forest - Scandinavia	Broad-leaved forest	ALN, BOR, ATN			600	2000	10000
	Coniferous forest	ALN, ATN					
	Mixed forest	ALN, NEM, BOR, ATN					
	Non-productive forest.	ALN, BOR, NEM					
	Transitional woodland-shrub	ALN, BOR, NEM					
Forest- Others	Broad-leaved forest	ATC, ATN, LUS, MDM, MDN, MDS, PAN, CON, ALS			300	2000	10000
	Coniferous forest	ATC, ATN, MDM, MDN, MDS, PAN, ALS					
	Mixed forest	ATC, ATN,					

Legend Name	Categories of simplified habitat	Environmental Zone	Altitude	Soil Map	Threshold 1 (ha)	Threshold 2 (ha)	Threshold 3 (ha)
		LUS,MDM, MDN, MDS, PAN, ALS, CON					
	Burnt areas	MDM, MDN, MDS, ALS, LUS					
	Forests	ALS,MDM, CON					
	Transitional woodland-shrub	ATC, ATN, LUS,MDM, MDN, MDS, PAN, ALS					
	Scrub and/or herbaceous vegetation associations	CON					
Atlantic heathlands	Moors and heathland	ATC, ATN, LUS			10	300	1500
Med heathland and shrubs	Moors and heathland	MDM, MDN, MDS			300	2000	10000
	Sclerophyllous vegetation	MDM, MDN, MDS					
	Sparsely vegetated areas	MDM, MDN, MDS					

Indicative map of the Pan-European Ecological Network for Western Europe

Reykjavik

Atlantic Ocean

Glasgow

Dublin

Birmingham

London

Rotterdam

Antwerpen

Bruxelles

Lille

Aachen

Köln

Düsseldorf

Dortmund

Essen

Hamburg

Bremen

Hannover

Berlin

Bielefeld

Leipzig

Dresden

København

Malmo

Sankt-Peterburg

Helsinki

Minsk

Praha

Wien

München

Nürnberg

Stuttgart

Karlsruhe

Frankfurt

Paris

Nantes

Bordeaux

Toulouse

Lyon

Zürich

Milano

Torino

Zagreb

Beograd

Sofiya

Thessaloniki

Poznan

Lódz

Wroclaw

Katowice

Kraków

L'viv

Budapest

Porto

Lisboa

Sevilla

Málaga

Madrid

Zaragoza

Barcelona

Valencia

Napoli

Palermo

Mediterranean Sea

Environmental zones and bird migration routes

- Alpine North
- Alpine South
- Atlantic North
- Atlantic Central
- Continental
- Mediterranean North
- Mediterranean Mountains
- Mediterranean South
- Boreal
- Nemoral
- Panonian
- Lusitian

CORE AREAS

Inland water/wetland
I
II
III

Alpine/calcareous grassland
I
II
III

Marsh
I
II
III

Moist grassland
I
II
III

Heath/Mediterranean scrub
I
II
III

Forest
I
II
III

SIZE CLASSES OF CORE AREAS
I: Suboptimal area, 70 - 90% of the required area for the selected species
II: Large area, 90 - 100% of the required area for the selected species
III: Very large area, sufficient for all selected species

Internationally acknowledged area

- Important Bird Area
- Ramsar Site
- Prime Butterfly Area

CORRIDORS
Search areas for corridors

OTHER SYMBOLS
Capital city
Large river

Explanation on the development and the interpretation of this map can be found in:
Jongman et al (2006) The Indicative Map of the Pan European Ecological Network in Western Europe,
Technical Background Document. Alterra Report 1429, ISSN 1566-7197.
The Report is available through www.alterra.nl

ECNC european centre for nature conservation
WETLANDS INTERNATIONAL
De Vlinderstichting
BirdLife INTERNATIONAL
ALTERRA WAGENINGEN UR

0 500 1000 2000 3000 4000 5000 Kilometers