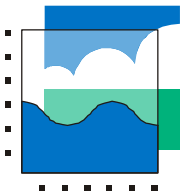

CML
Institute of Environmental Sciences

Integrating Natura2000 into critical load calculations for nitrogen

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CML technical report 44
Department of Environmental Biology

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Preface

The Coordination Centre for Effects (CCE) located at MNP, commissioned the Institute of Environmental Sciences, Leiden University (CML) to integrate the Natura2000 into the critical load calculations for nitrogen. The research includes the necessary basic steps of collection, description, assemblage, conversion of Natura2000-information and adaptation of critical load procedures to include this information. Results of this study were presented at the CCE-workshop (Sofia, 23-25 April 2007). The research had been carried out by Nancy de Bakker (Chapter 1, partially 2, and 3) and Maarten van 't Zelfde (Chapter 2 and 4) under supervision of Wil Tamis (Chapter 5 and redaction) at CML, and Jaap Slootweg and Jean-Paul Hettelingh at CCE. Arjan van Hinsberg (MNP) is gratefully acknowledged for the discussions about impact indicators for nitrogen deposition for biodiversity in the SEBI-project.

Wil Tamis
Leiden, July 2008

Summary

The Coordination Centre for Effects (CCE) develops modelling and mapping methodologies on European critical loads. This includes collaboration with 27 National Focal Centres in Europe on critical loads and related variables. CCE deliverables become available for integrated assessment models used for the support of air pollution policies under the LRTAP-Convention and the European Commission.

One of the main aims of air pollution control policies is the protection of biodiversity by providing good environmental quality. Therefore, biodiversity, especially at the European scale, should play a more pronounced role in critical load analysis. CCE commissioned the Institute of Environmental Sciences of Leiden University (CML) to integrate Natura2000 areas, one of the main instruments to protect biodiversity in Europe, into the critical load calculations for nitrogen. The general aim of this technical project was to collect information of Natura2000 areas, both on geography and biodiversity, and develop procedures to apply and interpret this biodiversity information in calculations of critical loads for nitrogen.

Information of Natura2000 areas was collected and described, regarding spatial (geographical position) and attribute data (status, habitats, biodiversity, threats etc.). This information was aggregated and converted to make further processing in the critical load calculations for nitrogen possible. This includes the selection of information of the Natura2000 areas and of combining information of Habitat- and Bird-directive per Natura2000 area, the conversion of geographical codes and eventually the overlay with the EMEP50-grid.

It is further investigated whether and how the different Natura2000 areas and species can be included in the critical load analysis by using a 'habitat-approach'. A procedure was developed to establish whether a critical load calculation for nitrogen is necessary for a particular N2000 area, e.g. for an area used as wintering ground for birds no critical load analysis is needed. It is concluded that for species mentioned in the Habitat and Bird Directive habitat-information is lacking at the moment. The conversion of the habitat classification used for Natura2000 areas to the EUNIS habitat classification used in the critical load analysis is described. With these EUNIS habitat classes a coupling with empirical critical loads (eCL) is possible. Also the need and possibilities to include changes in biodiversity in critical load analysis was explored.

Based on former information and procedures the production in several steps of the critical load maps is described. Several variants of eCL-maps for Natura2000 areas are presented and compared among each other and with the eCL-map for all ecosystems (non-Natura2000 ánd Natura2000 areas) from the SEI-map. Depending on the variant Natura2000 areas are more sensitive than non-Natura2000 areas, with exception of Scandinavian and mountainous regions. The results are dependent of the kind of habitat information included in the analysis.

A large number of discussion points and recommendations are mentioned. These are focused on the one hand on the improvement of the available data on Natura2000 areas and eCL. On the other hand these are focused on the improvement of the procedures to perform critical load analyses and to produce critical load maps, especially with attention to which kind of habitat information to include in the map for the critical load analysis.

Samenvatting

Het Coordination Centre for Effects (CCE) van het MNP ontwikkelt modellen voor de bepaling van kritische drempels [Eng.: critical load(s), afk. CL] voor atmosferische depositie. Voor dat doel werkt het CCE nauw samen met 27 National Focal Centres in Europa met betrekking tot deze kritische drempels (CL). De producten van CCE ondersteunen het internationale (LRTAP) en Europese beleid ter bestrijding van luchtverontreiniging. Een van de hoofddoelen van het beleid ter bestrijding van luchtverontreiniging is de bescherming van de biodiversiteit door het verzorgen van een goede milieukwaliteit. Hiervoor zou biodiversiteit op Europese schaal een meer centrale rol moeten spelen in de CL analyse. CCE heeft het Centrum voor Milieuwetenschappen van de Universiteit Leiden (CML) de opdracht gegeven om Natura2000, een van de belangrijke instrumenten ter bescherming van de biodiversiteit in Europa, te integreren in de CL analyses voor stikstof. Het algemene doel van dit technische project was om hiertoe geografische en biodiversiteit-informatie te verzamelen van Natura2000 gebieden, en procedures te ontwikkelen om deze informatie toe te passen in de CL analyses.

De informatie over Natura2000 gebieden is verzameld en beschreven. Het betreft ruimtelijke (geografische positie) en attribuut gegevens (status, habitats, biodiversiteit, bedreigingen e.d.). Deze informatie is verder bewerkt, zodat verdere toepassing mogelijk is in de CL analyses voor stikstof. Deze bewerkingen omvatten het selecteren van de informatie en het combineren van informatie van de Habitat- en Vogelrichtlijn per gebied, de omzetting van de geografische codes en tenslotte de “overlay” met de EMEP50-grid.

In deze studie wordt voorgesteld om de verschillende habitats en soorten genoemd in de Habitat- en Vogelrichtlijn te integreren door de toepassing van een “habitat-benadering”. Er is een procedure ontwikkeld waarin wordt bepaald of het noodzakelijk is om een CL analyse uit te voeren, bijv. voor een overwinteringsgebied voor vogels is een dergelijke analyse niet nodig. Deze habitat-benadering is op dit moment nog niet mogelijk voor de soorten uit de Richtlijnen, door een gebrek aan habitatgegevens voor deze soorten. De omzetting van de habitat classificatie voor de Natura2000 gebieden naar de EUNIS-habitat classificatie gebruikt in de: CL analyses wordt beschreven. Met de EUNIS habitat klassen is een koppeling mogelijk met de empirisch vastgestelde kritische drempels (eCL). Ook de noodzaak en mogelijkheden om veranderingen in biodiversiteit op te nemen in de CL analyses zijn onderzocht.

In Hoofdstuk 4 worden de verschillende stappen voor de totstandkoming van de “critical load” kaarten voor de Natura2000 gebieden beschreven. Verschillende varianten van de eCL-kaarten voor de Natura2000 gebieden worden gepresenteerd en onderling en met een “totale” (niet-Natura2000 én Natura2000 gebieden) kaart vergeleken. Afhankelijk van de kaartvariant zijn Natura2000 gebieden gevoeliger dan niet-Natura2000 gebieden, met uitzondering van de Scandinavische en berggebieden. De resultaten zijn afhankelijk van het type habitat informatie.

Er zijn een groot aantal discussiepunten en aanbevelingen behandeld. Aan de ene kant kunnen de beschikbare gegevens van de Natura2000 gebieden en eCL verbeterd worden. Aan de andere kant dienen de verschillende procedures voor de CL analyses en de productie van de CL kaarten verder onderzocht te worden, met name met welke habitat informatie deze kaarten gemaakt zouden moeten worden.

1. Introduction

1.1. Nature protection in Europe: Natura2000

Nature in Europe is threatened due to loss and fragmentation of habitats by more intensified land use, major infrastructures and spread of urban areas, and due to loss of habitat quality by e.g. climate change, disturbance, air pollution especially nitrogen enrichment. The European Union wants to stop the decline in biodiversity by 2010. One of the main instruments to stop this decline is the creation of an ecological network of protected sites across Europe: Natura2000. The aims of the Natura2000 network are to preserve and restore biodiversity in the European Union (LNV, 2003).

Member states were asked to select nature protection area's based on the Bird Directive from 1979 and the Habitat Directive of 1992 (EC, 2005a). In the Bird directive (EC, 1979) all wild birds and their most important habitats across EU are protected. Based on this directive EU members have to protect the most important sites for all migratory birds and 195 threatened species, in so-called Special Protected Areas (SPA). The Habitat Directive (EC, 1992) contributes to preservation and restoration of biodiversity through the conservation of natural habitats and protection of wild fauna and flora. Member states have to propose protected area's, so called 'Sites of Community Interest' (SCI) for habitats of Annex I and species from Annex II of the Habitat Directive. The European Commission evaluates the proposed sites according the rules from Annex III of this directive. After approval Member states designate the SCI as Special areas of conservation (SAC). Both the SPA and SAC together form the Natura2000 network.

1.2. Nitrogen deposition

One of the most important anthropogenic factors influencing biodiversity is nitrogen enrichment. Emissions of nitrogen, as ammonia and nitrogen oxides, have strongly increased in Europe in the second half of the 20th century. While ammonia is mainly emitted by intensive agriculture, nitrogen oxides derive mainly from burning of fossil fuels, traffic and industry (Acherman and Bobbink, 2003). Both by wet and dry deposition, these nutrients become available in the surroundings or further away from the source. The effects of nitrogen emissions on flora and fauna can be direct, via toxicity, or indirect via changes in soil properties that affect habitats for plants and animals. Nitrogen enrichment affects ecosystem via acidification of soils, an important recognized problem since the early 1980s, but also by enhanced availability of the nutrient nitrogen (eutrophication). Acherman and Bobbink (2003) summarised the indirect effects of enhanced nitrogen loads:

- enhanced plant productivity that may result in changes in species composition in oligo- and mesotrophic habitats;
- enhanced nitrogen concentrations in plant tissue, affecting palatability of vegetation for herbivores or sensitivity to pathogens;
- increased nitrogen leaching from soils to deeper ground water when soils are saturated;

- changes in dominance of nitrogen form from nitrate to ammonium; affecting species that are sensitive to ammonium;
- acidification;
- increased susceptibility to secondary stress and disturbance factors as drought, frost, pathogens or herbivores.

The size of the effects of deposition depend on several factors, like duration and amount of increased inputs, sensitivity of organisms, abiotic conditions, land use and management (Acherman and Bobbink, 2003). For ecosystems these effects become visible via e.g. biomass increases or shifts in species composition (Acherman and Bobbink, 2003) and may ultimately lead to changes in habitat type and structure, thereby affecting all kinds of organisms.

1.3. Calculations of critical loads for Natura2000 areas

The Coordination Centre for Effects (CCE) in Bilthoven, The Netherlands is the data centre of International Cooperative Programme (ICP) of the Long-range Transboundary Air Pollution (LTRAP). It collects and collates data of National Focal Centers (NFCs) on critical loads and related variables, applies ICP calculation methods and generates data bases available for integrated assessment models (CCE, 2007). A critical load is used as a quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to the present knowledge (Nilsson and Grennfelt, 1988). Critical loads for nitrogen can be estimated based on soil properties and steady-state mass balance methods or based on scientific knowledge on effects of nitrogen enrichment on ecosystems, so-called empirical critical loads. From the critical loads and nitrogen deposition the exceedance of the critical load can be calculated using several methods (CCE, 2007). Exceedance of critical loads for nitrogen results in nitrogen enrichment, which leads to changes in biodiversity.

Since Natura2000 areas are specifically designated to protect specific habitats, specific plants, birds and other animals, and enhanced nitrogen deposition may be a significant threat to biodiversity (Bareham *et al.,* 2007), it is important to take the Natura2000 network into account in the critical load analysis. By integrating biodiversity and changes therein in calculations of critical loads possible exceedances of nitrogen in Natura2000 areas can be signalled more precisely.

1.4. Aim of the project

The general aim of this project is:

> *To collect information of Natura2000 areas, both on geography and biodiversity, and develop procedures to apply and interpret this information in calculations of critical loads for nitrogen.*

This general aim led to the following research objectives that are covered in the chapters of this report:

- information from Natura2000 areas was collected and described on geographical position, status, biodiversity, etc. This information was aggregated and converted to make further processing in the critical load calculations for nitrogen possible (Chapter 2);
- biodiversity information from the Natura2000 areas was evaluated (Chapter 3):
    - the habitat classification of the Natura2000 areas was converted to the EUNIS classification used in critical load calculations (§ 3.2.);
    - a procedure was developed to include the available biodiversity information from the Natura2000 areas into the critical load analysis (§ 3.3.);
    - and the availability of data on changes in biodiversity in Natura2000 areas for critical load calculation was evaluated (§ 3.4.);
- and finally a procedure was developed to combine the information on Natura2000-areas with critical loads for nitrogen for these areas (Chapter 4).

Simultaneously with this project Expert group 4 of the European Union Project Streamlining European 2010 Biodiversity Indicators (SEBI) focused on the availability of (existing) indicators for nitrogen deposition and assessed the impact of nitrogen deposition for biodiversity. Since both projects had some cooperative aims, both projects profited from exchange of information.

2. Basic data of Natura2000

2.1. General

First the basic information from the Natura2000 areas is described (§ 2.2.). This information has been processed, so that it can be used in the critical load analysis. This includes the conversion of codes and the combining information of Habitat- and Bird-directive (§ 2.3) and eventually the overlay with the EMEP50-grid (§ 2.4.).

2.2. Description of the Natura2000 data

The Natura2000 data is stored in two files. One file which contains mostly spatial information and another file which contains most of the attribute information.

Spatial information

The spatial file is an ARC-GIS 9.X personal-geodatabase (version 15 January 2007) with polygon information per area. It has been delivered on CD officially by the European Commission to CCE in July 2007 and contains 23,105 Natura2000 areas of both directives, see Table 1. The majority, c. 81%, of the number of areas is under the Habitat directive. Areas identified in the spatial file to be assigned to both directives comprise only less than 1%. However, this number is much higher, because from the geographical overlay of the information (see further) is became clear that though many areas are under both directives, this is not identified in the spatial file. After the overlay the areas under both directives comprises about the half of the total surface of the Natura2000 areas (data not shown).

Table 1. Number of Natura2000 areas in the official spatial database of the EU, characterized per directive type.

Type	number	%
Bird-directive (SPA) only:	2,807	12.1
Habitat-directive (SCI) only:	18,596	80.4
Both directives:	1,672	7.2
Unknown directive:	30	<0.3
Total	23,105	100.0

Besides the geographical information of the areas, this database also contains spatial information on geometrical variables like AREA and PERIMETER of the areas.
Other information included in the spatial file is:

- SITECODE: identification code Natura2000 areas and link to attribute file;
- SITETYPE: type of directive and in case of two directives for a specific area the extent of overlap between the directives;
- SITENAME: full name of Natura2000 area.

Attribute information

The second file, the attribute file, is a Microsoft-Access 2003 database (version 30 August 2006), which is downloaded from the website of EEA (EEA, 2007). The information in the attribute file is based on the 'standard data form' for Natura2000 areas (EC, 2007). The file includes information on geographical, ecological and site descriptive data and information about impacts and activities around the Natura2000 areas. Important tables are:

- BIOTOP (table with all Natura2000 areas);
- HABIT1 (table with cover (%) for each Annex I habitat in Natura2000 areas);
- HABIT2 (table with cover (%) for coarse habitat codes in Natura2000 areas).

The file contains information on 16,491 areas of both directives, see Table 2. Again the areas from the Habitat directive form the lion's share (86%) of all areas. This file contains information on the presence of one or several habitat types for each area. These habitat types may be according to a fine or coarse classification. For the Bird directive about 60% of the areas have a fine habitat classification, whilst this percentage is 96% for the areas of the Habitat directive. The presence of habitat information is often not for 100% of the area, and sometimes covers a small percentage (like 1%) of the total area.

Table 2. Number of Natura2000 areas in the official attribute database of the EU, characterized per directive type and presence of habitat information.

	Habitat-information				
Directive*	fine (only)	coarse (only)	both	none	total
Bird-directive (only)	43	1570	666	182	2461
Habitat-directive (only)	275	524	11255	24	12076
Both	64	60	1826	2	1952
Total	382	2154	13747	208	16491

* Bird directive includes subtypes: A, D, F, H, J; Habitat directive include subtypes: B, E, G, I, K; both directives include subtypes: B, C, D, E, F, G, H, I, J, K.

Comparison of spatial and attribute files

There are 14,778 areas which are present in both the spatial and attribute file. So, 64% of the areas in the spatial file have information in the attribute file. And, 90% of the areas in the attribute file have information in the spatial file. Especially the twelve new or future EU-countries (so called EU10 countries and Romania and Bulgaria) have limited attribute information of Natura2000 areas, see Table 3. For Romania and Bulgaria there are even no Natura2000 areas in the files at all at this moment.

Table 3. Availability of spatial and/or attribute information of Natura2000 areas per country in the European Union.

Country	spatial (only)	attribute (only)	both	total
EU15 countries (15 members of the EU before 2004)				
Austria (AT)	3	0	210	213
Belgium (BE)	1	1	450	452
Germany (DE)	2259	1083	2841	6183
Denmark (DK)	1	11	332	344
Spain (ES)	766	6	894	1666
Finland (FI)	78	1	1779	1858
France (FR)	470	1	1204	1675
Greece (GR)	208	0	151	359
Ireland (IE)	13	80	461	554
Italy (IT)	1245	51	1279	2575
Luxembourg (LU)	0	0	59	59
Netherlands (NL)	0	0	211	211
Portugal (PT)	51	3	85	139
Sweden (SE)	13	461	3537	4011
United Kingdom (UK)	3	21	844	868
Subtotal	5111	1719	14337	21167
EU10 (12 members of the EU since 2004)				
Bulgaria (BU)	0	0	0	0
Cyprus (CY)	28	0	2	30
Czech Republic (CZ)	864	0	38	902
Estonia (EE)	486	0	67	553
Hungary (HU)	457	0	55	512
Lithuania (LT)	299	1	39	339
Latvia (LV)	239	0	97	336
Maltha (MT)	27	0	6	33
Poland (PL)	175	0	72	247
Romania (RO)	0	0	0	0
Slovenia (SI)	259	0	27	286
Slovakia (SK)	382	0	38	420
Subtotal	3216	1	441	3658
Total	8327	1720	14778	24825

2.3. Conversion of spatial information of Natura2000 areas

The spatial data from the Natura2000 areas is not compatible with the data structure of de CCE-CL database: 1) there can be several records for one Natura2000 area, because areas are (partially) designated to both directives, whilst the CCE-CL database requires one record per area; 2) in the CCE-CL database a EMEP-polar projection and a EMEP50-grid is used for the geographical characterization of areas; the Natura2000 areas have a different

projection and lack the EMEP50-grid information. In the Annexes a full description of all files and queries, and a flow diagram is presented for the processing of the results.

Conversion to one record per Natura2000 area in the CCE-CL database

Areas can be designated to both the Bird directive and Habitat directive, resulting in two records per area. Furthermore there are areas without directive information in the spatial database. In order to convert the spatial data to one record per area with directive information the following procedure have been used.

First, the different directives were separated. This have been done by using the variable (SITETYPE), which describes to which directive(s) an area had been designated (Bird directive: classes A, C, D, F, H and J; and Habitat directive: classes B, C, E, G, I and K; no directives: blank value). This variable is present in both the spatial and attribute database. The classes for the variable SITETYPE were not always the same in the spatial and attribute database, but were always indicating the same directive. We used principally the SITETYPE information from the spatial database, because the spatial database is more recent than the attribute database. However, there were 201 areas without directive information in the spatial database, but with directive information in the attribute-database. For these cases we used the SITETYPE-information from the attribute-database. In order to identify these special cases we added a new variable to the spatial database (SITETYPE_UPDATE).

Second, an overlap was made of the polygons of the areas of the different directives, in order to create sub-areas with none, one or a combination of directives. This step was done per country, because the spatial files were too big to execute this step in once for the whole of Europe. An automated Python 2.4 procedure (COMBINE_DIRECT_LOOP.PY**)** was developed using ARCGIS 9.2. The following steps have been carried out per country:

- Creation of a new personal geodatabase per country, which contains the outcomes of the following actions;
- Selection of the terrestrial and freshwater areas per country by clipping, so excluding marine areas and areas outside or crossing borders. For clipping we used the European polygon shape files (European country map EUnAllAr);
- Overlay of the directive information using the UNION-function;
- Adding a new variable for determining the directive-class and calculating the directive class by means of a query: 1) Bird directive, 2) Habitat directive, 3) Both and 4) Unknown;
- Part of this Python-procedure is also to create 100 m raster map (see last paragraph of this chapter).

Geographical characterization of Natura2000 areas compatible with CCE-CL database

During the former step the projection of the data was converted from latitude-longitude to the EMEP-polar projection. Further an overlay was made between the Natura2000 areas, resulting from the former step, and the EMEP50-grid. Finally, in order to use Natura2000

area information in the CCE-background database, this information was converted to a grid of 100 m x 100 m.

The overlay with the EMEP50 was carried out by using a Python 2.4 procedure (OVERLAY_DIRECT_EMEP.PY), with the following actions per country:

- Overlay of the combined directive Natura2000-areas from the former step with the EMEP50-grid using the Identity-analysis using the personal geodatabases from the former step;
- Combination ('dissolving') of the areas by EMEP50grid with the same directive information and calculation of these combined areas in hectares;
- Exporting of the attribute part of the spatial database to a combined personal geodatabase for the whole of Europe;

The spatial information from this step will be combined in the further CL-analysis with the EUNIS-codes and Empirical critical loads from the attribute part (see Chapter 3 and 4).

For the use of the Natura2000 information in the European critical load background database, 100 meter raster maps were created per country. This was done by former mentioned Python 2.4 procedure (COMBINE_DIRECT_LOOP.PY), with the following actions per country:

- The creation of a geodatabase and clipping, described in the former conversion step;
- Conversion of the directive-polygons files to 100 meter raster grid files in EMEP-projection;
- Raster overlay of the 100 meter grids using MapAlgebra and obtaining the earlier mentioned directive classes;
- Exporting the 100 meter raster grid maps by country in ESRI-ASCII-format;
- N.B. We chose deliberately to use the EUNIS-habitat information from the Natura2000 areas themselves, instead of extracting that information from the SEI-map, see also section 5.2 first recommendation.

3. Biodiversity in Natura2000 areas in relation to critical load analysis

3.1. General introduction

In this chapter the relation between biodiversity in Natura2000 areas and critical load analysis is worked out. In § 3.2. need and possibility to include fauna into critical load analysis is explored. In the next section (§ 3.3.) it is investigated whether and how the different Natura2000 areas and species can be included in the critical load analysis. In § 3.4. the conversion of the habitat classification used for Natura2000 areas to the one used in the critical load analysis is described. The following section comprises the coupling of the empirical critical loads to the converted habitat types of the Natura2000 areas. Finally, the need and possibilities to include changes in biodiversity in critical analysis is explored.

3.2. Nitrogen enrichment effects on fauna

Deposition of nitrogen may affect ecosystems via acidification and eutrophication. The various ecosystems differ in their vulnerability for nitrogen enrichment due to differences in soil properties, duration and amount of nitrogen input etc. (Acherman and Bobbink, 2003, Bareham *et al.,* 2007). Most scientific publications on effects of enhanced nitrogen deposition have focussed on effects on vegetation (see also Chapter 1). Not only plants and vegetation types are affected by nitrogen deposition, but also fauna is directly, but mostly indirectly affected via changes in habitats of the organisms. Enhanced nitrogen deposition affects food quality, food availability and changes in environmental conditions, heterogeneity in landscape and vegetation structures needed by animals to complete their life-cycle (De Vries *et al.,* 2006)[1]. Since the effects of nitrogen deposition on fauna mainly act via changes in habitats, the susceptibility of fauna for nitrogen enrichment needs to be considered via the different habitats that are needed for the different phases in their life-cycle: e.g. reproduction, staging, and wintering. Dependent of the species, these different habitats may be at different places in Europe, further away from each other or close together. Not only migratory birds, but also many other animals use different habitats during different stages of their life cycle. One example of such a species is the dragonfly *Aeshna viridis*, a species from Annex IV of the Habitats Directive, which occurs in Europe and western Siberia and is for reproduction restricted to aquatic vegetations with *Stratiotes aloides* (NVL, 2002). Adult of this species however, use semi-aquatic reed and sedge vegetations, and open areas in and edges of terrestrial forests for feeding and shelter (NVL, 2002, GG, 2007). To protect the species in e.g. a Natura2000 area, the habitats used by the species in the particular area need therefore to be considered. In conclusion, effects of enhanced nitrogen deposition on fauna mainly occur via changes in habitat. Since different species often need different habitats to complete their life cycle, it is important to consider these different habitats in assessing importance for critical load analysis and in the selection procedure for Natura2000 areas.

[1] De Vries *et al.* (2006) describes the effects of nitrogen deposition on fauna, due to changes in food quality and micro-climate as direct effects. However, we consider these effects as indirect effects since the effects acts via changes in a.o. nutrient content in plant organic matter or plant species composition. We consider direct effects as toxicological effects through high concentrations of nitrogenous compounds, like ammonia. These effects are most likely irrelevant at the scale of our focus and therefore not considered in this report.

3.3. When and how to apply critical load analysis in Natura2000 areas?

Since ecosystems and habitats differ in sensitivity for nitrogen enrichment, from sensitive to even quite insensitive, the question arises whether we can prioritize the different ecosystem for further critical load analysis. In Figure 1 a scheme is presented of a possible procedure to prioritize Natura2000 areas to be considered in critical load analysis for nitrogen. The procedure makes use of the data EU members have to supply in the designation of Natura2000 areas (EC, 1997). Crucial elements in the procedure in Figure 1 are the protected habitat types and the required habitats for protected species and birds. In the next paragraphs the different 'routes' in the scheme are explained. In addition, restrictions and complications are discussed and recommendations are put forward. Ideally for each protected habitat, bird and/or species in a specific Natura2000 area the schema should be followed, so that the appropriate combinations of critical loads could be set for a Natura2000 area.

Explanation of prioritization procedure

The European Natura2000 network comprises of Natura2000 areas that are designated by the EU members based on the Bird and Habitat Directive (abbreviated further as BD and HD, respectively). These Natura2000 areas are designated to protect 218 habitat types listed in Annex I of the HD, 887 species (and their habitats) listed in Annex II of the HD, 195 bird species from Annex I of the BD and regularly occurring migratory birds not listed in this Annex I. For each Natura2000 area the aims for protection and restoration are known in the designation documents. The procedure described below is based on the information available from the Natura2000 attribute database (see § 2.2.). The Natura2000 attribute database contains information on the present status of habitats and species in Natura2000 areas. Note that this may differ partly from the final target for protection and restoration for a particular Natura2000 area, since restoration and conservation measures are being conducted. In Figure 1 the different bases for designation from the HD and BD are referred to as: habitat protection, species protection and bird protection.

The protected habitat types (218) in Natura2000 areas (Habitat protection in Figure 1) are listed in Annex I of the Habitat Directive and full descriptions of these habitat types are available in the Interpretation manual of European Habitats (EC, 2003). The habitats in Annex I are classified according to the Palaearctic habitat classification (EC, 2003). Empirical critical loads (abbreviated to eCL, Acherman and Bobbink, 2003) are used to assess the susceptibility of habitats to nitrogen deposition, since these eCL are based on negative effects of nitrogen enrichment on habitats and biodiversity. Acherman and Bobbink (2003) reviewed the effects of nitrogen enrichment on several, mainly sensitive, habitats based on scientific publications. These eCL for specific habitats were set at an expert workshop in Berne in 2002. The habitats for which an eCL had been determined are classified according to the EUNIS habitat classification (Davies *et al.,* 2004). So, in order to use eCL for Natura2000 areas a conversion of the Palearctic classification to the EUNIS classification was carried out (Davies *et al.,* 2004; see § 3.3.). In addition, information about the exact locations of the different habitat types within the Natura2000 area is not

present in the Natura2000 area documentation. This type of information could contribute to a more precise critical load analysis.
Protected species mentioned in Annex II of the Habitat Directive (Species protection Figure 1) covers organisms of different groups, except birds (Table 4). Since the effects of nitrogen enrichment on species mainly acts indirectly via changes in habitat quantity and quality (see § 3.1.), assessment of nitrogen sensitivity for Natura2000 areas designated for species protection acts via the habitats. Therefore it is important to know for which stage of their life-cycle for a specific species the Natura2000 area is designated and thereby what habitats are present or required then. In the information of the Natura2000 areas a distinction is made only between protected resident species, which are present year round, and protected migratory species for which the area could be important for either reproduction, staging of wintering. However, specific information about the habitat types used by each of these protected species is however lacking in the Natura2000 documentation. This type of information should be made available, preferably directly as EUNIS classes, so it can be used in the assessment (as described in de 'habitat protection route' and in § 3.3.). When habitat information is available for the protected species, again eCL can be set, like for protected habitats.

Table 4. Number of protected birds, protected habitats and protected species by the Birds Directive and Habitat Directive . In addition to the number of birds also regularly occurring migratory birds are protected in Natura2000 areas.

Birds Directive Annex I

EU 25	Total number
Birds	195

Habitats Directive Annex I - habitats

EU 25	Total number	Priority species
Habitat types	218	67

Habitats Directive Annex II - species

EU 25	Total number	Priority species
Mammals	51	18
Reptiles	24	7
Amphibians	24	4
Fish	82	7
Invertebrates	134	14
Animal species	**315**	**50**
Pteridophyta	19	3
Gymnosperma	1	1
Angiosperma	520	196
Bryophytes	32	4
Plant species	**572**	**204**
Total	**887**	**254**

* Among Fishes, 4 groups of species (taxa) are mentioned as genus in the Annex II of the Habitat directive, which represent in total 22 species in EU territory (EC, 2007).
** Priority species: species which are threatened with extinction and the main natural distribution areas are within the European Community, so that the European Community has a special responsibility for conservation of these typical European species threatened with extinction (EC, 1992).

The procedure for Natura2000 areas designated for Bird protection (Figure 1) follows the same route as for Habitat Directive Annex II species. Also for birds information is available in the Natura2000 area documentation on the habitat use: resident versus migratory. But, again information on the habitat requirements of the different species is not available from the Natura2000 attribute database. For all resident and migratory breeding birds it may be clear that it is important to evaluate habitat the susceptibility of the required habitats to nitrogen deposition. Habitat requirements for these species have to be examined and should preferably become available as EUNIS classified habitats. Again, these EUNIS habitat types can be coupled to the eCL as described in de 'habitat protection route' and § 3.3. In contrast to the species from Annex II of the HD, large numbers of bird species use specific areas that might be less nitrogen sensitive during staging and wintering. Many wintering and staging birds in the Netherlands, for example, use large open waters or large open agricultural areas. Critical load analysis for these areas has no direct priority, since these systems are either mostly eutrophic (and thereby less sensitive to nitrogen enrichment), or often heavily influenced by agricultural nitrogen enrichment by fertilization and manuring. The possible exclusion of these staging or wintering species or areas across Europe should be studied in further detail. In addition, breeding birds from agricultural areas in general are also probably not influenced by nitrogen enrichment too, since nitrogen enrichment via deposition can be assumed to be negligible compared to agricultural input. However, if this applies for all birds from agricultural areas in Europe needs further study.

In absence of the essential information on habitat requirements for birds and species and of any eCL information of Annex I habitats, the general habitat description (see Figure 1) present in the Natura2000 area documentation may give information on susceptibility for nitrogen enrichment. The general habitats distinguished in the Natura2000 attribute database are listed in Table 5. These general habitat types were converted to the first and second level EUNIS classifications (Davies *et al.,* 2004). These EUNIS classes cover different habitats, sometimes including large ranges of nutrient availability (from oligotrophic to eutrophic) and thereby large ranges in sensitivity to nitrogen deposition. From the general habitat descriptions it is unclear which of the more specific habitat types within the EUNIS class is present in a specific Natura2000 area. To assess sensitivity to nitrogen deposition the EUNIS-converted general description should be coupled to the eCL. In some cases different eCL ranges are available for different subclasses within the first and second level EUNIS class and in many cases eCL data are simply lacking. In Table 5 three eCL values were added to the general habitat descriptions: the minimum eCL of all known eCL-ranges at the first level EUNIS class and the median of the minimum or of the averages or the eCL-ranges within a particular EUNIS class. Application of the minimum eCL for a specific EUNIS class will protect both sensitive and less sensitive habitats, however it is clearly an overestimation of the sensitivity of the Natura2000 area. An alternative is the application of one of the median eCL, however then sensitive habitat types within the general descriptions may be missing. The NFC may have more detailed information and may use models to determine the eCL in greater detail. We stress that the use of these general habitat classes is only indicative for nitrogen sensitivity, and used only where specific habitat information is lacking. In addition, ideally, detailed information is needed for each species in order to assess the impact of nitrogen deposition on the species.

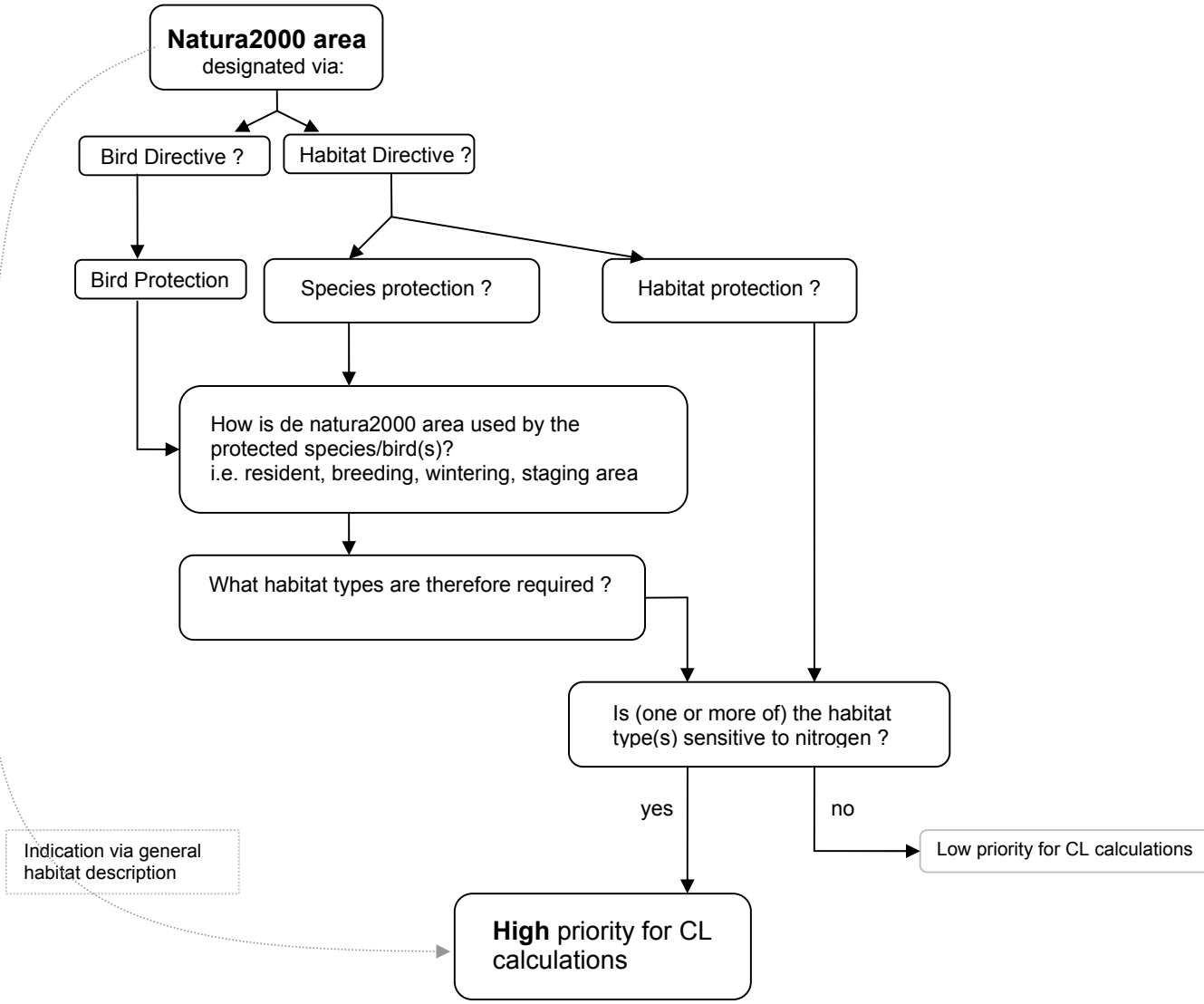


Figure 1. Procedure to prioritize Natura2000 areas sensitive for nitrogen enrichment and relevant for critical load analysis. For each of the protected habitats, bird or species in a specific Natura2000 area the scheme should be followed. Coupling of the known eCLs from Acherman and Bobbink (2003) to the habitat types in a Natura2000 area will lead to a set of eCLs that can be used for critical load analysis. In absence of information on habitats for species, the general habitat classes (dashed line) may give indications for priorization of the Natura2000 area for critical load analysis. See text for full details.

Table 5. Overview of general habitat classes used in the description of Natura2000 areas and translation to EUNIS classes. See text for explanation of the derivation of these eCL; + = not available, but relevant, - = not available, but also not relevant for eCL-analysis.

General habitat class	General habitat description	EUNIS class	Minimum eCL	Median eCL (average)	Median eCL (minimum)
N01	Marine areas, Sea inlets	A	+	+	+
N02	Tidal rivers, Estuaries, Mud flats, Sand flats, Lagoons (including saltwork basins)	A/X0/?	+	+	+
N03	Salt marshes, Salt pastures, Salt steppes	A2.5/D6/E6	30	35	30
N04	Coastal sand dunes, Sand beaches, Machair	B	10	15	10
N05	Shingle, Sea cliffs, Islets	B	10	15	10
N06	Inland water bodies (Standing water, Running water)	C	5	11	8
N07	Bogs, Marshes, Water fringed vegetation, Fens	D	5	18	13
N08	Heath, Scrub, Maquis and Garrigue, Phygrana	F	5	12.5	7.5
N09	Dry grassland, Steppes	E1	10	15	10
N10	Humid grassland, Mesophile grassland	E2/E3	10	17.5	12.5
N11	Alpine and sub-Alpine grassland	E4	5	12.5	10
N12	Extensive cereal cultures (including Rotation cultures with regular fallowing)	I	-	-	-
N13	Ricefields	I	-	-	-
N14	Improved grassland	E2.6	-	-	-
N15	Other arable land	I	-	-	-
N16	Broad-leaved deciduous woodland	G1	10	15	10
N17	Coniferous woodland	G3	10	15	10
N18	Evergreen woodland	G2	+	+	+
N19	Mixed woodland	G4	10	15	10
N20	Artificial forest monoculture (e.g. Plantations of poplar or Exotic trees)	G5	+	+	+
N21	Non-forest areas cultivated with woody plants (including Orchards, Vineyards, Dehesas etc.)	G2/E7/FB	+	+	+
N22	Inland rocks, Screes, Sands, Permanent Snow and ice	H	-	-	-
N23	Other land (including Towns, Villages, Roads, Waste places, Mines, Industrial sites)	J	-	-	-
N24	Marine and coastal habitats (general)*	A/B	10	15	10
N25	Grassland and scrub habitats (general)*	E/F	5	15	10
N26	Woodland habitats (general)*	G	10	15	10
N27	Agricultural habitats (general)*	I	-	-	-

* not mentioned in standard data form

Other useful information from Natura2000 area documentation for prioritization

The Natura2000 area documentation also contains information about relevant and threatening 'impacts and activities' in and around the Natura2000 areas, which could also be possibly used in the prioritization procedure. These 'impacts and activities' relate to all human activities and natural processes that may have an influence (positive or negative) on the conservation and management of the site (EC, 1997). Not only impacts within the Natura2000 area, but also impacts from the surroundings area that may affect the integrity of the Natura2000 site are reported. Both in- and outside impacts are of importance for the protection of the Natura2000 area. The impacts are grouped under agricultural -,, fishing - and mining activities, urbanisation, transportation, leisure, pollution, human induced changes in wet areas and natural processes. This information includes the size of intensity (high – medium – low), the percentage of the area under influence and the direction of the impacts (positive – neutral – negative). For the prioritization procedure the impact-

categories ‘eutrophication’ and ‘air pollution’ are of importance. From some other impacts the description (like the presence of highways) is too general to take this information into account, though it might be relevant. More detailed information on these possibly relevant categories is required (e.g. route of highways). When the impact of ‘eutrophication’ and ‘air pollution’ is assessed as ‘negative’, both within a Natura2000 area or in its surroundings, the Natura2000 area may be threatened by nitrogen enrichtment. Therefore, the areas threatened by these impacts should ideally be considered in critical load analysis.

In summary, a procedure was described to include Natura2000 areas in eCL analyses. One major point of discussion is how to deal with ‘insensitive’ areas (such as wintering grounds for geese) in the critical load analysis: by excluding or by applying a high critical load. Due to lack of information about habitat requirements of species (Annex IV Habitat directive and Bird directive) we propose use all available information on a detailed level (Habitats Annex I Habitat directive) and a coarse level (Habitat and Bird directive) in critical load analysis.

3.4. Conversion from Palearctic to EUNIS habitat types

The habitats in Natura2000 areas are described in the Interpretation manual of European Union habitats (EC 2003). The classification of habitats for Natura2000 had originally been based on the CORINE classification. With entrance of new member states in the EU, this CORINE classification was considered insufficient and had been updated with the PHYSIS database, which uses a Palaearctic classification of habitat types (EC, 2003). These Palaearctic classification (latest version ’97) forms the basis for the codes in the Interpretation manual of European Union habitats.

For the critical load calculations the European Nature Information System habitat classification (EUNIS) is being used (Davies *et al.,* 2004). The EUNIS classification describes a hierarchical typology of the habitats in Europe and its adjoining seas.

From the EUNIS website a conversion table was obtained for habitat types mentioned in Annex I of the Habitat Directive to the EUNIS habitat classification (Moss and Davies, 2002; EUNIS, 2007). So this concerns only the fine and not the coarse habitat types. The Annex I habitats types are converted to a third, or more detailed, EUNIS level. Additional information is provided on the relationships between both classifications: 1) overlap between both descriptions, 2) whether the description of the Annex I habitat is narrower, broader or identical than the EUNIS habitat. Often several EUNIS habitats are mentioned for one Annex I habitat type. In most of these cases there are subgroups at the detailed level within one EUNIS level, however, in some other cases different EUNIS-classes at the first or second level relates to a Annex I habitat type. As described in the former section, information about the habitats required by birds and other species are currently unavailable. If this kind of habitat information would become available, it should be preferably become available as EUNIS-classes, to prevent conversion problems as described above.

Table 6. Overview of the available empirical critical loads. The eCL are set in Acherman and Bobbink (2003) and additional eCL are derived for some EUNIS classes by De Bakker *et al.,* 2007). B2003: Acherman and Bobbink (2003); dB2007: De Bakker *et al,.* 2007.

EUNIS code	Short habitat description	eCL(kg/ha/yr)	Remarks	Source
A2.54 & A2.64	Pioneer and low-mid salt marshes	30-40		B2003
B1.3	Shifting dunes	10-20		B2003
B1.4	Coastal stable dune grasslands	10-20		B2003
B1.5	Coastal dune heaths	10-20		B2003
B1.8	Moist to wet dune slacks	10-25		B2003
C1.1	Permanent oligotrofic waters – softwater lakes	5-10		B2003
C1.16	Permanent oligotrofic waters – dune slack pools	10-20		B2003
D1	Raised and blanket bogs	5-10		B2003
D2.1	Quaking fens and transition mires	10-15	footnote in B2003	B2003
D2.2	Poor fens	10-20		B2003
D2.3	Valley mires	15-20	footnote in B2003	B2003
D4.1	Rich fens	15-35		B2003
D4.2	Mountain rich fens	15-35		B2003
E1	Dry grasslands	15-25		dB2007
E1.26	Sub-atlantic semi-dry calcareaous grasslands	15-25		B2003
E1.7	Non-mediterranean dry acid and neutral closed grasslands	10-20		B2003
E1.8 & E1.A	Mediterranean dry acid and neutral closed/open grassland	15-20		dB2007
E1.9	Non-Mediterranean dry acid and neutral open grassland, including inland dune grassland	10-20	Adopted E1.94 & E1.95	
E1.94	Inland dune pioneer grassland	10-20		B2003
E1.95	Inland dune siliceaous grasslands	10-20		B2003
E2.1	Permanent mesotrophic pastures and aftermath-grazed meadows	20-30		dB2007
E2.2	Low and medium altitude hay meadows	20-30		B2003
E2.3	Mountain hay meadows	10-20		B2003
E3.5	Moist and wet oligotrophic grasslands	10-20	Adopted from E3.52	
E3.51	Moist and wet oligotrophic grasslands – *Molinea aerulea* meadows	15-25		B2003
E3.52	Moist and wet oligotrophic grasslands – Heath (*Juncus*) meadows and humid (*Nardus stricta*) swards	10-20		B2003
E4.2	Moss and lichen dominated mountain summits	5-10		B2003
E4.3 & E4.4	Alpine and subalpine grasslands	10-15		B2003
F1	Tundra	5-10		B2003
F2	Acrtic, alpine ans subalpine scrub habitats	5-15		B2003
F4.11	Northern wet heaths 'U' *Calluna* dominated wet heath	10-20		B2003
F4.11	Northern wet heaths 'L' *Erica tetralix* dominated wet heaths	10-25		B2003
F4.2	Dry heaths	10-20		B2003
G	Forest habitats	10-20	eCL depends on process	B2003

3.5. Coupling of empirical critical loads to Natura2000 areas

Coupling of empirical critical loads (eCL) to Natura2000 areas is possible by using the EUNIS-classes after conversion from the Palearctic to the EUNIS habitat classification (see former section). Acherman and Bobbink (2003) have set eCL for several EUNIS classes of habitats. Based on this study we derived in a parallel project additional eCL for some other EUNIS habitats classes used in the critical load analysis (De Bakker *et al.,* 2007), see Table 6. From this table it is clear that for quite a number of EUNIS habitat types eCL are missing. The EUNIS classes of Natura2000 areas are often known at a more detailed EUNIS level than the EUNIS habitats for which an eCL is known or derived. Therefore, an available eCL for a EUNIS class has to be applied to this EUNIS class and all (more detailed) subgroups of this EUNIS class. For example, when an eCL is available for F1 all more detailed subgroups of the EUNIS class F1 get the same eCL. Since Annex I habitats may be converted to multiple EUNIS classes, coupling to the available eCL may lead to different eCL for one Annex I habitat type. For 132 Annex I habitats an eCL could be derived and from these only 5 habitat types have two eCL. For 85 Annex I habitat types no eCL information was available. For some of these 85 Annex I habitats no eCL information is necessary since these habitats, as e.g. caves, are probably unsusceptible to nitrogen enrichment. It is clear that for many EUNIS habitats eCL information is lacking. New eCL information should be derived with priority for the protected habitats for which eCL information is lacking at the moment.

3.6. Changes in biodiversity in Natura2000 areas

Changes in biodiversity in Natura2000 areas are important for several reasons. First, the results of the critical load analysis should support the restoration of degraded Natura2000 areas. Second, information on changes in biodiversity in Natura2000 areas could be combined with changes in exceedances of critical loads, in this way the critical load analysis is supported and validated by the biodiversity information.

The aim of the Natura2000 network is to protect and restore biodiversity in the European Union (LNV, 2003). Specific aims for protection of habitats, birds and other species for the specific Natura2000 areas are part of this designation. These aims have not been reached in all Natura2000 areas. However, the biodiversity information about Natura2000 areas do not include the desired habitats, but the present (possibly degraded) habitat types and (lower) population sizes of species. To reach the aims for e.g. restoration of specific habitats conservation measures have to be taken. This may lead to changes in habitat types (e.g. from degraded to restored), altered species abundances and changed biodiversity. Note that a recovered habitat may be classified as a different habitat type than the present. This may result in a different, probably lower, eCL too, since the recovered habitat may be more sensitive to nitrogen enrichment. Also the presence of new (desired) protected species may result in specific habitat requirements that have other eCL. Ideally, the desired, restored habitats, and the desired birds and species should be considered in critical load analysis. Then the eCL will not change during e.g. the restoration of a habitat and this eCL warrants the possibility to recover. However, the information on the desired habitats and species (abundances) is only qualitative available in the Natura2000

designation documents, but not available in the Natura2000 database, so it cannot be used in critical load analysis.

Many organisations collect and publish information on changes in biodiversity in Natura2000 areas. At the national level, non-governmental organizations gather, analyze and publish information on species presence and abundance in Natura2000 areas. E.g. in the Netherlands, members of the VOFF (Vereniging Onderzoek Flora en Fauna) collect information on different groups of species. One of the members of the VOFF, SOVON, collects information on birds in The Netherlands and specifically in Natura2000 areas and publishes these data in reports. In each country such information will be probably present, though these data cover many different studies, probably often reported in the national language, etc. Therefore, application of this kind of information in critical load analysis on the European scale needs a lot of efforts, to sample, translate and convert to database formats. However, these monitoring data may be part of the information EU members have to report on the status of the Natura2000 areas to the European Union.

EU members have to report each 6 years on the conservation measures and the effects thereof on the protected habitats, protected species and birds according Article 17 of the Habitat Directive. This information should be collected and reported according a standard format (Format for the next status report, period 2000-2007, see EC, 2007). The EEA is developing an electronic application for this reporting (EEA, 2007). If and how this information is joined to the Natura2000 database information is yet unknown. To date, it is also uncertain whether this type of information will be freely accessible (J. Thissen, LNV, personal comment). NFC may have access to the monitoring information for the Natura2000 areas. From the information of the EU members, the EU commission will evaluate the status and trends of biodiversity in relation to the measures per biogeographical region in Europe (EC, 2005b; EC, 2006).

Besides the information on the national and European scale, scientific publications may yield information about biodiversity across Europe. This information is, however often not at the level of individual Natura2000 areas and gives overviews on biodiversity trends in Europe or in a particular country.

In summary, electronic information on changes of biodiversity in Natura2000 areas will probably become available in the forthcoming years, which might be used to support the critical load analysis.

4. Production of eCL-maps for Natura2000 areas

4.1. General

In this chapter eCL maps have been produced for Natura2000 areas on basis of the basic information of the Natura2000 areas (Chapter 2) on the one hand and procedures and eCL information for the Natura2000 areas (Chapter 3) on the other hand. In the first section the different steps to adapt the available eCL- and habitat-information for the production of eCL-maps are described. In the final section the production of the eCL maps for Natura2000 areas is described and several eCL-maps are presented. In the Annexes a full description of all files and queries, and a flow diagram is presented for the processing of the results.

4.2. Handling of habitat information and assignment of eCL for Natura2000 areas

The habitat information of the Natura2000 areas is the key information for the assignment of eCL to Natura2000 areas, as described in Chapter 3. The Natura2000 habitat codes have to be converted to EUNIS-habitat codes to make linkage with eCL possible. In this section the different adaptation steps are described.

For these steps the following input tables have been used:
- BIOTOP (table with all Natura2000 areas);
- HABIT1 (table with cover (%) for each Annex I habitat in Natura2000 areas);
- HABIT2 (table with cover (%) for coarse habitat codes in Natura2000 areas).

These three input tables are part of the attribute database, see Chapter 2.
- Table 5 and 6, which are the result of the adaptation of the eCL-information in Chapter 3.4.

The following aspects of habitat and eCL-information have been taken into account:
1. in the conversion from Natura2000 habitat codes to EUNIS habitat codes different types of relationships between these codes have to be accounted for;
2. some coarse Natura2000 habitat classes have been converted to combinations of EUNIS-classes;
3. for some areas Natura2000 habitat codes are used, that are not mentioned in Annex I of the Habitat directive;
4. for some areas information about surface is missing for some habitats;
5. for some areas the sum of the cover for all habitats within one area is less or more than 100%;
6. habitat information is present at a fine (Annex I) and/or coarse level (see Chapter 3), so this information have to be combined if necessary and possible.

Ad 1) As described in section 3.4. the conversion of Natura2000 habitat codes to EUNIS habitat codes, several types of relationships can be distinguished between the types of codes, see Table 7. One Natura2000 habitat code can be converted to several EUNIS habitat codes at different levels with different relationships.

Table 7. Different relationships between Natura2000 habitat types (left from symbol) and EUNIS habitat types (right form symbol), see also § 3.4.

>	: EUNIS class is narrower then Habitat Directive Annex I class
=	: EUNIS class is equal to Habitat Directive Annex I class
<	: EUNIS class is broader then Habitat Directive Annex I class
?	: Unknown relation
#	: Overlap between the EUNIS class and the Habitat Directive Annex I class

For the conversion from Natura2000 habitat codes to EUNIS habitat codes the following procedure have been used. First, if there is just a one-to-one relationship then the type of relationship has not been used. In case of a one-to-many relationships, it is first identified whether a = relationship (habitat types identical) is present. If so, then the other relationships have been ignored. In case of a one-to-many relationships and no = relationship is present, only the relationship(s) on the finest EUNIS-level have been used and the other relationships at the higher levels were ignored. The ? relationship has been treated equally as the other type of relationships. In most cases, they are still one-to-many relationships between habitat types after these simplification steps. In these cases the cover percentage for one Natura2000 habitat type is divided equally over the remaining different EUNIS habitat types (as described in Ad 6). The result of this conversion is saved in table Link_EUNIS_and_AnnexI_Selection. For the conversion of the coarse Natura2000 habitat codes to EUNIS habitat codes these 'translation'-problems do not exist, since we made the conversion table ourselves, without the complicating different types of relationships.

Ad 2) The conversion of some coarse habitat classes from the Natura2000 areas to EUNIS resulted in some cases in combinations of EUNIS-habitat classes for one Natura2000 habitat class, see Table 5 in § 3.3. A new table has been made in which the combinations are split up in their components: LINK_HABIT2_EUNIS, presented in Table 8.

Ad 3) The unknown Annex I habitat codes we encountered in the attribute database all consists of finer habitat codes (or subcodes) of known Annex I habitat codes. All these unknown Annex I habitat codes are therefore first converted to a higher/more coarse level (or uppercodes; e.g. 2132 ->2130; in this example the finest level at the fourth position, viz. …2 has been converted to the general level, viz. …0).

Ad 4) In 5247 of the 74809 records (7.0%) with Annex I habitat codes, cover information is missing; in these cases a default value of 0.0001 is used. In 4183 records of the 75676 records (6.3%) with coarse habitat codes cover information is missing; in these cases a default value of 0.01 is used. These default minimum values have been derived from the minimum values of the known cover values.

Table 8. The adapted conversion table (LINK_habit2_EUNIS) of coarse habitat classes to EUNIS-classes, as described in step 2 on the former page. eCL in kg N/ha.yr. For explanation of the different eCL see § 3.3.; -1 = no data.; HABCODE = coarse habitat codes from Habitat- and Bird Directive; EUNIS = EUNIS habitat code.

HABCODE	EUNIS	MIN_ECL	MED_ECL_AVG	MED_ECL_MIN	MAX_ECL
N01	A	-1	-1	-1	-1
N02	A	-1	-1	-1	-1
N03	A2.5	30	35	30	40
N03	D6	-1	-1	-1	-1
N03	E6	-1	-1	-1	-1
N04	B	10	15	10	25
N05	B	10	15	10	25
N06	C	5	11	7.5	20
N07	D	5	18	13	35
N08	F	5	12.5	7.5	20
N09	E1	10	15	10	25
N10	E2	10	25	20	30
N10	E3	10	15	10	25
N11	E4	5	12.5	10	15
N12	I	-2	-2	-2	-2
N13	I	-2	-2	-2	-2
N14	E2.6	-1	-1	-1	-1
N15	I	-2	-2	-2	-2
N16	G1	10	15	10	20
N17	G3	10	15	10	20
N18	G2	-1	-1	-1	-1
N19	G4	10	15	10	20
N20	G5	-1	-1	-1	-1
N21	E7	-1	-1	-1	-1
N21	FB	-1	-1	-1	-1
N21	G2	-1	-1	-1	-1
N22	H	-2	-2	-2	-2
N23	J	-2	-2	-2	-2
N24	A	-1	-1	-1	-1
N24	B	10	15	10	25
N25	E	5	15	10	30
N25	F	5	12.5	7.5	20
N26	G	10	15	10	20
N27	I	-2	-2	-2	-2

Ad 5) For each Natura2000 area the sum of the cover has been determined for habitat codes in the following way for the fine and coarse codes respectively.

For the fine habitat codes, first a conversion has been made of the Annex I habitat codes to EUNIS habitat codes (and eCL). In case of more than one EUNIS habitat code per Annex I habitat code, the cover is divided equally over the new EUNIS codes. If the sum of the covers for the whole Natura2000 area for the fine codes is larger than 100%, then these data have been normalized to 100%.

For the coarse habitat codes, first a conversion has been made of the coarse habitat codes to EUNIS habitat codes (and eCL). Again in case of more than one EUNIS habitat code per coarse Natura2000 habitat code, the cover is divided equally over the new EUNIS codes. If the sum of the covers for the whole Natura2000 area for the coarse codes is larger than 90%, then these data have been normalized to 100%. In case the some of these 'coarse' covers is lower or equal than 90%, then a EUNIS-code Y (meaning: EUNIS-code unknown), has been added, with a cover value equal to the missing cover value.

Ad 6) The main approach is to use first the fine (Annex I) habitat information and to combine it with the coarse habitat information in addition only if necessary. So, first it is determined whether the sum of cover for the fine habitat codes is less than 100%. If this is the case, then information has been used of the coarse habitat codes. This additional information is normalized, so that total cover of fine and coarse habitats is 100%.

The results of all these steps are saved in the following tables, which contain information on area identification (variable SITECODE), EUNIS-habitats, cover percentage and eCL.

- SITE_HABIT_EUNIS_ECL_AREA_FINE

Contains the results on the original most detailed level; the finest EUNIS-level is 7; a total number of records of 475,232 records.

- SITE_HABIT_EUNIS_ECL_AREA_DIS

Contains the same information, but records within one area with the same EUNIS-habitat code have been combined; a total of 466144 records;

- SITE_HABIT_EUNIS3_ECL_AREA_DIS

Contains the same information, but now only at the third level of EUNIS-classification and again at this level records within one area with the same EUNIS-habitat code have been combined; a total of 201,589 records. The third level of EUNIS-classification is the finest level used in the designation of eCL to EUNIS-habitats. This table was used to produce the critical load maps in the next section.

4.3. Production of the eCL-maps for Natura2000 areas

Combination of geographical and attribute information

For the production of the eCL-maps for the Natura2000 areas the geographical information from each Natura2000 area and the eCL-information per EUNIS-habitat code have been combined.

Therefore the following steps have been carried out in the personal geodatabase created for the whole of Europe as described in § 2.3.

1) For each country and for each Natura2000 area (or sub-area) the geographical information from the geographical file is linked with the EUNIS-habitat codes and eCL from the attribute-file. Linkage is based on the SITECODE variable(s) for Bird- and/or Habitat Directives. For each EUNIS-habitat in each Natura2000 (sub)area the surface (area?) was calculated by multiplying the percentage cover (see § 4.2.) with the area in hectares. These calculations were carried out for both

Directives, however, in case of two Directives for one sub-area, habitat information had been used from the Habitat Directive.
2) The results of step 1 were combined again for the whole of Europe.
3) For each country Natura2000 areas are selected (based on country code information, the first two characters, in the SITECODE variable). For each EUNIS-habitat code in each Natura2000 area a separate table was made for the eCL-minimum, eCL-maximum and eCL-median-minimum (see for the different eCL § 3.3) and these all other variables for the critical load analysis were included in these tables in a CCE-format. The minimum surface area was adapted to 1 m^2.
4) Exporting of eCL per country.
5) With CCE-programs calculations of different percentile eCL per EMEP-grid cell were carried out and eCL-maps were made.

The resulting eCL-maps for the Natura2000 areas

Several eCL-maps have been produced for the Natura2000 areas for whole Europe based on the EMEP50-grid and compared with a similar eCL-map for all areas (non-Natura2000 ánd Natura2000 areas, based on the SEI-map, see De Bakker *et al.,* 2007). In all these maps EUNIS-classes B and C were not included, because they are yet not included in eCL-map based on the SEI-map. A first evaluation of the maps showed large much lower eCL for the Natura2000-map than for the 'total' map. We suspected, that this could be an artefact of the combination of eCL from fine and coarse habitat-information as described in the procedure in the former section. An obvious reason is that coarse (or high level) habitats often contain some susceptible habitats which lower the eCL. In addition an eCL-map had been made for the Natura2000-areas, without the eCL-information of the coarse habitats.

In Figure 2 the 0% percentile of the minimum eCL of the EMEP-grid cells in several variants are presented. So, these maps show the most vulnerable ecosystems on a European scale. In the upper left part of Figure 2 ('first Natura2000 map') the eCL are shown for the Natura2000-areas. In the upper right part the same ('second Natura2000') map is shown, but now for a 'median-minimum' (in this case for the coarse habitats minimum eCL is calculated as the median of the eCL from their finer habitat-components, see for further explanation, Table 5. and § 3.3.). The lower left part of Figure 2 ('third Natura2000 map') is identical to the upper left part, but now the eCL-information from the coarse habitats have been excluded. Finally, the lower right of Figure 2 ('total map') is identical tot the upper left part, but shows us the eCL for all non-Natura2000 ánd Natura2000 areas.

If the first Natura2000 map is compared tot the total map, almost whole Natura2000 areas show very low eCL. Only for the Scandinavian countries, and the mountainous regions in Europe the eCL ares equal or even higher (e.g. Sweden). In the second Natura2000 map, based on an average of all eCL-minima within one coarse habitat type, large parts of central Europe and the Mediterranean are less sensitive than in the first Natura2000 map. It is also apparent from this map that for some areas, e.g. Poland, there is predominantly coarse habitat information available. The third Natura2000 map shows a similar picture as the total map, though the amount of more sensitive areas in e.g. France and Spain are larger than in the total map. This map shows the strong effect of including eCL-information from the coarse habitats.

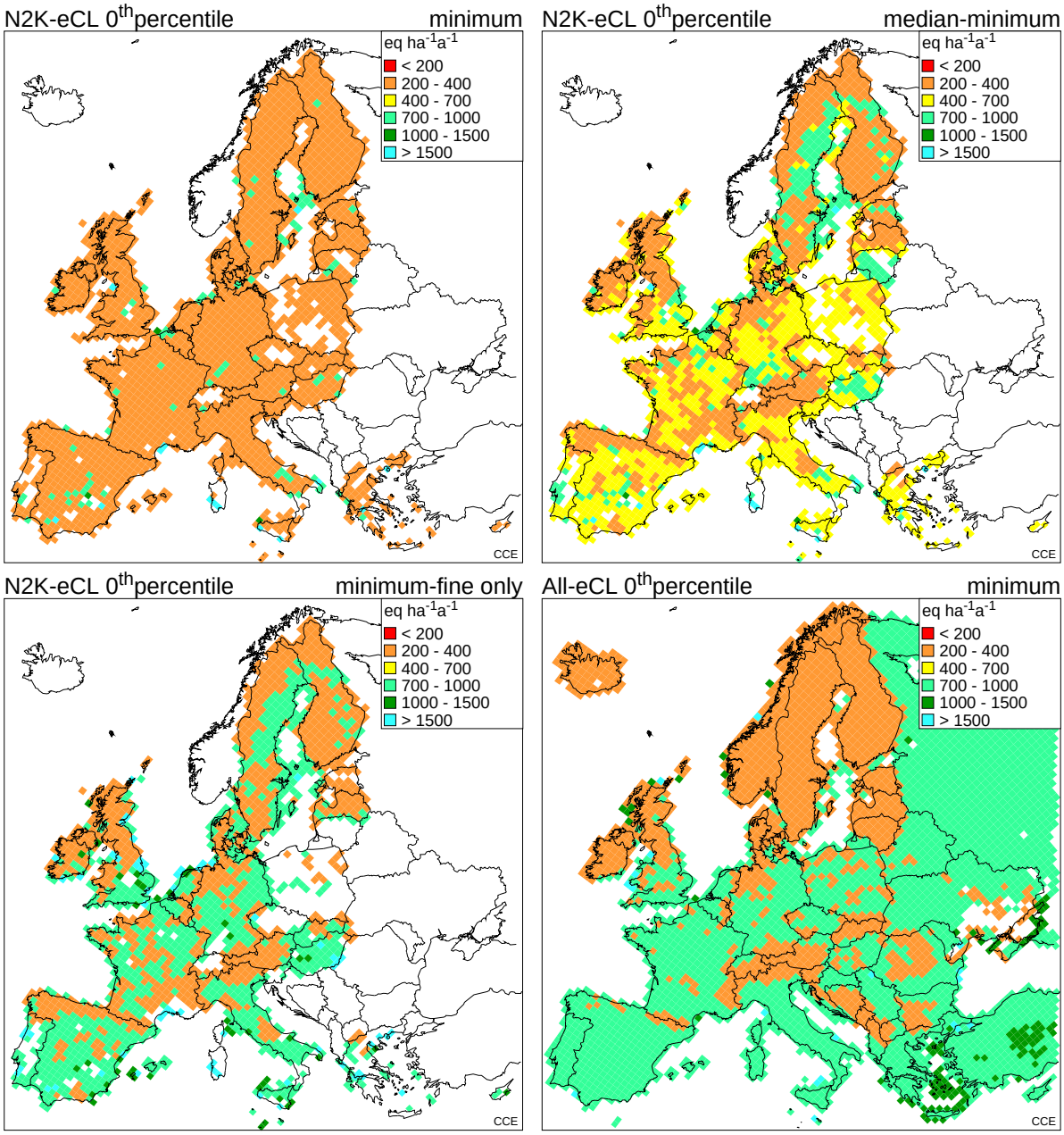


Figure 2. Critical load maps for Natura2000 areas; upper left: 0% percentile of minimum eCL of Natura2000 areas; upper right: 0% percentile of median-minimum eCL of Natura2000 areas (for explanation, see text); lower left: 0% percentile of minimum eCL without eCL information of coarse habitats of Natura2000 areas (for explanation, see text) and lower right: 0% percentile of minimum eCL for all areas.

5. Discussion and recommendations

5.1. Information and production of eCL-maps for Natura2000 areas

For the EU10 countries almost no data were available about the habitats in the Natura2000 areas in the attribute database, which is publicly available from the internet. However, we do know that this information is available and inclusion of this information would be a large improvement of the European Natura2000 eCL-map.

Recommendation 1: The essential habitat information of the Natura2000 areas for the EU10 countries should be made available as soon as possible and included in an improved European Natura2000 eCL-map.

In the processing of the geographical information of the Natura2000 areas a procedure had been used to process the data per country, in order to speed up data handling. As a consequence some information is being lost e.g. marine aquatic Natura2000 areas are not included (because of clipping with country-outline) and parts of Natura2000 areas which are crossing borders, will be stores in wrong country. There is an alternative way of processing of the information, which do not have this drawbacks.

Recommendation 2: An alternative procedure has to be developed, which take into account the presence of marine aquatic Natura2000 areas and which do not assign border crossing parts of Natura2000 areas to neighbouring countries. This can be achieved by using the country information in the geographical database in combination with an overlay with the EMEP50-grid and clipping only for the 100m raster grid at the end.

The geographical database and the attribute database for the Natura2000 areas used in this study were different versions and only a part of the attribute information is free accessible. This hampers the adequate use of all essential data from Natura2000 areas for critical load analysis.

Recommendation 3: The information of the Natura2000 areas should be transparent, normalized, e.g. same versions for different constituent databases, and freely accessible.

An important step in the production of the eCL-maps for Natura2000 areas is the conversion of Natura2000 habitat codes to EUNIS habitat codes. In many cases one Natura2000 habitat type is translated to several EUNIS habitat types on different levels with different possible relationships between the different codes. An alternative approach, not used in this study, is to extract information on EUNIS habitats from the SEI-map, with the advantage of the exact localization of EUNIS-habitats, but the disadvantage of not using the proper habitat information from the Natura2000 areas themselves.

Recommendation 4: The conversion of Natura2000 habitats into EUNIS habitats should be re-evaluated in order to determine whether some relationships (which are now evaluated equally) are ecologically more relevant than other. It should also be investigated whether the use of EUNIS habitat information from the SEI map would be an adequate alternative.

5.2. Integration of Natura2000 areas into the critical load analysis

Natura2000 areas are designated according to the Habitat- and Bird Directives, in which particular habitats and/or species are protected. Habitats are the principal element in the assignment of eCL to Natura2000 areas. However this information is not available yet for the species mentioned in the Habitat- and Bird Directives.

Recommendation5: Information about habitat use of the species mentioned in the Habitat- and Bird Directive is needed, to include them in the critical load analysis. If any habitat information is lacking habitat information could be derived from the SEI-landcover map.

Only for a limited number of EUNIS habitats eCL are available. Additional eCL information is required to improve the critical load analysis. These new eCLs should first become available for the EUNIS classes from the Annex I habitats and for the general habitat descriptions for which eCL information is lacking.

Recommendation 6: Information about eCL should be derived with priority for the EUNIS-classes used in the critical load analysis, which lack this information this moment.

In addition, often only limited cover of detailed ('fine') habitat information was available, so we developed a procedure to include coarse habitat information. However, this has a clear drawback because the eCL-information had to be combined for these coarse habitat types, which might cause artefacts.

Recommendation 7: Information about habitat types should be as specific as possible and with complete coverage. The possible artefacts by using eCL from coarse habitat types should be studied in greater depths.

The exact location of the different habitats within one Natura2000 area is unknown, which causes a problem in case a Natura2000 area crosses an EMEP-grid border. At this moment the only feasible procedure is to divide proportionally the different habitats for that area in the 2-4 neighbouring EMEP-cells.

Recommendation 8: Additional information about the exact location of Annex I habitats within the Natura2000 area could be used to improve the CL analysis, especially in cases where the Natura2000 areas cross EMEP grid borders. See also recommendation 5.

Information on the present, not the desired or restored, habitats seem to be available in the Natura2000 attribute database. Desired or restored habitats could have different habitat codes with different, presumably lower eCL. An update of the habitats in the Natura2000 areas is based on the 6-yearly report of members of the European union.

Recommendation 9: Critical load analysis should preferably be based on the desired/aimed habitat types in Natura2000 areas. If this information is not available, then it should be discussed how the update of habitat information should be included in the critical load analysis, e.g. not to update in case of further decrease in habitat quality with higher eCL.

In this report the first building blocks for a procedure has been described in § 3.3. to prioritize Natura2000 areas for critical load analysis, and how to focus on sensitive areas and to exclude insensitive areas.

Recommendation 10: Whether and how to exclude insensitive habitats and species in the critical load analysis should be further studied, especially which habitats and species are insensitive and the possible ways to take this into account in the analysis.

In this study some general information and principles are used for e.g. the conversion of Natura2000 habitat types to EUNIS habitat types, the habitat and species information in the Natura2000 databases, the eCL based on European studies. However, the NFC may have access to more appropriate and detailed information.

Recommendation 11: It should be investigated how the critical load analysis could be refined by using more detailed and relevant information on a national level regarding the presence of (desired) habitats, monitoring of species, the conversion of habitat types etc.

Information on status and changes in biodiversity is being sampled in the future as part of the Natura2000 program. This kind of information could play a role in the determination of the effectiveness for recovery of biodiversity by the air pollution abatement programs.

Recommendation 12: The possibilities of including biodiversity status of and changes in biodiversity of Natura2000 areas, which will probably become available in the near future, into the critical load analysis, warrants further study.

References

Achermann, B. and R. Bobbink, 2003. Empirical critical loads for nitrogen. Proceedings from the expert workshop held in Bern Switzerland November 11-13 2002. Environmental Documentation no. 164. Swiss agency for the Environment, Forest and Landscape.

Bareham, S.A., M.A. Sutton, A. Van Hinsberg, T. Dirnböck ,M. Hens, M. Sponar, S. Blagodatsky, A. Feest, V. Horlyck, A. Bleeker, A. Teller and B. Delbaere, 2007. Selecting of a European indicator for nitrogen deposition. 1st annual report of SEBI: Streamlining European 2010 Biodiversity, Expert group 4: Nitrogen deposition (final draft).

CCE, 2007. CCE-website, methods and models. http://www.mnp.nl/cce/methmod/

Davies, C.E., D. Moss and M. O'Hill, 2004. EUNIS habitat classification Revised 2004. European Environment Agency, European topic centre on nature protection and biodiversity. http://eunis.eea.europa.eu/upload/EUNIS_2004_report.pdf

De Bakker, N.V.J., M. Van 't Zelfde and W.L.M. Tamis, 2007. A comparison of EUNIS classes and critical loads of nitrogen between NFC-data and the harmonized land cover map under LRTAP Convention, Technical report no. 42, CML, Leiden.

De Vries, W., H. Kros, G.J. Reinds, W. Wamelink, H. Van Dobben, R. Bobbink, S. Smart, C. Evans, A. Schlutow, P. Kraft, S. Belyazid, H. Sverdrup, A. Van Hinsberg, M. Posch and J.-P. Hettelingh, 2006. Developments in modelling critical nitrogen loads for terrestrial ecosystems in Europe. Alterra, CCE (final draft).

EC, 1979. Council Directive 79/409/EEC on the conservation of wild birds, commonly referred to as the Birds Directive.
http://ec.europa.eu/environment/nature/legislation/birdsdirective/index_en.htm

EC, 1992. Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31992L0043:EN:HTML

EC, 1997. 97/266/EC: Commission Decision of 18 December 1996 concerning a site information format for proposed Natura2000 sites. Official journal nº L107 from 24.4.1997.
http://ec.europa.eu/environment/nature/legislation/habitatsdirectiveindex_en.htm#sdf

EC, 2003. Interpretation manual of European Union habitats. EC, DG environment Nature and biodiversity.
http://ec.europa.eu/environment/nature/legislation/ habitatsdirective /docs/ 2007_07_im.pdf

EC, 2005a. Natura2000 – Europe's nature for you. Luxembourg: Office for official publications of the European Communities (folder about Natura2000 sites).

EC, 2005b. Assessment, monitoring and reporting of conservation status – preparing the 2001-2007 report under article 17 of the Habitat Directive. Note European Commission. Brussels, 15.3.2005.

EC, 2006. Assessment, monitoring and reporting under Article 17 of the Habitat Directive. Explanatory Notes & Guidelines. Final Draft, October 2006. http://forum.europa.eu.int/Public/irc/env/monnat/library?l=/guidlines_reporting&vm=detailed&sb=Title

EC, 2007. Monitoring and the Nature directives.
http://forum.europa.eu.int/Public/irc/env/monnat/library?l=/reporting_framework

EEA, 2007. Natura2000 EUNIS database.European Environment Agency.
(http://dataservice.eea.europa.eu/dataservice/metadetails.asp?id=774).

EUNIS 2007. Codes/Classifications. European Environment Agency.
http://eunis.eea.europa.eu/habitats-code.jsp.

GG, 2007, website containing information on *Aeshna viridis*, http://www.groeneglazenmaker.nl/.

LNV, 2003 Nederland werkt aan Natura2000: belangrijke informatie over de aanmelding van Habitatrichtlijngebieden. Den Haag, Ministerie van Landbouw, Natuur-beheer en Visserij.

Moss, D. and C.E. Davies, 2002. Cross-references between the EUNIS habitat classification and the Palaearctic habitat classification. European Environment Agency, European topic Centre on Nature protection and biodiversity EUNIS habitat classification 2001 work programme. Report Centre for Ecology and Hydrology project no. C00389.
http://www.tu-berlin.de/~kehl/project/twinning/documents/pdfs/EUNIS/EUNIS_Palearctic_relation_0202_links_3.pdf

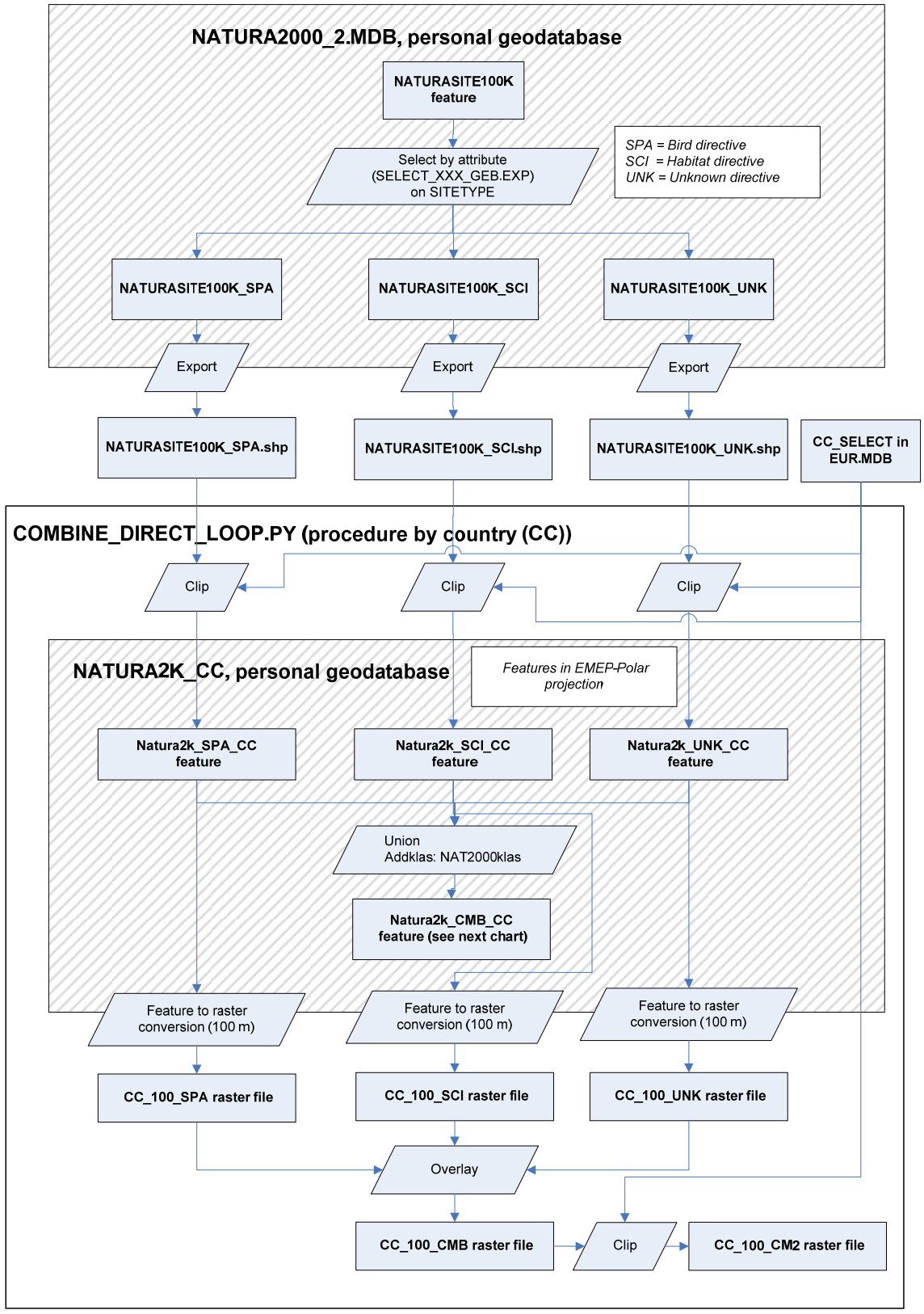
Nilsson, J. and P. Grennfelt (eds.), 1988. Critical loads for Sulphur and Nitrogen Report from a Workshop at Skokloster, Sweden, 19–24 March 1988, NORD. Miljørapport 1988: 15. Nordic Council of Ministers, Copenhagen.

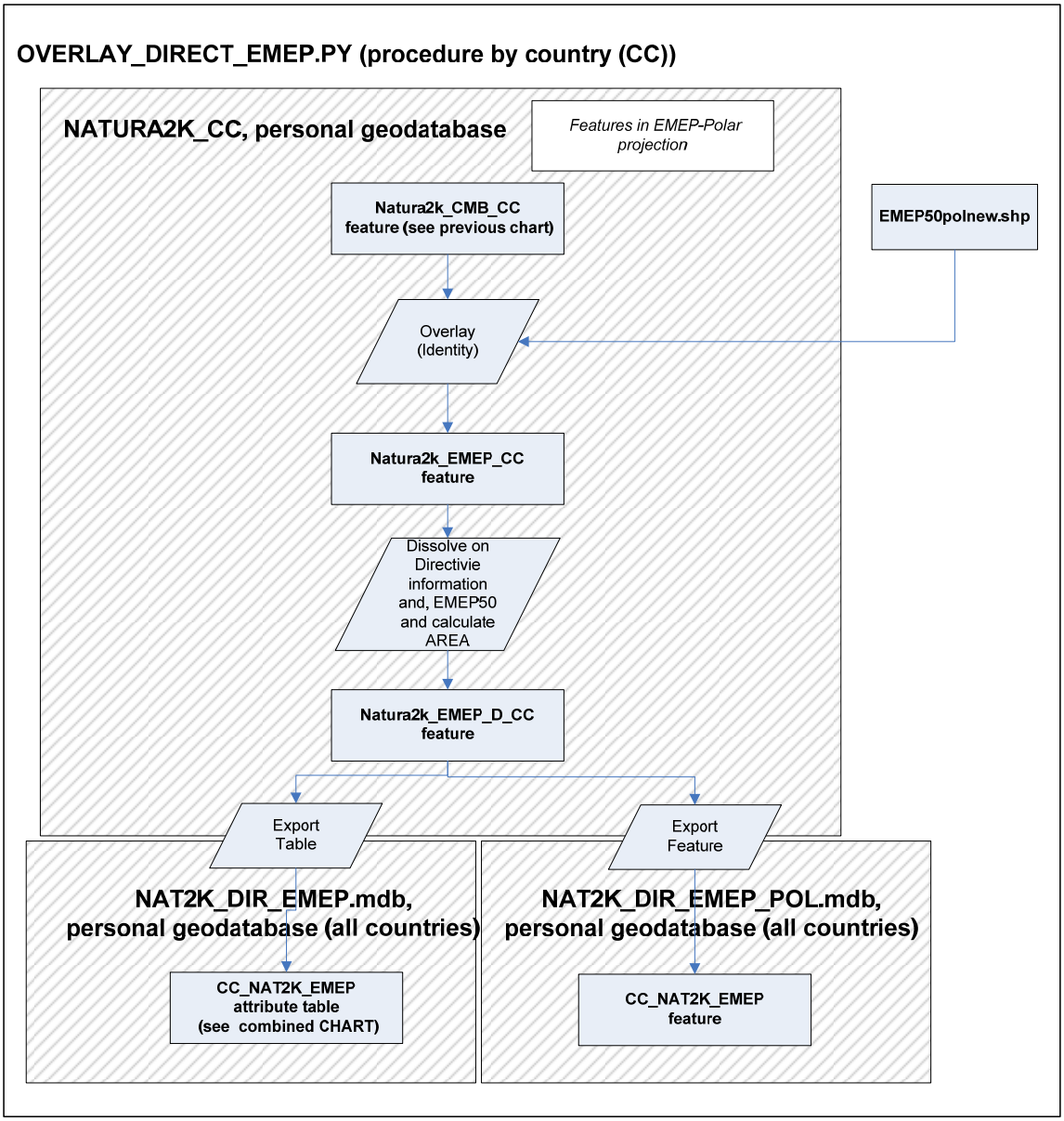
NVL, 2002. Nederlandse Vereniging voor Libellenstudie. De Nederlandse libellen (Odonata). Nederlandse Fauna 4. Nationaal Natuurhistorisch Museum Naturalis, KNNV Uitgeverij & European Invertebrate Survey-Nederland, Leiden.

Annex 1 Flowcharts of data handling for Natura2000 areas

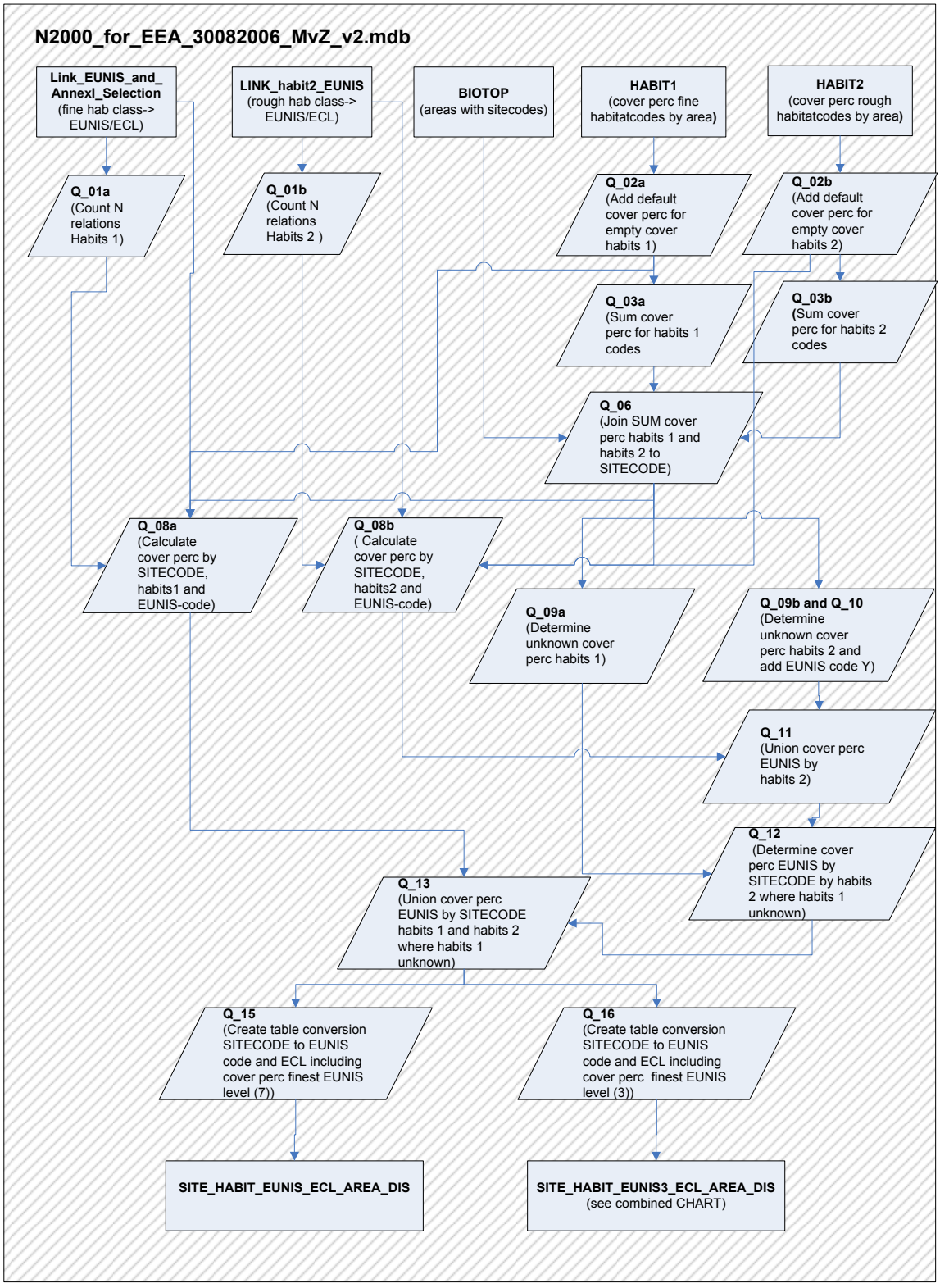
These are three flowcharts for data-handling of:
- spatial information (see section 2.3) on two pages
- attribute information (see section 4.2)
- combination of the spatial- and attribute information (see section 4.3)

Conversion of spatial information of Natura 2000 areas (see section 2.3)

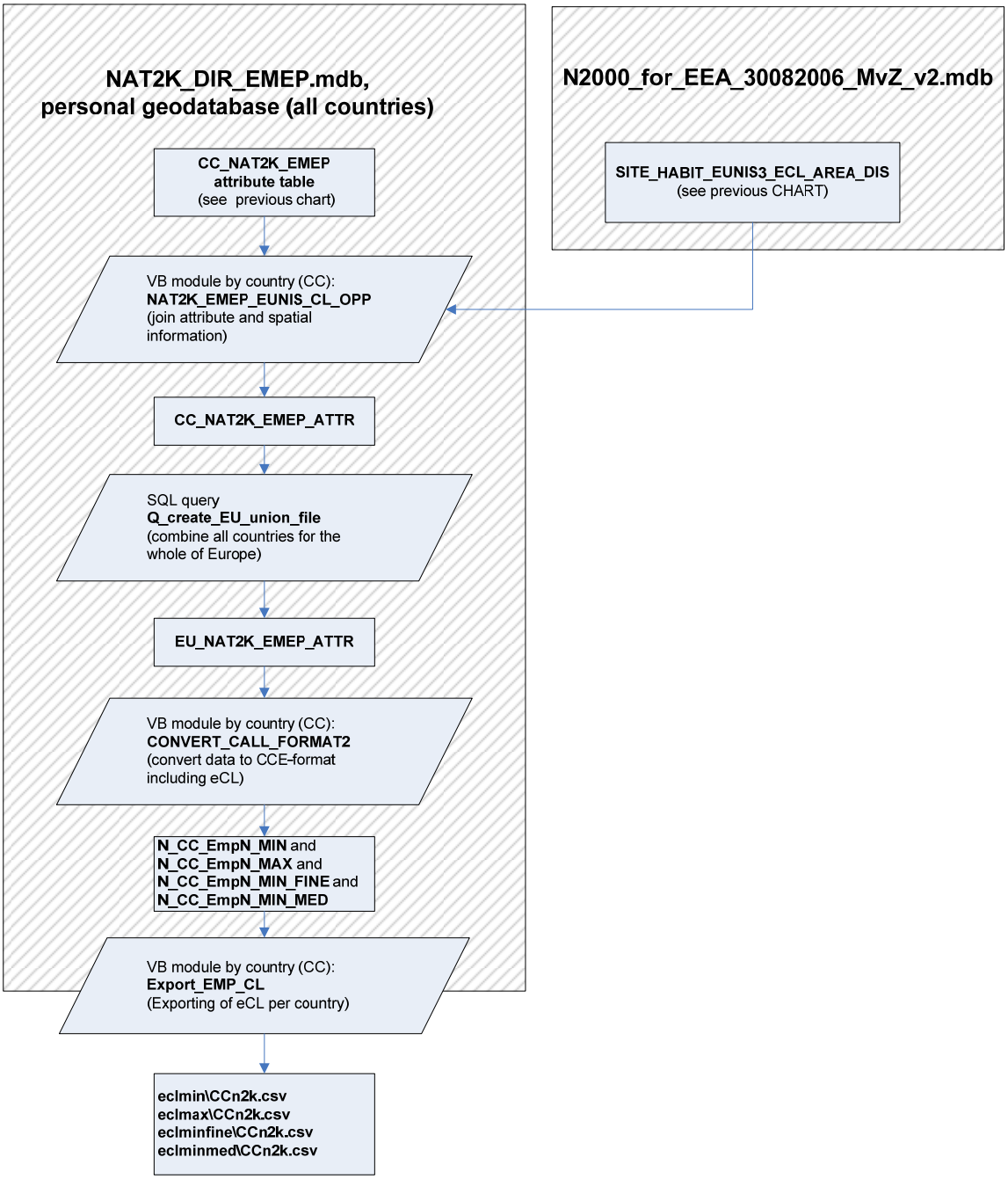



OVERLAY_DIRECT_EMEP.PY (procedure by country (CC))
NATURA2K_CC, personal geodatabase
Features in EMEP-Polar projection
Natura2k_CMB_CC feature (see previous chart)
EMEP50polnew.shp
Overlay (Identity)
Natura2k_EMEP_CC feature
Dissolve on Directivie information and, EMEP50 and calculate AREA
Natura2k_EMEP_D_CC feature
Export Table
Export Feature
NAT2K_DIR_EMEP.mdb, personal geodatabase (all countries)
NAT2K_DIR_EMEP_POL.mdb, personal geodatabase (all countries)
CC_NAT2K_EMEP attribute table (see combined CHART)
CC_NAT2K_EMEP feature

Conversion of attribute information of Natura 2000 areas (see section 4.2)



Combination of spatial and attribute information (see section 4.3)



Annex 2 Overview of directories and files in Natura2000 folder

This overview is alphabetically
- is file
* is directory

*** Annex1**
- **AnnexI_EUNIS_v2.mdb** = Database with conversion of Annex I to Eunis) (Link_EUNIS_and_AnnexI_Selection is final table which have been used
* **BASIS_annex1_data** = Source tables for conversion of AnnexI to Eunis)

*** ARCGIS_91_universes**
Directory with ARCGIS 9.1 projects.

*** ARCGIS_92_universes**
Directory with ARCGIS 9.2 projects.

*** Command_files**
Python scripts for ArcGIS 9.1 (old versions)

*** Command_files_92**
Python scripts for ArcGIS 9.2 (used versions)

Most important scripts:
- **ASCII_EXPORT_NATURA.PY** = export of 100 meter rasters of natura 2000 areas with directive(s) by country
- **COMBINE_DIRECT_LOOP.PY** = overlay of directives for both polygons and rasters and clipping with country bordes. Procedure by country. See report paragraph 2.3
- **OVERLAY_DIRECT_EMEP.PY** = overlay of natura2000 polygons with EMEP50 grid and
- **MOSAIC_100M.PY** = Test-Procedure to try to combine Nat2000 raster maps 100m to one European raster map

*** GIS**
Directory with most of the spatial data.

*** GIS\arjan van hinsberg**
Directory with Natura 2000 spatial files obtained from Arjan van Hinsberg (version December 2006). Original files. 20062 recods.
Spatial part with only site-codes (no directive information).

*** GIS\countries**
For 25 EU-countries spatial outcome of overlay procedures (see directory command_files_92). Files are in Arc_GIS format.

Most important files by country:
- **CC_100_SPA** = 100 meter raster file bird directive
- **CC_100_SCI** = 100 meter raster file habitat directive
- **CC_100_UNK** = 100 meter raster file unknown directive
- **CC_100_CMB** = 100 meter raster combined directives
- **CC_100_CM2** = 100 meter raster combined directives clipped border.
- **NATURA2K_CC.MDB** with directives in polygon format.
Personal geodatabase with features:

- NATURA2K_SPA_CC = polygons bird directive
- NATURA2K_SCI_CC = polygons habitat directive
- NATURA2K_UNK_CC = polygons unknown directive
- NATURA2K_CMB_CC = polygons combined directives (overlay)
- NATURA2K_EMEP_CC = polygons combined directives + emep50
- NATURA2K_EMEP_D_CC = NATURA2K_EMEP_CC dissolved polygons.

*** GIS\databases**
Natura2000 spatial personal geodatabases in different versions

Most important databases:
- **Natura2000_org.mdb**
Original database of 6 december 2005 (22530 sites)
- **Natura2000_1.mdb**
Natura 2000_org.mdb including Natura2000 files Arjan van Hinsberg
- **Natura2000_org_jan2007.mdb**
Original official spatial database version 15 jan 2007 (23105 sites)
- **Natura2000_2.mdb**
Natura 2000_1.mdb including official version 15 jan 2007 (23105 sites)
Most important feature: NATURESITE100K. is starting point for whole conversion procedure and working version.

* **GIS\EEA_version**
Latest Natura2000 files from Peter de Smet (November 2007), 100 m and 250m tiff files

* **GIS\N2000_EEA_30082006_database**
Attribute databases with habitat information downloaded from internet.

Most important versions:
- **N2000_for_EEA_30082006.mdb**
Original downloaded attribute database – date 30 august 2006.
- **N2000_for_EEA_30082006_NdB.mdb**
Exploration database of Nancy de Bakker for overview tables
- **N2000_for_EEA_30082006_MvZ.mdb**
Calculation database with conversion from habits --> Eunis (final)

* **GIS\natura2k_100m_countries**
Directory with all the final 100 meter natura2000 raster files with directive information (ARCGIS-format).

* **GIS\natura2k_100m_export**
Directory with all the final 100 meter natura2000 raster files with directive information (ASCII-format).

* **GIS\outputs**

CL-version in csv format for ECL files in four formats. (see &3.3)

* **GIS\outputs \eclmax**
Maximum ECL

* **GIS\outputs \eclmin**
Minimum ECL based on absolute minimum

*** GIS\outputs \eclminfin**
Minimum ECL only for fine habitat codes (Annex1)

* **GIS\outputs \eclminm**
Minimum ECL based on median minimum

* **GIS\output_database**
Databases for combining spatial and attribute data.
- **NAT2K_DIR_EMEP.mdb** = Attribute table of spatial database + Combining of spatial and attribute data.

Most important VB-modules:
1 **NAT2K_EMEP_EUNIS_CL_OPP**
Calculation of area of EUNIS class by unique combination of site, directive and EMEP cell by country
2 **Q_CREATE_EU_Union_file**
Query for union of all country-parts.
3 **CONVERT_CALL_FORMAT**
Selection by county of necessary information for MAKEDAF application (eCL-maps)
4 **EXPORT_EMP_ECL** Export of eCL maps by country in csv format.

- **NAT2K_DIR_EMEP_code.mdb** **=** Program code of Nat2K_DIR_EMEP.mdb
- **NAT2K_DIR_EMEP_POL.mdb** = All polygons dissolved on natura2000 directive, EMEP cell by country

* **GIS\reports**
Reports of ArcGIS python scripts.

In GIS-folder three arcview shapefiles:
- **NaturaSite100K_SCI** = for Europe selected habitat directive polygons
- **NaturaSite100K_SPA** = for Europe selected bird directive polygons
- **NaturaSite100K_UNK** = for Europe selected unknown directive polygons

* **habit2**

- **habit2_eunis.mdb**
With table **LINK_habit2_EUNIS** for conversion rough habitatcode to EUNIS code

* **jslscripts**
Some copied jsl-scripts

* **NFC_data**
Directory for testing overlay Natura2000 areas (old) with NFC-points

* **offertes**
Original offers of project

* **original_Data**

* **original_Data \database_30082006**
Atribute database of Natura 2000 downloaded.

* **original_Data \Documentation**
  Background information about Natura 2000

* **original_Data \GSEforest**
  Spatial database with 22530 sites EU15 only
  By Mette Lund who have obtained on 19 mei 2006 a version of Danny vd Broeke (6 december 2005)

* **original_Data \N2k**
  Spatial database with EU15 sites (20062) and EU10 spatial and attribute data By Mette Lund (19 juli 2006)

- N2K.zip (zipped file version of above described directory)

- **Natura2000 2007_07.zip**
  100 m tif en 250 m tif obtained by Peter de Smet.

- **Official_CD_original_july2007**
  Zipped version of original green CD (23105 sites) which have been used. (15 januari 2007)

* **python**
  Some test pythonscripts

* **Report**
  Different versions of CML-report about Natura2000-project