Nitrogen Deposition and the Nature Directives

Impacts and Responses: Our shared experiences

Department for Environment Food & Rural Affairs

JNCC Joint Nature Conservation Committee

NATURA 2000

Theme 1: Working Group 1: Assessing Nitrogen Impacts on Conservation Status for the 2013 Habitats Directive Article 17 Reporting round: methods and outcomes

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The workshop is being organised by JNCC on behalf of the UK Government, Devolved Administrations and country nature conservation bodies, in collaboration with the Dutch Ministry of Economic Affairs and in co-operation with the Task Force on Reactive Nitrogen.

1. Summary

The Habitats Directive requires Member States to report every six years on the implementation of the directive and specifically on the conservation status of habitats and species listed in the directive.

Nitrogen deposition is one of many pressures and threats to conservation status. This working group will examine how nitrogen deposition impacts are taken into account in the assessment of conservation status for Article 17 reporting. The group will examine the approaches taken under the latest reporting round (2013) and it will review the outcomes.

2. Introduction

The Habitats Directive requires Member States to take measures to maintain at, or restore to, favourable conservation status, the 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). The latest Article 17 reporting round was 2013; Member States were required to submit their reports to the Commission during the summer.

The impacts of nitrogen deposition are recognised as a major threat to biodiversity across large areas of Europe, particularly the Atlantic Biogeographic Region (Nordin *et al*, 2011; Dise *et al*, 2011). The policy assessment of impacts of air pollution on the natural environment relies heavily on the use of critical loads[1]. Currently, nitrogen deposition exceeds nutrient nitrogen critical loads over a substantial area of (semi-) natural habitat in Europe (Posch *et al*, 2012).

Since the Habitats Directive is one of the priorities in European nature conservation policy, it is important to understand the risks from nitrogen deposition impacts to achieving the directive's objectives.

A European workshop "Nitrogen Deposition and Natura 2000" was held in 2009 (Hicks *et al*, 2011). It brought together scientists, policy advisors and conservation practitioners to review new evidence of nitrogen impacts and to review and develop best practices when conducting assessments. The workshop examined the approach undertaken by Member States in the 2007 Habitats Directive Article 17 reporting round. It found that a small number of Member States had included an assessment of nitrogen deposition impacts based on an application of critical loads, although precise methods varied as did the extent to which this influenced the conclusions for conservation status. Some other Member States used evidence from field surveys or a combination of these alongside critical loads assessments. Whilst for some other Member States, nitrogen deposition was not explicitly considered. The workshop recommended a harmonisation of the methodology for nitrogen deposition assessment in Article 17 reporting. In response, in 2010, the Co-ordination Centre for Effects and JNCC co-wrote a paper providing information on using critical loads for nutrient nitrogen to assess the threat from nitrogen deposition to achieving "favourable conservation status". This was

[1] A critical load is 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 present knowledge"

not prescriptive guidance; rather it provided an approach to identify the threat from nitrogen deposition. The approach was proposed as a first level risk assessment and recognised that some Member States would be able to undertake a more detailed assessment of nitrogen deposition impacts drawing on other evidence or modelling.

3. Focus of the Working Group

Building on the 2009 Workshop (Hicks *et al*, 2011), Working Group 1 will revisit the topic of how nitrogen deposition impacts are taken into account in the assessment of conservation status for Article 17 reporting. The group will examine the approaches taken under the latest reporting round (2013) and it will review the outcomes.

Section 4 of this paper sets out the objectives of the working group. Section 5 provides an overview of the methodology for assessing conservation status and briefly discusses how it may be impacted by nitrogen deposition.

In advance of the workshop, representatives from the Atlantic Region Member States attending the workshop were asked for information on their country's approach to nitrogen assessment for Article 17 reporting and the indicative results. Information was received from five Member States and this is presented in Section 6.

In section 7, a provisional list of questions/points of discussion is proposed. This list will be refined and prioritised at the workshop. Finally, section 8 provides a short overview of how the group will operate and invites presentations.

4. Objectives of the working group

The objectives of this working group are:

- ***Objective 1:*** to share information on the approaches taken for nitrogen assessment within Article 17 assessments in 2013;
- ***Objective 2:*** to examine and summarise what impact nitrogen has on conservation status, and compare this to results of other assessments of nitrogen impacts on biodiversity;
- ***Objective 3:*** to make recommendations to support future reporting rounds, including identifying critical gaps in understanding of impacts and recovery or guidance, and make recommendations for how these can be addressed.

5. Background to reporting/conservation status method

The Habitats Directive requires Member States to report every six years on the implementation of the directive and specifically on the conservation status of habitats and species listed under Annexes I, II, IV and V of the Habitats Directive. This requirement comes under Article 17 of the directive, and the reporting in 2013 is the third of its kind and the second to report on conservation status.

Within the directive, favourable conservation status of a habitat is defined in Article 1(e) as when:

i. its natural range and areas it covers within that range are stable or increasing, and
ii. 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
iii. the conservation status of its typical species is favourable as defined in Article 1(i).

For species, favourable conservation status is defined in Article 1(i) as when:

i. 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
ii. the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and
iii. there is, and will probably continue to be, a sufficiently large habitat to maintain its population on a long term basis.

To assist Member States, the European Commission has developed these definitions into a set of detailed explanatory notes and reporting guidelines (Evans and Arvela, 2011). These 'EC Reporting Guidelines' cover the concept, definitions and recommended methods to assess conservation status and its component parameters. The reporting format requires a separate assessment for each habitat and species in each biogeographic region that a country covers. The focus of this workshop is the Atlantic region.

The assessment of conservation status is based on four parameters for habitat and species:

For habitats:

- Range
- Area
- Specific structures and functions including typical species
- Future prospects

For species:

- 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 (Evans and Arvela, 2011). Additionally, for structure and function and future prospects parameters, wherever the conclusion reached was unfavourable-inadequate or unfavourable-bad, a status qualifier was added to the conclusion to indicate if things are stable, improving or declining. An overall assessment of conservation status of each of the habitats and species is determined from these individual parameters, and in general, reflects the least favourable of the individual parameter conclusions. Table 1, summarises the possible conclusions for conservation status.

Table 1: Summary of possible conclusions for Conservation Status assessments

Conclusion	Qualifier
Favourable	*Not applicable*
Unfavourable Inadequate	Improving Stable Declining
Unfavourable Bad	Improving Stable Declining

Within the assessment of "specific structures and functions", there is a requirement to identify and rank the pressures currently acting on the habitat or species. For the future prospects parameter, there is a requirement to identify and rank the future threats. The pressure and threat codes/categories were based on a standard list provided via the EC Reporting Guidelines. The full list of EC pressures amounted to 400 separate categories, which are provided in a hierarchal structure. Nitrogen input [deposition] (H04.02) is listed under the Air Pollution (H04) category.

The guidance requires each pressure/threat to be ranked as follows:

- H = High importance/impact (important direct or immediate influence and/or acting over large area);
- M = Medium importance/impact (medium direct or immediate influence, mainly indirect influence and/or acting over moderate part of the area/acting only regionally);
- L = Low importance/impact (low direct or immediate influence, indirect influence and/or acting over small part of the area/acting only regionally).

Additionally, there is an option to report pollution qualifiers:

- N = Nitrogen input;
- P = Phosphorous/Phosphate input;
- A = Acid input/ acidification;
- T = toxic inorganic chemicals;
- O = toxic organic chemicals;
- X = Mixed pollutants.

Nitrogen deposition may cause changes to species composition, sometimes including a reduction in species richness and/or diversity, a loss of sensitive bryophytes and lichens, changes to soil microbial processes, changes to plant and soil chemistry; and increased

susceptibility to abiotic and biotic stresses. Such impacts could affect the "structure and function" parameter of conservation status for Annex I habitats, or habitat for species.

Whilst there is a strong evidence base of nitrogen impacts on biodiversity across the Atlantic region, it nevertheless remains challenging to assess the impacts on conservation status. In reviewing the approaches taken by Members States the reasons for any differences may reflect gaps in our evidence or scientific understanding and hence interpretation. Some of the issues will be discussed by other working groups. For example, how historic nitrogen deposition impacts are considered in setting conservation objectives (Working Group 2), or how nitrogen induced changes, such as reduced species richness, relate to measures of conservation status (Working Group 3). Another example is when considering future prospects of structure and function. In this case, predicted future nitrogen deposition should be considered. Nitrogen deposition is predicted to decline slightly over the period to 2025. This will reduce the per cent area of habitats exceeding the critical load and will reduce the average accumulated exceedance (the amount of deposition above the critical load). This could be interpreted as an improvement. Conversely, since habitats are responding to cumulative deposition, it could be interpreted as unfavourable future prospects i.e. a critical loads will remain exceeded over large areas, nitrogen deposition continues to be a threat, albeit lower inputs will slow down the rate of further damage compared to higher inputs.

6. Summary of approaches for nitrogen assessments used by Member States for the 2013 round and the results

The following series of tables provide a summary of Member States' approaches for nitrogen assessment in Article 17 reporting in 2013 and the outcomes for Annex I habitats (Tables 2-8) and species (Tables 9-15), based on information provided via the Member States' contacts for the Natura seminar.

Table 2: Annex I habitats. H04 = air pollution. H04.02 = nitrogen input.

To what extent was nitrogen recorded as a pressure and threat?	
Belgium	31 habitats have H04.02 or H04 recorded as a pressure: 16 High, 5 Medium and 10 Low. 30 habitats have H04.02 or H04 recorded as a threat: 15 High, 5 Medium and 10 Low.
France	8 habitats have H04 recorded as a pressure: 3 Medium and 4 Low. 7 habitats have H04 recorded as a threat: 5 Medium and 5 Low.
Ireland	10 habitats (out of 58) have H04.02 or H04 recorded as a pressure and threat: in all cases as Low. In addition, other pressures/threats listed were reported with an associated nitrogen pollution qualifier. The impact of the pollution identified would have linked with the presence of plant species that indicate elevated nutrient level.
Netherlands	N-deposition was recorded as a threat for 25 habitats (out of 53): 20 High, 3 Medium and 2 Low.
UK	56 habitats (out of 77) have H04 recorded as a pressure: 34 High, 11 Medium and 11 Low. 58 habitats (out of 77) have H04 recorded as a threat: 34 High, 11 Medium and 13 Low.

Table 3: Annex I habitats

What information/evidence was used to determine whether nitrogen deposition was a pressure/threat?	
Belgium	N-deposition was identified as a pressure for a given habitat type if the actual, average nitrogen deposition exceeded its critical load. Critical loads of nitrogen for habitat types were assembled by an intensive literature survey and compiled in habitat quality assessment tables (T'jollyn *et al*, 2009). As the actual nitrogen deposition in Flanders (measurements made, and maps drawn, by VMM-VITO and others, MIRA report) exceeds for many habitats the threshold over the whole territory, it was indicated as a high pressure. As no significant declines in nitrogen deposition are expected in the near future, nitrogen deposition was also indicated as a threat.
France	Information not provided.
Ireland	There have been no specific studies commissioned by the National Parks and Wildlife Service (DAHG) on the effects of air pollutants on these habitats in Ireland, however expert judgement was used to assign nitrogen deposition as a pressure and a threat to all upland habitats as they are subject to high precipitation rates. Nitrogen deposition (specifically as H04.02/H04) was not considered to be an issue for most other Annex I habitats, although there is no specific data to support this assumption.
Netherlands	Exceedance of critical loads is used in the assessment of state of conservation in the Standard Data Forms. These states are "added up" to the national level as a part of the assessment of structure & function of the habitat type. The determination of N-deposition as a threat is expert judgement.
UK	For 41 Annex I habitats it was possible to assign a relevant critical load. Critical load exceedance was then used to determine if nitrogen deposition was a pressure/threat as set below. For the remaining habitats a critical load could not be assigned, either because they are not sensitive or they are sensitive but there is no correspondence with a EUNIS class for which a critical load is set. In these cases, expert judgement was used. For those with a critical load, identification of nitrogen as a pressure or threat was based on per cent of Annex I habitat area exceeded by the relevant nutrient nitrogen critical load. Current deposition informed the assessment of "pressure" and deposition estimates for 2020 informed assessment of "threat" under the future prospects assessment. It was scored as High, Medium or Low based on: § >25% area of habitat exceeds nutrient N critical loads – High § 5-25%, area of habitat exceeds nutrient N critical loads – Medium § <5%, area of habitat exceeds nutrient N critical loads – Low.

Table 4: Annex I habitats

Were critical loads used to inform if nitrogen deposition was pressure and threat?	
Belgium	Yes
France	Information not provided.
Ireland	No
Netherlands	Yes
UK	Yes (for 41 habitats; others were based on expert judgement).

Table 5: Annex I habitats

How were critical loads set?	
Belgium	Through a literature survey on the thresholds of N for habitat quality (vegetation composition) as well as own research data. These data are compiled in T'jollyn *et al*, (2009). Average nitrogen deposition is Flanders was derived from (1) air quality and deposition measurements conducted by the Flemisch Environment Agency and the Research Institute for Nature and Forest, and (2) a regional deposition model (VLOPS).
France	Information not provided.
Ireland	Critical loads were not used (but they are under development).
Netherlands	For each Annex I habitat, it has been determined whether there is an empirical critical load (Hettelingh and Bobbink, 2011). - If so, this range has been further specified with results from simulation models and (if necessary) expert opinion to set a concrete value. - If not, the critical load value has been based upon the mean value of the results from a national simulation model. - If not, and if there was also no result available from a simulation model, the critical load value has been based upon expert opinion.
UK	All potentially sensitive UK Annex I habitats were identified. Relevant critical load ranges were applied based on the correspondence between the Annex I habitat and a EUNIS class for which a critical load is set (Hettelingh and Bobbink, 2011). Where an Annex I habitat was "equal" or "contained within/contains/overlaps" a EUNIS class for which a critical load is set, the critical load was assigned to that Annex I habitat. This was then further refined by setting a particular point within the critical load range based on UK evidence or, in the absence of evidence, using the lower part of the range on a precautionary basis. For Annex I habitats which do not correspond with any of the EUNIS classes for which critical loads are set, no critical loads based assessment was undertaken. In those cases, nitrogen deposition was recorded as a pressure or threat if there was specific evidence to support this.

Table 6: Annex I habitats

How was exceedance established?	
Belgium	For Article 17 reporting purposes, we did not conduct a spatially-explicit assessment. Such calculations have recently been performed by INBO (Herr *et al*, 2012) to support the development and implementation of the Flemish Natura 2000 policy.
France	Information not provided.
Ireland	Critical load exceedance was not used, but national monitoring networks were used to assess nitrogen deposition inputs.
Netherlands	Information not provided.
UK	Nitrogen deposition estimates were derived for "present" and 2020 based on UK national modelling of nitrogen deposition at 5x5 grid resolution. % habitat exceedance was estimated by each country of the UK based either on a) % area of SACs containing the Annex I habitat exceeding the relevant critical load or where habitat distribution maps were available b) % area of the Annex I habitat exceeding the critical load. These were then aggregated on weighted basis to provide an estimate of the per cent area exceeded of the Annex I habitat resource in the UK.

Table 7: Annex I habitats

How did the identification of nitrogen deposition (or air pollution) as a pressure and/or threat affect the outcome of the assessments? For example, was it a cause (or a contributory cause) of unfavourable status?	
Belgium	The identification of nitrogen deposition as a pressure or threat itself did not affect the outcome of the assessment. However, continued nitrogen enrichment has strongly impacted the species composition and primary production of a range of habitats, resulting in a bad assessment for a selection of criteria of 'structure & functions' (T'jollyn *et al*, 2009). For instance, as the 3000 and 4000 habitats have become dominated by *Molinia* and *Betula* under elevated N deposition, their quality has been set as inadequate
France	Information not provided
Ireland	Nitrogen deposition may encourage more nutrient demanding species such as grasses at the expense of bryophytes etc. The impact was however assigned a low ranking particularly as the more mountainous western districts would be less likely to incur nitrogen deposition due to prevailing westerlies and greater distance from potential sources
Netherlands	For several habitat types nitrogen deposition is probably an important reason for unfavourable conservation status of the structure & function of the habitat type. Future prospects are sometimes bad because of expectation of not enough improvement in deposition levels. It is hard to point this out exactly, because of the extra step through the Standard Data Forms.
UK	For those habitats based on expert judgement and not critical loads, the identification of nitrogen as a pressure of threat did not influence directly the outcome of the assessments. However, nitrogen impacts may have affected habitat condition and hence the structure and function parameter. For those habitats with a relevant critical load, the nitrogen critical loads exceedance data were used together with site-condition data (which currently under-reports nitrogen effects) to inform the conclusion of the assessment for Structure and Function and Future Prospects, according to a set of rules. Whilst nitrogen deposition did influence the outcome of the future prospects parameter and of the status qualifiers, in only two cases was the overall status conclusion unfavourable bad as a consequence of the nitrogen assessment (i.e. although in some cases nitrogen deposition contributed to a conclusion of unfavourable bad status (31 cases) it was usually not the only cause of this, so without the N assessment it would still have been unfavourable bad). In 20 habitats the overall status qualifier was "worse" that it would have been if the air pollution assessment had not been included. For example, the overall qualifier may be declining when it would have been stable in the absence of air pollution assessment, or it may be stable, when it would have been improving. Most of these habitats were kinds of sand dune, heathland, grassland, bog, fen or woodland

Table 8: Annex I habitats

Did nitrogen deposition have an impact on the status of the "range" or "area" parameters of conservation status?	
Belgium	No. Nitrogen deposition is only considered to affect habitat quality. One could argue that e.g. for oligo-mesothrophic waters, nitrogen enrichment deposition there can be an hypothetical effect on range or area when vegetation composition changes that drastically, so that the vegetation does not belong anymore to the habitat type, but it has not been proven that this is (only) linked to nitrogen deposition
France	Information not provided
Ireland	No
Netherlands	No
UK	No

Species

Table 9: Species. H04 = air pollution. H04.02 = nitrogen input.

To what extent was nitrogen recorded as a pressure and threat?	
Belgium	Due to lack of relevant data (i.e., critical load data, sensitivity information), the role of nitrogen deposition and air pollution was not assessed for Annex II/IV species in Article 17 reporting
France	5 species have H04 recorded as a pressure: 4 Medium and 1 Low 6 species have H04 recorded as a threat: 2 High and 4 Medium
Ireland	An assessment was not undertaken due mainly to the fact that nitrogen deposition (specifically as H04.02/H04) is considered to be a relatively minor impact.
Netherlands	Nitrogen deposition was identified as threat for 12 species (out of 79): 7 High,,4 Medium and 1 Low.
UK	13 species have H04 recorded as a pressure: 6 Medium and 7 Low 13 species have H04 recorded as a threat: 7 Medium and 6 Low

Table 10: Species

What information/evidence was used to determine whether nitrogen deposition was a pressure/threat?	
Belgium	See Table 9
France	Information not provided
Ireland	See Table 9
Netherlands	There is a low level of the nitrogen deposition issue with species experts (they are hardly involved in all the work that is done by authorities and managers of the sites on nitrogen deposition). More often threats like “pollution to surface waters by…” (under H01) for aquatic species, “agriculture intensification” (A02.01) and Fertilisation (A08) are identified.
UK	This was based on expert judgement.

Table 11: Species

Were critical loads used to inform if nitrogen deposition was pressure and threat?	
Belgium	See Table 9
France	Information not provided
Ireland	See Table 9
Netherlands	Sometimes.
UK	No

Table 12: Species

How were critical loads set?	
Belgium	See Table 9
France	Information not provided
Ireland	See Table 9
Netherlands	Species are connected with habitats, sometimes these are Annex I habitat types, sometimes other habitats (bases on nature targets). All those habitats have a critical load (as described in Table 5). There was an assessment if the effect of the nitrogen deposition on the habitat also affects the species, and in what way (for example: not able to find prey/food, prey/food disappears, not able to reproduce etc.). This information is used in the sites to consider measures and impacts, but hardly (or not) in the Article 17 report.
UK	Critical loads assessment was not undertaken for Article 17 reporting for species. However, for use in Article 6.3 assessments, relevant critical loads have been assigned to Annex II species in some cases. This is based on the habitat for the species and only where the species’ habitat is sensitive to nitrogen deposition and any changes to

	the habitat as consequence of critical load exceedance would adversely affect the species.

Table 13: Species

How was exceedance established?	
Belgium	See Table 9
France	Information not provided
Ireland	See Table 9
Netherlands	See Table 12
UK	See Table 12

Table 14: Species

How did the identification of nitrogen deposition (or air pollution) as a pressure and/or threat affect the outcome of the assessments? For example, was it a cause (or a contributory cause) of unfavourable status?	
Belgium	See Table 9
France	Information not provided
Ireland	See Table 9
Netherlands	It may have had influence on the assessment of the quality of the habitat of the species, which is one of the three aspects of the assessment of habitat of the species. "Bad" quality means the habitat of the species is unfavourable-bad. "Moderate" quality means the habitat of the species cannot be favourable. For most species with unfavourable habitat assessment there is (also) a problem with the size and trend (mostly of the size) of the habitat. For only one species it seems that nitrogen deposition effected the overall assessment (1400 *Leucobryum glaucum*).
UK	This is not explicit in the assessments.

Table 15: Species

Did nitrogen deposition have an impact on the status of the "range" or "area" parameters of conservation status?	
Belgium	See Table 9
France	Information not provided
Ireland	See Table 9
Netherlands	No
UK	Unknown

7. Discussion points or questions

The following questions or recommended points of discussion represent a provisional list which should be further developed by the working group, in response to presentations from Member States. The questions are set out under the heading of each objective, although in practice they are inter-linked.

Objective 1 - to share information on the approaches taken for nitrogen assessment within Article 17 assessments in 2013.

i) Summarise the methods for how nitrogen deposition impacts have been taken into account (directly or indirectly, if at all) in Article 17 reporting (building on section 6).
ii) Identify and discuss the similarities and differences in approaches.

iii) What are the consequences of differences in approach?

Objective 2 - to examine and summarise what impact nitrogen has on conservation status, and compare this to results of other assessments of nitrogen impacts on biodiversity.

iv) Summarise the implications of nitrogen impacts for Conservation Status assessments under Article 17.
    - To what extent was nitrogen deposition recorded as a High and a Medium pressure/threat?
    - What impact has nitrogen deposition had on the conclusions for conservation status (did it cause unfavourable status or contribute to it)?
v) Are the results consistent with other evidence of nitrogen impacts, such as country or European based survey and experimental evidence? If not, what could be the reasons for this?

Objective 3 - to make recommendations to support future reporting rounds, including identifying critical gaps in understanding of impacts and recovery or guidance, and make recommendations for how these can be addressed.

vi) Are there critical gaps in our scientific understanding or evidence base, which are limiting how Member States can take into account nitrogen impacts in assessments of Conservation Status?
vii) Is further development and harmonisation of method necessary, and if so what is the mechanism for this?

8. How the group will operate

Members of the group are invited to provide a short presentation related to the objectives and the discussion points above. We request that Member States agree a representative for the working group who will provide such a presentation.

A digital projector and power point will be provided. Presenters are encouraged to bring printed handouts of their presentation, so these can be circulated amongst the group. However, delegates may wish to make a more informal presentation for example, a short report, without the use of slides.

Following the presentations, the group will:

- discuss any similarities and differences in approaches between Member States;
- share experience of accounting for nitrogen impacts within Conservation Status assessments;
- agree the key discussion areas to focus on in order to meet the objectives of the working group.

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