Critical Loads based nitrogen deposition assessment for Habitats Directive Article 17 reporting

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Cover Note for Critical Load National Focal Centres and Authorities responsible for Article 17 reporting:

This document provides information on using critical loads for nutrient nitrogen to assess the threat from nitrogen deposition to achieving favourable "conservation status" for species and habitats listed in the Annexes of the EC Habitats Directive (92/43/EEC). It is relevant only to EU27 countries.

The objective of the Habitats Directive is to achieve favourable conservation status for the species and habitats listed in the Annexes. Article 17 of the Directive requires Member States to report the conservation status of habitat and species listed in the Directive every six years. The next reporting round is due in 2013. The Commission and Member States have produced guidance for undertaking conservation status assessments. Nitrogen deposition is recognised as a threat to biodiversity in Europe. It is listed as a potential 'pressure and threat' to conservation status in the Commission guidance.

The document sets out the background to the reporting obligations under the Directive and recommends a methodology for assessing nitrogen as a pressure/threat to Annex I habitats based on (empirical) critical loads of nutrient nitrogen. It has been produced following agreement at the 2010 Task Force meeting of the ICP on Modelling and Mapping. The document is aimed at both NFCs and authors of Article 17 reports. It aims to promote the use of established assessment methods developed under CLRTAP to assess the threat to conservation status.

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1. Aim

1.1. Nitrogen deposition is a threat to biodiversity across large areas of Europe (Hettelingh *et al*., 2009). The aim of this paper is to provide (a) guidance to habitat experts for using exceedances of critical loads for nutrient nitrogen within the assessment framework of Article 17 of the Habitats Directive (92/43/EEC), and (b) guidance to National Focal Centre representatives under the ICP Modelling and Mapping[1] of the LRTAP Convention[2] for reporting possible nitrogen induced effects to Conservation Status of a habitat. This paper sets out the background to the reporting obligations under the Habitats Directive and recommends an approach for assessing nitrogen as pressure/threat to Annex I habitats based on (empirical) critical loads of nutrient nitrogen.

1.2. The approach suggested in this paper is proposed as a first level risk assessment. It builds on methodologies agreed under the Convention on Long-Range Transboundary Air Pollution and published in the Manual of the ICP on Mapping and Modelling[1]. These methods allow for a harmonised risk assessment at a fairly coarse scale. Some Member States will be able to undertake a more detailed assessment of nitrogen deposition impacts drawing on other evidence or modelling. Furthermore, it is recommended that a more detailed methodology for a 'level two' risk assessment is developed over time.

1.3. The stepwise approach described in this paper can be used both by habitat experts as well as by National Focal Centres to assess whether nitrogen deposition is a "pressure/threat" to *habitats* listed in Annex I of the Habitats Directive. The methods are currently not extended to an assessment of nutrient nitrogen as a pressure/threat to *species* listed in the relevant annexes of the Directive, since there needs to be further consideration of whether or how to apply critical loads in such cases. Critical loads, by definition, should protect the most sensitive elements of an ecosystem. This would include species features, but an exercise is required to link species to habitat and then to critical loads. Some countries have already done this, but it is not included in this guidance.

2. Background

2.1. The Habitats Directive is a cornerstone of Europe's nature conservation policy. The Directive promotes the maintenance of biodiversity and requires Member States to take measures to achieve favourable conservation status for the habitats and species listed in the Directive; this may be through maintenance of conservation status or restoration to achieve it.

2.2. 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 an assessment of **conservation status** of all the habitats and species listed in the relevant Annexes of the Directive.

2.3. There is widespread survey evidence of nitrogen deposition impacts on (semi-) natural habitats across Europe and critical loads for nutrient nitrogen are

[1] International Cooperative Programme on the Modelling and Mapping of Critical Level and Loads and Air Pollution Effects, Risks and Trends (ICP M&M; www.icpmapping.org)
[2] Convention on Long-range Transboundary Air Pollution (http://www.unece.org/env/lrtap/welcome.html)

exceeded over large areas (Hettelingh et al., 2009; Dupre et al, 2010, Bobbink and Hettelingh 2011). Under the Article 17 reporting framework of the Habitats Directive, nitrogen inputs from air pollution are recognised as a possible 'pressure' to current structure and function of habitats and a 'threat' to future prospects.

2.4. The International Co-operative Programme on Modelling and Mapping (ICP M&M) of the Convention on Long-Range Transboundary Air Pollution (CLRTAP) establishes critical loads for the assessment of impacts of air pollutants on ecosystems. These are used in the integrated assessment[3] of sources, emission reduction potentials, abatement costs and the effects to public health and the environment, of air pollutants. These results are used to inform air pollution policy development, for example for the revisions of the Gothenburg Protocol and the EU National Emissions Ceilings Directive (2001/81/EC). National Focal Centres (NFC) are established in most countries of the European Union (Appendix I: NFC contacts list) and are responsible for providing critical loads data to the Co-ordination Centre for Effects[4] which models and maps critical loads and exceedances at the European scale. This provides a common approach for assessing the risk of nutrient nitrogen impacts on ecosystems across Europe.

2.5. A review of methods used by Member States for assessing nitrogen deposition impacts as a pressure/threat to conservation status in 2007 (Whitfield and Strachan, in 2011) showed that only a small number of Member States explicitly considered nitrogen deposition. These assessments were often based on critical load exceedance, but methods varied. In addition, in some cases, evidence from field surveys and monitoring was used, or a combination of this alongside critical loads exceedance assessments.

2.6. In 2009, experts at a European (COST 729) workshop "Nitrogen Deposition and Natura 2000" (Whitfield et al, 2011) recommended that exceedance of empirical critical loads of nutrient nitrogen should be used to inform conservation status assessments required by Article 17 of the Habitats Directive. Following this, it was agreed at the 2010 Task Force meeting of the ICP M&M[5] that its work can be useful for reporting on the threats of nitrogen deposition to habitat conservation status. The Task Force recommended that a common methodology between the CLRTAP groups and the Habitat Directive community to use critical loads for the assessment of biological effects and of the threat to Conservation Status respectively. The habitat community could thus review the possible use of critical loads as part of the next Article 17 reporting round in 2013 in close collaboration with National Focal Centres under the LRTAP Convention who are familiar with the establishment and use of critical loads. Conversely, National Focal Centres could be advised by habitat experts on the evidence of effects of nutrient nitrogen deposition. The latter information can then be used following the guidelines for the reporting of effects to the Working Group on Effects under the LRTAP Convention.

3. The Habitats Directive and Article 17

3.1. Article 17 requires Member States to report every six years on the implementation of the Directive, including an assessment of conservation status. The next reporting round in 2013.

[3] Based on the Greenhouse Gas, Air Pollution Interactions and Synergy (GAINS) model
[4] http://www.pbl.nl/en/themasites/cce/index.html
[5] (http://icpmapping.org/cms/zeigeBereich/20/france-2010.html)

3.2. Favourable Conservation Status 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).

3.3. 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).

3.4. Guidance on Article 17 reporting (European Commission, 2006; & in press) stipulates four parameters for assessing the conservation status of habitats. These are:

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

3.5. Each of these parameters is assessed as being in one of the following conditions: Favourable, Unfavourable-Inadequate, Unfavourable-Bad, or Unknown, according to agreed guidelines (European Commission, 2006). In addition to assessing the individual parameters referred to above, Member States are also required to bring the parameters together to create an overall assessment of the conservation status of each of the habitats using an agreed method.

3.6. Part of the assessment is to list the ***pressures to current structure and function*** and the ***threats to the future prospects*** (i.e. viability, over a timescale of about 12 years). A list of potential pressures/threats is provided, as well as guidance on prioritising them (guidance in preparation). Nitrogen input from air-borne pollutants is included in this list. In addition, the reporting of threats and pressures includes a category for a "pollution qualifier". This allows a pollutant, from a specified list, including nitrogen input, to be included as a qualifier for other pressures/threats, for example which have an indirect pollution effect (e.g. some of the pressures/threats under "livestock farming and animal breeding (without grazing)").

3.7. Therefore, Member States need to come to a judgement as to whether to record nitrogen input (deposition) as a pressure or a threat and how important it ranks alongside other pressures/threats. Nutrient nitrogen empirical critical loads exceedance data offer an established and scientifically accepted risk assessment approach to help inform this. A methodology is described below.

4. Using nutrient nitrogen critical loads exceedance in the conservation status assessment framework

4.1. The expert group at the European (COST 729) "Nitrogen Deposition and Natura 2000" workshop in 2009 (Whitfield et al, 2011) recommended using empirical critical loads for nutrient nitrogen for assessing potential nitrogen impacts on sensitive Annex I habitats. This represents a level-one risk assessment. It builds

on the already established critical loads methodologies developed by the ICP M&M and documented in the Mapping Manual, but requires these to be applied to Annex I habitats of the Habitats Directive. The group recommended that critical loads exceedance (i.e. where nitrogen deposition is greater than the critical load) be used to inform whether nitrogen deposition should be recorded as a "threat to future prospects". The group recommended that on its own, without corroborative evidence, critical loads exceedance is not used as a basis for attributing nitrogen deposition as a current pressure to structure and function. This is because empirical critical loads exceedance estimates do not allow us to say whether damage has already occurred, or when it will, but simply that it is likely to occur. However, many countries have strong evidence of changes to habitats, such as a reduction in species richness, as a consequence of nitrogen deposition. In such cases, empirical critical load exceedance may be useful in supporting judgements based on vegetation or biogeochemical data in order identify whether nitrogen deposition is a 'pressure to current structure and function'. Dynamic models for nitrogen exist and are being further developed; they may help with temporal assessments of the risk from nitrogen deposition.

4.2. The expert group at the Nitrogen Deposition and Natura 2000 workshop recommended further work to develop a level-two assessment (Whitfield et al, 2011).

5. Outline method

5.1. Guidance for conservation status assessment the 2013 Article 17 reporting does not give detailed information on nitrogen deposition assessment, but refers to other sources, including the CCE and this paper.

5.2. The aim of this paper is to describe an approach which could be adopted by Member States, for the 2013 round, drawing heavily on critical loads methods employed by NFCs.

5.3. The assessment should be based on empirical critical loads for nutrient nitrogen (Bobbink and Hettelingh, 2011) since these are derived from empirical evidence of effects, of nitrogen deposition on habitats, which are related to the concept of habitat structure and function e.g. species change, biogeochemical function.

5.4. An assessment is required for each Annex I habitat as they occur in each biogeographic region[6] in each Member State.

5.5. The UK, Netherlands and Denmark have each used empirical nitrogen critical loads to make assessments of the potential impacts on Special Areas of Conservation and/or conservation status. More information on the approaches used by each country can be found in the following links (note all these predate

[6] The assessment of the conservation status is carried out for each species/habitat in each biogeographical region present in a Member State. This division of Europe into biogeographic regions aims to allow a comparison between areas with similar geography and biodiversity. There are nine regions mentioned in the Directive to which four marine regions (Atlantic –North east, Atlantic – Macaronesia, Baltic & Mediterranean) have been added for the purpose of Article 17 reporting.

Where a Member State is entirely within one region only one report for each habitat type and species is required. If a Member State has territory in two or more regions a report is required for each region in which the species/habitat occurs.

See http://www.eea.europa.eu/data-and-maps/figures/biogeographical-regions-in-europe; and http://biodiversity.eionet.europa.eu/activities/Natura_2000/chapter1

the revision to empirical critical loads at the Noordwijkerhout workshop in June 2010):

5.5.1. UK

- Article 17 reporting 2007 http://www.jncc.gov.uk/pdf/FCS2007_techIII_airpollution.pdf;
- Applying critical loads to Special Areas of Conservation http://www.sniffer.org.uk/Webcontrol/Secure/ClientSpecific/ResourceManagement/UploadedFiles/AQ02.pdf;
- CCE 2007 Status Report http://www.pbl.nl/en/themasites/cce/publications/cce-progress-report-2007/index.html)
- Conservation Status Denmark (includes allocation of critical loads to Annex I): http://www2.dmu.dk/Pub/FR647.pdf
- Apply critical loads to Annex I habitats in the Netherlands: Van Dobben Van Hinsberg (2008).

6. *Step 1. Applying empirical CL to Annex I habitats*

- Obtain the list of Annex I habitats for the relevant Member State.(i)
- Obtain critical loads from Bobbink and Hettelingh 2011 relevant to the Annex I habitats present in the Member State,(ii), (iii) and/or collaborate with NFCs to also obtain critical loads, as submitted for that region/site to the European critical loads database at the CCE, as appropriate.
- In addition, it may be possible to consult with appropriate national experts to correspond other sensitive Annex I habitats with EUNIS classes for which nutrient N critical loads have been set.(iv), (v)

6.1. Notes:

(i) Annex I of the Habitats Directive lists the 231 habitats of community importance. These are described in an Interpretation Manual[7] and there are also country specific interpretation documents[8]. Only a subset of these Annex I habitats will be present in any one Member State which will be known by those dealing with Habitats Directive work within a country.

(ii) The report of the Noordwijkerhout workshop (Bobbink and Hettelingh, 2011), which reviewed empirical nutrient nitrogen critical loads in 2010, sets critical loads for habitats defined under the EUNIS classification scheme (European Nature Information System) (Davies and Moss 2002). In general, critical loads are defined at EUNIS level 3 (e.g. E1.2; perennial calcareous grasslands and basic steppes). Critical loads are only set for habitats where there is sufficient empirical evidence to do so. As a result, there are large numbers of EUNIS classes which are potentially sensitive to nitrogen deposition, but for which no critical loads have been set.

(iii) Published correspondence tables[9] describe the relationship between Annex I habitats and EUNIS classes. The Noordwijkerhout report uses these correspondence tables to show the relationship between the EUNIS classes

[7] http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/2007_07_im.pdf
[8] http://biodiversity.eionet.europa.eu/activities/Natura_2000/pdfs/Habitat_Manuals.pdf
[9] http://eunis.eea.europa.eu/

for which critical loads are set and Annex 1 habitats, thus establishing empirical nutrient nitrogen critical loads for a selection of Annex I habitats.

(iv) The correspondence tables describe the relationship between the different habitat classifications. However, often there is not a precise match (i.e. "is equal to") between an Annex I habitat and a EUNIS class for which a critical load has been set, but there is some correspondence (i.e. "overlaps with"; is "contained within"). Sometimes this is a result of the critical loads having been set at EUNIS level 3 rather than a higher level which corresponds more exactly with Annex I descriptions. NFCs and habitat experts are encouraged to provide a national synthesis between classifications, in addition to those published in Bobbink and Hettelingh (2011) to establish links between EUNIS classes and Annex I habitat classification. Prior to 2010, the UK, Netherlands and Denmark had undertaken this process for the Annex I habitats in their countries; see previous section.

(v) Inevitably there are some gaps where there is no correspondence between an Annex I habitat and a EUNIS category for which a critical load has been set; in such cases it will not be possible to undertake a critical loads assessment. However, the Netherlands, for example, have set their own critical loads in such cases based on modelling or expert judgement (van Dobben and van Hinsberg 2008).

7. Step 2. Mapping critical loads

- For Annex I habitats to which critical loads have been assigned (see step 1), use the distribution maps of the habitat in each biogeographic region covered by the Member State; some NFCs may already hold suitable habitat distribution maps.[(i),(ii),(iii)]
- Produce critical load maps for each Annex I habitat, for each biogeographic region, for the Member State; i.e. apply the agreed critical load value(s) to each grid cell of each habitat distribution.[(iv)]

7.1. Notes.

(i) Spatial data of the habitat distributions enable critical loads to be mapped and overlaid on maps of deposition data (Step 3 below) to determine the area of habitats where critical loads are exceeded. It is important to note that the assessment of conservation status is not confined to Annex I habitats as they occur in Special Areas of Conservation (SAC or SCI) or Natura 2000 sites, but rather the whole resource inside and outside of protected sites.

(ii) The types and format of habitat maps available will vary between Member States and possibly between habitat types. The Article 17 leads should discuss with their NFC what the most appropriate distribution maps may be for this purpose. This may depend, in part, on the resolution of deposition data available (see step 3). As a minimum requirement, Member States are expected to provide habitat distribution maps at 10x10km resolution.

(iii) As the reporting for Article 17 needs to be by Annex I habitat for each biogeographic region in each Member State, maps/data identifying these regions will also be needed[10].

(iv) Empirical critical loads for nutrient nitrogen are set as a range, reflecting intra-ecosystem variation over Europe. This leads to the question as to which part

[10] http://www.eea.europa.eu/data-and-maps/figures/biogeographical-regions-in-europe;

of the range should be used for the assessment of exceedance of Annex I habitats. Article 17 leads should discuss this with NFCs.

- Bobbink and Hettelingh (2011) list abiotic modifying factors (e.g., precipitation, altitude) with the table of empirical nitrogen critical loads. These may be used to determine where within the range the critical load should be set. Note: when identifying, for example, high and low precipitation areas, this needs to be taken in context of the precipitation across the whole geographic distribution of the habitat across Europe.
- Some NFCs may have established a single empirical critical load value for specific natural regions (e.g. "mapping values" in the UK) rather than a range, using these modifying factors and reflecting the environmental conditions in their country.
- In the absence of a single empirical critical load value there are two options. Firstly to use the value in the middle of the range if there are no data to support use of the upper or lower end of the range,or secondly to adopt a precautionary approach and use the critical load at the lower end of the range. In the report of the Noordwijkerhout workshop[11] it was stated "additional qualitative information had been assigned to a number of modifying factors, in comparison to recommendations reported in 2003 on interpreting the agreed critical load ranges in specific situations and ecosystems. The workshop did not reach full agreement on how to quantify modifying factors for assessments on broad regional scales. Therefore, the workshop decided to use the minimum value of the empirical critical load ranges of every EUNIS class to calculate exceedance of deposition assuming different emission abatement scenarios."

8. Step 3. Deposition data

- Obtain and map nitrogen (oxidised plus reduced) deposition data for the most recent year available and if available a future scenario e.g. 2020.[(i),(ii),(iii),(iv)]

Notes

(i) At the European level, estimates of deposition are available through EMEP (http://webdab.emep.int/Unified_Model_Results/AN/) currently on the EMEP 50x50 km resolution grid. NFCs may be able to help with relating the EMEP gridded data to the habitat distribution data. Wet, dry and total (wet + dry) deposition for recent years are available to download from the EMEP web site.

(ii) Many countries have their own national deposition data, derived from monitoring data and/or atmospheric dispersion models which maybe at a higher resolution. The NFC may be able to advise on the best available national deposition data and the resolution of that data (which may also influence the resolution of habitat and critical load mapping required).

(iii) Different deposition estimates may be available for different habitat types; for example, deposition to semi-natural grassland or to woodland. These different estimates take into account how (dry) deposition is "captured" by different heights of vegetation. If such data are available, then the appropriate values should be used for the different habitats in the exceedance calculations below. Note that the EMEP deposition available for download from their website is a grid average for all ecosystems and not ecosystem-specific. Ecosystem specific deposition values can be obtained via the National Focal Centres (in collaboration with the CCE).

[11] http://www.unece.org/env/documents/2010/eb/wge/ece.eb.air.wg.1.2010.14.e.pdf

(iv) If possible it would be useful to carry out the assessment, of nitrogen deposition as a threat to 'future prospects' of a habitat, for a relevant future deposition scenario in addition to the present day estimates. NFCs may be able to advise on available deposition forecasts based on appropriate scenarios and timescales. The Article 17 guidance (European Commission, 2006) advises that the 'future prospects' of a habitat should be considered over a 12 year timescale (two reporting rounds).

9. Step 4. Generate exceedance estimates

- Calculate critical load exceedances; i.e. deposition minus the critical load. In addition, the so-called Average Accumulated Exceedance (AAE; Posch et al, 2001) can be computed for areas with more than one critical load value. The AAE (for natural areas) gives the area weighed exceedance on any geographical scale desired, i.e. from a set of sites, areas, regions, nations to the European scale. A negative AAE implies that deposition is below the critical load and the habitat is not at risk from the impacts of nitrogen deposition.(i) NFCs can assist in computing the AAE.
- Calculate the percentage area of each habitat where the critical loads are exceeded.(i)
- A separate assessment is required for each Annex I habitat for each biogeographic region in the Member State.(ii),(iii)

9.1. Notes

(i) This analysis can be done using a GIS to overlay the spatial data sets and calculate exceedances; the exceeded areas for each habitat can then be overlaid on the relevant habitat distribution map to calculate the area of habitat at risk.

(ii) The exceeded areas for each Annex I habitat need to be considered in relation to the biogeographic regions of the Member State. Either the critical loads can be mapped by Annex I habitat and biogeographic region, or the exceedance results for Annex I habitats extracted by overlaying with biogeographic region maps.

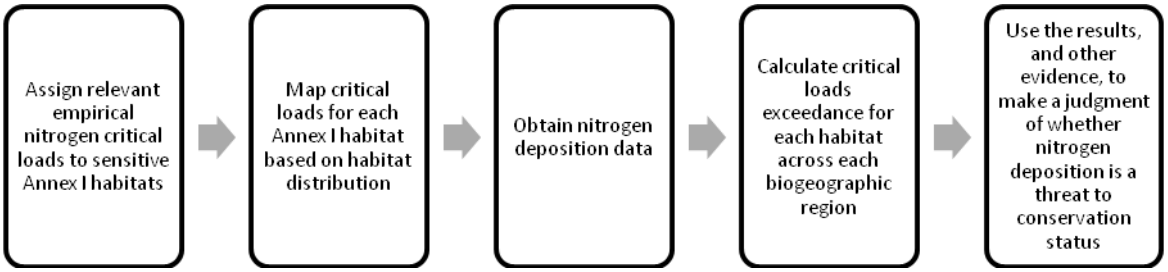
(iii) Many countries have already generated exceedance estimates for Natura 2000 sites or Special Areas of Conservation (SAC or SCI). The Article 17 assessment of conservation status is not confined to the Annex I habitat resource within these protected sites and needs to consider their status in the 'wider countryside' in addition to sites. However, if countries already hold exceedance statistics based on Annex I habitat features and NFC results within Natura 2000/SACs these may inform the assessment of whether nitrogen deposition is a threat to conservation status of these habitats. The area of the Annex I habitat resource occurring in Natura 2000 or SACs needs to be considered as well as and how representative the sites are of deposition to habitat areas outside of sites. It should be noted that the modelling and Mapping of critical loads by NFCs also includes natural areas outside of Natura 2000 sites.

10. Step 5. Record nitrogen deposition as threat to future prospects

- Use the exceedance estimate to inform whether to include nitrogen input (deposition) as a threat to future prospects.
- Use the exceedance estimates, together with other information on sources of nitrogen (source attribution) to inform whether to include nitrogen deposition as a qualifier for another threat.

- Use the exceedance estimates, together with appropriate species or biogeochemical evidence or modelling, if available, to inform whether to include nitrogen deposition as a pressure to current structure and function or as qualifier for another pressure.

Figure 1 Summary of approach



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