Assessing Nitrogen Deposition Impacts on Conservation Status – Topic 2

Comparison of approaches to assessing and reporting nitrogen deposition impacts on conservation status (Habitats Directive Article 17) and discussion of harmonising approaches for future reporting rounds

Background Document for the 'Nitrogen Deposition and Natura 2000: Science & practice in determining environmental impacts' Workshop at the Bedford Hotel and Conference Centre, Brussels, 18th – 20th May, 2009

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Summary

The Habitats Directive requires Member States to take measures to maintain at, or restore to, favourable conservation status, natural habitats and species of Community Importance. Member States are required to report on the implementation of the Directive every six years, including an assessment of conservation status (Article 17).

Nitrogen deposition impacts are considered to be a significant threat to sensitive habitats across Europe. Therefore, it is necessary to understand the effects of nitrogen deposition on attaining favourable conservation status. In turn, this should inform air pollution policy development, helping to target it appropriately to account for the objectives of the Habitats Directive.

For the recent Article 17 reporting round, which covered 2001-2006, a number of Member States have included an assessment of nitrogen deposition impacts based on an application of critical loads. Other Member States have used evidence from field surveys or a combination of these alongside critical loads assessments. However, the detection and attribution of nitrogen deposition impacts is not straightforward, and the application of critical loads in this context also raises a number of challenging questions.

This background paper identifies some of the key issues concerning the assessment of nitrogen impacts on conservation status. These will be expanded on and discussed at the workshop with a view to sharing experience and good practice, and with a forward look to improving methodologies and consistency in their application for the next reporting round in 2013.

1. Introduction

The Habitats Directive (92/43/EEC) together with the Birds Directive (79/409/EEC) are the main drivers of Europe's nature conservation policy. The Habitats Directive promotes the maintenance of biodiversity and requires Member States to take measures to maintain or restore the threatened natural habitats and wild species listed in the Directive at favourable conservation status, introducing robust protection for those habitats and species of European importance.

The provisions of Article 17 of the Habitats Directive require Member States to produce a report every six years on the implementation of the Directive, including the assessment of **conservation status** of all the relevant habitats and species listed in the Annexes of the Directive. The second report, which covered the period 2001-2006, included such assessments for the first time. The methodology for assessing the impacts of nitrogen deposition on conservation status is the subject of this workshop topic.

Nitrogen deposition remains a threat to biodiversity across large areas of Europe (CCE, 2008). This concern is reflected in the incorporation of an indicator for nitrogen deposition under the Streamlining European Biodiversity Indicators 2010 (SEBI 2010) programme (EEA, 2007), which helps measure progress towards the European target to halt the loss of biodiversity by 2010. Common assessment methods, such as critical loads, are already well established for use in European air pollution policy development. Critical load exceedance maps identify areas at risk from atmospheric nitrogen deposition. They show that a substantial area of semi-natural habitat in Europe exceeds the critical loads (see Figure 1).

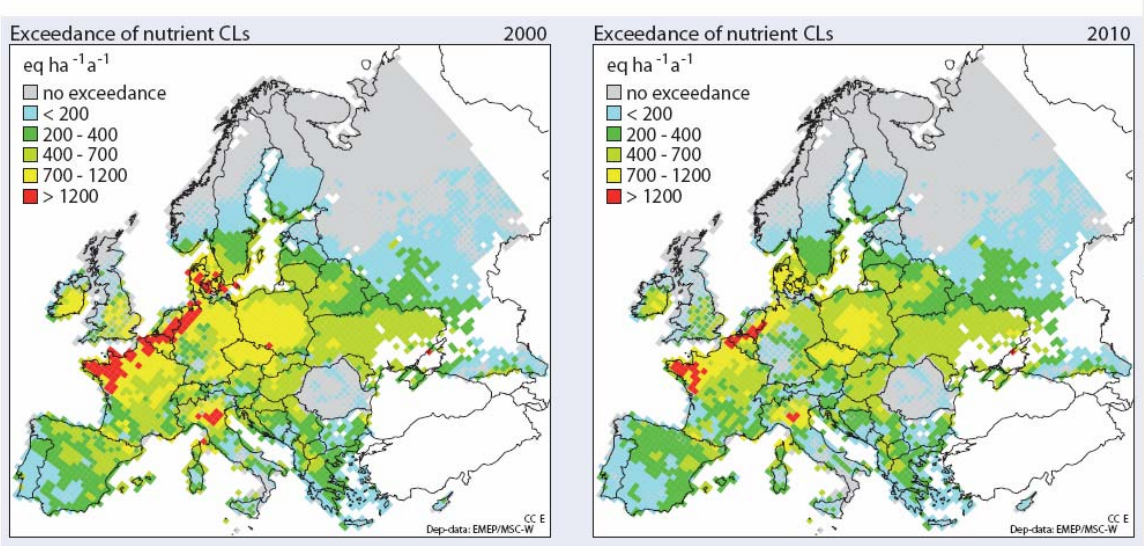

Figure 1. Exceedance of critical loads for eutrophication by nitrogen deposition in 2000 and 2010 under current legislation (courtesy of CCE, 2008).

Since the Habitats Directive is one of the priorities in European nature conservation policy, it is important to understand the risks from nitrogen deposition to achieving the Directive's objectives. An assessment of nitrogen deposition impacts on attaining favourable conservation status, based on a robust assessment approach, is essential to inform air pollution policy development and to ensure that it is targeted appropriately to help achieve the objectives of the Habitats Directive.

In this background paper we provide an introduction to the reporting of conservation status and consider how nitrogen deposition may impact on conservation status. We then provide a summary of the approaches taken by a selection of Member States to assess nitrogen deposition impacts on conservation status. An overview is then presented of the preliminary results from the most recent reporting round, in relation to the reporting of "air pollution" and "eutrophication" as a "pressure" or a "threat". Building on this experience and anticipating the next reporting round in 2013, we aim to begin to identify some key questions and challenges, concerning assessment methodology and procedures, which require further development to ensure a harmonized, robust and consistent approach between countries. Overall, the aim is to share experience and to open up discussion on the methods and mechanisms for future assessments.

2. An introduction to conservation status assessments

(a) Background to reporting

The Habitats Directive requires Member States to report every six years on the conservation status of the habitats listed in Annex I and the species listed in Annexes II, IV and V of the Directive. The methodology for reporting conservation status is determined by the EC Habitats Committee. Supplementary guidelines were produced by the European Commission in collaboration with Member States (European Commission, 2006) to ensure that the reporting is done on a consistent and comparable basis. The reporting format requires a separate analysis for each habitat and species in each biogeographical region that a country covers.

Favourable Conservation Status (FCS) of a habitat is defined in Article 1(e) of the Directive as being when:

- Its natural range, and areas it covers within that range, are stable or increasing, and
- The specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- The conservation status of its typical species is favourable as defined in Article 1(I).

FCS for a species is defined in Article 1(I) of the Directive as being when:

- Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- There is, and will probably continue to be, a sufficiently large habitat to maintain its population on a long-term basis.

In other words, in simple terms it can be described "as a situation where a habitat type or species is prospering (in both quality and extent/population) and with good prospects to do so in future as well" (European Commission, 2006).

The Commission guidance states that the range and area of the listed habitats, and the range and population of the listed species, should be at least maintained at their status when the Directive came into force or, where the status at that time was not viable in the long term, should be restored to a position where it would be viable. The six-yearly reports are intended to measure the effectiveness of the Directive in meeting its aims, which are essentially to secure favourable conservation status. The 2001-2006 report provides a baseline by which future assessments can be judged.

It is very important to recognise that the assessment of conservation status for a habitat or species should be made across the whole of its range, rather than being confined to Special Areas of Conservation (SAC) (which together with Special Areas of Protection make up the Natura 2000 network). The proportion of a feature which occurs within SACs will vary on a case by case basis and between countries and biogeographic areas. In many cases a substantial proportion occurs outside SACs in the 'wider countryside' or seas.

The Commission guidance stipulates four parameters for assessing the conservation status of habitats. These are:

- Range
- Area
- Specific Structures and Functions including typical species
- Future Prospects

For species, the parameters are:

- Range
- Population
- Habitat for the Species
- Future Prospects

Each of these parameters is assessed as being in one of the following conditions: Favourable, Unfavourable-Inadequate, Unfavourable-Bad, or Unknown, according to agreed standards (European Commission, 2006). In addition to assessing the individual parameters referred to above, Member States are also required to make an overall assessment of the conservation status of each of the habitats and species following an agreed method. This overall assessment is determined by reference to the conclusions for the individual parameters, and, in general, reflects the least favourable of the individual parameter conclusions.

(b) Taking nitrogen deposition into account

As stated above, for the conservation status of a habitat to be favourable, "the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue

to exist for the foreseeable future". Habitat structure and habitat function varies widely between different habitats, but it is clear that the various ecological processes essential for a habitat have to be present and functioning for the habitat to be considered to be at favourable conservation status (European Commission, 2006).

A large number of the habitats (and species, either directly or indirectly) listed under the Habitats Directive are sensitive and potentially vulnerable to atmospheric nitrogen deposition. Nitrogen deposition may cause changes to composition, often including a reduction in species richness and a loss of sensitive 'lower plants'; changes to soil microbial processes; changes to plant and soil biochemistry; increased susceptibility to abiotic stresses (such as winter injury) and biotic stresses (such as pests and pathogens); and it also contributes towards acidification (NEGTAP, 2001). It is clear that such impacts could adversely affect the "specific structures and functions" element of conservation status, as well as threatening the future prospects, for sensitive habitats and species. In some cases nitrogen deposition may also have affected the range of a habitat (though change in species composition) or species.

Under the assessment of "specific structures and functions" for habitats Member States are required to provide a list of the "main pressures" currently acting on each habitat. Similarly, for the "future prospects" assessment, future threats (to the range, extent, structures and functions) must be documented. The guidance (European Commission, 2006) provides an example under the notes for "future prospects" for defining "unfavourable-bad" (i.e. the habitat's prospects are bad, severe impact from threats expected; long-term viability not assured) as "under pressure from significant adverse influences, e.g. critical loads of pollution exceeded".

The EC guidance lists a suite of pressures and threats (European Commission, 1997) including "air pollution" (code 702). "Eutrophication" (code 952) is also listed separately, but in the context of biocenotic evolution (ecological succession). However, there is no guidance on the definitions of the listed pressures/threats, which are open to inconsistent interpretation, nor are there criteria for judging whether the severity of threat warrants its inclusion (but note that this is now being addressed by the EC Expert Group on Reporting). Presumably "air pollution" would be expected to include consideration of acidic and eutrophying deposition (and direct effects of the gases associated with these pollutant species) and ozone, in so far as an assessment is possible.

As documented in the introduction to this paper, the most recent reporting round for Article 17 was 2007/8 and covered the period 2001-2006. Currently, the Commission and the European Topic Centre for Biological Diversity (ETC) are collating and analysing the results with a view to publishing a report this summer. The ETC has kindly provided the authors of this paper with a working draft copy of a database of the results of the conservation status assessments. This has allowed an analysis across the EU, Member States and biogeographic regions of where "air pollution" and/or "eutrophication" have been identified as a pressure or threat for each habitat assessment.

The main focus of this background paper is on the assessment for Annex I habitats, rather than species, since most information is available for these; and a comparison to other assessment tools, such as critical loads, is more straightforward. However, an assessment is still required for species and this will be covered in discussions at the workshop if time permits.

3. Examples of the methodology used by a selection of Member States

(a) Introduction

Member States were required to submit Article 17 reports, including conservation status assessments, in 2007. Each individual habitat and species assessment (by country and biogeographic region) is available on the ETC's website (http://biodiversity.eionet.europa.eu/article17). However, as stated earlier, the EC guidance (European Commission, 2006) on Article 17 reporting did not include guidance or criteria for identifying and assigning the main pressures and threats, and there was no obligation to provide details of the methodology used for such purposes. As a consequence, whilst it is possible to query the results of the individual habitat/species assessments, information on the generic approach to nitrogen deposition assessment is only available for a small number of countries (notably UK and Denmark) through the ETC website (http://rod.eionet.europa.eu/countrydeliveries?actDetailsId=269).

In an attempt to present an overview of approaches taken by different Member States, the authors requested details of the methodology used by a selection of Member States from members of the workshop advisory committee and other contacts. The summaries below reflect responses received. The paper describes methods of the UK, Denmark, Belgium, Austria, Germany and The Netherlands. Contacts from some other countries have indicated that there was no explicit consideration of the issue (i.e. Czech Republic and Portugal). However, overall 18 Member States have reported air pollution as a threat or pressure for at least one habitat assessment (and likewise all 25 reported eutrophication, although this may include non-atmospheric inputs and discharges to water in marine and freshwater/wetland habitats).

It is hoped that representatives from a range of Member States will present their methodology at the workshop.

(b) Country Summaries

UK

The UK assessment of "specific structures and functions" for habitats was made based on the main pressures currently acting on the habitat, information on the habitat condition and, where relevant information was available, the status of typical species associated with the habitat.

Information on habitat condition from site condition monitoring formed a major component of the assessment. However, since the approaches used for site condition monitoring in the UK are largely based on fairly rapid visual assessment of key attributes of the habitat, it is acknowledged that this is not a sensitive tool for detecting and, in particular, attributing nitrogen deposition impacts (Williams, 2006). Therefore, a nitrogen deposition assessment, based on the use of empirical nutrient nitrogen critical loads and modelled nitrogen deposition from the UK models FRAME (Singles et al., 1998) and CBED (Smith et al., 2000), was also undertaken. This also has the advantage of providing a predictive approach for assessing 'future threats'. The methodology is reported in a technical annex to the UK's submission

(http://www.jncc.gov.uk/pdf/FCS2007_techIII_airpollution.pdf) but a brief summary is given below.

The critical loads based assessment was carried out for Annex I habitats only. Species were excluded because of the difficulty in linking habitat-based critical loads to effects on individual species. Habitats judged not to be sensitive to nitrogen deposition (and acidification) impacts were also excluded from the assessment. In addition, habitats which could not be assigned a critical load (see later) were excluded.

The UK does not have nutrient nitrogen critical load maps for Annex I habitats, so existing critical loads information was adapted for the purposes of the conservation status assessments. The UK was in a fortunate position having undertaken a substantial exercise to assign relevant critical loads to interest features on SACs known as Site Relevant Critical Loads (SRCL) (Bealey et al., 2007). Exceedance data for all sensitive Annex I habitats as they occur in SACs is therefore available. In this exercise, the 'relevant' critical loads were assigned to Annex I habitats where there is adequate equivalence with a EUNIS class for which critical loads have been assigned (UNECE, 2003). A few Annex I habitats which are potentially sensitive had to be excluded because there is not a habitat for which a critical load is set, which has sufficient equivalence with the Annex I habitat. This assignment of 'relevant' critical loads to Annex I habitats based on the EUNIS habitat classification is critical; it is a common theme amongst those countries which have used a critical loads based assessment for conservation status reporting, and will be considered in the workshop discussion.

However, the UK's SRCL exceedance data only provides information for the proportion of habitats which occur within SACs. To ensure the assessment adequately represented the risk to the whole Annex I habitat resource, a combined approach was used which drew on UK national critical loads exceedance mapping for Broad Habitats (Hall et al., 2003) (as defined under the UK's Biodiversity Action Plan (BAP) which is a part of its contribution to the Convention on Biological Diversity) in addition to the SRCL data. Difficulties with different habitat classifications, resolution of mapping and so on meant that only a qualitative assessment was possible.

Where 'relevant' critical loads are exceeded over a significant area for a particular habitat, air pollution was listed as a current "pressure" and future "threat" (future/foreseeable impacts). Any field evidence of impacts on the habitats, or other impacts information, was also used to inform whether air pollution would be listed as a current pressure or future threat. In practice, this was largely confined to coastal habitats, which were not well represented by the critical loads exceedance assessment, and freshwater habitats, for which there were no applicable critical loads.

Denmark

Denmark has established a new national monitoring programme (NOVANA) (Svendsen et al., 2005) which includes systematic monitoring of terrestrial habitats (and species). This aims not only to provide information on status and trends, but also to provide insight into natural and anthropogenic pressures in order to inform management. For each Annex I habitat, a set of measurable indicators of favourable conservation status has been developed. These define favourable biological status for the habitat type in question and what physical-chemical

conditions are required for this favourable status to be maintained. The programme is not only designed to detect any changes in conservation status, but also to give answers as to why the changes have happened. The programme combines intensive and extensive monitoring. The intensive monitoring will elucidate cause-effect relationships between trends, pressures and conservation status. The extensive monitoring provides representative data at national scale. Some of the parameters measured between the two are the same, but the frequency is lower in the extensive monitoring.

A number of the indicators relate to nutrient effects because of the established concern over eutrophication. These typically include nitrogen deposition (which should not exceed the relevant critical load (based on UNECE 2003)), C:N ratio in soil, tissue N content and pH, as well as species composition parameters.

Relevant empirical critical loads have been assigned to each Annex I habitat based on equivalence between habitat types (as in the UK and the Netherlands)

In the article 17 report, Denmark reported "unknown" future prospects for forest habitats, because the positive effects of better pollution control, nature and forest restoration/protection might outweigh the negative effects of air pollution within the next 20-30 years. However, it is recognised that there is uncertainty concerning this and little quantification of the true extent of critical load exceedance of forest habitats. As a result air pollution has not been listed as a pressure/threat on the forest habitat types in the Danish Article 17 report.

The Netherlands

There is no specific documentation within the Netherlands' Article 17 submission in respect of the approach for N deposition assessment. However, the results have shown that nitrogen deposition is a pressure and threat for several habitat types. This was based on a scientific report providing an approach for assessing nitrogen deposition impacts in Natura 2000 areas (Van Dobben and Van Hinsberg, 2008), which was subsequently adopted by the Dutch government (Dick Bal, pers comm.).

Van Dobben and Van Hinsberg (2008) provide a basis for setting critical loads for all Annex I habitat types based on a phased application of empirical critical loads for nutrient nitrogen (UNECE, 2003), model results and expert opinion:

- Phase 1. The Annex I habitat is compared to the habitat types (based on EUNIS habitat classification) for which empirical critical loads have been set (UNECE 2003). There are two possible outcomes (a) the Annex I habitat is equivalent to, is part of, or sufficiently resembles a habitat type defined under EUNIS for which a critical load range is set (referred to as "UN type"); or (b) the Annex I type does not resemble, or does not sufficiently resemble a UN type.
- Phase 2. The result from Phase 1 needs to be further refined (a) (i.e. value set within range) or estimated (b). As far as possible this is done on the basis of model results (from the SMART2 model). Where there are no sufficiently reliable model results a Phase 3 is required.

- Phase 3. This uses expert opinion to set the critical load (and indicates uncertainty) on the absence of reliable estimates from the model.

It is currently unclear how this critical loads information is then used within the conservation status reporting and we hope that this can be clarified at the workshop.

Austria

The conservation status assessments in Austria were undertaken by nine separate States. There was no common countrywide approach to reporting "air pollution" or "eutrophication" pressures or threats across a range of habitat types. These assessments were done exclusively by expert knowledge for all species and habitats (Thomas Dirnböck, pers. comm.).

Germany

Germany has not directly used critical loads, as such, for Article 17 reporting, but nitrogen deposition and eutrophication play an important role for assessing conservation status, being taken into account mainly in the assessment of structure and function, including typical species, via a series of evaluation matrices for every habitat/species that were negotiated with experts and the Federal Länder in order to ensure at least within Germany a homogenous approach of the 16 Federal States (Länder) (Axel Ssymank, pers. comm.).

Portugal

There is only one record of air pollution and two records of eutrophication as a pressure/threat on Portuguese habitats. These relate to grasslands. It was not possible to find any reports specific to this subject from the Portuguese Institute for Nature Conservation and Biodiversity (ICBN) or through direct contact, so the underlying assessment is unknown presently. However, the view of the some of the Portuguese scientific research community is that the impact of nitrogen on biodiversity is not a priority subject for conservation biology and management, in the ICBN. Thus, nitrogen deposition was unlikely to have been considered in habitat conservation status reporting. However, there is more widespread concern from Portuguese scientists regarding nitrogen (particularly ammonia) deposition impacts on biodiversity (Cristina Branquinho, pers. comm.). A range of publications document the use of lichens as biomonitors and the impacts on epiphytic lichen communities (Pinho et al., 2008 & 2008).

Belgium

The Article 17 reporting for Belgium has been conducted separately for the Atlantic and Continental biogeographical regions in Belgium. The Research Institute for Nature and Forest (INBO) was responsible for the conservation status assessments of habitats and species in the Atlantic region of Belgium, which encompasses nearly the whole of Flanders.

In Flanders, reports on nitrogen deposition and critical load exceedance in a number of ecosystems (forests, grassland, heathland) are published annually (see www.milieurapport.be, www.natuurindicatoren.be). These reports are based on modelled deposition rates (1 km^2 spatial resolution, OPS-model) and on a geographically distributed set of point locations for which 'exact' critical load values are available. 'Exact' means that detailed soil profile information and vegetation characteristics have been taken into account to determine the part of the critical load range to apply for each of these points.

For the Article 17 reporting, a somewhat more empirical and simplified approach was used to assess the pressures and threats from nitrogen deposition. For each Annex I habitat type, a single empirical critical load for nutrient nitrogen was put forward, based on critical load literature and expert judgement. This critical load value was compared to average nitrogen deposition rates during the period 2001–2006 . Hence, spatial variation was not accounted for in N deposition or for differences in critical loads between locations or between Natura-2000 sites.

Habitat types for which the average 2001–2006 deposition exceeded their critical load where identified. For these types, fertilisation ('120') and air pollution ('702') were listed among the main pressures and as threat in the habitat assessment. Subsequently, the conservation status at biogeographical level regarding both 'specific structures and functions' and 'future prospects' was scored as either inadequate (U1) or bad (U2), depending on other pressures and threats.

Although roughly in line with common practice among member states, INBO is aware that this pragmatic approach should be refined and improved for future conservation statues assessments. INBO is currently looking into ways to improve the spatial resolution of model-based assessments and to complement this approach with measurements of N enrichment effects (cause-effect monitoring).

4. Illustrations of the results from the 2007 Article 17 report

The preliminary results from the 2001-2006 conservation status assessments, amounting to some 2771 habitat records, have been provided by the ETC. This has allowed an analysis across the EU's different countries and biogeographic regions of when "air pollution" and "eutrophication" have been identified as a pressure or threat for each habitat assessment.

The tables below provide an illustration of some potential outputs from the dataset. However, interpretation of the results should be made with caution: different methodologies have been used (as presented in Section 3); the use of pressure/threat categories "air pollution" and "eutrophication" appear to have been used variably between countries; and some countries made no assessment of the impacts of nitrogen deposition (whether because of no evidence/concern of nitrogen deposition impacts or because of no methodology, is not usually clear). Therefore, the results do not necessarily give an accurate representation of nitrogen deposition impacts on conservation status across the EU. No comparison has been made with other pressures of threats as there is no guidance on prioritisation or weighting the relative importance (see comment in Section 2: this is now being addressed by the EC Expert Group).

Table 1 presents the proportion of records per broad habitat class across all Member States which have listed air pollution or eutrophication as a pressure to structure and function or as a threat to the future viability of the habitat. It is important to note that results also reflect other sources of eutrophication (and other nutrients for example phosphates) as well as atmospheric nitrogen deposition, particularly for habitats dominated by water and land-based sources such as marine, coastal and halophytic habitats and freshwater habitats.

Table 1. Proportion (%) of records (habitat/biogeographic region/country) which record air pollution (code 702) or eutrophication (code 952) as a pressure or threat in Article 17 reporting for 20001-2006.

Broad Habitat Class	Pressure (%)	Threat (%)	Total number of records
Marine, coastal and halophytic habitats	25	25	351
Coastal sand dunes and continental dunes	36	37	258
Freshwater habitats	37	40	362
Temperate heath and scrub	30	31	134
Sclerophyllous scrub (matorral)	10	10	116
Natural and semi-natural grassland formations	27	29	416
Raised bogs and mires and fens	36	37	275
Rocky habitats and caves	18	19	276
Forests	21	22	583

Table 2 presents, by country, the proportion of habitat assessments for four broad habitat classes (as defined under Annex I of the Habitats Directive) which report air pollution or eutrophication as a pressure. These four broad habitat types have been selected for illustration as they will tend to be dominated by atmospheric inputs (but not exclusively) of reactive nitrogen. These results can be compared to an estimate of risk from nutrient nitrogen deposition for each country, based on critical load exceedance in 2000 (EMEP domain) (CCE, 2008). The critical loads data incorporates all "natural ecosystem" area (as used by CCE, 2008), and care should be taken when comparing these with the columns presenting Article 17 assessment results which are presented as a proportion of the number of records per country which identify air pollution/eutrophication as a pressure (i.e. are illustrative of sensitivity and vulnerability) and are not illustrative of area. However, the table usefully shows that there are a number of countries where critical loads are exceeded over a substantial proportion of natural habitat, but where there are no records of air pollution or eutrophication being listed as a pressure (or threat – data not shown).

*Table 2. Proportion (%) of assessment records for each Member State's Article 17 reports for 2001-2006, which show air pollution (code 702) or eutrophication (code 952) as a pressure for the broad habitat classes: forests; temperate heath and scrub; natural and semi-natural grassland formations; raised bogs and mires and fens. Final column shows % of natural ecosystem area at risk of eutrophication based on critical loads exceedance in 2000 (CCE, 2008), this figure is not directly comparable with previous columns which show % of records not of area. * UK figure is considered an underestimate (see Hicks et al., 2008) and national estimate is 61% (Hall pers comm.). Number of assessment records is shown in parenthesis.*

Country	Code	Proportion of assessments (%) showing air pollution or eutrophication as a pressure				% 'natural ecosystem' area exceeding nutrient N CL in 2000
		Forests	Temperate heath and scrub	Natural and semi-natural grassland formations	Raised bogs and mires and fens	
Austria	AT	69 (32)	50 (4)	21 (24)	33 (15)	100
Belgium	BE	50 (20)	100 (4)	40 (15)	54 (13)	100
Bulgaria	BG	No data	No data	No data	No data	94
Cyprus	CY	0	0	25 (4)	0	68
Czech Republic	CZ	72 (25)	71 (7)	71 (21)	56 (9)	100
Germany	DE	86 (36)	33 (9)	23 (30)	64 (22)	84
Denmark	DK	0	100 (4)	44 (9)	85 (13)	100
Estonia	EE	0	0	0	13 (8)	67
Greece	EL	7 (27)	0	0	0	98
Spain	ES	6 (53)	0	6 (33)	47 (19)	95
Finland	FI	6 (17)	0	0	6 (16)	47
France	FR	2 (62)	16 (19)	30 (46)	44 (27)	98
Hungary	HU	0	0	0	20 (5)	100
Ireland	IE	0	33 (3)	0	0	88
Italy	IT	0	0	0	0	69
Lithuania	LT	15 (13)	0	0	0	100
Luxembourg	LU	0	100 (1)	29 (7)	100 (3)	100
Latvia	LV	11 (9)	0	0	14 (7)	99
Malta	MT	0	0	0	0	No data
Netherlands	NL	100 (7)	100 (2)	75 (8)	100 (7)	94
Poland	PL	28 (25)	25 (8)	37 (19)	0	100
Portugal	PT	0	0	19 (16)	0	97
Romania	RO	No data	No data	No data	No data	19
Sweden	SE	26 (35)	100 (8)	100 (31)	65 (23)	56
Slovenia	SI	0	0	11 (18)	0	98
Slovakia	SK	0	0	0	11 (9)	100
United Kingdom	UK	91 (11)	83 (6)	78 (9)	67 (9)	26*

5. Identification and discussion of key issues

(a) Introduction

In this paper, we have provided an introduction to conservation status reporting and have attempted, in so far that it has been possible, to provide examples of the methods used by a selection of countries to assess whether nitrogen deposition is a 'pressure' or 'threat', as well as an illustration of the results. However, in this collation, and in our own work for the UK's assessment of nitrogen deposition impacts, a number of issues and challenges have become apparent.

In this section we attempt to identify and summarise some of the key issues and challenges to assessing nitrogen deposition impacts on conservation status. During discussions at the workshop we hope to expand and develop this list, to discuss how the various issues could be addressed for the next reporting round in 2013 and to recommend mechanisms for taking these forward. A set of questions to initially steer discussion is given in Annex 1. The background paper will be updated to reflect the conclusions and recommendations of the workshop.

(b) Field evidence and confidence in attribution

Since historic/cumulative nitrogen deposition impacts should be evident in the current condition of habitats and their range and extent, consideration of the impacts is, in theory, implicit in conservation status assessments which are based on field surveys and monitoring. However, unless field sampling techniques are designed explicitly to do so, and are sufficiently representative to be scaled up, it is difficult to attribute nitrogen deposition effects and this can lead to significant under-reporting, or the reliance on risk assessment approaches such as critical loads. Nitrogen deposition impacts are particularly challenging to attribute because of the interplay between pollution impacts, management and abiotic and biotic stresses. Whilst there may be examples of some well researched sites where nitrogen deposition impacts can clearly be demonstrated and attributed, scaling this up to country level reporting and subsequently the biogeographic region is difficult. This leads to the question as to how confident we need to be to record something as a pressure or a threat and ultimately to engender a policy response?

Denmark specifically includes a range of biomonitoring measures in conservation objectives and undertakes monitoring of these as part of representative sampling across habitats. This represents the most rigorous approach (on the basis of reports available at the time of writing) to assessing nitrogen deposition impacts on conservation status. However, there remain questions regarding the robustness of biomonitoring methods (Sutton et al., 2004; Leith et al., 2005; and see background paper for Topic 3), in addition to significant resource implications if they were to be widely applied.

Two key topics for discussion are therefore (a) interpreting field evidence and the attribution of nitrogen deposition, and (b) use of bioindicators.

(c) Use of Critical Loads

A number of countries have used critical loads exceedance mapping (with various adaptations) as a basis for assessing whether nitrogen deposition is a current pressure or future threat. This is

unsurprising, and advantageous, since critical loads are an established tool (i.e. under the Convention on Long-Range Transboundary Air Pollution) and used routinely in European air pollution policy development. However, there are a number of issues concerning the application of critical loads and exceedance estimates. For example:

- They are a risk assessment tool and do not provide actual evidence of impacts (conversely this is useful for predictions of threats to future viability). There needs to be good confidence in the relationship between exceedance and effects on conservation status (e.g. structure and function, viability) of sensitive habitats and at present this is variable.
- Critical loads need to be assigned to Annex I habitats, since they are currently based on the EUNIS habitat classification. Many habitats will not have a 'relevant' critical load, others have a very weak equivalence with the habitats for which critical loads are set (which are often a lower EUNIS level). Furthermore, the research underpinning the 'relevant' critical load may be poorly indicative of impacts on a specific Annex I habitat.
- Countries' mapping of habitats for critical loads assessments may not correspond well with Annex I habitat mapping.
- Deposition modelling resolution varies and may not be appropriate for habitat/site level reporting.
- Critical loads are difficult to apply to species as they are habitat based and the relationship between habitat level responses and effects on species is complex.
- Dynamic models for nitrogen deposition impacts are under development and have been used by some countries to refine critical loads for Annex I habitats (and subsequently inform conservation status assessments). Their potential for a wider application in conservation status assessments should be discussed.

(d) Defining impacts on structure and function and viability

For the conservation status of a habitat to be favourable, the assessment must show that "the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future". There is little guidance on the definition of structure and function. Nitrogen deposition potentially represents a pressure to this parameter, but the mechanisms for this need articulating. Furthermore, the relevance and appropriateness of bioindicators (including biochemical measures) and critical loads exceedance, as measures of impact of nitrogen deposition on this parameter, need to be considered.

As described in Section 2, the Directive defines when the conservation status of a habitat is to be considered as favourable. It requires that the range and area of the habitat should be at least maintained at their status when the Directive came into force or, where the status at that time was not viable in the long term, should be restored to a position where it would be viable.

Since there may have been significant changes in plant communities and species distribution prior to the Directive in areas exposed historically to high deposition, it is interesting to consider the requirement for recovery. This raises the question of what the objectives for recovery should be in

order to fulfil the Directive's aims. It is unlikely that there is scope for highly aspirational targets in relation to conservation status i.e. a return to a former pristine state. A more relevant question for the workshop to consider is that of demonstrating the further/continuing risks to habitat viability. Understanding the impacts on habitat viability against a generally improving background deposition is an important consideration.

However, it is important to consider potential for recovery in the context of the 'future prospects' parameter. How should a declining background nitrogen deposition be accounted for even when critical load exceedance remains over large areas?

A further question to consider is whether there is cross linkage between conservation status assessment, and effects on structure and function, and consideration of ecosystem services and this will be considered in Topic 5.

(e) Definitions of threat and pressure

As stated in Section 2, in the assessments of conservation status, Member States were required to list the main pressures and threats from a list in the EC guidance. However, there is no guidance as to how to judge which are the 'main' pressures and threats (i.e. how to prioritise) nor any on the definitions themselves. It is apparent that two categories, those of "air pollution" and "eutrophication", have been used in respect of nitrogen deposition impacts. However, eutrophication is also commonly used with respect to water quality issues. It is therefore difficult to untangle the various sources of nitrogen inputs and compare results, thus limiting the degree of analysis which is possible. Looking forward to the next reporting round this is clearly an area which could be improved. This is recognised by the Commission and ETC and work has already started to address this issue among others (Doug Evans, pers comm.).

6. Conclusions

The results presented in Section 3 illustrate that 'air pollution' or 'eutrophication' have been recorded as a pressure or threat on a significant number of habitat assessments across Europe. It is not possible to undertake a detailed analysis of this and examine the relative importance of specific pathways of pollutant inputs (e.g. for eutrophication this may be water, land-based or atmospheric inputs), or to compare to other pressures and threats, and thus draw out many useful conclusions. However, a focus on habitats which are only vulnerable to atmospheric inputs supports the case that nitrogen deposition is an important pressure to habitat structure and function and a threat to future prospects.

The Habitats Directive is a cornerstone of European biodiversity legislation. A robust assessment of the effects of nitrogen deposition on conservation status is necessary. In turn, this can be used as a driver for air pollution policy development and mitigation. Because of the transboundary nature of air pollution and the active policy agenda on this issue in the European Union, it would be reasonable to advocate that a consistent methodology for assessing nitrogen deposition impacts on conservation status be agreed and implemented.

There are common assessment tools such as critical loads, used for example in impact analysis and optimisation under the Convention on Long-Range Transboundary Air Pollution and the

National Emissions Ceilings Directive. However, there is a need to strengthen the collaboration and, establish as common set of objectives, between the different communities working on nitrogen impacts assessment. It is recommended that the possibility of further work on improving/developing the use of critical loads, in the context of conservation status assessments, is explored. Furthermore, Topic 5 will also consider the requirement for the establishment of other tools/indicators for biodiversity loss, possibly relating to ecosystem services provided by Annex 1 habitats.

This paper has presented the methodologies used by some Member States for assessing the effects of nitrogen deposition on conservation status. 18 Member States reported that 'air pollution' was a pressure or threat in at least one habitat assessment (and all 25 reported "eutrophication" for at least one habitat record). However, it was difficult to get access to information on the approaches that different countries used for this assessment. Despite large critical load exceedance, in many countries only a small proportion of sensitive habitats, or some cases none, were recorded as being affected by nitrogen deposition. This raises the question as to whether it reflects a low level of recognition of the pressure in many countries, or whether it reflects that the effects, which are evident on the research scale and indicated by critical loads exceedance maps, are not widely detected, and/or attributed, in the field at the broad scale.

In the previous section, we identified some of the issues and challenges concerning the assessment of nitrogen deposition on conservation status. Looking ahead to the next reporting round in 2013, the aim of the workshop session is to agree a focussed list of issues/challenges, to explore how they may be addressed and to provide recommendations for taking this forward, including how it could feed into the current review and improvement of the reporting guidance. This will include discussing scientific questions (for example, regarding field evidence and application of critical loads) and also exploring the mechanisms/routes for delivery and the potential organisations involved.

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Annex 1 – Pointers for discussion at the workshop

During the workshop session, presentations will cover an introduction to conservation status assessments under Article 17 and the approaches various Member States have taken. The working group will briefly discuss the overview of results and then focus on the key issues identified in Section 5. The list of issues will be agreed and expanded initially, before taking each issue for discussion and subsequently producing recommendations and proposing mechanisms and approaches to take forward. The following questions, arising out of points in Section 5 (are not exhaustive are designed to help focus the discussions). This list will be discussed and modified accordingly at the start of the group discussion.

1. Demonstrating nitrogen impacts on habitat structure and function and habitat viability

a. How does N deposition effect habitat structure and function, and habitat viability.

b. How to measure/assess from field evidence:

   i. scaling from site to habitat/broad scale;

   ii. monitoring/surveillance approaches

   iii. attribution of N as a causal factor (versus other multiple drivers)

   iv. use of bioindicators: 'exposure' indicators; 'effect' indicators – linking response to habitat structure and function or viability.

2. Use of critical loads – are they a suitable surrogate for effects on habitat structure and function or viability?

a. Relationship to structure and function.

b. Assignment to Annex I habitats – methods and challenges.

c. Habitat mapping issues.

d. Resolution of deposition mapping – suitable?

e. What proportion of habitat area needs to be exceeded to trigger inclusion as a significant pressure or threat?

f. What extent/proportion of exceedance is needed to trigger conclusion of unfavourable?

g. Assignment of critical loads to species – methods and challenges

h. Dynamic model – what potential does it offer. Development requirements.

3.Future prospects

a. Accounting for declining emissions?

b. Accounting for management interactions - positive and negative

c. Predictive tools – critical loads and dynamic models. Availability of data.

4. Definitions of threats and pressures – views and recommendations