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The Pan European Ecological Network:

a review of international instruments
aiming at European ecological networks
and suggestions for unifying criteria
for the identification of core-areas.



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Abstract

Since the early 90-ties the establishment of a European ecological network has become a priority topic within the European Union and within the Council of Europe.

In this paper the aims and criteria of the existing European Nature conservation instruments are analysed. It appears that the Pan-European Ecological Network (PEEN) is the best device for a strong, coherent European Ecological Network as PEEN covers not only core areas, but also corridors, buffer-zones and nature development areas, which other networks in general do not.

It appears that naturalness and biodiversity are considered as central concepts in international nature conservation instruments.

In this paper naturalness is defined in terms of intensity of human influence in ecological processes in ecosystems, biodiversity is defined in terms of distribution and threat of species and ecosystems.

Aiming at the conservation of ecosystems and species that are of European importance, ecological criteria for the selection of sites as core areas of a Pan-European Ecological Network are formulated.

Based on these criteria an initial map of the major regions in Europe where core-area's could be established is presented.

Keywords: Pan-European Ecological Network; Network-architecture; Criteria; Core areas.

1. Introduction

1.1 Scope of this paper

The Pan-European Biological and Landscape Diversity Strategy is an initiative of the Council of Europe. The Strategy seeks to conserve ecosystems, habitats, species, their genetic diversity and landscapes of European importance through the development of the Pan-European Ecological Network (PEEN) within ten years (Council of Europe, UNEP & European Centre for Nature Conservation, 1996). The Pan European Ecological Network presents an enormous and inspiring task of ecological planning which will influence other European and National physical planning processes.

In this paper there will be made an analysis of the scope of international instruments, and of the criteria used in international instruments for the designation of core areas, if appropriate.

Concluding this paper, considerations are formulated which should enable the discussion on the "architecture" of Pan European Ecological Network. The paper results in ecological criteria for core-areas, corridors, bufferzones and nature development zones and in an initial map of major regions of Europe where core-areas should be established.

As far as the author knows this is the first paper that gives a full analysis of the criteria used in important, existing European Ecological instruments and the first that gives an explicit discussion on the architectural principles that should underlie the Pan-European Ecological Network.

Central concepts in this paper are: ecosystems, species, naturalness and biodiversity. An ecosystem is defined as a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit (Convention on Biological Diversity, 1992 article 2). Naturalness is defined in terms of intensity of human influence in ecological processes in ecosystems: it denotes to areas where human influence is absent or very limited, and where natural processes (erosion, sedimentation, fragmentation, deposition by water, wind, ice or grazing by wild wandering herds of natural or dedomesticated grazers) are predominant

Biological diversity is defined as the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (Convention on Biological Diversity, 1992; article 2).

The criteria that are defined are restricted to the ecological domain. This paper does **not** try to cope with political, societal or practical aspects. This has been done to make a sharp discussion on criteria possible. It does not mean that these aspects are not important.

1.2 Objectives of the Pan European Biological and Landscape Diversity Strategy

The Pan European Biological and Landscape Diversity Strategy (PEBLDS) seeks to conserve, protect or maintain ecosystems, habitats, species, their genetic diversity, and landscapes of European importance through the development of the Pan European Ecological Network within 10 years.

The Pan European Ecological Network will contribute to achieving the main goals of the Strategy by ensuring that a full range of ecosystems, habitats, species and their genetic diversity, and landscapes of European importance are conserved; habitats are large enough to give species a favourable conservation status; there are sufficient opportunities for the dispersal and migration of species; damaged elements of the key systems are restored and the systems are buffered from potential threats.

The Pan-European Ecological Network is aimed to maintain and enhance the conservation and coherence of natural and semi-natural ecosystems and natural processes of European importance, paying particular attention to characteristic threatened and endangered species, bearing in mind the intercontinental setting and relationships (Council of Europe, UNEP & European Centre for Nature Conservation, 1996).

In other words, the Pan-European Ecological Network has, by creating a European ecological network, the following objectives:

- to maintain characteristic ecosystems and species across their natu-

ral ranges,

- to support ecological processes across Europe,
- to restore in a sufficient degree natural ecosystems and processes,
- to conserve semi-natural and other ecosystems, especially where these are indispensable as substitutes for natural habitats,
- to adopt sustainability as a guiding principle for decisions and actions.

(After: Bennett (ed.) 1994)

Various existing international instruments already provide the identification and conservation of areas and species of European or global significance. These include the Bern Convention, the European Union Habitats and Birds Directive, the Ramsar Convention, the Bonn Convention, and the Fourth Protocol of the Barcelona Convention. The full and effective implementation of these instruments, and particularly the establishment of Natura 2000 under the Habitats Directive (European Union), and the Emerald Network under the Bern Convention (wider European), is of vital importance in building the Pan European Ecological Network, since these instruments provide the conservation of many valuable sites for nature-conservation in Europe. The physical realisation of PEEN should be based on existing initiatives and European directives.

2. Analysis: International Instruments and ecological Networks in Europe

2.1 Introduction: some international instruments and their scope

The international instruments aiming on a European level at the protection of sites are analysed. As this paper concentrates on ecological aspects, legal and/or political aspects are only shortly mentioned, just to give the reader an impression of these aspects of the instruments. The analysis in table 1 gives some characteristics of international instruments as international character, scope, network elements and legal basis (source: Delbaere, 1998 and 1999).

The criteria are worked out in the following way:

1. character: what kind of internatio-

nal body supports and promotes the network;

2. scope: what kind of biological elements are subject of the international instrument;
3. geographical delimitation: which part of Europe is covered;
4. legal basis: how strong is the protection the network can get: is it for example legally binding for member states, or is it "only" an intention, a Strategy?

It appears that PEEN is supported by a very large number of signing states and other international bodies.

Both Natura 2000 and PEEN aim at a vast network, encompassing all kinds of ecosystems, but Natura 2000 is, at the moment, geographically more limited, as it covers only the EU. The Emerald network should be the complementary part of the Natura 2000 network in the Bern-signing countries outside the EU.

PEEN is the only instrument covering the whole of Europe. It is clear that Natura 2000 has a very strong legal basis as PEEN is only a Strategy, although supported by a vast number of countries and international Institutions.

2.2 Criteria used in international instruments and/or ecological networks

In this paragraph there will be made an analysis of the criteria used in international instruments for the designation of core areas, if appropriate.

As first, existing international instruments are analysed. Important aspects as what is the biological object of the instrument, and what are the criteria used for the selection of sites for European Ecological networks are analysed. As it appeared that lists of priority species are used for the selection of core areas

TABLE 1: COPE OF INTERNATIONAL INSTRUMENTS ON THE EUROPEAN LEVEL AIMING AT THE PROTECTION OF SITES AND/OR THE ESTABLISHMENT OF ECOLOGICAL NETWORKS.

Name of international instrument	Name of ecological network:	1. Character:	2. Scope:	3. Geographical delimitation:	4. Legal basis:
Convention on Wetlands (1971)	-	International	wetlands including natural, semi-natural and artificial waters	Global	Legally binding for contracting parties
Biogenetic reserves (1976)	-	Council of Europe	natural or near-natural habitats or ecosystems	Europe	Ministerial resolutions
Pan European Biological and Landscape Diversity Strategy (P.E.B.L.D.S.) (1995)	Pan European Ecological Network	Council of Europe & UNEP	natural and semi-natural ecosystems, habitats, species and landscapes that are of European importance	Europe	Strategy
E.U. Birds Directive (1979)	Natura 2000	European Commission all species of naturally occurring birds in Europe	all species of naturally occurring birds in Europe	European Union territory	Legally binding for EU member States
E.U. Habitats Directive (1992)	Natura 2000	European Commission	natural habitats and wild fauna and flora. (including semi-natural habitats)	European Union territory	Legally binding for EU member States
Bern Convention (1979)	Emerald Network	Council of Europe	natural habitats and wild fauna and flora	Europe	Recommendation of the standing committee of the Bern convention
Helsinki Convention (1974, 1992)	-	Helsinki Commission: International convention	natural habitats and biological diversity; ecological processes (in the Baltic Sea Area)	Baltic Sea region	Legally binding for contracting parties
Barcelona Convention (1976/1995) and Geneva/Barcelona Protocol (1982/1995)	-	International convention	representative and/or endangered ecosystems of adequate size to maintain their biodiversity (in the Mediterranean region)	Mediterranean sea region	Legally binding for contracting

it was necessary to analyse the criteria used in international instruments for the evaluation of the conservation status of species in Europe. These aspects were analysed in a separate study from which the results are cited (table 3 and 4, from: Siepel et. al., 2001).

Table 2: the scope of international instruments aiming at the protection of sites and of the evaluation of these instruments.

The following criteria are used for the evaluation of the scope of international instruments:

1. Does the instrument cover all types of ecosystems, for example both aquatic and terrestrial?
2. And in particular, as PEBLDS focuses

on natural and semi-natural ecosystems: is this distinction made in the aims of the instrument?

3. Do the criteria used for the selection of priority species cover all taxonomic categories?
4. Do the criteria used for the selection of priority species cover all threatened (cf IUCN) species?
5. Do the criteria used for the selection of priority species cover all endemic species

As we have no data on the threat of European ecosystems and no data on the degree of endemism of ecosystems, there are no criteria formulated for the coverage of ecosystems in these instruments.

6. Does the instrument aim at the

establishment of a full network, including core-areas, corridors, nature-development areas and buffer-zones?

It is important that all kinds of ecosystems are covered in a Pan European Ecological Network, and that emphasis is laid on both natural and semi-natural ecosystems. It appears that only PEEN, Natura 2000 and Emerald fulfil these conditions (criterion 1 and 2).

As it appears that the criteria used in the conventions of Bonn, Bern, the Habitats Directive and the Birds Directive for the identification of core-areas are based on explicit priority species, these criteria are to be analysed in detail. The criteria 3, 4 and 5 are introduced to evaluate this. It appears (Siepel et. al., 2001, in press) that the priority-species lists of

TABLE 2: EVALUATION OF INTERNATIONAL INSTRUMENTS ON THE EUROPEAN LEVEL

Name of international instrument	Criterion 1: all types of ecosystems?	Criterion 2: both natural and semi-natural ecosystems??	Criterion 3: all taxonomic groups?	Criterion 4: all threatened species?	Criterion 5: all endemic species?	Criterion 6: full network including core-areas, etc.?
Convention on Wetlands	-	-	-	-	-	Core areas: protected wetland areas
Biogenetic reserves	+	-	-	-	-	Core areas; (the importance of interconnectivity is acknowledged)
Pan European Ecological Network (PEEN)	+	+	+	+	+	Core areas, corridors, buffer-zones and restoration areas.
Natura 2000 (E.U. Birds Directive and Habitats Directive)	+	+	+	-	-	Core areas
Emerald Network (Bern Convention)	+	+	+	-	-	Core areas (the importance of interconnectivity is acknowledged)
Helsinki Convention	-	-	-	-	-	Core areas
Barcelona Convention	-	-	-	-	-	Core areas: a system of Coastal and Marine Baltic Sea Protected areas; under certain circumstances: buffer-zones.

both the Habitat Directive and of the Bern Convention do not cover all endemic species and/or all species that occur on the IUCN Red Lists. In conclusion: there are a lot of species for which Europe is unique from a global point of view, or which are globally threatened that are not on any EU- or European legal priority list. In principle PEEN makes such an exhaustive list possible.

There appear to be large differences in the network elements: most of the instruments aim only at core areas. Only the Pan European Ecological Network concentrates on both core areas, corridors and bufferzones, and gives the possibility for nature-development areas. So, as regards the possibilities for the creation of an adequate functioning ecological network, PEEN seems to deliver the best possibilities. But, as regards the legal basis, Natura 2000 and the Emerald Network are much stronger.

2.3 Conclusions

From a legal point of view the Natura 2000 network has the strongest basis.

Not all international instruments are adequate for the realisation of a functioning ecological network on a European scale. The Pan European Ecological Network has, technically spoken, the broadest scope because it covers not only network elements as core areas, but also network elements as corridors and bufferzones which are lacking in almost all other international conventions. Especially the element of connectivity in PEEN is of great potential ecological im-

portance.

There are important differences in the criteria used for the selection of priority species and ecosystems and in the application of those criteria. By consequence there are large differences in the criteria used for the designation of sites as core areas. There is a strong need for coherent, encompassing criteria.

For the selection of species of European importance from a solid nature-conservation point of view the UN Red Data book of globally threatened plants and animals in Europe (1991), the IUCN Red List of threatened Animals (Baillie and Groombridge, 1996) and the IUCN Red List of threatened plants (Walter and Gillett, 1998) deliver a sound and solid starting point. There is an urgent need for the compilation of a list of so-called "target-species" for the Pan European Ecological Network, target species being defined as species of European importance, covering species that are endemic in or highly characteristic for Europe, and/or species that occur in Europe but whose survival in the near future is threatened on a global level, and/or species for which European legislation imposes its signatory states specific measures.

3. Naturalness, biodiversity and threat as criteria for the selection of species and ecosystems of European importance

3.1 Naturalness

"Natural and semi-natural habitats of European importance such as coastal zones, marine areas, wetlands, forests, mountain areas and grasslands, are under threat; so are many wild plant and animal species. The most obvious issues are changes in land use, and reduction in area of natural and semi-natural habitats, with their resulting fragmentation." (Council of Europe, UNEP and ECNC, 1996.)

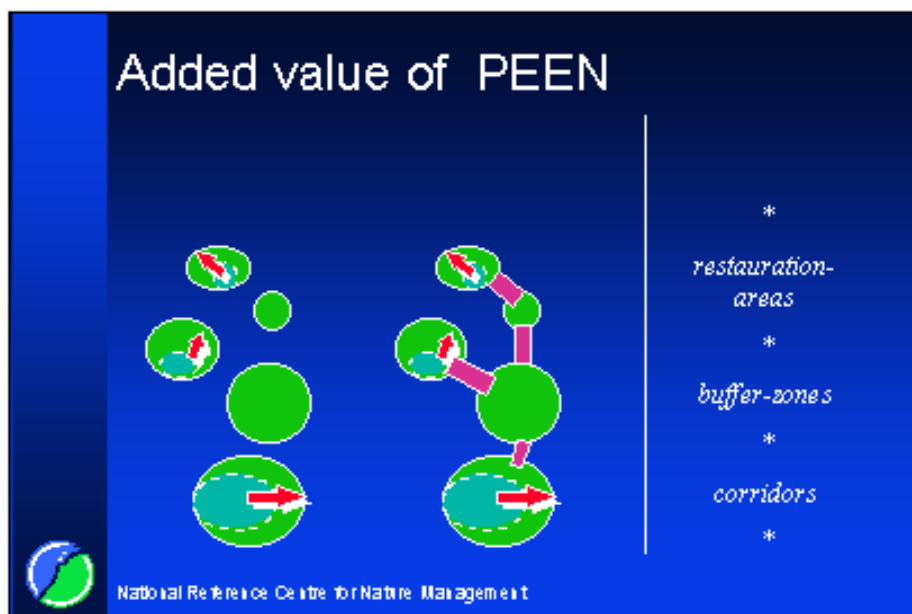
From this quotation it is clear that the concept of naturalness or wilderness has become a leading theme in nature conservation. Natural ecosystems and natural processes are seen as the best way to preserve biodiversity.

The rationale for this is that undisturbed, natural ecosystems are the best guarantee for preserving biodiversity, richness of species, richness of ecosystems, endemic species, threatened species, resource species, flag-ship species, and other natural values (Sobolev et.al., 1995).

The preservation of natural ecosystems with as less human influence and management as possible is in a lot of cases a very efficient way to maintain the biological diversity and to protect species. Natural processes such as sedimentation, erosion, aquifer recharge / discharge, hillslope processes, inundation, and grazing can have a diversifying effect on nature and should be allowed as much as possible.

Moreover, undisturbed ecosystems ("natural" ecosystems) have a large nature conservation value in itself: they make it possible to watch nature in its purest form, and permit scientific research on species and processes that are rapidly diminishing.

It is important to state that areas where (semi)natural ecosystems occur on a larger scale are rare in western Europe, and that they only occur on a wider scale in the Alps, the Pyrenees, and especially in Northern-Eastern Europe.



The following division of ecosystems according to their degree of human influence is suggested in PEEN:

- natural and almost natural ecosystems,
- semi-natural or semi-natural ecosystems.

In **natural and almost natural ecosystems** the actual and historical role of man in the functioning of the ecosystem is nil or almost nil. The functioning of the ecosystem is unaltered and has not been influenced by man. Species composition and species numbers are uninfluenced, not by exploitation, not by game-hunting, even not in an indirect way: for example by changing watercourse. Geomorphological, ecological and biological processes are almost undisturbed by man, large predators can fulfil their life-cycle. In this category also fall the almost natural ecosystems, in which the ecosystems are only very marginal exploited by man, thus where the natural processes are only to a very limited extent influenced by man.

Examples are the highest parts of the mountains, undisturbed parts of seas, lakes, rivers, tundra's, raised bogs, and primeval natural forest-ecosystems.

In **semi-natural ecosystems** the species composition is unaltered by man. There are no species introduced or planted by man. Soil- and water-management are unaltered, but man has to a limited extent influenced the natural processes, for example by taking over the role of natural grazing through extensive mowing or by taking over the role of great predators by fishing in great waters. The natural patterns of energy flow, primary production, matter cycling and competition between species are altered in such a sense that man has taken over the role of natural grazers, predators, or in such a sense that man has influenced the number and the role of natural grazers and/or predators.

These ecosystems do occur also in natural situations, but then they are limited to areas where natural grazing, erosion by rivers or streams, (etc.) reverse the natural succession to earlier stages, or prevent the natural succession. These ecosystems are rather complex (different tropic levels are still present) and can be very rich in species numbers, if the human use has been stable for many

years.

Almost all ecosystems resulting from "traditional" forms of agricultural land use as steppes, puszta's and wooded meadows fall in this category. In these situations there is a high degree of sustainable use. Sustainable use means the use of an organism, ecosystem or other renewable resource at a rate within its capacity for renewal.

3.2 Biodiversity

The concept of biodiversity is a central concept in both the Convention on Biological Diversity and the Pan European Biological and Landscape Diversity Strategy, as well as in a lot of other international conventions.

Biological diversity is defined as :

the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (Article 2 of the Convention on Biological Diversity).

This definition encompasses : "the totality of genes, species and ecosystems in a region" including those maintaining the genetic diversity of traditional varieties and races, excluding the manipulated genome.

The natural value of a region can be high if the region holds a significant percentage of the world population of a given ecosystem and / or species in a specific part of the life-cycle or within the total life-cycle.

It is useful to look at the role of Europe in maintaining biodiversity: there are a lot of species and ecosystems which are **endemic in, or characteristic for Europe**: species or ecosystems that only occur in Europe (so they are endemic on any scale) or for which Europe holds a significant part of the world population.

In this way the criterion: *European value* can be defined, all in order to make sure that PEEN gives in the most effective way a solid contribution to the conservation and development of ecosystems and species in Europe that are of European importance, and that need conservation measures.

Endemism refers to species (or ecosystems) that only occur in specific biogeographical (sub)regions or parts of biogeographical regions. We can say that a species has a greater value in the European context if it is endemic in Europe.

The nature conservation value lies in the combination of the rarity of the species (rarity: a given frequency of occurrence (or less) of a certain species or ecosystem in a given biogeographical region), and the very restricted area where the species occurs. It is obvious that a species that is endemic to a very restricted area, has very high conservation value due to its limited area of occurrence, as well as such a species will extremely vulnerable.

So these endemic species have a very high conservation value, and are potentially threatened because of the combination of their low numbers and the re-



Photo 1: Example of a natural ecosystem: mountain lake



Photo 2: Example of a semi-natural ecosystem: dry mountain grassland with *Arnica montana*

stricted area where they occur. The UN (1991) identifies several thousands of threatened single country endemic higher plants in Europe. Many islands are, due to isolation over a long period, rich in endemic species, for example Kreta, Corse. On the continent isolated mountain regions can be considered as island situations, e.g. parts of the Pyrenees or parts of the Balkans.

It is important to note that a species (or an ecosystem) can be endemic on regional, national or European level: some species are restricted to very small parts of, for example, Crete. So such a species is endemic on the European, the national and the regional level. In this paper we only use the criterion: endemic on a European level.

3.3 Threat

Threat is understood as the unfavourable conservation situation of a species or ecosystem (the overall negative trend of species or ecosystems) related to the recognised causes of that unfavourable conservation status. In general, threat is defined on a global scale. It is suggested to consider threat on a global scale because:

- it emphasises the contribution that Europe can deliver to the conservation of species from a global point of view: the motivation for undertaking these conservation actions is not only from an European but also from a global point of view useful.
- for practical reasons: both *data availability* and *criteria already in use* reflect threat on a global and not on an European scale. If it is necessary to evaluate the degree of threat on a European scale a lot of new work has to be done which might take years.
- for reasons of coherence with other, widely accepted criteria: the IUCN criteria (IUCN, 1994, Bailly and Groombridge, 1996, Walter and Gillett, 1998) refer to *global* threat, just as for example Tucker and Heath (1994).
- finally for political reasons: the definition of threat on a global scale is commonly accepted, see for example Recommendation no. 48 of the Standing Committee of the Bern Convention which speaks about the

conservation of European *globally* threatened birds (Council of Europe, 1996 and 1997).

3.4 Other criteria: species with a special role in nature-conservation

Some species have a special role in the ecosystem where they occur (e.g. as structuring the ecosystem by grazing, building dams, or a key-role in litter-decomposing, etcetera) or have a special economic, social or cultural value. Species can have a specific nature conservation value from an educative point of view too, they are called flag-ship species.

“The concepts of indicator, flagship and keystone species are also important. The presence of indicator-species is a useful measure of good wetland quality. Flagship-species have high symbolic value in the conservation movement whereas keystone-species play vital ecological roles. The recognition of the important ecological role of keystone species, which are often abundant and widespread, and the need for their conservation, is perhaps foreign to the traditional conservation ethic, but deserve serious consideration. Wetlands with significant populations of indicator, flagship and/or keystone species would merit consideration as sites of international importance.” (Convention on Wetlands)

Some species are especially favoured by a good functioning ecological network on a European scale, for example species that are highly sensitive to fragmentation on a European level. By adding this category of species the network-design is directed in an adequate, problem solution direction, as well as that a good parameter is created for testing whether the network is ecologically functioning.

All these categories can be considered as specific, extra categories for the selection of core areas.

3.5 Criteria for priority species and -ecosystems.

Table 3 defines the criteria “naturalness” and “biodiversity” (operationalised in distribution and threat) in order to select ecosystems and species that are of European importance.

4. Criteria for core areas

It is suggested to select all sites where one or more ecosystems or species occur that are of European importance as core areas of the Pan European Ecological Network.

4.1 Selection of sites as core areas based on ecosystems of European importance

Criterion 1: all sites covering natural or almost natural ecosystems, should be part of PEEN.

Argumentation: undisturbed natural ecosystems and processes are that rare and important for species, ecosystems and processes in Europe that it is wise that all these areas are part of PEEN.

This category will encompass no very large areas, is expected, as these specific areas without any human are rare. In Western Europe these kind of areas are almost non-existent. In Central and Eastern Europe, especially in the northern parts these areas are sometimes in large areas present. They all cover very high natural values. Often these areas are extremely important for natural values all over Europe. These ecosystems have a high biodiversity, or they form the natural niches of very specific species, that are almost all very rare or threatened.

Criterion 2: all sites, covering semi-natural ecosystems that are endemic in Europe should be part of PEEN.

Argumentation: this category is, even if protected in nature-reserves, under severe threat. The area in Europe is low and is rapidly declining, especially in the Western European countries. Possibilities of restoring these natural values are low, and the last remaining remnants can serve as important gene-pools. This category will be - in area- the largest part of PEEN. A very large number of the “classic ” natural reserves, established for the protection of (inter)national endangered ecosystems and species will fall in this category.

These ecosystem-types form essential parts of man-made landscapes, so they are also very important from a cultural point of view.

Criterion 3: all sites, covering semi-na-

tural ecosystems which are characteristic for Europe and as a type threatened on a global level should be part of PEEN.

Argumentation: this category does not reach large areas in Europe, especially not in Western Europe. From a global point of view it is logical to give these ecosystemtypes a special protection.

Especially in the Central and Eastern European Countries there are larger areas of these type of areas. It seems not necessary to put all the areas in Europe, covering semi-natural ecosystems under PEEN. Only the areas covering endemic types and the areas covering characteristic, threatened types are important enough to be designated as core-area of PEEN. Another argument is that this restriction to threatened characteristic semi-natural ecosystems only will help to limit the total coverage of the territory of PEEN to a certain % of the territory of a nation.

4.2 Selection of sites as core-areas based on species of European importance

Criterion 1: all sites where populations occur of **species that are endemic in Europe** should be part of PEEN.

Argumentation: this considers several thousands of species that are endemic in Europe, and that are not only of high natural-conservation value in itself but that also indicate natural ecosystems and natural ecological processes so that it is wise that all these areas are part of PEEN.

Criterion 2 : all sites where populations occur of **species that are characteristic for Europe and that are threatened** on the European level, should be part of PEEN.

Argumentation: this concerns several hundreds of species that are characteristic for Europe and that are threatened on a global scale. Protection of these sites delivers a sound contribution to the Pan European Ecological Network.

4.3 Selection of sites as core-areas based on flag-ship species

Criterion 3: all sites where populations occur of **flag-ship species** should be part of PEEN.

Argumentation: the concept of flag-ship

Table 3: Criteria for the selection of ecosystems and species that are of European importance:

Ecosystems of European importance:	Species of European importance:
all natural ecosystems	-
all semi-natural ecosystems that are endemic in Europe	all species that are endemic in Europe
all semi-natural ecosystems that are characteristic for Europe and globally threatened	all species that are both characteristic for Europe and globally threatened
-	all flag-species

Table 4: Criteria for the selection of sites as core areas based on ecosystems and/or species of European importance.

Ecosystems:	Species:
all sites covering natural ecosystems	all sites covering species that are endemic in Europe
all sites covering semi-natural ecosystems that are endemic in Europe	all sites covering species that are both characteristic for Europe and globally threatened
all sites covering semi-natural ecosystems that are both characteristic for Europe and globally threatened	all sites covering flag-ship species

species has been proven to be very useful for raising societal and political interest.

In this way there is a certain hierarchical relationship and sequence in activities between the establishment of core areas and of the other three elements of PEEN.

5. Criteria for corridors, nature-development areas and bufferzones

The ecological function of the corridors, development-zones and buffer zones is derived of the goals, the composition and the situation of the specific core-areas of PEEN. So the corridors (etc.) should in a direct or indirect way contribute to the protection and development of species and ecosystems that are of European importance.

The designation and location of corridors, developmentzones and buffer zones should be directly derived from the goals and functions of PEEN and of the core areas.

5.1 Corridors

Corridors should be established according to the following criterion:

- corridors should contribute (direct or indirect, on a medium term or on a longer term) to the protection or the ecological functioning of ecosystems or species of European importance.

This means that the designation and location of ecological corridors should be primarily determined by the ecological requirements of the threatened species and ecosystems. The location of corridors will be related to the projected functioning of specific core-areas. In fact, a lot of core-areas can act as corridors for specific species.

Many surviving areas of the natural habitats of species are too small to hold a population at a surviving level. Corridors can help such species with the expansion of these species in their natural habitats or into areas within their natural range currently not yet occupied or no longer occupied.

Many populations are fragmented and isolated. To avoid extinction a good ecological integration of the (meta-)population is necessary. Corridors can fulfill these needs.

In practice the following aspects are important:

- the actual or historical presence of species dispersion
- the actual or historical presence of species migration
- the actual, historical or proposed presence of (mid- or longer term) movements of individuals

Ecological corridors of European significance are for example:

- pan-European bird migration routes
- river corridors
- historical corridors of plant-spreading through mountain bridges, along warm river valleys, and through mountain ranges

Ecological corridors can be landscape structures of various size, shape and habitat composition that maintain, establish or re-establish natural landscape connectivity, supporting the favourable conservation status of species and habitats for which core-areas have been designated.

Corridors can be, according to their structure: continuous or interrupted or stepping stones.

Corridors can contribute to maintain species numbers, increase population size, prevent in-breeding and encouraging the retention of genetic variation. They can lead to increased foraging areas for wide ranging species, and provide refugia in case of large distances between (sub-) populations.

Potential disadvantages are: spread of

predators, introduction of species with high competitive value, disease, exotic species, weeds, insect pests, and can disrupt local adaptations or (sub)species (Jongman and Troumbis, 1996).

Certain matters need to be addressed, however. For certain species it is hardly known what kind of ecological corridor, if any, is needed. There is also a shortage of data on critical dimensions or distances, so often we do not know how ecological corridors can be established (Opschoor and Gleichman, in: Bennett, 1994).

It may be advisable to define different sets of criteria for corridors, depending on the projected functioning of the corridors, for example for linear ecosystems, functioning as corridors, and for sites functioning as stepping stones, etcetera. It will be clear that this matter needs further research. In general we should not define the criteria for corridors very sharp. What the corridors do contribute to PEEN is defined here above, while it will be left to the different nations to establish the corridors on the most appropriate way.

5.2 Nature-development-areas

Nature-development-areas should be established regarding the following criteria:

- development-areas should contribute (direct or indirect, on a mid term or on a longer term) to the protection or the ecological functioning of ecosystems or species of European importance.
- development-areas should have the potential to become core areas or corridors.
- there is higher priority for nature-restoration in situations where other network components do not adequately cover the needs of ecosystems and species of European importance.

In practice the following aspects can be used for the determination of development-areas:

- areas containing threatened ecosystems or species, but not fulfilling the core area criteria because of fragmentation of ecosystems, or

other causes

- areas with high potential natural values that are geomorphologically or ecologically intact but that are to a certain degree disrupted or polluted
- other areas with high potential natural values
- disrupted parts of core areas
- disrupted parts of corridors
- buffer zones which require rehabilitation

5.3 Criteria for buffer zones

Buffer zones should be established according to the following criteria:

Buffer zones should contribute (directly or indirectly, on a mid term or on a longer term) to the protection or the ecological functioning of ecosystems or species of European importance.

Buffer zones are strongly related to existing core areas. A buffer zone addresses a specific need for a particular core area with particular conservation objectives.

- In a sense, buffer zones are core-area-specific.
- Buffer areas are primarily established for a clearly precised reason: they are mostly established for immediate protection of an adjacent core area with specific and urgent problems which are (partly) solved by the establishing of the buffer zone. Examples are spray drift, nutrient enrichment, activities on adjacent lands.
- Buffer zones can be established for mitigation purposes as well: putting up barriers, to provide immediate protection.
- Buffer zones can be established for management purposes too: to affect directly the ecological conditions in the adjacent core area (water level, drainage), or to make the desired area management possible (extra grazing land to make extensive grazing possible)

And last, buffer zones can be established to avoid possible threats.

6. Indicative map of Pan Europecore Core Areas

6.1 Sources

The indicative map is based on the following sources:

- an indicative map of regions in Europe where on a large scale natural and semi-natural ecosystems do occur, based on landcover, derived from satellite-images and national inventories (in: Opstal, A. van, 2000).
- the distribution map of narrow endemics in Europe (Williams et. al. in Delbaere et. al., 1998). This map does not covers the whole of Europe because of a lack of data (E.g. indicative core-area's in Turkey and the formerly USSR-states are missing on this map).

6.2 Introduction to the indicative map

It appears that, considering naturalness and endemism as important criteria for the identification of core-areas, these core-areas are concentrated in the Mediterranean region, (especially the islands and the mountainous regions), the Pyrenees, the Alps and other mountainous regions, and the utmost northern regions of Europe (taiga's and tundra's).

On this map, in the more temperate western European and central European parts are no core-area's identified, so these are left blank. This is because in these regions there do not occur, on the scale of the map, larger, mappable area's that have a highly natural character or where there occur endemic species in vaste areas. These blank areas however contain ecosystems and species of European importance, more or less scattered in smaller patches or isolated. Also, the potentials for nature development of these blank areas can be great.

The mapped regions refer on a European scale to regions where there occur natural and/or semi-natural ecosystems and/or narrow endemics. However, this does not mean that in regions that are not indicated on the map there do not occur ecosystems or species of European importance. As in western- and middle Europe (semi-)natural ecosystems are very scattered, or occur only in small

areas, they have been left out. Also are missing, because the essential information is lacking, all major area's where characteristic species or flag-ship species occur.

As the primary sources on which the map is based, concentrate on terrestrial species and -ecosystems, the map is not valid for the Atlantic ocean, the North sea and the Mediterranean sea.

Corridors, bufferzones and nature-development areas are missing on this map: the identification of these network elements can only be achieved after that the core-areas are identified.

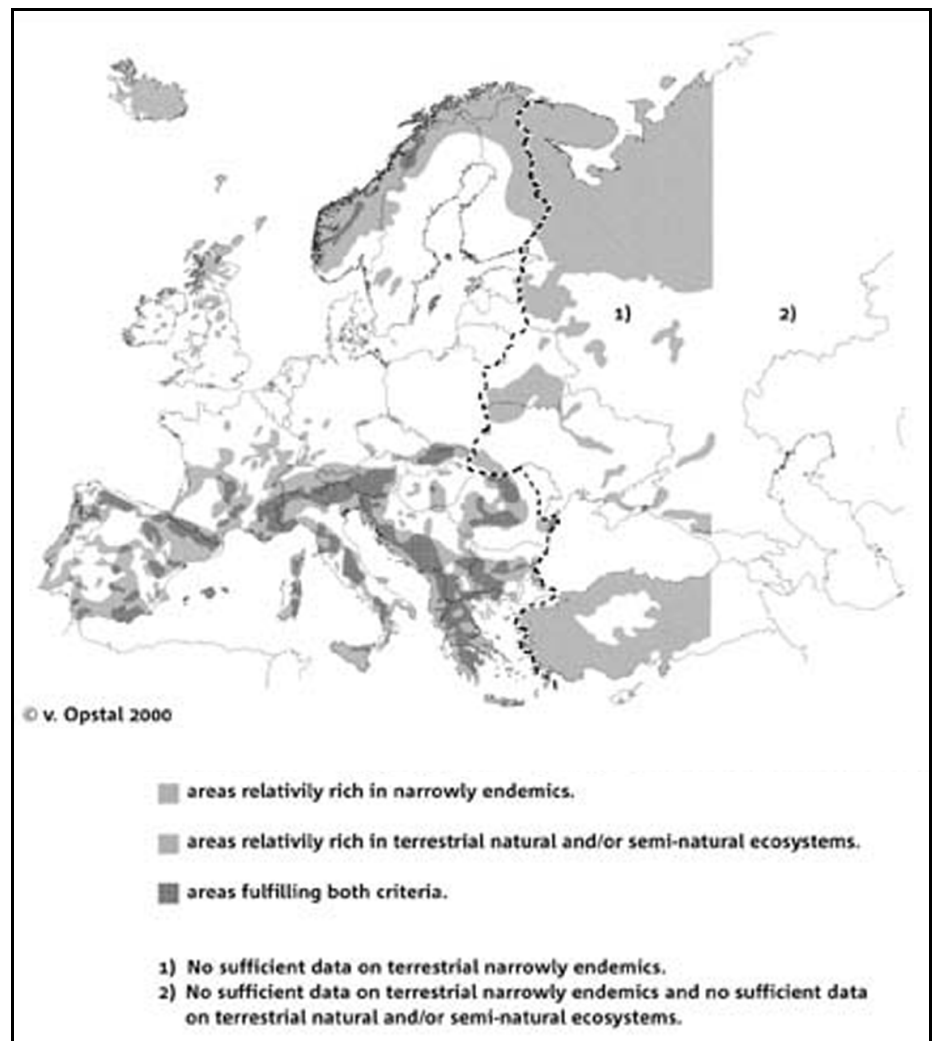
Finally, the indicated areas are not "pure" core areas: within the designated areas there are farmlands, roads, villages, and/or regions influenced by forestry-activities. The indicated areas should be seen as "search-areas for core areas".

7. General conclusions

7.1 European Instruments

The Pan European Ecological Network is, from a strict ecological point of view, the best international instrument for the designation of an European ecological network, as it covers not only core area's, but also corridors and bufferzones and gives opportunities for nature development zones. But the legal strenght is, at the moment, not very strong.

PEEN has strong potentials, but to realise these potentials it will be necessary that a strong cooperation between the political institutions and the administrative organisations will be realised. Furthermore, the existing legal instruments have a too narrow base, from a nature-conservation point of view. If the Pan European Ecological Network will be ba-



Map 1: Indicative map of major areas in Europe where, based on the criteria as presented in this paper, core areas for the Pan European Ecological Network could be established.

Sources: Williams et.al. in Delbaere 1998, Pelcom 1999, personal communications, adapted by the author.

sed on the existing EU and European instruments, the resulting network will be, so may be expected, not cover several hundreds of species that are globally threatened or endemic in Europe.

For the designation of PEEN it is necessary that there is consensus on explicit criteria for the selection of species and ecosystems that are of European importance. There is an urgent need for the compilation of a good list of "target-species" for the Pan European Ecological Network. Once there is agreement that such a list of species of European importance should cover not only the legally designated species but also the other globally threatened species and the endemic species, such a list can be compiled. If this list will be accepted as a basic tool for the identification of core areas, it will become possible to realise an evenly balanced Pan European Ecological Network. As regards the ecosystem approach, at this moment we do not have scientific insight in the degree of threat and/or of endemism of ecosystems. Only a few countries have such surveys (Switzerland, Germany). It will be necessary to realise in the coming years such a European survey, based on or related with the EUNIS habitat-classification. It is hoped that the Dutch initiative for a European Database of vegetation-analysis will provide the necessary data for this survey.

The large differences that have been demonstrated between the different European instruments are a very strong argument for unifying criteria for the Pan European Ecological Network. It is the opinion of the author that the in this paper presented criteria, defining naturalness and biodiversity, will provide the necessary unifying criteria for PEEN. Based on naturalness and biodiversity, the logic for the architecture of the Pan European Ecological Network is formulated. Biodiversity is operationalised in terms of distribution and, (using the IUCN- criteria) threat. Naturalness is operationalised in terms of degree of human influence in ecosystems.

7.2 Sketch-map of PEEN

Criteria are formulated for the selection of sites as core-areas, based on species and ecosystems that are of European importance. Corridors, nature development areas and bufferzones are derived of the aims of the core-area's. Application of the suggested criteria results in a

first sketch map of the major area's in Europe where core-area's should be designated. In these area's there do occur, in a large density, endemic species, and/or natural and semi-natural ecosystems. These area's do occur in the mediterranean regions, in the mountain regions, in the steppe regions and in the northern parts of Europe.

7.3 The process of establishing the network

Establishing of a national part of PEEN is only possible if there is solid information about the distribution and the nature-conservation status of the ecosystems and the species in the area. Besides this type of information, there will be also information needed on soil types, hydrology, potential natural vegetation, etcetera.

It is obvious that an iterative process between the national ecologists, national policy-makers, NGO's, international organisations and the coordinating Secretariat is very necessary. A balance between the systematic approach, the needs of the different ecosystems and species and the political opportunities should be reached.

When a start is made of the designation of core areas, we should start with the existing strict nature reserves with high conservational value, and look at the following items: size (the optimal size represents a surface large enough for the entire food-chain, ensuring a full range of plants animals and ecosystems) and spatial configuration (as regards soil, hydrology and management), homogeneity of the internal structure of the core area, spatial suitability (as regards functions of adjacent areas).

When selecting the core areas, the functions currently allocated to them in the land-use planning process have to be taken into account. In some cases (in cases that the core areas are primarily designated for the semi-natural values) core areas may have to a certain extent other functions than only nature conservation, such as forestry, fisheries, certain forms of recreation or of agriculture. We can call these activities: secondary activities. It is wise to make precise lists which ecosystems can support to what degree which kind of these secondary activities.

Drawing border lines of core areas should

be based on a as complete as possible understanding of the ecological needs of the ecosystems for which the core areas are designated, for example for ground water dependent ecosystems the hydrological relations have to be considered. Sometimes buffer zones are urgent: infiltration areas for ground water-dependent ecosystems are most often necessary.

Combination of functions will sometimes lead to win-win situations: seepage areas for which the infiltration areas are already well protected natural areas can be considered as areas with high potential for nature development.

Those areas that offer realistic prospects for the development of natural values of European value can be incorporated into the ecological network. "Realistic" is to be understood in a mid term: 10-20 years, and realistic from an optimistic, mid-term (10-20 years) financial and political point of view.

There will be large differences in the amount of purely natural, pristine ecosystems in the different parts of Europe. There will also be large differences in the coverage of data and the availability of the data needed. Therefore it is suggested to use the criteria for a good and unifying concept of PEEN, but to give the countries a rather large freedom in the application, all in good communication with the Board of Experts.

It is advised to be very firm in the targets of the ecological network, so to be ambitious in the criteria for the core areas, and in the delimitation of the core areas, and to give more flexibility to the final delineation of nature development-areas, buffer-zones and corridors.

It is logical from both an societal and political point of view that there will a certain balance in the territorial coverage of PEEN in the Northern-, Central- and West European, and Mediterranean European countries.

7.4 Coordination and monitoring of PEEN

The establishment of a coordinating mechanism has already been put forward at the Eeconet conference in 1993 in Maastricht (Bennet, 1994). Such coordination has to focus on monitoring the progress, the effectivity and the coherence of PEEN and coordinating actions:

- realises cooperation between the different international instruments and institutions that aim the protection of European Nature
- in particular: strenghtens the co-operation between PEEN, Natura 2000 and the Emerald Network
- support and facilitate the different countries with the designation and implementation of their part of the PEEN, watching over the way the unifying criteria are used, and looking over the tension between at one hand the necessary unity in criteria and on the other hand the flexibility necessary from a political or societal point of view
- watch over the right balance between the long term ecological targets and the shorter term required targets and actions
- measure progress, (yearly reports)
- monitor the effectiveness of PEEN
- support fund-raising
- disperse information
- coordinate research programmes
- facilitate trans-border establishment of PEEN

The Committee of Experts of the Pan European Ecological Network, under the Pan European Biological and Landscape Diversity Strategy with the European Centre for Nature Conservation in Tilburg as secretariat acts as a coordinati-

on mechanism.

7.5 Cooperation between PEEN, Natura 2000 and Emerald

In comparison to Natura 2000 and the Emerald Network, PEEN has some advantages and some disadvantages: PEEN has important extra features that Natura 2000 doesn't has, as corridors, bufferzones and nature development areas. Also, PEEN can be based on a much wider group of species that need special protection. On the other hand, Natura 2000 is much stronger as it is based on a EU directive and on explicit administrative procedures.

A strong cooperation is needed between Natura 2000, Emerald Network and PEEN in order to get a functioning ecological network, covering all the species that need special protection measures and giving opportunities to species for regeneration, migration and/or dispersal.

7.6 Research projects: target-species and priority habitats

There is a great amount of taxonomical, (syn)chorological, autecological, synecological and experimental research needed to make correct decisions possible on matters as:

- how to protect core areas,
- how to designate corridors and for which species (-groups),
- how to realise adequate buffering of core areas and

- how to restore natural values.
- Examples of these questions are:

how large should a core area be for the long-term survival of a certain species?

- which population-size of a certain species is needed in order to remain viable?
- which kind of connectivity or isolation is required for a certain species? and (especially in core areas covering natural and semi-natural ecosystems)
- which mosaic patterns of ecosystems can meet the necessary requirements of the various species and ecosystems?

Besides this kind of ecological research, there are large gaps in our knowledge of sociological and planning aspects of a project such as PEEN. In the following project proposals only the very essential research necessary to give the Pan European Ecological Network a sound base from a nature-conservation point of view is described.


Project 1: List of target species for the Pan European Ecological Network.

Based on the UNEP Red Data Book, the 1997 IUCN Red List of Treated Plants, the existing appendices of Bern, Habitats Directive (etc.), and the criteria suggested in this report there should be made: a final and official list of European priority species (target species).


Target-species are defined as "species of European importance": species that are endemic in or highly characteristic for Europe, and/or species that occur in Europe but whose survival in the near future is threatened on a global level, and/or species for which European legislation imposes its signatory states specific measures.

Within the Committee of Experts of the Pan European Ecological Network (PEEN), the idea of defining and identifying target species for PEEN has gained an increasing support. These target species can be used for the identification of core-area's of PEEN.

Start iterative process:



- establish Natura 2000 and Emerald as backbone of PEEN
- improve and unify existing European lists of protected species and ecosystems
- develop legal instruments for corridors, bufferzones and reaturation-area's
- establish PEEN as an much improved Natura 2000/Emerald, based on scientific sound criteria applied all over Europe, with corridors, buffer-zones and restoration-area's



National Reference Centre for Nature Management

Project 2: List of target ecosystem-types for the Pan European Ecological Network

This project aims at quantifying the "state of the art" of the different ecosystemtypes.

Based on the Corine-biotope system a systematic inventory of the conservation status of the ecosystemtypes of Europe should be made. The degree and scale of endemism of the ecosystemtypes should be mapped (This includes also the extension of the CORINE Biotopes classification-system to Central and Eastern Europe as is already ongoing).

An inventory of the abundance, decline and threat of ecosystemtypes on a global level should be completed.

Based on these two inventories and the criteria suggested in this report a final and official list of European priority ecosystem-types. (PEEN- ecosystemtypes list) should be made.



Photo 3: Target species for the Pan European Ecological Network: *Maculinea telejus*. threatened in Europe and protected under the Bern convention.

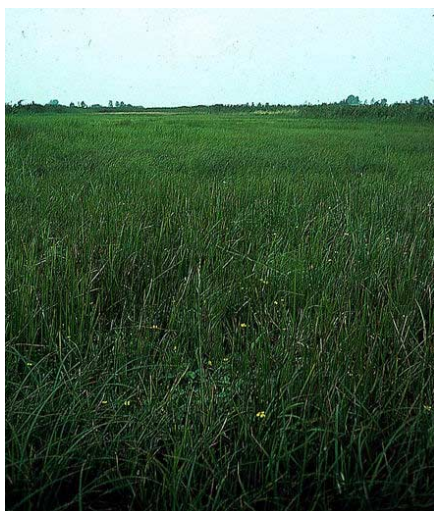


Photo 4: Target-ecosystemtype for the Pan European Ecological Network: mesotrophic moist semi-natural grassland. threatened in Europe and protected under the Habitat-directive.

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United Nations 1991. European Red List of globally threatened animals and plants and recommendations on its application as adopted by the Economic Commission for Europe at its forty-sixth session (1991) by decision D (46), New York.

Walter, K.S. and H.J. Gillett 1998. 1997 IUCN Red List of Threatened Plants. Cambridge/Gland, Switzerland.

Further information on the web:

Websites:

European Centre for Nature Conservation:

<http://www.ecnc.nl>

(full information on general backgrounds of PEEN and PEBLDS)

Council of Europe:

<http://www.coe.int;>

International Union for the Conservation of Species:

<http://www.iucn.org>

(with on-line databases on threatened species)

European Topic Centre: via European Environmental Agency:

<http://www.eea.eu.int>

(with on-line Eunis habitat classification)

database).

European Union:

<http://europa.eu.int>
(with on line EU legal texts)

Further reading:

The Architecture of the Pan-European Ecological Network: Suggestions for concept and criteria. By A. van Opstal, second edition, 2000.

(With summaries in French and Russian; in summer 2001 available in Japanese translation)

Some comments received:

"Extremely relevant. The report proves that Western and East-European experts have common views on Econet development." (V. Moshkalo, director IUCN-CIS office, Moscow)

"This is really an exhaustive overview of what already has been and still can be done at several levels within the framework of PEEN. The co-operation being the basis of this huge work, the result is a great hope for a further implementation, aiming at consolidated achievements." (M. Dejeant-Pons, head of the Environment and Sustainable Development Division, DG IV, Council of Europe, Strasbourg)

"Excellent basis for a good and constructive work". (Prof. Dr. L. Miklos, UNESCO Chair of Environmental Awareness, Bratislava)

Mapping the Pan European Ecological Network.

The ideas developed in this publication and in the report mentioned above are taken further in the coming years. In close cooperation with the Committee of Experts for the Pan European Ecological Network (Council of Europe) there will be a project carried out in 2000 and 2001 that will identify, using the ideas

and criteria suggested in the report mentioned above, core areas, corridors, bufferzones and nature-development zones in Eastern Europe (non ECE countries). In this project, with the ECNC in the lead, a large number of institutes from different nations cooperate. The project is funded by different nations.

Important Butterfly Areas.

In 2000 and 2001 the Dutch Butterfly Conservation will produce, in close cooperation with the British Butterfly Conservation and with a large number of institutes from different nations a report containing an overview of the Prime Butterfly Areas in Europe. The results of this report will be used for the realisation of the Pan European Ecological Network.

Target-species for the Pan European Ecological Network.

In 2001 and 2002 a group of international Institutes will produce a CD-Rom containing all the target-species of the Pan European Ecological Network. The CD-Rom will provide information on a.o.: legal status of species, conservation status of species, habitat-preferences and remarks on nature-management.

Also by the author on the Pan European Ecological Network:

Corridors of the Pan European Ecological Network.

By: Foppen, R.P.B., I.M. Bouwma, J.T.R. Kalkhoven, J. Dirksen and A.J.F.M. van Opstal 2000

Joint publication on behalf of the Committee of Experts of the Pan European Ecological Network by Alterra, ECNC and EC-LNV. Wageningen/Tilburg. (Also available in French).

Endemic and characteristic plants in Europe, part 1: Northern plants.

By: Opstal, A.J.F.M. van, T. Brandwijk, L. van Duuren and J.H.J. Schaminée 2000.

Joint publication by EC-LNV, CBS and Alterra.

Forthcoming publications:

Protection of species: a comparison of the Habitat-directive, the UN Red List of threatened species and the IUCN Red data books.

By: Siepel, H., A.J.F.M. van Opstal and E. Weeda 2001.

Joint publication by Alterra and EC-LNV.

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This paper is initiated by ECNC on behalf of the Committee of Experts of the Pan European Ecological Network. In the Workprogramme developed by the Committee of Experts of the Pan European Ecological Network at its first meeting on 3-4 July 1997 the development of a set of criteria for core-areas, corridors, bufferzones and development areas was given high priority.

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