



Natura 2000 Seminars

Atlantic Biogeographical Region

Nitrogen Deposition and the Nature Directives Impacts and Responses: Our Shared Experiences

2-4 December 2013, Peterborough, UK

Workshop Report





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**Nitrogen Deposition and the Nature Directives Impacts and Responses:
Our Shared Experiences.
Report of the Workshop held 2-4 December 2013**

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

The workshop was overseen by an Advisory Committee comprising representatives of the UK Government, Devolved Administrations and the UK statutory nature conservation bodies. Their assistance in the preparation of this report is gratefully acknowledged. We also thank members of the committee for their contribution to the workshop and constructive comments on the workshop programme and papers.

We are grateful to all of the workshop delegates for their valuable contributions at the workshop and to working group reports. We would particularly like to thank the Chairs and Rapporteurs of the working groups, the authors of the background papers and the working group reports.

Please note, the content of this report may reflect views and opinions given at the workshop by individuals and organisations, but do not necessarily reflect the views of either the JNCC or the UK Government.

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Summary

This report provides an overview of the presentations and discussions concerning the two themes of the workshop entitled 'Nitrogen deposition and the Nature Directives: Impacts and Responses: Our shared Experiences' which aimed to explore the practical solutions to reduce impacts of deposition of reactive nitrogen compounds. A series of accounts of the findings and recommendations of the workshop's working groups is also provided in Appendices 1-7. Whilst many of the conclusions and recommendations from the workshop groups contained a high level of detail that was specific to the working group topic, there were a number of recommendations made that were common amongst the groups.

These recommendations are brought together in a 'Conclusions' section to the report. The recommendations are grouped together under each of the two themes:

- Theme 1: Reporting and assessment of nitrogen deposition impacts; and
- Theme 2: Knowledge sharing of practical solutions to reduce nitrogen deposition impacts.

Additionally, cross-cutting recommendations are grouped together into those requiring future collaboration between experts, and those concerning the promotion and sharing of good practice.

Executive Summary

Introduction

There is compelling evidence that atmospheric deposition of reactive nitrogen represents a major threat to biodiversity in Europe.

The Habitats Directive promotes the protection of biodiversity in Europe. It requires Member States to take measures to maintain at – or restore to – ‘favourable conservation status’, the natural habitats and species of community importance. The directive establishes the Natura 2000 network, with the aim to assure the long-term survival of Europe's most valuable and threatened species and habitats.

In 2011, the European Commission launched the Natura 2000 Biogeographical Process. A continuing series of seminars is being held in each biogeographic region of the EU, with the aim of sharing practical management experience and best practices to address threats, in order to improve the overall conservation status of habitats and species of community importance.

This workshop, ‘Nitrogen Deposition and the Nature Directives - Impacts and Responses: Our shared experiences’, was organised as an agreed follow-up action from the Atlantic Natura 2000 Biogeographical Seminar held in the Netherlands in December 2012. During that milestone event, nitrogen deposition was highlighted, by representatives from Member States and expert stakeholders from the NGO community, as a major common threat to the conservation status of significant habitats and species in the Atlantic Region.

The workshop brought together over 50 delegates from Member States in the Atlantic Region, with experience of the assessment of nitrogen deposition impacts and/or of measures or strategies to reduce the impacts. The workshop report serves to act as a primary reference document, capturing information on Member States’ approaches and experience. It also documents the recommendations from the workshop to inform possible follow-up collaborative actions.

Workshop Objectives

The workshop objectives were to:

- Share knowledge and experience of the assessment of nitrogen deposition impacts on the conservation status of habitats;
- Examine and share best practices about strategies and measures to reduce the impacts of nitrogen deposition on Natura sites and the wider landscape.

These objectives were addressed within two themes and included a series of plenary presentations and detailed discussion in working groups - Theme 1: Reporting and assessment of nitrogen deposition impacts; and, Theme 2: Knowledge sharing of practical solutions to reduce nitrogen deposition impacts.

Main Conclusions

Theme 1: Reporting and assessment of nitrogen deposition impacts

Evidence presented and discussed during the workshop confirmed that nitrogen deposition represents a major threat to the objectives of the Natura 2000 sites and to European

biodiversity more widely, especially in the Atlantic Region. Furthermore, measures taken to reduce nitrogen deposition impacts on European biodiversity to have potentially significant benefits in protecting human health.

There is an increasing body of evidence of the detrimental effects of nitrogen deposition impacts in the scientific literature. In some Member States represented at the workshop, the impacts of nitrogen are recognised and incorporated into national reporting on the conservation status of Natura 2000 sites. In other Member States, this has not been integrated with formal reporting under the Habitats Directive. Commonly, it was felt that there was a low awareness of the issue of nitrogen impacts on biodiversity, outside of the communities directly working on this topic.

The proportion of the Annex I habitats reports from each country in the 2013 Article 17 report which recorded nitrogen deposition as a 'pressure' varied from 17 to 76%. Member States applied different approaches to identifying nitrogen as a pressure (or threat) and in accounting for this in their conclusions about conservation status. The variation limits the opportunity to form comprehensive conclusions in respect of nitrogen impacts and conservation status.

It remains unclear if, or how, individual Member States have taken into account the impacts of nitrogen deposition that occurred prior to the adoption of the Habitats Directive; consequently, it is difficult to assess whether or not overall site objectives set for 'recovery' (improvement) or 'maintenance' (no further deterioration) have made allowance for this consideration.

It is possible to model the relative benefits of emission reduction scenarios for biodiversity. To link this more closely to the objectives of the Habitats Directive, clear targets need to be defined for a habitat or soil chemical attributes. However, such a prescriptive approach is problematic as many habitat types occur over a wide geographic range and objectives for individual Natura 2000 sites need to reflect their context (in terms of their surroundings, socio-economic features and stakeholders), as well as their specific condition.

Theme 2: Knowledge sharing of practical solutions to reduce nitrogen deposition impacts

The workshop provided an excellent opportunity to share experience and best practices about measures to reduce nitrogen deposition impacts. This included how Member States integrate international policies with local policies and practical measures taken on the ground to restore habitats or mitigate impacts. The Programmatic Approach to Nitrogen (PAN), used in the Netherlands, was widely viewed as providing an excellent example of good practice in assessing and managing the impacts of 'critical load exceedance'. Such an integrated approach is seen to be particularly useful and could be applied by other Member States. Also, it can help developers to assess opportunities for sustainable growth and facilitate the permitting of plans and projects, whilst meeting the obligations of Article 6.3 of the Habitats Directive.

Integration and linkage between international, European, national and local plans are seen as being critical in order to deliver greater protection for Natura 2000 sites. Cross-sectoral benefits, including those for human health and biodiversity, can be optimised within national plans by spatially targeting mitigation measures to gain the greatest overall protection. Specifically, 'Nitrogen Action Plans' for Natura 2000 sites were proposed at the workshop: such plans could be used to evaluate long-range and local nitrogen sources, together with specific, better-integrated habitat management measures.

Many techniques and diverse measures are currently explored and implemented to reduce nitrogen emissions from agriculture in Europe. These include those based on low-emission animal housing, management and feeding strategies, low-emission manure/slurry management and storage/land spreading and soil-management techniques. Generally, workshop participants felt that more could be done to demonstrate the potential 'win-win' situations of various measures: for example, the costs-benefits and resource saving to farmers of some measures to reduce ammonia emissions should be championed.

Appropriate site-management measures can be effective in mitigating nitrogen deposition impacts, or partially offsetting impacts. Restoration measures, particularly hydrological, have also shown success. However, alongside this, clearly nitrogen deposition from other sources must also be reduced. Furthermore, prior to implementation, management measures need to be fully considered – for example, to avoid the consequences of some intensified management techniques, which may be harmful to other elements of the ecosystem, and would therefore be counterproductive.

Main Recommendations

The recommendations from the workshop (numbered 1 to 17, below) have been grouped together under each of the two themes. Additionally, cross-cutting recommendations are grouped together into those requiring future collaboration between experts and those concerning the promotion and sharing of best practice.

Theme 1: reporting and assessment of nitrogen deposition impacts

1. Take practical steps to improve reporting and foster more-consistent reporting practices in respect of nitrogen impacts on Article 17 reporting, and, where necessary, develop new guidance or seek to clarify existing guidance. Specific recommendations for Article 17 reporting were made by Working Group 1, which will be useful for consideration by the European Topic Centre on Biological Diversity (ETC/BD) and Member States as part of the post Article 17 report review.
2. Establish a mechanism to bring together experts on the impacts of nitrogen deposition and those who advise on conservation status, to define common desired outcomes and develop integrated approaches for the negation of harmful nitrogen deposition. For example, working together, consider how air pollution relates to conservation status, and how incidences of exceeding 'critical load' relate to achieving favourable conservation status.
3. Consider ways to set meaningful nature-conservation objectives for sites. This should be based on consideration and understanding about historical nitrogen impacts and how cumulative effects of nitrogen deposition will influence future prospects of ecosystem structure and function.
4. Communicate clear targets or objectives (with regard to nitrogen deposition) for protecting and enhancing biodiversity – for example, to support evaluation of air pollution policy and the assessment of different emission scenarios.

Theme 2: practical solutions to reduce nitrogen deposition

5. Individual Member States should make full use of existing policy commitments – for example, the national codes of good agricultural practice for reducing ammonia emissions under the Gothenburg Protocol, the use of Best Available Technology (BAT)

under the Industrial Emissions Directive (IED), and consider use of Rural Development Programme funding, where appropriate

6. Streamline existing instruments and practices, specifically in areas that would yield improved integration across sectors. This should include ensuring greater integration and linkage between international, European, national and local plans and policies to help deliver greater protection for Natura 2000 sites.
7. Implement a more-integrated agricultural approach, with increased awareness of air quality issues, in addition to water and soil quality issues, within the agricultural sector itself. The integrated approach should involve advisers and associated sectors, such as animal housing and agricultural machinery designers, at both Member State and EU levels.
8. Optimise national plans for benefits to human health and biodiversity and ecosystem services, via spatially targeting measures to gain the greatest protection.
9. Develop nitrogen action plans for Natura 2000 sites. These should evaluate long-range and local nitrogen sources, and identify and target measures to reduce nitrogen deposition inputs to sites. With stakeholder input, the plans should capture the conservation objectives, appropriate emission reductions and practical measures that can be adopted. This activity can (and may need to) incorporate appropriate habitat management actions required to restore a site. The PAN approach, adopted in the Netherlands, is an excellent example of this. Such an approach can be used to facilitate the permitting of plans and projects by considering nitrogen inputs from new proposals in the context of a wider set of measures to reduce nitrogen deposition on a site.
10. Propose a suite of integrated site-management options for sites to reflect their condition in the context of defined nature-conservation priorities. This must take into account each site's geographic context and dynamics, including stakeholder interactions, because stakeholder engagement is essential to ensure maximum gains for nature.

Cross Cutting: Take appropriate steps to foster sustained collaboration between experts

11. Increase overall awareness of nitrogen deposition impacts, their consequences to biodiversity and ecosystem services, and the measures needed to address them. Appropriate promotion activity needs to be undertaken across a range of stakeholders, including policy makers, land managers, industry (including agricultural) and the general public.
12. Improve links between those working in nitrogen impacts research and assessment fields and those with responsibilities to report on the nature directives – for example, take steps to apply the growing understanding and empirical evidence of the impacts of nitrogen deposition on vegetation to inform reporting of conservation status.
13. Recognising the importance of nitrogen deposition within Member States in North and Western Europe, a dedicated cross-sectoral expert group should be established (the 'Atlantic Region Nitrogen Deposition Expert Group'). Its primary purpose would be to foster long-term, regional-level collaborative evidence-based actions. The group would focus on a number of work areas, for example:
 - Improve data sharing, communication and collaboration between experts, as well as between research and reporting communities.

- Improve understanding about the relationship between 'critical loads' and 'conservation status' to resolve challenging issues – for example, how metrics of air pollution impacts relate to conservation status, or how exceeding critical load relates to achieving favourable conservation status.
- Promote and share best practices, for example about, national approaches, such as the PAN approach applied in the Netherlands.
- Share experience of air pollution impacts assessment under Article 17.
- Provide guidance on how to recognise the impacts of nitrogen deposition for each Annex I habitat.

Cross Cutting: Promoting and sharing best practice

14. It is recommended that there would be benefits from further exchange on best practice for 'appropriate assessments', integrated approaches, and measures to reduce emissions from sources, especially agricultural ones. This needs to use highly participative approaches to achieve good stakeholder involvement.
15. The PAN approach as used in the Netherlands provides an excellent example of good practice in assessing and managing the impacts of exceeding 'critical load'. As a follow-up step under the Atlantic Natura 2000 Biogeographical Seminar Process, ECNC proposes to develop a study visit to the Netherlands to share the PAN approach more widely so that experts from other countries can see first-hand how it operates and is applied in the field.
16. Develop mechanisms for sharing best practice information between Member States on reducing emissions and increasing overall nitrogen use efficiency so that farmers can refer to optimal practical methods. It is suggested that this is achieved through existing groups such as the Task Force on Reactive Nitrogen or Expert Group on Ammonia Abatement. Information should be made available via the Internet and in different languages.
17. Use the Natura 2000 platform as a primary resource for sharing and gathering useful information.

List of Delegates, indicating which working groups they attended

Name	Affiliation	Country	Group
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Aherne, J	Trent University	Ireland/Canada	2, 4
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Bal, D	Ministry of Economic Affairs	The Netherlands	2, 7
Balla, S	Bosch & Partner GmbH	Germany	2, 6
Bareham, S	Natural Resources Wales	UK	3, 5
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Björnholm Ottosson, U	European Commission	EU	4
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Bridgewater, P	Joint Nature Conservation Committee	UK	3, 7
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Cork, C	Natural England	UK	7
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Dodd, D	Environmental Protection Agency	Ireland	3, 6
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Gregory, A	Joint Nature Conservation Committee	UK	1, 6
Hens, M	Research Institute for Nature and Forest	Belgium	1, 7
Hettelingh, J	National Institute for Public Health & the Environment	The Netherlands	2, 7
Kros, H	Alterra, Wageningen-UR	The Netherlands	3, 6
Le Maresquier, L	European Commission	EU	2
Lee, A	Scottish Natural Heritage	UK	2, 7
Leermakers, C	Rijkswaterstaat	The Netherlands	3, 6
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Magnus, J	Joint Nature Conservation Committee	UK	
Mathieson, S	Scottish Environment Protection Agency	UK	5
McIntosh, N	European Centre for Nature Conservation	EU	2, 7
Meremans, D	Flemish Environment Agency	Belgium	3, 5
Mitchell, D	National Farmers' Union	UK	4
Mudge, G	Scottish Natural Heritage	UK	2, 6
Neirynck, J	Research Institute for Nature and Forest	Belgium	2
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Sherry, J	Natural Resources Wales	UK	2, 7
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Van den Bril, B	Flemish Environment Agency	Belgium	3, 5
Van Gils, W	Natuurpunt	Belgium	3, 6
Van Hinsberg, A	Netherlands Environmental Assessment Agency	The Netherlands	3, 7
Van Vliet, W	Natural England	UK	2, 5
Verguts, V	Vlaamse Landmaatschappij	Belgium	3, 4
Verhaeghe, W	Agency Nature & Forests - Flanders	Belgium	2, 6
Watkins, S	Environment Agency	UK	4
Whitfield, C	Joint Nature Conservation Committee	UK	1, 7
Wilmot, M	Ministry of Economic Affairs	The Netherlands	3, 5

Contents

1	Introduction to the workshop and structure of this report	1
1.1	The context of the workshop	1
1.2	Workshop objectives	2
1.3	Structure of this report	4
2	The Natura 2000 Biogeographical Process – background, purpose and strategic context	5
2.1	Introduction	5
3	Theme 1 – Reporting and assessment of nitrogen deposition impacts	8
3.1	Introduction	8
3.2	Regional scenario assessments of nitrogen critical load exceedances and of tentative impacts on species richness. <i>Jean-Paul Hettelingh, Coordination Centre for Effects</i>	8
3.3	What can we learn from the 2007–12 Article 17 report? <i>Douglas Evans, European Topic Centre on Biological Diversity</i>	9
3.4	Working Group 1 – Assessing nitrogen impacts on conservation status: methods and outcomes – key discussion points and conclusions	10
3.5	Working Group 2 – Establishing conservation objectives and conservation measures for Natura 2000 sites and applying critical loads at sites – key discussion points and conclusions	12
3.6	Working Group 3 – Impact assessments for air pollution policy and nature conservation policy – key discussion points and conclusions	13
4	Theme 2 – Knowledge sharing of the practical solutions to reduce nitrogen deposition impacts	14
4.1	Introduction	14
4.2	An integrated approach to tackling nitrogen deposition. <i>Mark Sutton, Co-Chair of the Task Force on Reactive Nitrogen, Centre for Ecology & Hydrology, UK</i>	14
4.3	Review of the EU Air Quality Policy 2011-2013. <i>Ulf Bjornholm-Ottosson, European Commission</i>	15
4.4	Presentations from Member States providing an overview of their approaches to reducing nitrogen deposition	18
4.4.1	Flanders (Belgium): <i>Dr Maarten Hens, Research Institute for Nature and Forest</i>	18
4.4.2	France: <i>Professor Didier Alard, University of Bordeaux</i>	19
4.4.3	Ireland: <i>Dr Julian Aherne, Trent University, Canada</i>	19
4.4.4	Germany: <i>Markus Geupel, Federal Environment Agency</i>	20
4.4.5	The Netherlands: <i>Mark Wilmot, Ministry of Economic Affairs</i>	21
4.4.6	UK: <i>Peter Coleman, Department for Environment, Food and Rural Affairs (Defra)</i>	22
4.5	Working Group 4 – Measures for reducing impacts from agriculture – key discussion points and conclusions	23
4.6	Working Group 5 – Measures to reduce nitrogen deposition from sources other than local agriculture - key discussion points and conclusions	24
4.7	Working Group 6 – Approaches to assessing the impacts of air pollution emissions from plans/projects for Article 6.3 assessments – key discussion points and conclusions	24
4.8	Working Group 7 – The effectiveness of on-site (intensified) habitat management measures and restoration measures to mitigate nitrogen deposition impacts and to promote recovery – key discussion points and conclusions	25
5	General Conclusions and Recommendations	27
5.1	Introduction	27
5.2	Main Conclusions	27
5.3	Main Recommendations	28
6	References	31

APPENDIX 1.....	35
Theme 1 – Reporting and assessment	35
Working Group 1 – Assessing nitrogen impacts on conservation status for the 2013 Habitats Directive Article 17 Reporting round: methods and outcomes	35
APPENDIX 2.....	49
Theme 1 – Reporting and assessment	49
Working Group 2 – Establishing conservation objectives and conservation measures for Natura 2000 sites and applying critical loads/level at sites	49
APPENDIX 3.....	58
Theme 1 – Reporting and assessment	58
Working Group 3 – Impact assessments for air pollution policy and nature conservation policy	58
APPENDIX 4.....	67
Theme 2 – Knowledge sharing of practical solutions to reduce nitrogen impacts	67
Working Group 4 – Measures for reducing impacts from agriculture	67
APPENDIX 5.....	79
Theme 2 – Knowledge sharing of practical solutions to reduce nitrogen impacts	79
Working Group 5 – Measures to reduce nitrogen deposition from sources other than localised agriculture (e.g. transport, power generation, industry and long-range emissions)	79
APPENDIX 6.....	86
Theme 2 – Knowledge sharing of practical solutions to reduce nitrogen impacts	86
Working Group 6 – Approaches to assessing the impacts of air pollution emissions from plans/projects for Article 6.3 assessments	86
APPENDIX 7.....	96
Theme 2 – Knowledge sharing of practical solutions to reduce nitrogen impacts	96
Working Group 7 – The effectiveness of on-site (intensified) habitat management measures and restoration measures to mitigate nitrogen deposition impacts and to promote recovery	96

1 Introduction to the workshop and structure of this report

1.1 The context of the workshop

Atmospheric deposition of *reactive nitrogen*¹ is a major threat to biodiversity in Europe. Critical loads for the protection of habitats from nitrogen deposition are being exceeded over large areas of Europe, including the Natura 2000 network, and will continue to be exceeded under current projections of reactive nitrogen emissions (Posch *et al* 2012).

There have been a number of recent European reviews of the impacts of nitrogen deposition affecting biodiversity and the environment more widely (e.g. Hicks *et al* 2011, Sutton *et al* 2011, European Commission 2013). Most notably, the European Nitrogen Assessment (Sutton *et al* 2011) provides an authoritative and comprehensive report of reactive nitrogen in the environment, and five key societal factors concerning reactive nitrogen are assessed:

- water quality,
- air quality,
- greenhouse gas balance,
- ecosystems and biodiversity well-being, and
- soil quality.

These considerations provide a useful framework for devising and promoting an integrated policy response to the reactive nitrogen problem.

Air pollution also remains a significant threat to human health. Air quality guidelines are regularly breached across Europe resulting in high damage costs².

Emissions of oxides of nitrogen (NO_x) and ammonia (NH₃) are controlled under a number of policy instruments. Recognising the transboundary nature of these pollutants, the Gothenburg Protocol (Protocol to Abate Acidification, Eutrophication and Ground-level Ozone adopted in 1999, revised in 2012) of the 1979 UNECE Convention on Long-Range Transboundary Air Pollution (CLRTAP)³ establishes emission reduction targets for NO_x and NH₃ (and other pollutants) for signatory countries, with the objective to reduce impacts on ecosystems and on human health. In the EU, a range of directives tackle emissions of nitrogen pollutants including the National Emissions Ceilings Directive, the Industrial Emissions Directive and the Air Quality Directive. Together, the CLRTAP and EU policies have led to significant reductions in a range of air pollutants. 2013 was the 'Year of Air Pollution' and as part of its air pollution policy review the Commission published, in December 2013, its Clean Air Policy Package⁴. This sets out its ambition for further reductions in emissions to achieve greater protection of human health and ecosystems. It is important to recognise that a range of other policy areas, including agricultural policy, influence nitrogen emissions. Furthermore, whilst NO_x and NH₃ are transboundary pollutants, there is potential for significant local impacts in source areas, particularly for ammonia (NH₃). Measures to address the impact of nitrogen deposition need to account for the local- through to the transboundary scale.

¹ Collectively any chemical form of nitrogen other than di-nitrogen (N₂). Reactive nitrogen (N_r) compounds include NH₃, NO_x, N₂O, NO₃⁻ and many other chemical forms, and are involved in a wide range of chemical, biological and physical processes. In this report the term 'nitrogen' is used to mean 'reactive nitrogen'.

² http://europa.eu/rapid/press-release_MEMO-13-1169_en.htm

³ http://www.unece.org/env/lrtap/multi_h1.html

⁴ http://ec.europa.eu/environment/air/clean_air_policy.htm

The Habitats Directive promotes the protection of biodiversity in Europe. It requires Member States to take measures to maintain at – or restore to – ‘favourable conservation status’, the natural habitats and species of community importance. The directive establishes the Natura 2000 site network, with the aim to assure the long-term survival of Europe's most valuable and threatened species and habitats. The provisions of the directive require strict site protection measures and avoidance of deterioration, and introduce a precautionary approach to permitting ‘plans or projects’ that may have a likely significant effect on a site.

The wealth of evidence of nitrogen deposition impacts on biodiversity (e.g. Dise *et al* 2011) suggests that nitrogen deposition presents a significant threat to the conservation status of sensitive habitats and species, listed in the Habitats Directive.

In 2009, a European workshop ‘*Nitrogen Deposition and Natura 2000*’ brought together scientists, environmental managers and policy makers to review, in the context of the Habitats Directive, (a) the latest research on nitrogen impacts, (b) assessment and modelling procedures, and (c) European and Member State policies to address impacts (Hicks *et al* 2011).

In 2011, the European Commission established the Natura 2000 Biogeographical Process. This is a series of seminars, which are being held in each biogeographic region of the EU, with the intention of improving overall conservation status of habitats and species listed on the Habitats Directive and the status of birds listed on the Birds Directive, as well as contributing to the achievement of the EU Biodiversity Strategy. Further information on the Natura 2000 Biogeographical Process is provided in Section 2 of the present report.

At the Atlantic Natura seminar⁵ in December 2012, nitrogen deposition was highlighted as a major threat to the conservation status of many habitat types. In response, the ‘*Nitrogen Deposition and the Nature Directives Workshop - Impacts and Responses: Our shared experiences*’, was held in December 2013.

The workshop built on the established evidence base of nitrogen impacts on biodiversity and the report of Hicks *et al* (2011). The emphasis was on sharing experience and approaches, thus promoting the exchange of information and best practice between Member States. It was attended by over 50 delegates from the Member States in the Atlantic Region⁶.

Delegates had experience of either the assessment of nitrogen deposition impacts on conservation status and/or of measures or strategies to reduce the impacts. Environmental and agricultural non-government organisations were also represented.

1.2 Workshop objectives

The workshop objectives were to:

- i. Share knowledge and experience of the assessment of nitrogen deposition impacts on conservation status of habitats.
- ii. Examine, and share best practice of, strategies and measures to reduce the impacts of nitrogen deposition on Natura sites and the wider landscape.

⁵<http://ec.europa.eu/environment/nature/natura2000/pdf/20130421%20Atlantic%20Seminar%20Report%20draft5.pdf>

⁶ Belgium, Denmark, France, Germany, Ireland, The Netherlands, UK. No representatives from Spain or Portugal attended the workshop.

These objectives were addressed via two themes through a series of plenary presentations and detailed discussion in working groups:

- ***Theme 1: Reporting and assessment of nitrogen deposition impacts***
 - Comparison of approaches to assessing nitrogen deposition as a pressure and threat for Article 17 reporting in 2013 and the outcomes.
 - Examining how Member States have considered nitrogen deposition impacts in setting conservation objectives, and how this relates to the setting of critical loads.
 - Exploring the potential links between the assessment process for nitrogen deposition impacts in the context of Article 17 and air pollution policy evaluations.
- ***Theme 2: Knowledge sharing of practical solutions to reduce nitrogen deposition impacts***
 - Sharing experience of approaches and measures used to reduce nitrogen deposition and impacts at Natura sites.
 - Considering a range of sources and site management approaches; discussing their effectiveness and co-benefits/threats to other policy areas.
 - Identifying the extent to which the Habitats Directive has provided a driver for emission reductions of nitrogen pollutants.
 - Sharing experience of how stakeholder support has been achieved.
 - Identifying gaps and making recommendations for practical measures to reduce nitrogen deposition inputs and mitigate impacts on sites.

There were a total of seven working groups. The schematic in Figure 1 describes the topics of the working groups and how they inter-relate.

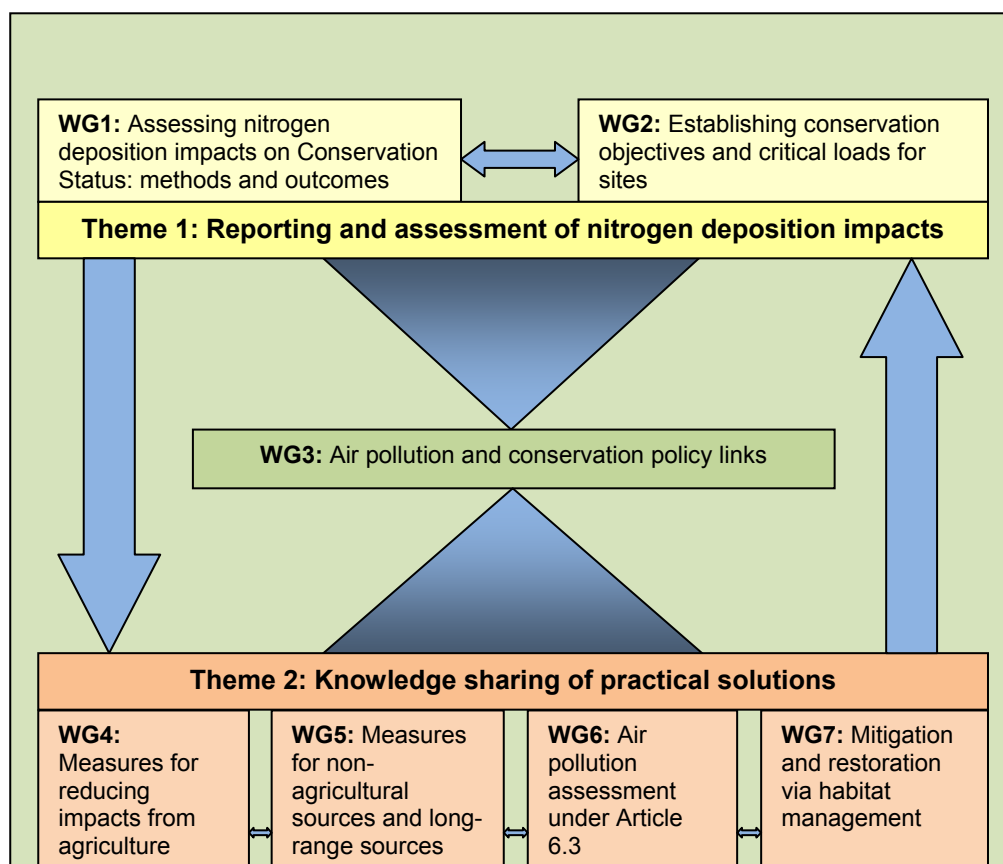


Figure 1. Summary of the workshop structure, highlighting the linkages between the two themes and the seven working groups (WG).

1.3 Structure of this report

The working groups were each supported by a background paper setting out the context for the group and a set of points for discussion. Each group provided a report of their findings, which built on the background paper, documenting approaches taken by the different Member States represented and presenting the group's conclusions and recommendations. These working group reports are presented in full in Appendices 1-7.

Sections 3 and 4 of this report present a summary collation of the findings from Theme 1 and Theme 2 respectively, based on the reports from the working groups and also the plenary presentations which set an introductory context for each theme. In this way, the workshop report serves to act as a reference document, capturing information on Member States' approaches and experience.

Additionally, the report serves to document the recommendations from the workshop to inform possible follow up work. The key conclusions and recommendations are summarised in Section 5.

It is noted that concentrations of NO_x and NH_3 may also cause direct effects, in addition to effects through deposition. Whilst for simplicity this workshop report refers almost exclusively to nitrogen deposition, this was a general term also intended to cover concentration-based effects.

2 The Natura 2000 Biogeographical Process – background, purpose and strategic context

2.1 Introduction

The European Commission launched the Natura 2000 Biogeographical Process in 2011. The first Seminar for the Atlantic Biogeographical region, hosted by the Dutch Ministry of Economic Affairs, took place in December 2013. The Nitrogen Deposition and the Nature Directives workshop was a follow up action.

The primary purpose of the Natura 2000 Biogeographical Process is to assist Member States to meet legal obligations under the nature directives with respect to the favourable conservation status of habitats and species of community interest. Through the Natura 2000 Biogeographical Process, a key aim is to ensure that Member States and expert stakeholders are enabled to realise collaborative networking events, associated information sharing and cooperative knowledge building activities, linked to common strategic priorities. The EU 2020 Biodiversity Strategy calls for a step change in efforts to halt the loss of biodiversity and to restore essential services that a healthy natural environment provides.

In the Natura 2000 network, as in the Strategy, the needs of biodiversity are central, but not isolated – for example, by taking an ecosystem-based approach, it is possible to ensure that nature (and therefore Natura 2000) continues to contribute to growth at local, regional, national and European levels. Working through the co-operation mechanisms provided by the Process, this means that:

- i. The inputs of Member States and expert stakeholders are central to defining the forms of collaboration required to achieve the 2020 targets.
- ii. Collaborative actions should focus on nature's many processes and functions to improve habitat condition and generate multiple benefits, including social prosperity and welfare.
- iii. There is opportunity to reflect and think collectively about practical ways to improve the favourable conservation status of habitats and species and to learn from Article 17 reporting experience – this includes utilizing the Process to, for example:
 - Identify the forms of collaboration appropriate for agreed common priorities, including exploring scope for potential LIFE or Interreg project proposals;
 - Discuss, agree and set conservation objectives at biogeographical level;
 - Define favourable reference values for conservation status at different levels within a biogeographical region.

Therefore, the Strategy captures the common objectives and specifies the key targets to be met - for example, to build understanding about how EU 2020 Target 1 is interpreted. Working with expert stakeholders in the NGO community, over the last 20+ years, significant gains in ecology knowledge, information and practical management experience have been acquired about Natura 2000. However, especially with regard to strengthening Natura 2000 as a coherent ecological network, there is scope to generate measurable improvements about how this knowledge and experience can be collectively developed and collaboratively applied. Cumulatively, improved nature conservation management practices will enable greater progress to be achieved towards the 2020 Biodiversity Strategy goals and targets. In this way, the Process can increasingly be utilized to guide participants towards 'common directions'.

2.2 New learning, new knowledge

To achieve progress within the strategic context, it is essential that there is clear and shared understanding about what is already known, what has to be achieved and what actions require to be developed together to safeguard biodiversity in Europe. Specifically, within the Natura 2000 Biogeographical Process, there are opportunities to:

- i. Generate better integrated approaches through mobilizing greater inputs from strategic stakeholders and increasing participation from practitioners.
- ii. Support opportunities to network (for example, through workshops or working groups) that generate recommendations for practical Natura 2000 management, matched by shared commitments for future actions.
- iii. Work with established Steering Committees in each biogeographical region and foster greater focus on strategic targets – for example, explore how to use Article 17 data more proactively and build common understanding about core strategic policy areas such as interpretations of favourable conservation status and favourable reference values.
- iv. Continue to systematically develop the Natura 2000 Platform in ways that facilitate learning and foster new know-how – for example, through improved search facilities, including searches by theme, promote best practices for specific Natura 2000 management issues.
- v. Include flagship species where useful as indicators and in raising public awareness.
- vi. A more proactive, catalyzing role for the EC's appointed contractor – for example, increase opportunities to learn from pilot studies, LIFE (and other) projects and monitoring results (including Article 17 reporting) to increase synergies.

The aim is to continue to develop the Natura 2000 Biogeographical Process with greater focus on strategic outcomes achieved through supporting a range of practical management co-operative actions that strengthen the implementation of Natura 2000. That includes the integrated joint working activities identified as being of added value for experts and Natura 2000 management practitioners working to address the impacts of nitrogen deposition.

2.3 Future opportunities

The Natura 2000 Biogeographical Process continues, with thematic 'Kick-off seminars' and 'Review seminars' being planned. Each seminar will be informed by background information on the conservation status and needs of the selected habitat types and species: a list of related habitat groups, cross-cutting issues and problems whose solutions should directly contribute to achieving favourable conservation status will also be addressed. In addition, the seminars will be organised at the level of biogeographical regions at intervals which take stock of the results of the thematic events in the region. Follow-up actions, identified as being most useful to Process stakeholders, can be further developed through networking and co-operation under a new proposed Natura 2000 Biogeographical Networking Programme. The follow-up actions can take the form of conferences, workshops, expert meetings, or study visits.

Hosted by national or regional actors (rather than lead countries), the Seminars will be supported, organized and facilitated by the European Commission's contractor, under a technical assistance contract to provide added value opportunities that progress the favourable conservation status of habitats and species of Community interest. The Seminars and follow-up networking events will aim to result in a jointly agreed list of recommendations and priority actions identified by Member States and expert networks for follow-up in-depth co-operation, networking and collaborative action in respective regions and, where appropriate, also between regions.

The results of the Seminars and networking events will continue to be shared on the Natura 2000 Platform⁷. As the content of the Platform expands with greater volumes of relevant Natura 2000 information, it will continue to be developed as a web-based tool for networking, dialogue building and exchanging information on conservation objectives and measures between all actors involved in the Process.

⁷ http://ec.europa.eu/environment/nature/natura2000/platform/index_en.htm

3 Theme 1 – Reporting and assessment of nitrogen deposition impacts

3.1 Introduction

Nitrogen deposition is a major threat to biodiversity across large areas of Europe, particularly the Atlantic Biogeographical region (Nordin *et al* 2011; Dise *et al* 2011). The impacts of nitrogen include: a loss of sensitive species, increased growth of 'rank' species, changes to habitat structure and function, the homogenisation of vegetation types, geochemical and biochemical imbalances, and diminished resilience against biotic and abiotic stresses. It is also recognised that nitrogen deposition can have both positive and negative effects on a wide range of ecosystem services.

The focus of the workshop was on impacts on biodiversity, through the changes described above, in the context of the requirements of the Habitats Directive. Nitrogen deposition poses a serious threat to many Natura 2000 and other protected nature sites across Europe. Forecasts of nitrogen deposition and 'critical loads exceedance' (see 3.2 below) show that this will continue over the next few decades, resulting in the degradation of biodiversity. Unless tackled proactively, in collaboration across the Atlantic region, there is a real risk that the EU 2020 Biodiversity Strategy targets will not be achieved and that the favourable conservation status of habitats and species of Community importance will continue to decline.

Under Theme 1, the workshop explored how Member States of the Atlantic region assess and report nitrogen deposition impacts in the context of the Habitats Directive. It looked at whether, and how, nitrogen impacts have been considered in the setting of conservation objectives for sites and, in turn, if this is reflected in critical loads for sites. The extent to which there was integration of the Habitats Directive and biodiversity policy with air pollution policy was also considered.

To introduce the topic, presentations were provided by two guest speakers. Dr Jean-Paul Hettelingh, from the Coordination Centre for Effects (CCE), provided an overview of assessment of critical load exceedance under different nitrogen deposition scenarios; Dr Doug Evans, from the European Topic Centre on Biological Diversity (ETC/BD) presented the preliminary findings from the 2013 national reports under Article 17 of the Habitats Directive. Summary points from their presentations are described below. This is followed by a summary account of the discussions of the three working groups held in Theme 1. Full reports of the working groups are provided in Appendices 1-7.

3.2 Regional scenario assessments of nitrogen critical load exceedances and of tentative impacts on species richness. *Jean-Paul Hettelingh, Coordination Centre for Effects⁸*

A critical load is defined as the amount of pollutant deposition below which significant harmful effects on specified sensitive elements of the environment do not occur, according to present knowledge. Critical loads are an indicator for the sustainability of an ecosystem, its biodiversity and its services. Nitrogen deposition loads in excess of nutrient nitrogen critical loads (known as 'exceedance') affect biodiversity and the multi-functionality of ecosystems.

⁸http://ec.europa.eu/environment/nature/natura2000/platform/documents/hettelingh_plenary_assessment_of_critical_loads_eng.pdf

Critical loads for nitrogen can be calculated using mass balance models, or established from empirical relationships between dose (deposition) and impacts. European critical loads are compiled under the UNECE Convention on Long-Range Transboundary Air Pollution (CLRTAP), for ecosystems classified in the European Nature Information System (EUNIS), enabling regional (and Natura 2000) impact assessment of emission reduction scenarios of nitrogen pollutants. Exceedance can be estimated from 1880 to 1980 and more-directly calculated from 1980 to the present day, with projections up to 2020 and presented in maps (including in Natura 2000 sites) showing the location and magnitude of the risk of exceedances of critical loads.

Currently, critical loads are exceeded over a large area of European ecosystems, including Natura 2000 areas. The European ecosystem area at risk of eutrophication improves from 67% (78% in Natura 2000 areas) in 2005 to 54% (65% in Natura 2000 areas) in 2020 (based on emission ceilings of the revised Gothenburg Protocol established in 2012 under the CLRTAP).

A dose-response relationship between nitrogen deposition and species richness, that has been established for specific sites (Stevens *et al* 2010), has tentatively been applied to selected European grasslands. This enables the *relative* comparison of species richness *between* emission reduction *scenarios* (i.e. a reduction in nitrogen deposition) and *target years*. A tentative scenario specific assessment illustrates species richness in grasslands in Natura 2000 areas to increase from 79% in 2005 to 82% in 2020.

The CCE require suitable indicators, or metrics, against which to measure the impacts of nitrogen on biodiversity in relation to the headline target of the EU Biodiversity Strategy 2020 “to halt the loss of biodiversity and the degradation of ecosystem services in the EU by 2020”. This can then be used to support cost-effective European policies addressing effects of air pollution, climate change and biodiversity and their interactions.

3.2.1. Conclusions and Recommendations

- i. Natura 2000 areas are at risk from excessive nitrogen inputs.
- ii. It is calculated that critical loads of nutrient nitrogen will be exceeded in 65% of Natura 2000 areas by 2020.
- iii. Plant species diversity is affected by excessive nitrogen inputs, which leads to adverse effects on the multi-functionality of ecosystems.
- iv. Critical load exceedances in most countries cannot be sufficiently curbed by national policies alone.
- v. Effects-based integrated assessments can be used to inform the development of policy strategies to tackle nitrogen deposition, establishing an integrated policy framework through links between, for example, air pollution policy, climate change policy and biodiversity policy.

3.3 What can we learn from the 2007–12 Article 17 report?

*Douglas Evans, European Topic Centre on Biological Diversity*⁹

The Habitats Directive requires Member States to “undertake surveillance of the conservation status of the natural habitats and species” (Article 11) and report on the implementation of the directive, including the main results from the surveillance, at six yearly intervals using an agreed common format (Article 17). Reports for each biogeographical region present in a country cover each habitat or species noted in Annexes I, II, IV and V of

⁹ http://ec.europa.eu/environment/nature/natura2000/platform/documents/evans_plenary_article_17_report_eng.pdf

the directive and cover the whole region, not just Natura 2000 sites. They include supporting information, such as information on threats and pressures, reported using a hierarchical typology. These are ranked in order of importance (high, medium, low). Nitrogen input is included under 'Air pollution, air-borne pollutants'. An optional qualifier allows the type of pollutant to be identified (acid deposition, nitrogen, etc.).

National reports for the period 2007-12 were due in June 2013. Initial reports are checked by the ETC/BD and countries are asked, if necessary, to make corrections before submitting a final report. By mid-November 2013, 14 Member States had submitted their final reports while all others (except Greece) had delivered their initial reports. Therefore, the figures quoted in the presentation and this report are a mix of initial and final deliveries and should be regarded as preliminary, although the general trends are unlikely to change.

The preliminary results show that nitrogen deposition is a significant issue: about one in five Article 17 assessments mention nitrogen as a pressure in their regions. However, this varies between countries. Also, when comparing countries, there are some anomalies. For example, Luxembourg does not report nitrogen as a problem, whereas all of its neighbouring countries do. Mires, dunes and heaths are the most common habitat types reported to be affected. North-West Europe is particularly adversely affected. Pressure from nitrogen deposition is also reported for 87 species, mostly plants, while there are many other pressures for both habitats and species which are qualified with 'N'.

The Article 17 reporting generally concurs with published maps of exceedance of critical loads for nitrogen, although there are some discrepancies, where countries experiencing high critical load exceedance do not report nitrogen as a pressure or threat in the Article 17 report. This requires further investigation.

3.3.1. Conclusion and recommendations

- i. Nitrogen deposition is an important pressure and threat for Annex 1 habitats, particularly in North-West Europe.
- ii. Further analysis should be performed once the dataset is complete.
- iii. Harmonisation of Article 17 reporting is desirable.

3.4 Working Group 1 – Assessing nitrogen impacts on conservation status: methods and outcomes – key discussion points and conclusions

This working group examined how nitrogen deposition impacts were taken into account in the assessment of conservation status for Member States' reports under Article 17. The group examined the approaches taken under the latest reporting round (2013) and reviewed the outcomes.

The objectives of the working group were:

- i. To examine and summarise what impact nitrogen has on conservation status, and compare this to results of other assessments of nitrogen impacts on biodiversity.
- ii. To share information on the approaches taken for nitrogen assessment within Article 17 assessments in 2013.
- iii. 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.

All countries participating in the working group had made some consideration of nitrogen deposition impacts in their assessments of conservation status for the 2013 Habitats Directive Article 17 reporting round. However, the approach varied.

Nitrogen deposition, or, more generally, air pollution, was identified as a pressure and threat to some habitat types and species within each of the six Member States represented in the working group. Provisional results from the 2013 reporting round record nitrogen deposition as a pressure or threat in between 17 and 76% of the Annex I habitats reports across each country for the Atlantic region: for species, the impact of nitrogen deposition is less clear. Although all Member States represented had conducted a species assessment, this had been less comprehensive in respect of nitrogen impacts than for the habitat assessments.

On the basis of the Article 17 reports, some Member States appear to be more affected by nitrogen deposition impacts than others. However, Member States apply different approaches to identify nitrogen deposition as a pressure/threat and in accounting for this in their conclusions for conservation status. As a consequence, it was agreed that a note of caution is necessary in drawing detailed conclusions from any analysis of the Article 17 results in respect of 'N', especially when comparing countries.

The picture given of nitrogen impacts across the Atlantic Region, based on an initial and (necessarily) fairly superficial review of the data (some data were still draft at the time of the workshop and the production of the report), show nitrogen deposition as an important pressure and threat. However the spatial pattern is not entirely consistent with areas at risk as determined by critical load exceedance maps for the region (e.g. Posch *et al* 2012).

The working group concluded that attribution of nitrogen deposition as a pressure/threat and the consequences of it for future prospects probably have been under-reported in some cases, particularly for species assessments. The main challenges have been: (a) the lack of join-up with, or barriers preventing full use of, evidence/research information; and, (b) that the pressure/threat may be recognised, but other issues are felt to be more severe and immediate, and hence of greater priority.

The working group further concluded that it is important to consider to what extent Article 17 reporting can be used as a mechanism for attributing and ranking causes of unfavourable status, particularly off-site pressures such as nitrogen deposition. Currently, the lack of methodological uniformity in assessing the pressures and threats limits ability to draw sound conclusions about the specific impacts of nitrogen deposition in terms of the relative importance of pressures/threats for a given habitat and from cross-country comparisons. It would be worthwhile exploring to what extent other information sources can be used to inform this and/or be incorporated in Article 17 reporting.

Given the issues discussed, the working group made a number of recommendations. Firstly, those directly related to the guidance and approach for Article 17 assessment, particularly concerning the identification of pressures and threats. Secondly, recommendations covering more general principles, including the need to develop thinking around how measures of air pollution impact relate to conservation status and how critical load exceedance relates to achieving favourable conservation status. These points relate to the objectives of Working Group 2.

3.5 Working Group 2 – Establishing conservation objectives and conservation measures for Natura 2000 sites and applying critical loads at sites – key discussion points and conclusions

The Habitats Directive aims to achieve ‘favourable conservation status’ of habitats and species of community interest. It obliges Member States to set conservation objectives for Special Areas of Conservation (SACs) and to establish the necessary conservation measures.

In areas with high nitrogen deposition inputs, it is likely that many Natura 2000 sites will already have been adversely affected by nitrogen deposition, and this may have occurred before designation. When setting conservation objectives, Member States need to establish whether there is a requirement to ‘restore’ (improve) the habitat at the site or to ‘maintain’ it. In relation to this, it is important to know how the impacts of nitrogen deposition have been considered.

The objectives of Working Group 2 were to:

- i. Share experience of how countries have taken direct or indirect account of nitrogen deposition impacts when setting conservation objectives and conservation measures for features of Natura 2000 sites.
- ii. Consider approaches to setting critical loads/levels for Natura sites and to explore the relationship with site conservation objectives based on habitat structure and function attributes.
- iii. Assess if and how Member States have established what overall level of nitrogen deposition input is ‘acceptable’, given the conservation objectives, and what scientific and practical challenges this presents.

The group found substantial differences between countries in how nitrogen deposition is dealt with in setting conservation objectives and conservation measures, and in developing and applying critical loads. Approaches are summarised in Appendix 2.

Differences stem from a number of variables, such as differences in exposure to nitrogen deposition (and thereby the level and severity of impacts on habitats and species); variations in understanding about the nitrogen deposition ‘problem’; and differences in the level of priority (and resources) given to the issue in comparison to other pressures affecting habitats and species of conservation priority.

Most countries have developed, or are developing, critical loads for Natura sites. These are either based on the CLRTAP empirical critical load ranges or are further specified using modelling techniques to produce site-specific, quantitative critical loads for all designated features. In most cases, critical loads were used to inform assessments for proposed plans and projects under Article 6.3 of the Habitats Directive. In some cases, critical load exceedance informs the site management measures or a wider action plan for the habitat or site. The Programmatic Approach to Nitrogen (PAN) as used in the Netherlands provides an excellent example of good practice in assessing and managing the impacts of critical load exceedance.

Unfortunately, a lack of time prevented discussion of third objective in the list above. Consequently, the group was not able to ascertain how Member States establish what level of nitrogen deposition input can be regarded as ‘acceptable’ taking into account the conservation objectives, nor was it able to outline the scientific and practical challenges that this presents.

That said, the value of sharing scientific and practical knowledge and experience was recognised as being crucial to dealing with the issue of nitrogen deposition and its impact on habitats and species of Community interest in the Atlantic Biogeographical region.

3.6 Working Group 3 – Impact assessments for air pollution policy and nature conservation policy – key discussion points and conclusions

Nature and air pollution policy development are not often regarded as being closely connected. Traditionally, nature conservation has been focused on what is happening on (and in) the ground (and waters), and, consequently, such aspects have determined the development of appropriate management measures. Normally, there is a lack of attention for proactive management of external pressures on a site or area.

Air pollution policy is driven by the assessment of abatement costs for certain emission sources and its impacts on the protection of human health (first and foremost) and ecosystems (often as a secondary consideration). The (often) transboundary dispersion of pollutants is taken into account. For European air pollution policy, targets for health protection are based on WHO advice. Targets for biodiversity protection have thus far not been based on European biodiversity policy targets, but on methods developed within the Working Group on Effects of the CLRTAP.

The challenge is to achieve greater integration and links between conservation practice and policy and air pollution policy at local, national and European scales. At each of the scales, with respect to the objectives of the Habitats Directive (or other biodiversity policy commitments), two key questions arise:

- (a) What evidence of nitrogen impacts is required to trigger a policy response?
- (b) What policy relevant measures are useful to assess the impacts of nitrogen deposition (including the benefits of emission reduction scenarios)?

The aims of this working group were to identify the key biodiversity and air pollution policy drivers and to consider what the scientific and evidence requirements are to enable a better integration of these two policy areas.

It was concluded that general awareness of the need to reduce nitrogen emissions is growing. However, the ways that nature conservation policy objectives are taken into account in air pollution policy and agricultural policy is different in different Member States, in terms of extent and methodology. There was consensus that all levels of government – that is, at local, national and international scales – have a role and a responsibility for preserving biodiversity and implementing policies to realise conservation objectives. Furthermore, all steps to accelerate the vertical and horizontal integration of nature conservation policy targets into other environmental policies are strongly endorsed.

To achieve this, targets or objectives for protecting and enhancing biodiversity need to be clear. To support evaluations of air pollution policy and the assessment of different scenarios, there need to be more clearly defined ambitions for specific habitats, species, ecosystem functions and appropriate indicators or measures.

4 Theme 2 – Knowledge sharing of the practical solutions to reduce nitrogen deposition impacts

4.1 Introduction

Following on from Theme 1, the assessment and reporting of the impacts of nitrogen deposition, the workshop progressed to focusing on the actions taken by Member States to address those impacts.

Within Theme 2, the Member States represented shared their experience of the approaches and measures used to decrease nitrogen deposition and the impacts at Natura sites. Subjects discussed included tackling emission of nitrogen pollutants from a range of sources, such as agriculture, roads and industry, as well as approaches to habitat management to reduce impacts and promote recovery.

To introduce the topic, presentations were provided by two guest speakers. Professor Mark Sutton, Co-Chair of the Task Force on Reactive Nitrogen, Centre for Ecology & Hydrology, UK, made the case for an integrated approach to tackling nitrogen deposition. Ulf Bjornholm-Ottosson, European Commission, provided an overview of the European Union Air Quality Policy review in 2011-2013. This was followed by presentations from six of the seven Member States represented at the workshop, which provided an outline of their strategies and approaches to reducing emissions of reactive nitrogen and the extent to which these are driven by the Habitats Directive. Key points from the presentations are described below. This is followed by a summary account of the discussions of the four working groups held in Theme 2. Full reports of the working groups are provided in Appendices 1-7.

4.2 An integrated approach to tackling nitrogen deposition.

*Mark Sutton, Co-Chair of the Task Force on Reactive Nitrogen,
Centre for Ecology & Hydrology, UK¹⁰*

Excess reactive nitrogen poses threats across five key areas: water quality, air quality, greenhouse balance, ecosystems and soil quality. The European Nitrogen Assessment estimated the damage costs of reactive nitrogen at €70-€320 billion per year (Sutton *et al* 2011).

The concept of the 'nitrogen cascade', illustrates how the different forms of nitrogen inter-convert through the environment. It demonstrates how action at one level affects other forms of nitrogen further down the cascade. Adopting an integrated approach to tackling nitrogen deposition would lead to greater results, action at one level having a positive 'knock-on' effect through the cascade.

At the European scale, there is widespread exceedance of nutrient nitrogen critical loads. However, the picture is not uniform: zooming in at a local scale reveals degrees of patchiness in emissions, sources and patterns of concentrations and deposition. The issue of scale further complicates the appropriate responses, and also the visibility of the problem.

The Task Force on Reactive Nitrogen (TFRN) CLRTAP was initiated in 2007. The goal of the TFRN is to develop technical and scientific information for strategy development, with the

¹⁰http://ec.europa.eu/environment/nature/natura2000/platform/documents/sutton_integrated_approach_to_tackling_n_deposition_theme2_eng.pdf

long-term aim being to identify ways in which current and future nitrogen-related policies can be better streamlined and integrated. Recent focus of the TFRN includes:

- mitigation measures for **agricultural nitrogen**, with special attention to ammonia;
- development of regional **nitrogen budgets** to inform full nitrogen optimisation strategies;
- assessment of the relationships between **nitrogen and food** choices; and
- awareness and knowledge building on **nitrogen in countries of Eastern Europe, Caucasus and Central Asia (EECCA)**.

In 2020, ammonia will be the largest contributor to acidification and eutrophication in the EU. It is also a significant source of secondary particulate matter that affects human health. We need to move beyond only discussing technical measures to reduce emissions, towards greater awareness of the problems to inform societal choices about patterns of consumption.

To illustrate this point, society's food choices are critical to tackling nitrogen emissions. The EU is a net importer of nitrogen in feed and food. The average European's protein consumption exceeds the amount necessary for a healthy diet by over 70% (Reay *et al* 2011). If the demand for meat is reduced, the demand for livestock and animal feed will be less, and hence ammonia emissions will be reduced. The key challenge is to optimise (reduce) meat consumption to improve our quality of life, whilst recognising in other parts of the world that food security represents a real challenge.

4.2.1. Conclusions

- i. In 2020, ammonia will be the largest contributor to acidification and eutrophication.
- ii. Maintaining a profitable livestock sector whilst achieving critical priorities for biodiversity, points to the need to set priority areas for biodiversity protection.
- iii. Nitrogen strategies need to take an integrated view of the nitrogen cycle, linking agricultural ammonia, nitrous oxide and nitrate losses.
- iv. Co-ordination of international policies could be improved and the co-benefits better recognised.
- v. Communication about nitrogen pollution needs to be more effective and far-reaching if it is to drive a policy response and inform societal choices.

4.3 Review of the EU Air Quality Policy 2011-2013.

*Ulf Bjornholm-Ottosson, European Commission*¹¹

The European Commission published the Clean Air Policy Package on 18 December 2013¹² (*after* the Nitrogen Deposition and the Nature Directives Workshop which is reported in the present document). It was therefore not possible to present the new package at the workshop. Instead, the focus of Mr Bjornholm-Ottosson's presentation was to provide an overview of the policy review and some insight into what the package may include.

Air pollution is a complex policy area, involving many pollutants, sectors and impacts. The existing air policy framework is established at international, EU and national levels. At the EU level, it includes the EU Thematic Study on Air Pollution, the National Emission Ceilings Directive (NECD), Ambient Air Quality Directives, Industrial Emissions Directive and source-specific legislation.

¹¹ http://ec.europa.eu/environment/nature/natura2000/platform/documents/ottosson_eu_policy_overview_eng.pdf

¹² http://ec.europa.eu/environment/air/clean_air_policy.htm

EU air policy faces several challenges. The air quality objective set out in the 7th Environment Action Programme (EAP), viz. "no significant negative impacts on health and the environment", and World Health Organisation (WHO) guidelines have not been achieved. There are significant problems of compliance: several Member States are currently facing infringement cases because they exceed EU air quality standards, with serious health and environmental impacts and considerable economic costs.

Air policy has been effective: in recent decades, emissions of major air pollutants have been greatly reduced. There has been a decoupling between economic growth and emissions/pollution. However, in the EU, air pollution still kills 10 times more people than road traffic accidents and the downward trends in emission have not been fully matched by improved air quality.

Ammonia emission causes serious environmental problems: contributing to eutrophication, acidification and health impacts (secondary particulate matter (PM)). Historically, ammonia emissions have not reduced as much as other air pollutants (e.g. sulphur dioxide) and baseline emission projections indicate almost no further reductions without additional measures. Emissions of primary PM, oxides of nitrogen and sulphur dioxide are expected to be significantly reduced in future under the Business As Usual (BAU) scenario¹³. Consequently, the relative importance of ammonia emissions will increase. Therefore, if we want to further limit negative health impacts and eutrophication from air pollution, ammonia emissions will need to be significantly reduced in the to 2030.

Over 90% of ammonia emissions come from agriculture. With a few exceptions (e.g. the Netherlands and Denmark), Member States have so far done little to actively reduce ammonia. The limited reductions of ammonia emissions in the EU (7% reduction 2002-2012; 30% reduction 1990-2010) have in large part been due to structural changes in the agricultural sector and/or reductions in animal numbers. The impact assessment therefore identifies ammonia reductions as particularly cost-effective, achieving substantial air quality benefits at low cost; that is, ammonia reduction is relatively more cost effective to achieve than strategies for other pollutants. Any ambition level chosen in the main impact assessment will be difficult (expensive) to achieve without additional measures for ammonia.

Measures to reduce ammonia emissions from agriculture, such as low-emission manure application, covered manure storage and substitution of urea fertiliser, are very cost-effective compared to many other measures.

The estimated costs for the agriculture sector in the Commission's new clean air policy package (about €800 million) are higher than for other economic sectors. This is because most of these other sectors are already facing significant costs in implementation of existing legislation, such as the Euro 6/VI standards for vehicles and the requirement to apply best-available techniques under the Industrial Emissions Directive.

Combined benefits of applying ammonia abatement measures to the farmer may also be significant (though often neglected), because many measures (e.g. deep injection of slurry or balanced nitrogen application) can simultaneously increase nitrogen use efficiency, reduce the need for costly mineral fertilisers, improve agronomic flexibility, and simultaneously reduce emissions of other environmental and climate legislation (e.g. the Nitrates Directive¹⁴ and Water Framework Directive¹⁵).

¹³ http://ec.europa.eu/environment/air/pdf/clean_air/Impact_assessment_en.pdf

¹⁴ <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31991L0676>

¹⁵ <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000L0060>

The **short-term** aims of the Clean Air Policy Package will be to define actions to resolve present compliance problems by 2020, with ceilings for ammonia likely to be based on those in the amended Gothenburg Protocol; in the **medium term**, the Clean Air Policy Package will define new targets and action for the period to 2030; and in the **long term**, it will strive to achieve the objective of 'no significant impacts' and the WHO air quality guidelines (to 2050).

The main options under consideration are:

- i. a revised NECD, including new ammonia ceilings for 2020 and 2030;
- ii. new EU source legislation;
- iii. re-inforced national/local action; and
- iv. non-regulatory options.

The new 2030 ceilings in the NECD are proposed on the basis of an in-depth analysis using the GAINS optimisation model: the model has considered *which* measures are most cost-effective; *where* they are most cost-effective; past and future emission and livestock number trends; and the specific structure of the agriculture sector in different Member States. There is thus a relatively large variation between different Member State ceilings.

To reach the ceilings, a wider uptake of existing best practice across the EU is necessary. In summary, the measures focus on:

- i. fertiliser management (e.g. urea substitution; balanced fertilisation);
- ii. low emission manure application techniques;
- iii. low emission (covered) manure storage;
- iv. low emission feeding strategies;
- v. low emission housing facilities; and
- vi. national-/farm-level nitrogen budgets.

Article 6 in the proposed revised NECD requires that Member States, "to the extent necessary", include ammonia control measures listed in Annex 3 in their national NECD programmes. This provides clear direction to Member States about which measures should be used, while still leaving ample room for national adaptations as necessary. The listed measures and removal efficiencies are based on adopted guidance under the CLRTAP¹⁶ - these are designed to:

- i. help Member States to implement the ammonia ceilings by pointing to available best practice;
- ii. create a more-level playing field by facilitating a wider uptake of best practice at EU level (e.g. as called for by farmers in some Member States); and
- iii. facilitate implementation of other environmental and climate legislation as many ammonia control measures will have positive synergy effects.

EU financial support for ammonia measures is available through the Rural Development Programme (RDP) (with a total budget of around €85 billion for 2014-2020), following the addition of ammonia measures as a new RDP priority area in the recent Common Agricultural Policy (CAP) agreement. While acknowledging that there will be many claims for RDP support, it is clear that ammonia control measures can be funded under this instrument if Member States give priority to this area.

¹⁶http://www.unece.org/fileadmin/DAM/env/documents/2012/air/Draft_guidance_document_for_preventing_and_abating_ammonia_emissions_from_agricultural_sources.pdf

4.3.1. Conclusions

- i. The EU Clean Air Policy Package will be published in December 2013.
- ii. It will set out proposals for emission reductions by 2020 and for 2030.
- iii. It will provide clear direction to Member States on which measures should be used for ammonia control.

4.4 Presentations from Member States providing an overview of their approaches to reducing nitrogen deposition

4.4.1 Flanders (Belgium): Dr Maarten Hens, Research Institute for Nature and Forest¹⁷

The need to reduce nitrogen deposition in Flanders is high: there remains exceedance of nutrient nitrogen critical loads across Annex I habitat types despite reductions in deposition since the 1990s.

Current nitrogen reduction policies are driven by the CLRTAP, the NECD, the Nitrates Directive and the manure action plan, and the Water Framework Directive.

Over half of ammonia emissions come from agriculture. From 2009 to 2020, ammonia emissions are expected to fall slightly in all sectors. Emissions of sulphur dioxide and nitrogen oxide are expected to increase in all sectors, with the exception of transport. Therefore, unless appropriate measures are taken, nitrogen deposition levels will remain at levels which jeopardise site condition and risk improvements to the favourable conservation status of habitats and species of Community importance.

The following is planned:

- alignment of air quality and deposition monitoring to nitrogen-sensitive Natura 2000 habitat types;
- development of air quality models and ecosystem models to support policy;
- improvement of quantification of critical and target loads for Natura 2000 habitat types; and
- scenario analyses to support optimal design of nitrogen reduction policies.

Additionally, the goal in Flanders is to implement a structural solution for the problem, that is, an 'integrated nitrogen approach', which also creates possibilities for economic development. Planned for 2016, and involving a range of stakeholders, the components of this approach will be:

- source oriented;
- accounting for and re-inforcing overall policy;
- site specific;
- effect oriented: re-inforcing resilience in nature; and
- economic development oriented.

There will be a transition period between now and implementation of the 'integrated approach'. During this time there will be improvements to current implementation of Article 6.3 assessments to provide greater consistency (e.g. in approaches for

17

http://ec.europa.eu/environment/nature/natura2000/platform/documents/hens_flanders_overview_eng.pdf

appropriate assessments). There will also be a focus on source-oriented activities (for example, retrofitting stables), and effect-oriented activities (for example, standardisation of mitigating measures).

4.4.2 France: Professor Didier Alard, University of Bordeaux

In France, air pollution is seen primarily as a public health problem and the environmental consequences are not considered critical.

Nitrogen losses are seen as a problem for agriculture, mainly because of the costs involved (i.e. costs to farmers). Atmospheric nitrogen deposition is mostly unrecognised as an environmental problem, or is, at least, significantly underestimated. Recent research is beginning to challenge this view, although there is a considerable knowledge gap between scientists, policymakers and those with responsibilities for Natura 2000 reporting.

A national plan for the improved use of nitrogen in agriculture was produced in June 2013. It has yet to be formally adopted. The objectives of the plan include nitrogen fertilizer reduction and increased organic nitrogen efficiency. For farmers, the main motivation to reduce the use of fertilisers is to reduce costs.

4.4.3 Ireland: Dr Julian Aherne, Trent University, Canada¹⁸

In Ireland, approximately 13.5% of the terrestrial land area is designated as Natura 2000, of which 59% (564,000ha) is farmed. The most-recent assessment of conservation status for habitats (Article 17 [2013], Habitats Directive) assigned 9% as 'favourable' status and 41% as 'unfavourable bad', with the principal threats and pressures being land modification and agriculture. However, there is growing concern that elevated atmospheric nitrogen deposition may also influence the conservation status of habitats.

Mapped estimates of nitrogen deposition to Irish grasslands range from 2 to 22kg N/ha/yr (Henry & Aherne 2014), with average deposition (12.1kg N/ha/yr) dominated by reduced nitrogen (9.7kg N/ha/yr) compared with oxidized nitrogen (2.4kg N/ha/yr). Observations at long-term atmospheric monitoring stations in Ireland confirm that wet, gaseous and particulate nitrogen deposition, and air concentration, is dominated by reduced nitrogen (Henry & Aherne 2014). National assessments of critical load of nutrient nitrogen, carried out under the UNECE Convention on Long-Range Transboundary Pollution, indicate significant areas of exceedance (EPA 2012). Approximately 35% of natural acid grasslands are estimated to receive nitrogen deposition in excess of their critical load (Henry & Aherne 2014), indicating potential ecosystem changes such as biodiversity loss. There has been little change in exceedance of nutrient nitrogen since 1990 owing to limited reductions in nitrogen emissions, especially ammonia (Figure 2).

Agriculture is the dominant source of ammonia emissions (98%), approximately 80% of these emissions arise from the dairy and beef sectors, specifically 47% from animal housing and storage, and 34% associated with the land spreading of slurries and manures. Under 'Food Harvest 2020'¹⁹, an agricultural industry strategy for Ireland, agricultural production is set to increase across all sectors by 2020 (e.g. 50% in dairy, 20% in sheep, 20% in beef, etc.). In the absence of stricter emission controls, licensing

¹⁸ http://ec.europa.eu/environment/nature/natura2000/platform/documents/aherne_theme2_ireland_eng.pdf

¹⁹ <https://www.agriculture.gov.ie/agri-foodindustry/foodharvest2020/>

and regulation, threats and pressures resulting from nitrogen deposition at Natura 2000 sites may potentially increase.

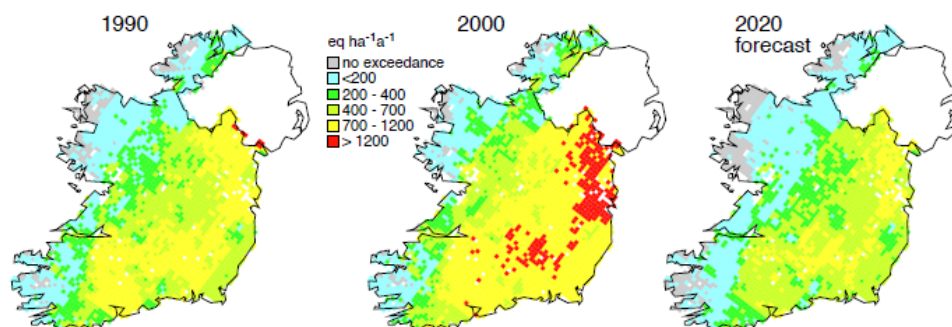


Figure 2. Average accumulated exceedance of critical loads of nutrient nitrogen in 1990, 2000 and 2020 under Gothenburg Protocol emissions (Source: EPA 2012).

4.4.4 Germany: Markus Geupel, Federal Environment Agency²⁰

Germany covers an area of 357,021 km². Around 190,000km² are used as agricultural land, about 70% for arable farming, the remaining as pasture land. Forests cover 110,000km². Additional predominant characteristics of agriculture are an increase in intensive livestock production in the north and north-west (pig and poultry production) and smallholder dairy farming in the south-east of Germany.

These circumstances lead to high nitrogen emissions and negative nitrogen-induced effects in the environment throughout the country. Critical loads for nutrient nitrogen are exceeded at around 70% of all natural and semi-natural ecosystems. The situation has improved over the last 20 years, mostly due to reductions in NO_x emissions. Despite this, the emission ceiling for Germany for 2010 defined under the NECD was not met. Emissions from the agricultural sector to air and water ecosystems remained relatively constant. However, the gross nutrient balance indicator for agricultural activities in Germany shows a slight decline, which is mainly due to an increased productivity. As a central European country, Germany receives a considerable amount of reactive nitrogen via (e.g. atmospheric) imports and is in turn responsible for exports of reactive nitrogen compounds to neighboring countries and the sea.

To tackle nitrogen emissions from agriculture, in principle, one can distinguish between agricultural policies and air pollution control policies applied in the agricultural sector. A crucial instrument to increase nitrogen efficiency in fertilisation and to reduce losses of reactive nitrogen compounds is the federal ordinance on fertiliser application. It is part of the implementation of the Nitrates Directive into German law and defines application caps and cut-off times as well as the requirement to calculate nutrient balances at the field level. Revision proposals by a stakeholder group, with foreseen significant reduction potential, are currently under political discussion. Pollution-control policies are applied when licensing new animal housing (Best Available Techniques; BAT) and focus on total nitrogen deposition.

Numerous measures exist to tackle nitrogen emission other than from agricultural sources. The main instruments are the national programme for the implementation of the NECD in Germany and the air pollution control legislation with definitions for installations (BAT) and regions (concentration limits). For health protection, the latter is successful as it brings together different stakeholders (transport, planning and industry)

²⁰ http://ec.europa.eu/environment/nature/natura2000/platform/documents/geupel_plenary-theme2_germany-overview_eng.pdf

to work through a regional air quality plan when limit values are exceeded. The national NECD programme does not include regional consideration of effects.

The assessment of plans and projects under Article 6.3 of the Habitats Directive (92/43/EEC) is regulated in German nature protection law. However, assessment values are still not uniformly defined as yet in a federal approach. Currently, a national approach is being elaborated. Critical loads (CL) are considered to provide robust assessment criteria and a contribution from a project of more than 3% of the CL is considered to be an adverse effect. Project-specific cut-off criteria (e.g. 0.3kg/ha/yr) are under discussion. There is no approach yet to consider background deposition in the context of Natura 2000 site management.

To reduce the background deposition more effectively, the following could be promising:

- regional air quality planning including agricultural stakeholders;
- a more regional implementation of the national NECD programme; or
- the integration of NH₃ limit values into air quality legislation.

4.4.5 The Netherlands: Mark Wilmot, Ministry of Economic Affairs²¹

The Netherlands has adopted a Programmatic Approach to Nitrogen (PAN, or, in Dutch, *Programmatische Aanpak Stikstof*). It is due to be implemented in mid-2014. The PAN, supported by the online calculation tool AERIUS²², guarantees that Natura 2000 objectives will be met, while creating room for economic development. It uses an inter-governance approach, across all sectors and areas. The PAN includes analysis of scenarios for emission reduction, based on generic measures, an additional national package of measures for the agriculture sector, measures at provincial/regional level and measures at the local level, such as habitat restoration measures.

The AERIUS toolkit calculates both emission and deposition levels for Natura 2000 sites, caused by new or expanding economic activity. It provides a validated management approach, defining the risks and options for restoring and maintaining habitat integrity under different nitrogen regimes. It provides information about the requirements for permit applications. By pinpointing areas and sites of high-value habitat, it enables resources to be concentrated for permit requests. Permit requests and assessments are processed automatically, saving a great deal of time and resources, and enabling more-consistent outcomes. Its scenarios allow all parties to reach agreement and it is useful in monitoring those agreements. Once the PAN has been implemented, initiators of projects will be legally obligated to use AERIUS to calculate the nitrogen impact of their project. This applies to all sectors: agriculture, industry and transport. For more details, and to become a user of AERIUS Calculator see www.aerius.nl/en

Progress so far includes:

- financial resources to carry out the necessary measures (€75 million per year) are secured;
- almost all Natura 2000 sites have evidence-based recovery plans, which take into account the downward slope of deposition and the recovery measures;
- scope for economic expansion is integrated;

²¹ http://ec.europa.eu/environment/nature/natura2000/platform/documents/wilmot_aerius_theme2_netherlands_en_g.pdf

²² www.aerius.nl/en

- the highest judicial authority is part of the decision-making process and has power to make a final legal judgement in contentious cases; and
- political support, as well as support from, NGOs, has been secured for the programme.

Work remaining includes:

- adjustment of legislation;
- organising support to carry out the measures (especially hydrology);
- continuous development of AERIUS; and
- implementing the system of monitoring and licensing.

4.4.6 UK: Peter Coleman, Department for Environment, Food and Rural Affairs (Defra)

In the UK, Defra protects and improves the environment and human health by ensuring that:

- concentrations of pollutants in outdoor air meet EU limits and targets;
- UK emissions remain within existing 2010 ceilings set in EU legislation and under the CLRTAP; and
- current and planned policies deliver the expected emission reductions in order to meet more stringent targets for 2020 set under the amended Gothenburg Protocol.

The UK emissions of oxides of nitrogen (NO_x) have decreased substantially over the last two decades (a 64% reduction of emissions in the period 1990-2011). The main emissions of NO_x are from combustion sources (power, transport, heating). Emissions of NO_x have been addressed through integrated pollution control (since 1990), the introduction of transport vehicle standards Euro 1/I to 6/VI, and the regulation of medium combustion plants (20-50MW). Decarbonisation policies are bringing improvements in energy efficiency and reduced use of fossil fuel in power stations. The decarbonisation of transport is progressing more slowly. The International Maritime Organization (IMO) agreement on shipping emissions will bring benefits in the longer term. However, changing deposition patterns have meant that the declines in UK emissions of NO_x have reduced the UK export of NO_x emissions to a proportionally greater extent, so deposition of oxidised nitrogen in the UK has seen relatively smaller declines (i.e. fewer benefits from the emission reductions).

Agricultural activity accounts for almost 90% (approx. 250 kilotonnes per annum) of UK ammonia emissions. Emissions from agriculture have decreased by 21% since 1990, mainly as a result of declining livestock numbers and improved fertiliser use efficiency. An 8% decline in ammonia emissions to 2020 is tentatively projected, but there is a risk that emissions may increase over the period 2020-2030, without additional measures.

Apart from the Industrial Emissions Directive (IED), which controls emissions from large pig and poultry units, there are no regulatory drivers in place aimed at reducing ammonia emissions. Voluntary actions to reduce ammonia include the 'Campaign for the Farmed Environment'²³, and co-benefits exist with measures deployed in other voluntary schemes (e.g. 'Catchment Sensitive Farming'²⁴). If widely adopted, such actions could lead to significant reductions in emissions. However, they have to

²³ <http://www.cfeonline.org.uk/home/>

²⁴ <http://www.naturalengland.gov.uk/ourwork/farming/csf/default.aspx>

contend currently with low farmer/farm adviser awareness of ammonia impacts. Defra is working to incorporate messages on ammonia into the Farm Advisory Service and other advice streams.

The Rural Development Regulation (RDR) allows the use of RDR funding for ammonia measures. These are a devolved matter in the UK. Options to mitigate emissions that are verifiable and meet the criteria for inclusion, appear to be limited.

In the absence of regulation, increased communication of the opportunities for the sector to be more competitive through preserving nitrogen is a priority. Key mitigation options for ammonia:

- Farm productivity measures (e.g. improved animal housing, roofing of slurry stores, reduced spreading costs and steps to address capacity needs).
- Nitrogen management measures (e.g. fertiliser application management, use of urea-based fertilisers).
- Dietary measures (e.g. optimise the nitrogen content of livestock feed).
- Maximising co-benefits with productivity water and climate measures and minimising trade-offs.

4.5 Working Group 4 – Measures for reducing impacts from agriculture – key discussion points and conclusions

It is a challenge to sustain or increase food production and, at the same time, reduce losses of reactive nitrogen to the environment. However there are many potential benefits for farmers and wider society associated with improving so-called 'nitrogen use efficiency'.

Working Group 4 shared knowledge and experience about the *implementation* of these measures, building on the work of other international groups.

Many techniques/measures are being explored and implemented to reduce nitrogen emissions from agriculture in Europe, based on low emission animal housing, management and feeding strategies, low emission manure/slurry management and storage, and low emission land spreading/soil management techniques. Guidance on identifying ammonia control measures is provided by the UNECE Task Force on Reactive Nitrogen,²⁵ European Commission,²⁶ national ammonia abatement legislation and programmes, and others.

The working group concluded that:

- more could be done to make the case for reducing ammonia emissions through demonstrating potential 'win-win' situations;
- communications could be improved so that relevant sectors and stakeholders are more aware of the nitrogen issue and what actions they need to take to help address it;
- Member States need to be able to capture the air quality achievements resulting from farmers' good practice (so these changes are registered in emission inventories) and to be able to attribute successes in reducing emissions to particular initiatives (e.g. advice schemes);
- greater integration between the monitoring of Natura 2000 sites/features, air quality, and agricultural emissions is also required in terms of assessing the threat to conservation status (as defined under the Habitats Directive); and

²⁵ <http://www.unece.org/env/lrtap/taskforce/tfrn/welcome.html>

²⁶ http://ec.europa.eu/environment/air/clean_air_policy.htm

- a mechanism is needed for sharing good practice in ammonia reduction measures from agriculture.

4.6 Working Group 5 – Measures to reduce nitrogen deposition from sources other than local agriculture - key discussion points and conclusions

Nitrogen deposition from a range of emission sources currently has a detrimental impact on many habitats across Europe. This is forecast to continue into the foreseeable future despite the provisions of existing pollution legislation.

The aim of Working Group 5 was to share knowledge and experience of measures for non-agricultural sources (i.e. transport, electricity production, industry) to address local impacts from NO_x and measures or strategies for long-range pollution (including oxidised and reduced forms of nitrogen).

While the emission reduction policy is most usually aimed at achieving national ceilings, greater effort should be made to target emission reduction to benefit habitats at a national and local level. There needs to be integration between national emission strategies and local plans to target the reduction in nitrogen deposition.

In the Netherlands, a national plan to reduce emissions is linked to regional and local plans, in which the requirements of the Habitats and Birds Directives are also considered. This linked 'top-down/bottom-up' approach applied in the Netherlands was considered as the best example within the group, which other Member States would be advised to follow.

Working Group 5 concluded that:

- although nitrogen deposition across Europe is dominated by agricultural ammonia emissions, other emissions of oxides of nitrogen remain a concern at both a national and local level;
- the countries that have made most progress with tackling nitrogen deposition have both national strategies and local plans which are integrated;
- there was some concern that, within Member States, the devolved autonomy of regional administrations could present barriers to developing a fully integrated nitrogen emission approach; and
- control of water pollution across the EU is delivered under the auspices of an overarching Water Framework Directive. There are many separate directives and drivers to tackle air pollution but there is no analogous overarching Air Framework Directive to govern air pollution reductions.

4.7 Working Group 6 – Approaches to assessing the impacts of air pollution emissions from plans/projects for Article 6.3 assessments – key discussion points and conclusions

Article 6.3 of the Habitats Directive requires strict site-safeguard measures for Natura 2000 sites. It requires that plans and projects are permitted if they are shown to have "no adverse effect on the integrity" of a Natura 2000 site (subject to certain provisions).

The main objective of this working group was to understand how each country decides on what level of additional nitrogen deposition arising from plans and projects can be considered as not having an adverse effect on site integrity (in the context of Article 6.3 assessments). The working group looked at the 'test' of likely significant effect, the 'in combination'

assessment and the thresholds used by countries for concluding “no adverse effect on integrity”.

With the exception of Ireland, each of the Member States used nutrient nitrogen ‘critical loads’ (and sometimes ‘critical levels’) as a benchmark against which to assess the potential impacts of additional contributions of nitrogen deposition from new plans and projects. In these countries, criteria have been established for screening out plans and projects that have no likely significant effect on a site. The application of the concept of ‘in combination’ varies between the countries, making direct comparison of screening thresholds problematic. Despite this, approaches to assessing the overall impact are broadly comparable in that they require an assessment of current nitrogen inputs and the consequence of the additional nitrogen contribution from the plan or project.

In most cases, Member States represented in the group have established thresholds below which “no adverse effect on integrity” can be concluded. These are based on either an absolute amount of nitrogen (e.g. 1kg N/ya/yr) or a value relative to the critical load (e.g. 3% of the critical load for the site/interest feature). There is considerable variation in the thresholds established by Member States.

The approach in the Netherlands has been to move away from establishing a single threshold for “no adverse effect on integrity”, which had created a deadlock situation for permitting industrial installations and development. The Programmatic Approach to Nitrogen (PAN), supported by AERIUS, is being developed to solve the issues around nitrogen deposition and the objectives for Natura 2000 sites. It is intended to realise a continued reduction in nitrogen deposition. This will be applied alongside ecological restoration measures at Natura 2000 sites. The approach is to use part of the deposition reduction to create ‘headroom’ for the development of new or expanding economic activities for which permits are required. This room for development is only made available after ecological experts have determined that the project reduction in deposition in combination with restoration measures will not put the achievement of the Natura 2000 targets at risk.

Belgium is developing its own integrated approach along similar lines to the Dutch example. It was concluded that such integrated approaches provide greater certainty for industry, in terms of providing some security in proposed investment and from the variability on what constitutes no adverse effect. A level of security for the authorities is also provided in that the risk of adverse effects is greatly lessened.

4.8 Working Group 7 – The effectiveness of on-site (intensified) habitat management measures and restoration measures to mitigate nitrogen deposition impacts and to promote recovery – key discussion points and conclusions

Habitat management measures offer a means to reduce the impacts of nitrogen deposition either through removal of nitrogen from the system or through maintaining habitat structure. In some cases, even if the most stringent air pollution control policies were to be applied, some ecosystems would not fully recover within a reasonable time period. In these cases, active restoration has to be considered as a necessary management tool to preserve habitats.

This working group aimed to share knowledge and experience of using intensified habitat management to reduce nitrogen impacts and in cases of ‘damaged’ habitats then use restoration measures.

It was concluded that each Natura 2000 site is unique in terms of its habitats, species, geographical location, mix of stakeholders and the dynamics of the natural and human interactions that take place in or around that site. Therefore, effective site management requires management of the scientific investigations, the practical techniques to be deployed, well-thought through nature conservation objectives and appropriate management measures, engagement of stakeholders and monitoring to ensure effectiveness.

In the UK, there has been a recent review of the effectiveness of on-site habitat management to reduce atmospheric nitrogen deposition. In the Netherlands, a handbook of management and restoration measures for nitrogen effects has been produced (see Appendix 7).

These studies show that the potential for reducing the impacts of nitrogen deposition varies greatly between habitats and also management practices. Managing for any single issue, such as nitrogen deposition impacts, in isolation may result in unintended and undesirable outcomes and there is a need to consider the conservation objectives of the site and the possible outcomes of a change in management practices.

The working group concluded that whilst in some cases, intensified management measures may partially mitigate impacts and restoration measures, particularly hydrological, have shown some success, alongside this, inputs of nitrogen deposition must be reduced.

The value of sharing experience and methods was agreed and recommendations were made for how to enhance this in future.

5 General Conclusions and Recommendations

5.1 Introduction

The preceding sections have provided an overview of the presentations and discussions under the two themes of the workshop: assessment and reporting of nitrogen deposition impacts and the practical solutions to reduce impacts. More detailed accounts of the findings and recommendations of the working groups are provided in Appendix 1-7. Whilst many of the conclusions and recommendations from the groups were detailed and specific to the working group topic, there were a number of common recommendations across the groups. These are brought together in this section. The recommendations are grouped together under each of the two themes. Additionally, cross-cutting recommendations are grouped together into those requiring future collaboration between experts and those concerning promoting and sharing best practice.

5.2 Main Conclusions

The evidence provided at the workshop reinforced that nitrogen deposition represents a major threat to the objectives of the Natura 2000 sites and to European biodiversity more widely. Measures taken to reduce nitrogen deposition impacts on European biodiversity should also have significant benefits in protecting human health.

In some of the Member States represented at the workshop, the impacts of nitrogen are recognised and incorporated into national reporting on conservation status. In some other Member States, whilst there is an increasing body of evidence of nitrogen impacts in the scientific literature, this has not been integrated with formal reporting under the Habitats Directive. More generally, it was felt that there was a low awareness of the issue of nitrogen impacts on biodiversity, outside of the communities directly working on this topic.

Nitrogen deposition was recorded as a 'pressure' in 76% of country based Annex I reports in the 2013 Article 17 reporting round. Member States applied different approaches to identifying nitrogen as a pressure (or threat) and for accounting for this in the conclusions about conservation status. This limits the extent to which overall conclusions can be drawn in respect of nitrogen impacts and conservation status.

It remains unclear if or how Member States have taken into account the impacts of nitrogen which occurred prior to the adoption of the Habitats Directive and consequently what influence this has on whether site objectives are set for 'recovery' (improvement) or 'maintenance' (no further deterioration).

It is possible to model the relative benefits of emission reduction scenarios for biodiversity. To link this more closely to the objectives of the Habitats Directive, clear targets need to be defined in terms of a suite of desirable species for a habitat or soil chemical attributes. However, such a prescriptive approach is problematic as many habitat types occur over a wide geographic range.

There are clear benefits in comparing and sharing data, information and experience at European and regional levels. It was concluded that the workshop provided an excellent opportunity to share experience and best practice of measures to reduce nitrogen deposition impacts. This included how Member States integrate international policies through to local policies and measures, including taking practical measures on the ground to restore habitats or mitigate impacts. The Programmatic Approach to Nitrogen (PAN), used in the Netherlands, was widely viewed as providing an excellent example of good practice in

assessing and managing the impacts of critical load exceedance. Such an integrated approach is seen to be useful and could be applied across all Member States. Utilising detailed models, such as those generated by the Dutch AERIUS tool, is seen to be of further value in ensuring that a transparent and consistent approach is adopted. Equally, such an integrated approach can help developers to assess opportunities for sustainable growth and facilitate the permitting of plans and projects whilst meeting the obligations of Article 6.3 of the Habitats Directive.

Integration and linkage between international, European, national and local plans is seen as being critical in order to deliver greater protection for Natura 2000 sites. Cross-sectoral benefits, including those for human health and biodiversity, can be optimised within national plans by spatially targeting measures to gain the greatest protection. By way of example, measures developed to reach National Emission Ceilings could also be applied at locations where they deliver most benefit to Natura 2000 sites. An additional proposal was for nitrogen action plans, developed for Natura 2000 sites, where nitrogen deposition is a concern. Such plans could be used to evaluate long-range and local nitrogen sources, together with specific habitat management measures in an integrated manner. Nitrogen pollution affects multiple receptors, such as human health, semi-natural habitats and water quality. There is greater potential for better integration of policies and plans to optimise benefits to these receptors and prevent the swapping of impacts from one environmental medium to another.

More could be done to demonstrate the potential 'win-win' situations of various measures. For example, the costs-benefits and resource saving to farmers of some measures to reduce ammonia emissions should be championed

Appropriate management measures can be effective in mitigating nitrogen deposition impacts. Restoration measures, particularly hydrological, have also shown success. However, alongside this, inputs of nitrogen deposition must also be reduced.

Different habitat management measures should be checked and balanced for compatibility and how they complement each other. The measures need to be assessed and monitored to check progress towards the outcomes to be achieved. The management measures implemented must not be counterproductive. To illustrate this, intensifying nature management may be helpful and necessary in some situations. However, it is necessary to be aware of potential consequential problems, for example, more mowing and sod cutting, may result in less fauna. On the other hand, mitigating nitrogen effects by solving other problems (for example, drought, erosion, sedimentation, *etc.*) can save time to help offset nitrogen deposition. Specific measures require specific, yet integrated, actions by different stakeholders. Where, in order to protect a site, certain activities may have to be modified or curtailed, appropriate compensation may have to be provided.

5.3 Main Recommendations

Theme 1: reporting and assessment of nitrogen deposition impacts

1. Take practical steps to improve reporting and foster more-consistent reporting practices in respect of nitrogen impacts and Article 17, and where necessary, develop new guidance or seek to clarify existing guidance. Specific recommendations for Article 17 reporting were made by Working Group 1 and these should be considered by the ETC/BD and Member States in the post Article 17 report review.
2. Establish a mechanism to bring together experts in the impacts of nitrogen deposition and conservation status to define common desired outcomes and develop integrated actions for nitrogen deposition impacts. For example, working synergistically in this way, consider how air pollution impacts relate to conservation status, and how critical load exceedance relates to achieving favourable conservation status.

3. Consider ways to set meaningful nature conservation objectives for sites. This should be based on consideration and understanding about historical nitrogen impacts and how cumulative effects of nitrogen deposition will influence future prospects of structure and function.
4. Communicate clear targets or objectives (with regard to nitrogen deposition) for protecting and enhancing biodiversity, for example, to support evaluation of air pollution policy and the assessment of different emission scenarios. Appropriate indicators or metrics of air pollution impacts need to be developed for specific habitats, species or ecosystem function.

Theme 2: practical solutions to reduce nitrogen deposition

5. Individual Member States should make full use of existing policy commitments. For example, the national codes for good agricultural practice for reducing ammonia emissions under the Gothenburg Protocol, the use of BAT under IED, and consider use of Rural Development Programme funding where appropriate
6. Streamline existing instruments and practices, specifically in areas that would yield improved integration across sectors. This should include ensuring greater integration and linkage between international, European, national and local plans and policies to help deliver greater protection for Natura 2000 sites.
7. Implement a more-integrated agricultural approach, with increased awareness of the air quality issue, in addition to water and soil quality issues within the agricultural sector itself. The integrated approach should involve advisers and associated sectors, such as animal housing and agricultural machinery designers at both Member State and EU levels. The benefits to human health should also be considered. For example control of ammonia emissions will significantly lower levels of ammonium nitrate which forms a key part of secondary urban particulate matter (PM_{2.5}).
8. National plans should be optimised for benefits to human health and biodiversity and ecosystem services, via spatially targeting measures to gain the greatest overall protection.
9. Develop site action plans that evaluate long-range and local nitrogen sources and identify and target measures to reduce nitrogen deposition inputs to sites. These should capture the conservation objectives, appropriate emission reductions and practical measures that can be adopted involving stakeholder input. This can (and may need to) incorporate appropriate habitat management actions required to restore a site. The PAN approach, adopted in the Netherlands, is an excellent example of this. Such an approach can be used to facilitate the permitting of plans and projects by considering nitrogen inputs from new proposals in the context of a wider set of measures to reduce nitrogen deposition at the site.
10. Propose a suite of integrated site management options for sites to reflect their condition in the context of defined nature-conservation priorities. This must take into account each site's geographic context and dynamics, including stakeholder interactions, as their engagement is essential to ensure maximum gains for nature.

Cross Cutting: Take appropriate steps to foster sustained collaboration between experts

11. Increase overall awareness of nitrogen deposition impacts, its consequences to biodiversity and ecosystem services, and discuss measures to address them. This needs

to be undertaken across a range of stakeholders, including policy makers, land managers, industry (including agricultural) and the general public.

12. Improve links between those working in nitrogen impacts research and assessment fields and those with responsibilities to report on the nature directives – for example, take steps to apply the growing understanding and empirical evidence of the impacts of nitrogen deposition on vegetation to inform reporting of conservation status.
13. Recognising the importance of nitrogen deposition within Member States in North and Western Europe, a dedicated cross-sectoral expert group should be established: the 'Atlantic Region Nitrogen Deposition Expert Group'. Proposed as a small group, it would operate predominantly via teleconferences and email exchange, with an option for periodic face-to-face meetings as required. Its primary purpose would be to foster long-term, regional-level collaborative evidence-based action. Such co-ordinated effort is considered to be necessary to reduce background levels of nitrogen deposition successfully. The group would focus on a number of work areas, for example:
 - Improve data sharing, communication and collaboration between experts, as well as between research and reporting communities.
 - Improve understanding about the relationship between critical loads and conservation status to resolve challenging issues – for example, how measures of air pollution impacts relate to conservation status, or how critical load exceedance relates to achieving favourable conservation status.
 - Promote and share best practices, for example about, national approaches, such as the PAN applied in the Netherlands.
 - Share experience of air pollution impacts assessment under Article 17.
 - Provide guidance on how to recognise the impacts of nitrogen deposition for each Annex I habitat.

Cross Cutting: Promoting and sharing best practice

14. It is recommended that there would be benefits from further exchange on best practice for 'appropriate assessments', integrated approaches, and measures to reduce emissions from sources, especially agricultural. This needs to use highly participative approaches to achieve good stakeholder involvement.
15. The PAN as used by the Netherlands provides an excellent example of good practice in assessing and managing the impacts of critical load exceedance. As a follow-up step under the Atlantic Natura 2000 Biogeographical Seminar Process, ECNC proposes to develop a study visit to the Netherlands to share the PAN approach more widely so that experts from other countries can see first-hand how it operates and is applied in the field.
16. Develop mechanisms for sharing best practice information between Member States on reducing emissions and increasing overall nitrogen use efficiency so that farmers have access to integrated solutions. It is suggested that this is achieved through existing groups such as the Task Force on Reactive Nitrogen or Expert Group on Ammonia Abatement. Information should be available via the Internet and in different languages. For example, exchange best practices of integrated approaches in agriculture, specifically those that demonstrate practical ways to involve multiple stakeholders.
17. Use the Natura 2000 platform as a primary resource for sharing and gathering useful information.

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APPENDIX 1

Theme 1 – Reporting and assessment

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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Summary

The Habitats Directive requires Member States to report on the implementation of the directive every six years, including an assessment of conservation status (Article 17).

Working Group 1 examined how nitrogen deposition impacts were taken into account in the assessment of conservation status for Member States' reports under Article 17. The group examined the approaches taken under the latest reporting round (2013) and reviewed the outcomes.

All six of the countries participating in the working group had made some consideration of nitrogen deposition impacts in their assessments of conservation status for the 2013 Habitats Directive Article 17 reporting round.

Nitrogen deposition, or, more generally, air pollution, was identified as a pressure and threat to some habitat types and species within each of the six Member States present. Provisional results from the 2013 reporting round, show that the proportion of the Annex I habitat records per country represented which record nitrogen as a pressure or a threat is between 17-76%. For species, the impact of nitrogen deposition is less clear. Although all Member States represented had conducted a species assessment, this had been less comprehensive in respect of nitrogen impacts than for the habitat assessments.

Member States applied different approaches to identifying nitrogen deposition as a pressure/threat and for accounting for this in the conclusions for conservation status. As a consequence, it was agreed that a note of caution is necessary in drawing detailed conclusions from any analysis of the Article 17 results, especially when comparing countries.

The Working Group concluded that attribution of nitrogen deposition as a pressure/threat, and the consequences of it for future prospects, probably have been under-reported in some cases and particularly for species' assessments. The main challenges have been (a) the lack of join-up with, or barriers preventing full use of, evidence/research information; and (b) the pressure/threat may be recognised but other issues are felt to be more severe and immediate, and hence of greater priority.

The Working Group concluded further that it is important to consider to what extent Article 17 reporting can be used as a mechanism for attributing and ranking causes of unfavourable status, particularly for 'off-site' pressures like nitrogen deposition. Currently, the lack of methodological uniformity in assessing the pressures and threats limits ability to draw sound conclusions about the specific impacts of nitrogen deposition in terms of the relative importance of pressures/threats for a given habitat and from cross-country comparisons. It would be worthwhile exploring to what extent other information sources can be used to inform this and/or be incorporated into Article 17 reporting.

Given the issues discussed, the working group made a number of recommendations. Firstly, those directly related to the guidance and approach for Article 17 assessment, particularly concerning the identification of pressures and threats. Secondly, recommendations covering more general principles, including the need to develop thinking around how measures of air pollution impact relate to conservation status, and critical load exceedance relates to achieving favourable conservation status. These points relate to the objectives of Working Group 2.

A1.1 Background

The Habitats Directive²⁷ requires Member States to take measures to maintain at, or restore to, favourable conservation status, the natural habitats and species of importance to the European Community. 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 period was 2007–2012; Member States were required to submit their reports to the European Commission in summer 2013.

The impacts of nitrogen deposition are recognised as a major threat to biodiversity across large areas of Europe, particularly the Atlantic Biogeographical 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’. Currently, nitrogen deposition exceeds nutrient nitrogen critical loads over a substantial area of (semi-) natural habitat in Europe (Posch *et al* 2012).

Since the implementation of 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 advisers 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 the critical loads concept, 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.

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

The following Section A1.2 in this Appendix provides an overview of the methodology for assessing conservation status and briefly discusses how it may be impacted by nitrogen deposition. The objectives of the working group are presented in Section A1.3. Section A1.4 provides details of the Member States’ approaches and the outcomes and a discussion of the methods. Finally, Section A1.5 gives recommendations from the working group.

²⁷ Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora ([The Habitats Directive](#), consolidated 01.01.2007).

A1.2 Article 17 reporting requirements

Under Article 17, 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. The 2013 report 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 follows:

- 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:

- 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 and Member States have agreed a reporting format and the European Topic Centre on Biological Diversity has published 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 biogeographical region that a country covers. The focus of this workshop is the Atlantic Biogeographical region.

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

Table A1.1. Parameters for the assessment of conservation status for habitats and species

Habitats	Species
Range	Range
Area	Population
Specific structures and functions including typical species	Habitat for the species
Future prospects	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 the agreed five standards (Evans & Arvela 2011). 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. It was recommended to qualify the assessments of each parameter as stable, improving or declining and obligatory for the overall conclusion. Table A1.2 summarises the possible conclusions for conservation status.

Table A1.2. Summary of possible conclusions for conservation status assessments.

Conclusion	Qualifier
Favourable	<i>Not applicable</i>
Unfavourable-Inadequate	Improving Stable Declining
Unfavourable-Bad	Improving Stable Declining
Unknown	<i>Not applicable</i>

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 that is used for reporting under both nature directives: Article 17 of the Habitats Directive, Article 12 of the Birds Directive, and to support descriptions of Natura 2000 sites on the Standard Data Forms. The full list of EC pressures amounted to 400 separate categories, which are provided in a hierarchical structure. Nitrogen input [deposition] (H04.02) is listed under the Air Pollution (H04) category.

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

- 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); and
- 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; and
- 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 for species, the habitat for the 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 Member States, the reasons for any differences may reflect gaps in our evidence or scientific understanding and hence interpretation. Some of the issues were discussed by other working groups. For example, how historical 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 percentage 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. critical loads will remain exceeded over large areas, and nitrogen deposition continues to be a threat, albeit lower inputs will slow down the rate of further damage compared to higher inputs.

A1.3 Objectives of the working group

Building on the 2009 Workshop (Hicks *et al* 2011), the task of Working Group 1 was to discuss the current reporting process; for example, how nitrogen deposition impacts are taken into account in the assessment of conservation status for Article 17 reporting, and to identify gaps and make recommendations for future reporting.

These objectives were further defined as:

- Objective 1. 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 2. To share information on the approaches taken for nitrogen assessment within Article 17 assessments in 2013; and
- 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.

A1.4 Results and Discussion

Objective 1: Headline results

Prior to the workshop each participating Member State completed a questionnaire that included information on the Article 17 assessment results and methods. This questionnaire provided information to aid discussion and was expanded on in the meeting. The headline results, in relation to nitrogen deposition, from the 2007–2012 reporting round for each of the Member States are presented in Table A1.3 for habitats and Table A1.4 for species. The methods for assessments are documented in Table A1.5.

It should be noted that, of the countries comprising the Atlantic Biogeographical region, Spain and Portugal did not participate in the workshop and Denmark was unable to provide information to this working group. Furthermore, results for some of the countries were in draft, pending submission of the final Article 17 report.

Table A1.3. The extent to which nitrogen deposition was recorded as a pressure and threat for Annex I habitats.

Country	Number of habitats with H04 or H04.02 listed (total Annex 1 habitats)	% of total	Pressure			Threat		
			High	Medium	Low	High	Medium	Low
Belgium	31 (of 48) Pressure 30 (of 48) Threat	65 62	16	5	10	15	5	10
Germany	41 (of 54) Pressure 33 (of 54) Threat	76 61	25	13	3	10	17	6
France	7 (of 72) Pressure 10 (of 72) Threat			3	4		5	5
Ireland	10 (of 58) Pressure & Threat	17			10			10
Netherlands	25 (of 53) Pressure & Threat	47	20	3	2	20	3	2
UK	56 (of 77) Pressure 58 (of 77) Threat	73 75	34	11	11	34	11	13

Table A1.4. The extent to which nitrogen deposition was recorded as a pressure and threat for Annex II, IV and V species. Results are for the Atlantic region only.

Country	Number of species with H04 or H04.02 listed (total Annex 1 habitats)	% of total	Pressure			Threat		
			High	Medium	Low	High	Medium	Low
Belgium	Species not assessed	-						
Germany	2 (of 95)	2		2			2	
France	5 (of 151) Pressure 6 (of 151) Threat			4	1	2	4	5
Ireland	Species not assessed	-						
Netherlands	12 (of 79) Pressure & Threat	15	7	4	1	6	4	1
UK	13 (of 125) Pressure & Threat	10		6	7		7	6

Objective 2: Summary of national approaches

All countries considered nitrogen deposition, in so far as it is reported as a pressure and threat. However, the approaches varied. The details are documented in Table A1.5.

Table A1.5. Summary of national approaches to the nitrogen assessments for Annex I habitats and Annex II/IV/V species in Article 17 reporting in 2013.

Country	Belgium	France	Germany	Ireland	Netherlands	UK
Question						
What information/evidence was used to determine whether nitrogen deposition was a pressure/threat?	<p>N deposition was identified as a pressure if the actual, average N deposition exceeded its critical load. Critical loads were established by literature review and compiled in habitat quality assessment tables (T'jollyn <i>et al</i> 2009).</p> <p>As N deposition in many habitats exceeds critical load over the whole territory, it was indicated as a high pressure. No significant declines in N deposition are expected in the near future; therefore, N deposition is also indicated as a threat.</p>	Expert judgement used.	<p>Empirical data from the monitoring of habitat structure and function, which included indicator species for nitrogen impacts, was used to inform the assessment.</p> <p>The assessment of future prospects was based on expert judgement and expected changes of airborne nitrogen input and accumulation.</p>	<p>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.</p> <p>N deposition (specifically as H04.02/H04) was not considered to be an issue for most other Annex I habitats, although there are no specific data to support this assumption.</p>	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 and function of the habitat type. The determination of N deposition as a threat is expert judgement.	<p>Critical loads were assigned to 41 Annex I habitats. Critical load exceedance was used to determine if N deposition was a pressure or threat. Expert judgement was used for the remaining habitats where 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. 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:</p> <ul style="list-style-type: none"> • >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.
	Due to lack of relevant data (i.e. critical load data, sensitivity information), the role of N deposition and air pollution was not assessed for Annex II/IV species.	Species assessment was based on expert judgement.	Species were not assessed.	An assessment was not undertaken, as nitrogen deposition (specifically as H04.02/H04) is considered to be a relatively minor impact.	There is a low level of awareness of the impacts of N deposition among some species experts (they are barely involved in the work that is done by authorities and managers of the sites on N deposition). More often threats like 'pollution to surface waters by...' (under H01) for aquatic species, 'agriculture intensification' (A02.01) and fertilisation (A08) are identified.	Species assessment was based on expert judgement.
Were critical loads used to inform whether nitrogen deposition was pressure/threat?	Yes	No	No	No	Yes, but more attention is required for the next reporting round (for 100% accurate implementation).	Yes (for 41 habitats; others were based on expert judgement)
	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.			An assessment was not undertaken, as nitrogen deposition (specifically as H04.02/H04) is considered to be a relatively minor impact.	In some cases, yes.	Not for species.

Country						
Question	Belgium	France	Germany	Ireland	Netherlands	UK
How were critical loads set?	Through a literature survey on the thresholds of nitrogen for habitat quality (vegetation composition) as well as own research data. These data are compiled in T'jollyn <i>et al</i> (2009). Average nitrogen deposition in Flanders was derived from (1) air quality and deposition measurements conducted by the Flemish Environment Agency and the Research Institute for Nature and Forest, and (2) a regional deposition model (VLOPS).	Critical loads were not used.	Critical loads were not used. Used indicators of effects upon habitats and species, although Germany is in the process of assigning critical loads to Annex I habitats.	For habitats critical loads were not used (but they are under development).	In the Netherlands we work with a Critical Load Report (Van Dobben <i>et al</i> 2013) that covers all habitats (habitat types and habitats of species). The report ²⁸ explains how these critical loads are set.	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 (Bobbink & Hettelingh 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.
	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.	Critical loads were not used.	Critical loads were not used.	An assessment was not undertaken, as nitrogen deposition (specifically as H04.02/H04) is considered to be a relatively minor impact.	Species are connected with habitats; sometimes these are Annex I habitat types, sometimes other habitats. All of these habitats have a critical load (as above). An assessment was made to determine if the effect of the nitrogen deposition on the habitat also affects the species, and in what way (for example: unable to find prey/food, prey/food disappears, unable to reproduce, etc.). This information was used in the sites to consider measures and impacts, but it was barely used in the Article 17 reporting.	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 a consequence of critical load exceedance would adversely affect the species.

²⁸ Available from the Nitrogen Deposition and the Nature Directives Workshop website: <http://jncc.defra.gov.uk/page-5954>

Country	Belgium	France	Germany	Ireland	Netherlands	UK
Question						
How was exceedance established?	For Article 17 reporting purposes, a spatially-explicit assessment was not conducted. Such calculations have recently been performed by INBO (Herr <i>et al</i> 2012) to support the development and implementation of the Flemish Natura 2000 policy.	Critical loads were not used.	Critical loads were not used.	Critical load exceedance was not used, but national monitoring networks were used to assess nitrogen deposition inputs.	On a national scale with exceedance maps.	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 for each country by the country Statutory Nature Conservation bodies 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; or (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.
	Due to lack of relevant data the role of nitrogen deposition and air pollution was not assessed for Annex II/IV species.			An assessment was not undertaken of nitrogen deposition (specifically as H04.02/H04) impacts on species as it is considered to be a relatively minor impact.	For species see comments above.	For species see comments above.
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?	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 'unfavourable bad' assessment for a selection of criteria of 'Structure & functions' (T'jollyn <i>et al</i> 2009). For instance, as the 3000 and 4000 habitats have become dominated by <i>Molinia</i> and <i>Betula</i> under elevated N deposition, their quality has been set as inadequate.	Information not provided for habitats or species.	The assessment of future prospects was based on expert judgement and expected changes of airborne nitrogen input and accumulation. Nitrogen indicators were monitored as part of the assessment of structure and function, so informed the conclusion for this parameter.	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.	In the report it is stated that nitrogen deposition is probably an important reason for unfavourable conservation status. Future prospects are sometimes 'unfavourable bad' due to the expectation that there will not be enough improvement in deposition levels. In the context of the Dutch Programmatic Approach to Nitrogen it is clear that most habitats suffer from an exceedance in nitrogen deposition and also that nitrogen deposition is one of the most important problems for many habitat types.	For those habitats based on expert judgement and not critical loads, the identification of nitrogen as a pressure or 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' than 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.

Country	Belgium	France	Germany	Ireland	Netherlands	UK
Question						
	For species, because of a lack of relevant data, the role of nitrogen deposition and air pollution was not assessed for Annex II/IV species.			An assessment was not undertaken, as nitrogen deposition (specifically as H04.02/H04) is considered to be a relatively minor impact.	It may have influenced 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. For most species with unfavourable habitat assessment there is a problem with the extent and trend (mostly of the size) of the habitat. It seems that nitrogen deposition affected the overall assessment for one species only (1400 <i>Leucobryum glaucum</i>).	For species this is not explicitly in the assessments.
Did nitrogen deposition have an impact on the status of the 'range' or 'area' parameters of conservation status?	No. Nitrogen deposition is only considered to affect habitat quality.	Information not provided for habitats or species.	Yes. Reduction in range in N-sensitive, nutrient-poor habitats due to quicker succession to non Annex I habitats, example forest type 91T0 (in combination with missing historical litter removal).	No	No	No
	For species, because of a lack of relevant data, the role of nitrogen deposition and air pollution was not assessed for Annex II/IV species.	Information not provided for habitats or species.	Yes. See range, but also assumed reason for some of the historic area losses of lowland Nardion (habitat type 6230), and accelerating natural lake eutrophication (which leads to slow area losses in oligotrophic to mesotrophic lakes 3130, 3140, developing into habitat 3150).	An assessment was not undertaken of nitrogen deposition (specifically as H04.02/H04) impacts on species as it is considered to be a relatively minor impact.	No	Unknown

Objective 3: Identify critical gaps, discussion and conclusions

All countries participating in the working group had made some consideration of nitrogen deposition impacts in their assessments of conservation status for the 2013 Habitats Directive Article 17 reporting round.

Nitrogen deposition, or, more generally, air pollution, was identified as a pressure and threat to some habitat types and species within each of the six Member States represented at the workshop. Results from the 2013 reporting round show that the proportion of the Annex I habitat records per country represented which record nitrogen as a pressure or a threat is between 17-76%. For species the impact of nitrogen deposition is less clear. Although all Member States represented had conducted a species assessment, this had been less comprehensive than for the habitat assessments. The indirect effects on habitat quality were not considered for most species, although there is emerging evidence that some groups of species are affected (Wallis de Vries & Van Swaay 2013). At the present time (December 2013), it has not been possible to make a comparison of the scale of the nitrogen deposition pressure/threat with other pressures/threats at the Atlantic region scale. However, the results confirm that nitrogen deposition is a significant pressure/threat to the conservation status of some habitats and species.

The working group discussed the differences between the methods used in respect of nitrogen deposition assessment and whether, and to what extent, this influenced the reporting outcomes. Belgium, the UK and the Netherlands all used 'exceedance of nitrogen critical loads' to inform their assessment, but the detail varied in respect of how critical loads are assigned to habitats, how exceedance is estimated and how the outcome of the assessment ultimately affected the conclusions for conservation status. Germany's assessment for the parameter structures and functions was based on monitoring information, which included indicator species for nitrogen impacts. Threats and pressures were ranked based on expert judgement. In France and Ireland, and also in the other countries to some extent, expert judgement was used to inform the identification of nitrogen deposition as a pressure and threat. It was noted that many habitats and species are in unfavourable status (anyway) and consequently where additional nitrogen assessments have been completed they often have not had a significant impact on the outcome, which was already unfavourable.

The group recognised that nitrogen deposition will, in some cases, have impacted habitats before the Habitats Directive came into force, and therefore will have affected current structure and function. In these cases monitoring and assessment of current structure and function would implicitly capture effects of nitrogen, although the cause of the effects may be difficult to attribute to, for example, nitrogen deposition. A critical unresolved question is how these historic effects are taken into account when assessing current structure and function and to what extent are some nitrogen impacts 'acceptable'. This was also a question put to Working Group 2 (Appendix 2) in respect of setting conservation objectives for sites.

In Germany, monitoring of habitat structure and function incorporates indicators of nitrogen impacts, but other countries, for example the UK, have not yet identified robust indicators for use at the site level. Therefore, critical loads assessment was additionally used, by some countries, to inform the identification of pressure to current structure and function, and to inform the conclusion of future prospects. For example, in the UK, site condition monitoring rarely attributes nitrogen deposition as a cause of unfavourable condition at site level, yet broad-scale evidence shows widespread impacts in sensitive habitats (Emmett *et al* 2011). Consequently, critical loads were used to identify nitrogen deposition as a pressure to current structure and function, whilst the conclusion for this parameter was based on site monitoring.

Critical loads were also used to identify the threat to future prospects and to inform the conclusion for future prospects on the basis that widespread critical load exceedance would lead to an unfavourable status in the future. The group concluded there was a need to further consider the relationship between favourable conservation status and critical load exceedance. For example, it is possible to have critical load exceedance of a habitat whilst having a favourable assessment in respect of structure and function. This may be because of a delayed response to nitrogen deposition, but it may also be because the status of structure and function may be judged to still be favourable despite some impacts of nitrogen. If the latter applies, the question arises as to how this affects our assessment of impacts on future prospects of structure and function. A number of related technical and scientific questions remain and can be the cause of different application of critical loads exceedance assessments. An example is how to account for the benefits of reducing nitrogen deposition and lower exceedance (area of habitat and average accumulated exceedance) whilst also recognising cumulative impacts of nitrogen. The group were unable to discuss these in any detail.

On the basis of the Article 17 reports, some Member States appear to be more affected by nitrogen deposition impacts than others. However, Member States applied different approaches to identifying nitrogen deposition as a pressure/threat and in accounting for this in the conclusions for conservation status. As a consequence, it was agreed that a note of caution is necessary in drawing detailed conclusions from any analysis of the Article 17 results in respect of nitrogen impacts, especially when comparing countries.

The picture given of nitrogen impacts across the Atlantic region, based on an initial and (necessarily) fairly superficial review of the data (some data were still in draft at the time of the workshop), show nitrogen deposition as an important pressure and threat. However the spatial pattern is not entirely consistent with areas at risk as determined by critical load exceedance maps for the region (e.g. Posch *et al* 2012).

The working group concluded that it is probable that attribution of nitrogen deposition as a pressure/threat and its consequences for future prospects have been under-reported in some cases and particularly for species assessments. The main challenges have been (a) the lack of join-up with, or barriers preventing full use of, evidence/research information, and (b) the pressure/threat may be recognised, but other issues are felt to be more severe and immediate, and hence of greater priority.

It is also important to consider to what extent Article 17 reporting can be used as a mechanism for attributing and ranking causes of unfavourable status, particularly off-site pressures such as nitrogen deposition. Currently, the lack of methodological uniformity in assessing the pressures and threats seriously limits ability to draw sound conclusions about the specific impacts of nitrogen deposition in terms of the relative importance of pressures/threats for a given habitat and from cross-country comparisons. It would be worthwhile exploring to what extent other information sources can be used to inform this and/or be incorporated into Article 17 reporting.

The working group identified a number of issues with the guidance (Evans & Arvela 2011) for recording pressures and threats to habitats and species, which may have led to differences in reporting nitrogen impacts:

- In some cases, whilst nitrogen deposition was recognised as an important impact on habitats and/or species, it was seen to be of a lower priority than other pressures and threats. The requirement to rank only five high-priority pressures/threats, in some cases resulted in nitrogen deposition not being listed as high priority.

- It was thought that nitrogen impacts were labelled under agriculture (A02), or another category, by some Member States (most of the regions in France and other Member States not represented in the group). Since the non-mandatory pollution qualifiers were not consistently used, these do not aid comparison.

Many Member States had made assessments (in relation to nitrogen deposition) based purely on expert opinion, particularly for species. While this allows a judgement to be made, without knowing the supporting evidence it is difficult to drill down into the detail and compare results. It was concluded that a transparent audit trail of the assessment process would be very helpful for this purpose. However, it was recognised that this is not mandatory, and even where provided, they may be difficult to access due to different languages.

A1.5 Recommendations

Given the issues discussed in the previous section, the working group made a number of recommendations. These fall into two categories. Firstly, those directly related to the guidance and approach for Article 17 assessment and secondly, some covering more general principles.

A1.5.1 Specific to Article 17 method/guidance

- Provide improved guidance on the definition of the pressures and threats categories and their application:
 - Revisit the 'pressures' and 'threats' ranking options.
 - Provide better definition of the pressures and threats categories to ensure nitrogen deposition impacts are captured consistently under a single category.
 - Clarify the purpose of the pollution qualifier and consider making it mandatory.
 - Ensure these comments, in addition to those from the post-Article 17 reporting questionnaire, are fully considered for future guidance.
- Biological and biogeochemical:
 - Agree whether and to what extent biogeochemical measures could be part of the structure and function assessment. For example, biogeochemical measures could be included as an early warning system of change (and therefore informing the future prospects conclusion). It is possible that some countries do this already. A prescriptive approach is unlikely to be favoured, but an indication (and, if appropriate, guidance), to whether this could be an option was thought useful.

A1.5.2 More general issues

- Improve links between the nitrogen impacts research/assessment communities and nature directives reporting communities. There is a growing understanding and empirical evidence base of the impacts of nitrogen deposition on vegetation. However, this is not always used to inform reporting of conservation status.
- Establish a mechanism to bring together nitrogen impacts experts and conservation status experts to discuss and develop thinking around how measures of air pollution impact relate to conservation status, and critical load exceedance relates to achieving favourable conservation status, for example:
 - resolve issues and understand the relationship between critical loads and conservation status; and
 - consider objectives for sites (see Appendix 2), hence how historic impacts are considered and how cumulative effects of nitrogen deposition will influence future prospects of structure and function.

A1.5.3 List of participating countries in Working Group 1

Belgium
France
Germany
Ireland
The Netherlands
United Kingdom

Also
European Topic Centre on Biological Diversity

APPENDIX 2

Theme 1 – Reporting and assessment

Working Group 2 – Establishing conservation objectives and conservation measures for Natura 2000 sites and applying critical loads/level at sites

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Summary

There is widespread evidence of the impacts of nitrogen deposition on terrestrial habitats across Europe and particularly within the Atlantic Biogeographical region. The Habitats Directive aims to achieve favourable conservation status of habitats and species of Community interest and obliges Member States to set conservation objectives for sites and to establish the necessary conservation measures. In relation to this, it is important to know how the impacts of nitrogen deposition have been considered.

Working Group 2 was asked to: (i) share experience of how countries have taken direct or indirect account of nitrogen deposition impacts when setting conservation objectives and conservation measures for interest features of Natura 2000 sites; (ii) present approaches to setting critical loads/levels for Natura sites and to explore the relationship with site conservation objectives based on habitat structure and function attributes; and (iii) assess if and how Member States have established what level of nitrogen deposition input is 'acceptable' given the conservation objectives and what scientific and practical challenges this presents.

The group found substantial differences between countries in how nitrogen deposition is dealt with in setting conservation objectives and conservation measures, and in developing and applying the concept of critical loads. Most countries use the empirical critical load ranges set under the Convention on Long-Range Transboundary Air Pollution to inform assessments for proposed plans and projects under Article 6.3 of the Habitats Directive. It was recognised that further work is required in most countries to further specify these critical load ranges using modelling techniques to produce site-relevant quantitative critical loads for all designated features. The Programmatic (Integrated) Approach to Nitrogen as used in the Netherlands provides an excellent example of good practice in assessing and managing the impacts of critical load exceedance. The value of sharing scientific and practical knowledge and experience was recognised as being crucial to dealing with the issue of nitrogen deposition and its impact on habitats and species of Community interest in the Atlantic Biogeographical region. The establishment of an Atlantic region Nitrogen Deposition Expert Group was suggested as a way to achieve better communication and collaboration.

A2.1 Background

There is widespread evidence of the impacts of nitrogen deposition on terrestrial habitats across Europe, particularly the Atlantic Biogeographical region (Hicks *et al* 2011, Nordin *et al* 2011). Whilst a decline in nitrogen deposition is predicted under current legislative commitments, deposition levels will still exceed critical loads over large areas of the region

(Dise *et al* 2011). As such, nitrogen deposition poses an on-going threat for the foreseeable future.

The Habitats Directive aims to achieve 'favourable conservation status' (FCS) of habitats and species of Community interest. Member States are required to establish Special Areas of Conservation (SACs) which, together with Special Protection Areas (SPAs) classified under the Birds Directive, form a coherent network of sites known as Natura 2000. The main objective of the network is to safeguard biodiversity in Europe. Member States have to take necessary measures to ensure FCS of the habitats and species of European importance.

The Directive obliges Member States to set conservation objectives for sites and to establish the necessary conservation measures. Thus, they need to establish a desired state, or condition, for the habitat and species features on a site so that they contribute to FCS of the habitat/species as a whole. Therefore, in setting objectives and conservation measures for habitats in Natura 2000 sites, Member States need to decide whether there is a requirement to restore (improve) the habitat or to maintain it. In relation to this, it is important to know how nitrogen impacts have been considered when setting objectives for sites. Theoretically, where sites are sensitive to nitrogen and deposition exceeds the relevant critical loads, at least three scenarios can be envisaged:

- i. A habitat (or species) at a site has been impacted by nitrogen deposition and current objectives are to restore the habitat.
- ii. A habitat (or species) has not been impacted by nitrogen deposition; objectives are to maintain the habitat, but the high deposition (in excess of critical loads) presents a risk of damage in the future.
- iii. A habitat at a site has historically been impacted by nitrogen deposition, but nevertheless is still thought to be adequately meeting its objectives in respect of habitat structure and function and contributing to FCS. The objective is to maintain the habitat.

Working Group 2 was asked to determine whether this hypothesis reflects the real situation and consequently to find out in these contrasting situations how and if countries have established an 'acceptable' level of nitrogen deposition to a site, that is, a level that will enable the feature to be maintained at, or restored to, favourable condition. The working group was also asked to examine how Member States have set critical loads for Natura 2000 sites and how this relates to conservation objectives and conservation measures that are focused on habitat structure and function.

A2.2 Objectives of the working group

The objectives of Working Group 2 were to:

- i. share experience of how countries have taken direct or indirect account of nitrogen deposition impacts when setting conservation objectives and conservation measures for interest features of Natura 2000 sites;
- ii. present, in brief, approaches to setting critical loads/levels for Natura 2000 sites and to explore the relationship with site conservation objectives based on habitat structure and function attributes; and
- iii. assess if and how Member States have established what level of nitrogen deposition input is 'acceptable' given the conservation objectives, and what scientific and practical challenges this presents (including what is realistically achievable).

The working group was asked to establish examples of 'good practice' and recommend the issues to be taken into account in setting, or evaluating, objectives and critical loads.

The objectives were discussed in succession. Member State representatives presented their approach in the context of Objectives 1 and 2 during which the following discussion points were addressed as far as possible. Due to time constraints, the working group was unable to consider or discuss Objective 3. Consequently, the group was neither able to establish what level of nitrogen deposition input is 'acceptable' given the conservation objectives, nor able to outline the scientific and practical challenges that this would present. The key discussion points for Objectives 1 and 2 were set out as follows.

Objective 1

- Gather examples of Member States' approaches to setting conservation objectives.
- Consider whether realised, or potential, nitrogen deposition impacts affected the setting of conservation objectives, either directly or indirectly.
- Establish if and how the conservation objectives help determine whether nitrogen deposition should be reduced at a site, either to maintain the feature or restore it (improvement).
- Gather examples of Member States' approaches to establishing conservation measures.

Objective 2

- Outline how critical loads (and levels if applicable) have been applied to habitats at sites and how this relates to conservation objectives for habitat structure/function attributes.

A2.3 Results and Discussion

Participants presented an overview on behalf of their own countries. The key points from presentations and discussions were recorded as follows.

Objective 1 – Conservation objectives

Belgium

Approach to setting conservation objectives

Broad regional conservation objectives have been set and these have also been refined for application to individual designated sites. Furthermore, requirements are assessed for localised patches across designated sites at a detailed scale of one hectare. Nitrogen deposition is not taken into account specifically in setting objectives, but is considered during a process of calibration which is carried out using a modelling approach. This involves optimising objectives for four sectors: agriculture, industry, owners and nature conservation.

Examples of approaches to establishing conservation measures

Conservation measures are set at a detailed site-level. Environmental Action Areas have been established to implement measures for a range of issues, including nitrogen deposition.

Ireland

Do the impacts of N deposition affect setting of conservation objectives?

The impacts of nitrogen deposition are not specifically taken into account when setting conservation objectives in Ireland. Nonetheless, nitrogen deposition was identified as a pressure/threat for ten habitats out of a total of 58 assessed under Article 17 reporting of the Habitats Directive. Until recently, the impacts of nitrogen deposition were ranked as less of a priority when compared with other environmental pressures. However, recently funded studies will investigate the impacts of ammonia emissions on Natura 2000 sites and set site-specific critical loads with respect to conservation objectives and conservation measures.

The Netherlands

Approach to setting conservation objectives

Qualitative objectives are set for designated sites with the relevant habitats and species listed alongside priorities such as 'maintain the present level' or 'improve quality and/or increase the area'. Where the objective is to 'maintain the present level', this is taken to be the same area and quality as mapped for the site at the time of designation. When the objective is to 'improve or increase', the level of required improvement is set out in the site management plans. These contain more-detailed, quantitative conservation objectives.

Examples of approaches to establishing conservation measures

Site management plans set out the measures that are necessary to meet the conservation objectives. These plans have been made obligatory by Dutch legislation. As the conservation status of most habitats and species is unfavourable, the majority of management plans contain objectives and measures for improvement. All objectives are being reviewed at a national level, to ensure that, once achieved, these will deliver the necessary area/quality for each feature to meet FCS.

Do the impacts of N deposition affect setting of conservation objectives?

Yes, although this has been achieved indirectly via the designation process whereby Articles 6.1 and 6.2 of the Habitats Directive ensure that ecological requirements are met for designated features and that deterioration must be prevented. The Netherlands is implementing a Programmatic Approach to Nitrogen (PAN) meaning that every critical load exceedance for each habitat in every Natura 2000 site is taken very seriously. The aim is to stop deterioration immediately and implement restoration measures where necessary. This involves assessment using the AERIUS online calculation tool and then implementing appropriate on-site and source-oriented measures to stop deterioration. This allows some continued economic development while maintaining/restoring habitat quality where necessary.

United Kingdom - England

Approach to setting conservation objectives

A recent review of conservation objectives in England recommended that they should be reviewed and updated, enabling clearer direction of site management, for example, to maintain, or restore to, favourable condition. They should also be more accessible and detailed, allowing developers to assess the impacts of their proposed plans and projects under Article 6.3 more easily. Consequently, quantitative site-level objectives are being drawn up, focusing on three specific areas:

- i. area (hectares) of Annex 1 habitat;
- ii. populations of qualifying species (groups); and
- iii. structure/function (quantitative if sufficient knowledge exists, otherwise qualitative).

This is to be supported by detailed mapping to give a full understanding of the distribution of habitats and species within sites.

Do the impacts of N deposition affect setting of conservation objectives?

The provisional target for air pollutants is to maintain or, where necessary, reduce concentrations and deposition of air pollutants to at-or-below the site-relevant critical load or level values given for the designated features of the site on the Air Pollution Information System (APIS, www.apis.ac.uk).

IPENS – a new strategic approach to managing England's Natura 2000 sites

The Improvement Programme for England's Natura 2000 sites (IPENS) is a new strategic approach to managing England's Natura 2000 sites. It is supported by EU LIFE+ funding

and will develop a strategic approach to achieving favourable condition by reviewing for each site:

- the risks and issues that are impacting on and/or threatening the condition of the site;
- which measures could be used to address them; and
- how much it will cost and where the money could come from.

As well as focusing on the site level, the project is considering wider thematic issues for which a more strategic approach to management may also be required. This includes nitrogen deposition. Further information on IPENS is available on the Natural England website at:

<http://www.naturalengland.org.uk/ourwork/conservation/designations/sac/ipens2000.aspx>.

United Kingdom - Scotland

Approach to setting conservation objectives

Scotland's current conservation objectives consist of high-level, strategic and qualitative statements. For example, conservation objectives for a habitat are set out as follows:

"To avoid deterioration of the qualifying habitat thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving FCS for each of the qualifying features; and

To ensure for the qualifying habitats that the following are maintained in the long term:

- *Extent of the habitat on site*
- *Distribution of the habitat within site*
- *Structure and function of the habitat*
- *Processes supporting the habitat*
- *Distribution of typical species of the habitat*
- *Viability of typical species as components of the habitat*
- *No significant disturbance of typical species of the habitat"*

A project is under way to prepare new Natura plans. These will seek to make the conservation objectives more specific and measurable and develop proposed conservation measures.

Do the impacts of N deposition affect setting of conservation objectives?

No, the impacts of nitrogen deposition do not currently affect the setting of conservation objectives (and are unlikely to in the future), because excessive nitrogen deposition is not a widespread issue across the country. Where sites are affected, the potential impacts of a proposed plan or project are taken into account by assessing the impacts on 'structure and function of the habitat' and 'processes supporting the habitat'.

United Kingdom - Wales

Approach to setting conservation objectives

In Wales, conservation objectives and associated management plans are currently being revised and redrafted on a site-specific basis. In setting objectives and conservation measures for habitats in Natura 2000 sites a decision on whether there is a requirement to restore (improve) the habitat or simply to maintain it will be required.

Do the impacts of N deposition affect setting of conservation objectives?

It has been difficult to separate out the impacts of nitrogen deposition from other issues such as under-grazing, as often the impacts on the habitat/species are the same. Consequently, nitrogen deposition has not been adequately tackled as an issue in its own right. Natural Resources Wales (NRW) is working with the UK's other Statutory Nature Conservation

Bodies on attributing nitrogen impacts as a cause of unfavourable condition and also at establishing solutions or actions to address the impacts. The work is due to complete in December 2014 and the information will be used to develop conservation objectives thereafter.

Objective 2 – Critical loads

Member States produce national maps of critical loads via the CLRTAP International Cooperative Programme (ICP) on Modelling and Mapping (<http://icpmapping.org/>) and their National Focal Centres for Critical Loads. National mapping of critical loads is used in analysis for policy, such as the CLRTAP and the EU Thematic Strategy on Air Pollution (TSAP). Additionally, in some cases, critical loads have been assigned to Natura 2000 sites. Amongst other things, critical loads may be used to inform assessments of plans and projects for Article 6.3 and in reporting on conservation status for Article 17.

Participants were asked to present an overview on how critical loads have been applied to habitats at sites and how this relates to objectives for habitat structure/function attributes. The key points were recorded as follows.

Germany

Critical loads are used in appropriate assessments under Article 6.3 as well as in setting compensatory measures to maintain the coherence of the Natura 2000 site network. However, they are not used in setting site-specific conservation objectives or conservation measures, or in developing site management plans. (Site-specific conservation activities do not include links to clean air policy yet.) Nevertheless, many site-/habitat-specific conservation objectives and management activities aim to maintain or restore nutrient-poor conditions on a qualitative basis, e.g. for grassland habitats H5130, H6110, H6210 and H6510.

The CLRTAP empirical critical load ranges are often too broad and unsuitable for application to habitats in Germany. Consequently, a project was commissioned by the Bundesanstalt für Straßenwesen (BAST) to define critical loads for habitats in this country. This work (now completed) was carried out in three steps:

- i. Approximately 2,000 habitat sub-types were carefully defined.
- ii. Critical loads were modelled for each sub-type, using a simple mass balance model combined with the BERN model (a plant community database with critical limits).
- iii. Critical loads were validated by expert judgement and cross-comparison with empirical critical loads.

The resulting critical load ranges tended to be a little broader than the empirical critical load ranges. As part of this work an automated tool was developed to provide critical load ranges for selected habitats (and sub-types) based upon climatic, soil and plant community variables. This provides critical loads for nutrient nitrogen and acidification at any selected site. If one or more variables are unknown then approximate ranges are produced.

Ireland

Critical loads are not specifically considered in setting conservation objectives and in assessing plans or projects under Article 6.3. Empirical critical loads have been used at the broad habitat level (not Annex I habitats) to assess transboundary impacts of nitrogen deposition under the CLRTAP. However, recently funded studies will link critical loads specifically to Natura 2000 sites and their qualifying features of interest.

The Netherlands

In Dutch Natura 2000 areas, critical loads are used in a national and local context as part of the PAN approach (Van Dobben *et al* 2013). The method involves setting unique critical loads for each habitat (expressed in kg N/ha/yr) and uses the following approach:

- i. For each habitat type occurring in the Netherlands it was determined whether an international empirical critical load range is available as adopted by the CLRTAP workshop in Noordwijkerhout in 2010 (Bobbink and Hettelingh 2011). A process of habitat correspondence was used to match EUNIS types with Annex I habitats. If the matching process was successful, this critical load range has been further specified using dynamic simulation models such as SMART and AquAcid (and, if necessary, expert opinion), to set a unique value (Van Dobben *et al* 2013).
- ii. If no corresponding empirical critical load was available, the critical load value has been derived from the mean value of the results from a national simulation model.
- iii. If the simulation model provided unsuitable results, then the critical load value has been based upon expert opinion alone.

Several heterogeneous habitat types have been split into sub-types in order to set clear conservation objectives in the site designation information and management plans. The critical loads are also related to these sub-types. Furthermore, 'variants' within habitats or their sub-types may have different critical loads, e.g. for trophic variations within the same Annex I habitat. For example, habitat H2190 (Humid dune slacks) has been split into four sub-types, but the dune lakes (sub-type A) has two critical loads: one for oligotrophic and one for eutrophic forms.

Of the 75 habitat sub-types found in the Netherlands, 60 appear to be sensitive to nitrogen deposition (Critical Load < 34kg N/ha/yr). Another 14 nitrogen-sensitive habitats supporting species of the Habitats and Birds Directives are also included and given a critical load value.

These critical loads are accepted as the appropriate standard by everyone in the country, including the government and the highest administrative court. They are used in the site management plans as well as in the Article 6.3 permitting process. Every exceedance of the critical load for each habitat in every Natura 2000 site is taken seriously. This includes assessment (using AERIUS) which compares critical load exceedance with habitat types or sub-types on a one hectare mapping grid.

For every critical load exceedance, suitable on-site and source-oriented measures must be taken to stop deterioration immediately and improve the quality where needed. Because the critical loads are set as precise values rather than as ranges, it is clear when exceedance has occurred. In Article 6.3 assessment for nitrogen-producing plans or projects, new permits are not allowed when the critical loads are exceeded.

At the broader international scale, the Netherlands also computes critical loads for EUNIS classes (including Natura 2000 areas), to support effect-based air pollution abatement policies under the CLRTAP and the EU TSAP. The set of Dutch critical loads in the CLRTAP database is based on the same approach as described above (steps i and ii), using the same models and international empirical critical load ranges.

United Kingdom

The Statutory Nature Conservation Bodies in the UK and the UK environment agencies have worked together to establish 'site relevant critical loads' (SRCL) to Annex I habitats and to sites. The critical loads are based on the empirical critical loads for nutrient nitrogen set under the CLRTAP. An exercise was carried out to match EUNIS habitat types for which critical loads are set to Annex I habitats. An SRCL can then be derived for every feature on each SAC and SPA in England. For species features, the relevant critical load for the

supporting habitat is used, provided that a change in the habitat in response to nitrogen deposition would negatively affect the species' use of that habitat.

Further work is required to refine the approach and overcome challenges, for example:

- some habitats still have no critical load set as they correspond to EUNIS habitats that do not have a critical load. Extrapolation using expert judgement may be necessary in some cases;
- some species (e.g. animals) live in a range of habitats, so it is difficult to develop an appropriate critical load for them; and
- the critical load range makes it difficult to apply a specific value, unless local evidence is available to produce a site-specific critical load.

The SRCL have been used to inform assessments for plans and projects under Article 6.3, with the lower end of the range applied, unless local evidence is available to produce a site-specific critical load.

A2.4 Conclusions

- i. There are substantial differences between countries in how nitrogen deposition is dealt with in setting conservation objectives and conservation measures, and in developing and applying critical loads.
- ii. Differences between countries may be related to a number of variables, e.g. differences in exposure to nitrogen deposition (and thereby the level and severity of impacts on habitats and species), variations in understanding of the nitrogen deposition 'problem', and differences in the level of priority (and resource) that is given to the issue in comparison to other pressures affecting habitats and species of conservation concern.
- iii. In most countries, the CLTRAP empirical critical loads or, where available, modelled site-specific critical loads, have been used to inform assessments for proposed plans and projects under Article 6.3 of the Habitats Directive.
- iv. It was agreed that setting *precise critical loads* (instead of critical load ranges) is likely to be easier for countries with a more homogeneous climate. For example, in the Netherlands, factors such as climate, soil type and plant communities are less variable when compared with other countries, and so precise critical loads are more easily developed and applied there.
- v. Some sites are currently in favourable condition despite the fact that critical loads are exceeded. This can be explained by the fact that the critical load is based on a lengthy time period. For these sites, it is likely that condition will deteriorate to 'unfavourable' once the effects of continued critical load exceedance are borne out in the field.
- vi. The value of sharing scientific and practical knowledge and experience was recognised as being crucial to dealing with the issue of nitrogen deposition and its impact on habitats and species of Community interest in the Atlantic Biogeographical Region. Only through enhanced communication and a better sharing of data and information can the aim of achieving Favourable Conservation Status be attained.
- vii. Nitrogen deposition is an issue at the transboundary level, and perhaps a more harmonised, cohesive approach across the Atlantic Biogeographical Region would help to deal with it more effectively.

A2.5 Recommendations

- i. There would be value in setting up an Atlantic Region Nitrogen Deposition Expert Group; a small group that could operate predominantly via teleconferences and email exchange with an option for periodic face-to-face meetings as necessary.
- ii. The Programmatic Approach to Nitrogen (PAN) as used by the Netherlands provides an excellent example of good practice in assessing and managing the impacts of critical load exceedance. As a follow-up step under the Atlantic Natura 2000 Biogeographical Seminar Process, ECNC proposes to develop a study visit to the Netherlands to share the PAN approach more widely so that experts from other countries can see first-hand how it operates and is applied in the field.
- iii. Guidance is needed on how to recognise the impacts of nitrogen deposition for each Annex I habitat, which enables experts to separate out the impacts of nitrogen deposition from natural variations in habitat/species attributes. This work could be taken forward via the proposed Atlantic Region Nitrogen Deposition Expert Group.
- iv. Empirical critical loads should be completed with modelled assessments of critical loads and adverse effects of nitrogen deposition. Only then can site-relevant quantitative critical loads be applied more widely for all Annex I habitats. This work could be taken forward via the proposed Atlantic Region Nitrogen Deposition Expert Group.
- v. There are clear benefits in comparing and sharing data, information and experience at European and regional levels (e.g. via workshops or working groups). Communication and collaboration between ICP Modelling and Mapping experts and the habitat specialist community should be strengthened, e.g. through calls for data from the Coordination Centre for Effects and Article 17 reporting mechanisms. The proposed Atlantic Region Nitrogen Deposition Expert Group could also help to achieve better communication and collaboration.

A2.5.1 List of participating countries

Belgium
Denmark
France
Germany
Ireland
The Netherlands
United Kingdom

Also
European Commission
ECNC
Co-ordination Centre for Effects

APPENDIX 3

Theme 1 – Reporting and assessment

Working Group 3 – Impact assessments for air pollution policy and nature conservation policy

Mark Wilmot¹ and Rob Maas²

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²*National Institute for Public Health and the Environment (RIVM), The Netherlands*

Summary

The development of biodiversity and air pollution policies is often not closely connected. The challenge is to achieve greater integration and links between conservation practice and policy and air pollution policy at local, national and European scales. At each of the scales, with respect to the objectives of the Habitats Directive (or other biodiversity policy commitments), two key questions arise:

- What evidence of nitrogen impacts is required to trigger a policy response? and
- What policy relevant measures are useful to assess the impacts of nitrogen deposition (including the benefits of emission reductions scenarios)?

The aims of this working group were to identify the key biodiversity and air pollution policy drivers and to consider what the scientific and evidence requirements are to enable a better integration of these two policy areas.

Working Group 3 explored in detail the extent to which Member States include abatement of nitrogen emissions in local, regional or national nature policy and if nitrogen policy is regarded as a local, regional, national or European responsibility. Furthermore, Member State representatives explained whether nature policy targets are taken into account in the development of air pollution policy or agricultural policy and, if so, which indicators and/or measures of impacts are used to support this.

The working group agreed that the general awareness of the need to include the abatement of nitrogen emissions is growing. The integration of nature conservation policy targets into other environmental policies (e.g. air pollution or agricultural policy) differs per Member State. There would be real merit in steps that improve efforts towards integration. All levels of government have a role and a responsibility to protect biodiversity and implement policies to realise conservation objectives.

To achieve this, targets or objectives for protecting and enhancing biodiversity need to be clear for specific habitats, species and ecosystem functions.

The overall conclusion was that a European-level integrated approach is necessary to reduce background nitrogen deposition, as well as a policy framework that enables Member States to create scope for economic development alongside additional (local) measures adjacent to or within Natura 2000 sites.

A3.1 Introduction

Nature conservation and air-pollution policies are often developed in isolation from each other. The conservation of nature has a focus on soil and (surface) water processes and the best ways to manage a nature area, taking into account several external pressures. Often however, there seems to be a lack of effort to actively influence external developments that exert pressures on a site or area. Air-pollution policy, on the contrary, is driven by the assessment of abatement costs for certain emission sources and its impacts on the protection of human health and ecosystems, taking into account the often transboundary dispersion of pollutants. For European air-pollution policy, targets for health protection are based on World Health Organization advice and standards. Specific targets for mitigating the impacts of background nitrogen deposition have so far been developed predominantly on the basis of methods within the Working Group on Effects of the Convention on Long-Range Transboundary Air Pollution (CLRTAP) rather than being based on European biodiversity targets.

In the last decade, human health impacts have been the main driver for additional air-pollution policy measures. Compared to the situation in the 1980s, the long-term protection of ecosystems against acidification and eutrophication has recently become more of a secondary issue.

The major challenge is to strengthen the link between the two policy processes by:

- broadening the toolbox for nature policy to influence external developments;
- increasing the political profile of biodiversity conservation in the development of air pollution policy; and
- co-ordinating efforts in greening agricultural practices.

According to the Convention on Biological Diversity (CBD) the main drivers for biodiversity loss are:

- habitat loss and degradation;
- invasive alien species;
- pollution and nutrient load;
- overexploitation and unsustainable use of resources; and
- climate change.

Figure A3.1 shows the relationship between nitrogen deposition and species richness as estimated by Stevens *et al.* (2010).

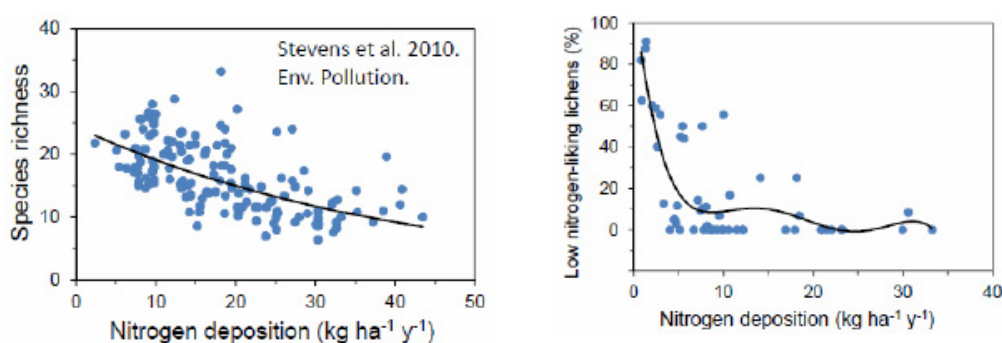


Figure A3.1. Relationship between nitrogen deposition and species richness (Stevens *et al* 2010).

This relationship has been used by the Coordination Centre for Effects (CCE) to assess the loss of biodiversity in Europe due to air pollution (Figure A3.2).

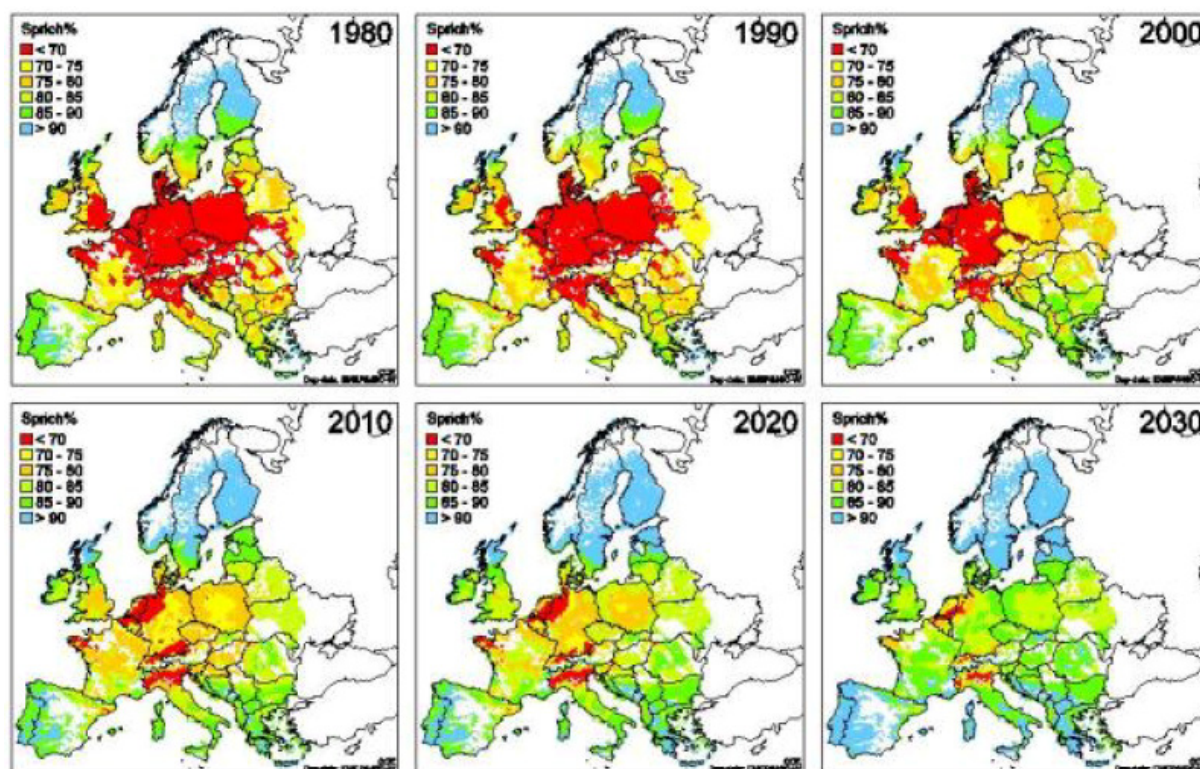


Figure A3.2. Average species richness (%) in Natura 2000 grasslands (EUNIS class E1, E2, E3). The 2030 map refers to the maximum technically feasible reduction scenario. (Source: CCE)

Improvements in habitat and species protection are the result of reductions of oxides of nitrogen (NO_x) and ammonia (NH_3) emissions. At the European scale (based on the EU-27 pre-2013), emissions of NO_x declined by about 35% from 1990 to 2005 and are projected to decrease by about 65% from 1990 to 2020 under the maximum feasible reduction (MFR) scenario. Under the MFR scenario the average EU ammonia emissions are projected to decrease by approximately 40% in 2020 compared with 1990 levels. However, deposition levels will continue to exceed critical loads over large areas.

This species information and critical loads exceedance information from the CCE is being applied to support the revision of the Thematic Strategy on Air Pollution of the European Union and the National Emission Ceiling Directive (NECD). This revision should lead to further reductions of pollutants, including NO_x and NH_3 , both major constituents of nitrogen deposition.

However, questions remain as to how measures such as species richness, used in the example above, relate to objectives set for the Habitats Directive and measures of favourable conservation status or other policy objectives, such as provision of ecosystem services. For example:

- What is the relationship between species richness and the long-term resilience of habitats? and
- How can the relevance of species richness for the ecosystem services that are provided by the Natura 2000 network best be measured (e.g. appreciation by visitors, gathering and hunting, wood production, carbon sequestration, nutrient cycling, etc.)?

The challenge, at local, national and European scales, is to improve the linkages between conservation practice and policy and air pollution policy. Two key questions that arise at each scale with respect to the objectives of the Habitats Directive (or other biodiversity policy commitments) are:

- What evidence is required of nitrogen impacts to trigger a policy response? and
- What measures (or response variables) are used to assess the impacts of nitrogen deposition and the benefits of emission reduction scenarios?

A3.2 Objectives of the working group

The aim of Working Group 3 was to identify the key biodiversity and air pollution policy drivers, and the scientific and evidence requirements that will enable a better integration of these two policy areas. Expected outcomes included:

- Identification of linkages between information requirements for nature policy and air pollution policy.
- Examples of good practice at different scales, and the challenges at each scale.
- An overview of indicators or measures/response variables used in the countries for assessing impacts on biodiversity and the integrity of habitats, e.g. is there a focus on specific species (and if so, which?), on species richness (what is the reference state?) or on the abiotic conditions for a favourable conservation status?
- Requirements for further research.

A3.3 Results and discussion

The background paper for this working group presented four discussion points:

- i. To what extent does your country include abatement of nitrogen emissions in local, regional or national nature policy?
- ii. To what extent are nature policy targets taken into account in air pollution policy or agricultural policy?
- iii. Is nitrogen policy seen as a local, regional, national or European responsibility?
- iv. What indicators and/or response variables are used to support nature policy and nitrogen impacts?

In his introduction as the chair, Rob Maas stated that people working in the field of nature conservation should more often influence people from other environmental policy themes to include nature goals and measurements in their environmental evaluations. This would make it possible to answer the research question on how to reach the environmentally relevant objectives in the most cost-effective way.

A3.4 Overview by country²⁹

Belgium: Assessing nitrogen and ammonia deposition by means of monitoring

In Belgium, background deposition is calculated using the (VL)OPS³⁰ model. Results show that none of the Natura 2000 sites are below critical load. However, 47% of the background

²⁹ All working group presentations are available on the Natura 2000 Platform, which is the web-based resource currently being developed to support the Natura 2000 Biogeographical Process.
http://ec.europa.eu/environment/nature/natura2000/platform/action_results/102_nitrogen_deposition_and_nature_directives_en.htm

³⁰ (VL)OPS is de Flanders (VL) version of the Operational Priority Substance (OPS) Model developed by the National Institute for Public Health and the Environment (RIVM).

deposition is imported from other Member States. Therefore, the problem should be tackled in a European context.

The primary objective in Flanders is to develop a local and regional modelling tool that can be used to assess the impact of ammonia emission changes on the exceedance of critical loads in Natura 2000 sites.

Denmark: Vegetation change modelling and critical loads in Denmark (and the EU)

How important is air pollution? In general, the greatest vegetation changes arise from other pressures, such as land-use changes. However, focusing on nature areas, it is clear that climate change and nitrogen deposition are the most important factors driving biodiversity change. That said, it is noted that NO_x-related nitrogen deposition is expected to decrease by 2050 as a result of current and proposed policy commitments. NH₃-related deposition, however, will decrease only moderately (Amann 2014). Air pollution as a pressure and threat is generally underestimated in nature policy. A large number of species are threatened as a consequence of air pollution; a large proportion of these are nationally red-listed.

Annex I habitat types are very wide-ranging, so research should be tailored according to the needs of one species or habitat type. Furthermore, acidification leads to displacement of habitats, resulting in more homogeneous habitat areas and the loss of specific habitats. A reduction in habitat heterogeneity results in a loss of biodiversity.

However, there is no widely accepted single indicator for biodiversity loss from air pollution, and in practice several indicators are being used (leading to a variety of results), e.g. exceedance of critical loads, mean species-abundance, loss of charismatic species, development of red list species, abundance of dominant species such as grasses or nettle.

If we wish to use the concept of 'halting the loss of biodiversity' in air pollution policy, then more clarity is needed on the biodiversity indicator and the base year for the halting of the loss. What is the reference condition we are aiming to achieve – in relation to N impacts and the Habitats Directive? Do we want ecosystems to be restored to (or kept in) their state as in 1950, 2010 or 2020?

Germany: Links between air pollution and nature conservation

In Germany, there is a decline in background nitrogen deposition. The main driver at the national level is the NECD. Regionally, air policies have so far mainly been based on human health impact.

However, since critical loads for nitrogen deposition are exceeded in many Special Areas of Conservation (SACs), more and more projects are confronted with the need to prove compliance with Article 6.3 of the Habitats Directive. According to the courts, only contributions up to 3% of the critical load are considered allowable for sensitive habitats on Natura 2000 sites. This includes relevant contributions of in-combination projects. Thus, authorities at the national, federal and regional levels are facing demands to find effective ways to reduce background deposition. Tools are needed to provide more-detailed information on background deposition. Nature conservation, including SAC management, will have to provide information that allows priorities to be set and to reduce pressures on and threats to the conservation status of Natura 2000 habitats.

UK

Within the UK there are a number of policy frameworks that drive action on air pollution and biodiversity – for example, the obligation to ensure the favourable conservation of habitats and species under the EU Habitats Directive and commitments to reduce pollution impacts under the CBD, as well as the NECD. A close collaboration between biodiversity and air-

quality policy has been established that includes, for example, joint research funding for policy-relevant evidence projects.

Different assessment tools are being developed to evaluate the benefits to habitats of a reduction of nitrogen deposition and the valuation of the impact on ecosystem services.

The Netherlands

In the Netherlands, biodiversity reporting is focused on the 'structure and functions' of ecosystems and linkages between causes and effects (Figure A3.3). Internationally there are a lot of indicators for biodiversity loss, but fewer on what is causing the loss or how to deal with the consequences.

Integration in the Dutch approach aims at linking targets for sustainable conservation of species to determining factors, e.g. air pollution and nature management. Indicators are only selected when there is a clear link with targets for sustainable conservation of species.

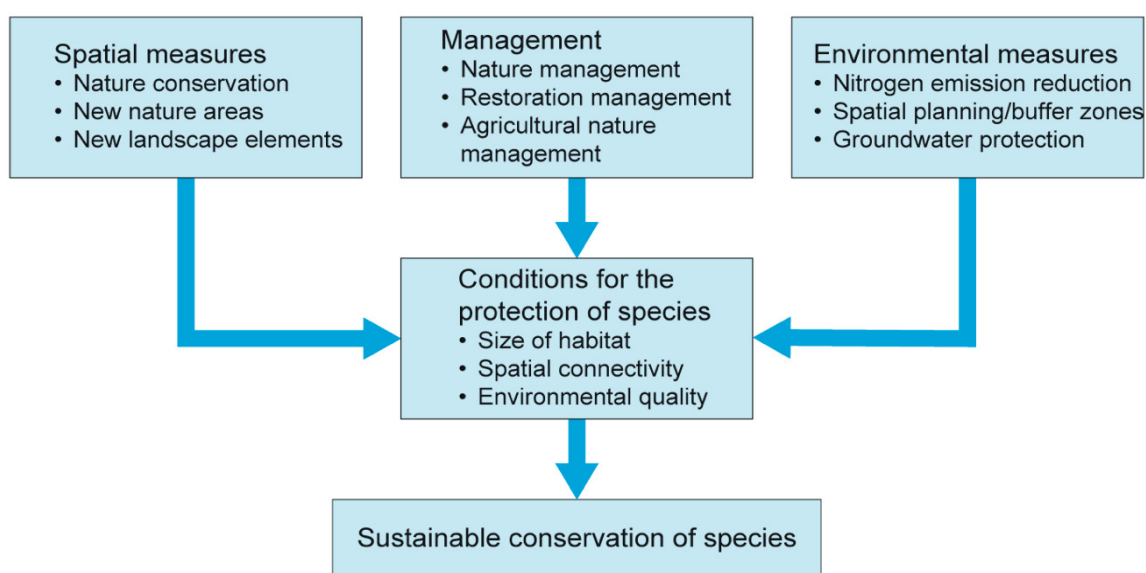


Figure A3.3. Different parties and policies are involved in options for more effective linkage.

This forms the basis of the Programmatic Approach to Nitrogen (PAN) in the Netherlands. This is based on the ecological hypothesis that, against a background of sufficient steadily reducing nitrogen deposition, recovery is possible and further deterioration will be prevented.

Ireland

Critical loads are not used in Ireland in Article 17 reporting or in legislation. Nitrogen deposition is recognised as a threat, but as a low risk. The primary driver for air-pollution legislation is human health, not biodiversity.

Food Harvest 2020³¹ is a project that will significantly increase the number of livestock in Ireland, in particular dairy cattle. It is possible that this will result in an increase in ammonia emission. Ireland is currently meeting the emission ceilings required by the NECD for ammonia, but staying below the ceiling may prove challenging in the future.

Using common terminology on the subject of air pollution and biodiversity conservation should be a primary goal. Evidence-based research should be used to better communicate

³¹ <https://www.agriculture.gov.ie/agri-foodindustry/foodharvest2020/>

the impacts of nitrogen deposition. Greater partnerships between vested interests are required.

A3.5 Conclusions

All the Member States represented in this working group are working at various levels of government in order to enable protection of biodiversity from nitrogen deposition impacts and to ensure public support for the measures.

To be able to use the concept of 'halting the loss of biodiversity' in air-pollution policy, more clarity is needed on the biodiversity indicators and the reference condition of ecosystems. Do we want ecosystems to be restored to (or kept in) their state as in 1950, 2010 or 2020? Together with policymakers and stakeholders it should be decided what reference condition we are aiming to achieve – in relation to N impacts and the Habitats Directive, and what the consequences are for (local) economic activities.

Reflecting several of the discussion points raised, the following questions posed to the countries participating in the working group enabled some conclusions to be drawn:

- How does your country include abatement of nitrogen emissions in local, regional or national nature policy?
 - *Generally, awareness to include the abatement of nitrogen emissions is growing.*
- How are nature policy targets taken into account in air pollution policy or agricultural policy?
 - *This is very different per country, ranging from fully incorporated to not taken into account at all.*
- Is nitrogen policy seen as a local, regional, national or European responsibility?
 - *There is consensus that all levels of government should play their role.*
- What models or indicators are used to support nature policy and nitrogen impacts?
 - *There are different approaches in different countries. However, in most of the countries represented in the working group, measurements and monitoring are facilitated by use of computational models, with temporal and spatial scales ranging from nationwide to incidental, to yearly and nationwide, to site specific.*

A3.6 Recommendations

- Nitrogen deposition levels can be reduced with local, national or European abatement measures. There is work to be done to establish the most cost-effective strategy. How important is a decrease of the European background deposition in relation to the costs of local measures needed to meet biodiversity targets? Better vertical policy-coordination across geographical scales is needed for the implementation of a cost-effective strategy. Linkages between European, national and local assessment models (that link emission abatement measures to nitrogen deposition) would be needed to support such policy coordination.
- Nitrogen deposition can be reduced by tackling its different sources. A cost-effective strategy to meet biodiversity targets would imply horizontal coordination across policy areas such as land use, agriculture, industry and traffic. The use of integrated assessment models such as GAINS and [AERIUS](http://www.aerius.nl/en)³² is very useful.
- The challenge of local action plans will be to implement biodiversity targets while enabling economic development in the region and accommodating new activities. The challenge of local biodiversity action plans would ideally accommodate some new contributions to nitrogen depositions due to 'economic growth' whilst maintaining an overall reduction in deposition. If this is the case, this could simplify permitting and environmental impact assessments for new sources.
- Better integration of representatives from agriculture, nature and environment at European, national and regional levels would be beneficial. Scientists should create tools that can be used on different spatial scales to link causes and effects, enable policy formulation and support consensus building on biodiversity targets and required nitrogen deposition reductions. The Dutch AERIUS model is a good example of such an approach.

³² <http://www.aerius.nl/en>

A3.7. List of participating countries

Belgium
Denmark
Germany
Ireland
The Netherlands
United Kingdom

Also
Task Force on Reactive Nitrogen
Task Force Integrated Assessment Modelling

APPENDIX 4

Theme 2 – Knowledge sharing of practical solutions to reduce nitrogen impacts

Working Group 4 – Measures for reducing impacts from agriculture

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²Natural England, UK

Summary

Nitrogen is essential for producing the crops to feed the world's growing population, yet it is also a source of air, soil and water pollution with significant negative impacts on human health and the environment.

It is a challenge to sustain or increase food production and at the same time reduce losses of reactive nitrogen to the environment, but there are many potential benefits for farmers and wider society associated with improving so-called nitrogen-use efficiency.

Many techniques/measures are being explored and implemented to reduce nitrogen emissions from agriculture in Europe, based on low-emission animal housing, management and feeding strategies, low-emission manure/slurry management and storage, and low-emission land spreading/soil management techniques. Guidance on *identifying* ammonia (NH₃) control measures is provided by the UNECE Task Force on Reactive Nitrogen³³, European Commission³⁴, national ammonia abatement legislation and programmes, and others.

Working Group 4 shared knowledge and experience around the *implementation* of these measures, building on the work of other international groups.

The working group concluded that:

- more could be done on making the case for reducing emissions through demonstrating potential win-win situations (for example, with regard to lower ammonia emissions, the cost-benefits and resource efficiencies for farmers and the wider human health and environmental benefits for society);
- communications could be improved so that relevant sectors and stakeholders are more aware of the nitrogen issue and what actions they need to take to help address it;
- Member States need to be able to capture the air quality achievements resulting from farmers' good practice and to be able to attribute successes in reducing emissions to particular initiatives (e.g. advice schemes);

³³ <http://www.unece.org/env/lrtap/taskforce/tfrn/welcome.html>

³⁴ http://ec.europa.eu/environment/air/clean_air_policy.htm

- greater integration between the monitoring of Natura 2000 sites/features, air quality, and agricultural emissions is also required *in terms of assessing the threat to conservation status (as defined under the Habitats Directive)*; and
- a mechanism is needed for sharing good practice in ammonia reduction measures from agriculture.

A4.1 Background

Agriculture in Europe contributes about 90% of the total emissions of ammonia (NH₃) into the atmosphere (Oenema *et al* 2007). Ammonia dominates atmospheric nitrogen deposition to semi-natural vegetation in agricultural areas, especially in northern Europe. Most of the ammonia originates from animal manure in livestock housing, from manure storage systems and from the application of animal manure to agricultural land. The use of mineral nitrogen fertilisers also contributes to ammonia emissions, especially urea-based fertilisers.

Reactive nitrogen as a nutrient is well-documented for its positive effects in agricultural production systems, human nutrition and food security. Nitrogen, along with other plant nutrients, is essential for plant growth and is needed to achieve optimum crop yields.

By 2050, it is expected that the global population will be approaching nine billion and, with the added challenge of climate change, food shortages may be likely (Sutton *et al* 2012). European agriculture should be well positioned to play a key role in meeting food needs, not just in Europe, but also contributing to meeting global food demands.

Farmers and land managers are already taking steps to better manage nitrogen and its impacts by being more efficient. For example, fertiliser use on farm crops has changed significantly in the past 20 years, showing a decline in use of major nutrients, including nitrogen. In addition, farmers plan their nutrients to match crop needs, with more farmers adopting nutrient management plans and the trend towards the use of low-emission equipment is increasing.

However, only a fraction (on average 40-50%; Oenema *et al* 2007) of the nitrogen input via fertilisers and animal manure to agricultural land is utilised for crop production; the remainder is lost to the environment. Excess nitrogen, in its various forms, plays a major role in a number of environmental issues, including: the loss of biodiversity, eutrophication of waters and soils, drinking-water pollution, acidification, greenhouse gas emissions, human health risks from exposure to nitrogen oxides, ozone formation and secondary particulate matter formed by ammonia in the air, and destruction of the ozone layer (Sutton *et al* 2009). The UNECE Gothenburg Protocol (Protocol to Abate Acidification, Eutrophication and Ground-Level Ozone, adopted in 1999, revised in 2012) contains a series of mandatory control measures that the Parties shall employ for the control of ammonia emissions from agricultural sources. It also requires Parties to establish, publish and disseminate an advisory code of good agricultural practice to control ammonia emissions. Furthermore, the proposals for a revision to the National Emission Ceilings Directive 2001/81/EC (NECD), includes 'ceilings' for ammonia emissions and an annex containing the cost-effective measures to achieve these ceilings. Emissions from the larger intensive agricultural units/installations for pigs and poultry are regulated under the EU Industrial Emissions Directive.³⁵ It requires each installation to have a permit containing conditions based on the application of Best Available Techniques (BAT), as guided by European guidance notes (Best Available Techniques reference document or BREF), set to minimise emissions of pollutants to air, water or land.

³⁵ In December 2010, the Directive on Industrial Emissions (integrated pollution prevention and control) (Recast) (2010/75/EU) combined the original IPPC Directive with six other directives.

The Nitrates Directive, adopted by the European Union in 1991, is aimed at protecting water quality across Europe by preventing nitrates from agricultural sources polluting ground and surface waters through the promotion of good farming practices. Full implementation of the Nitrates Directive is expected to contribute to the reduction of ammonia emissions³⁶ as measures limiting, for example, amounts of fertiliser applied, reduce nitrate losses to waters and ammonia emissions to air. The Common Agricultural Policy (CAP) promotes the implementation of the Nitrates Directive through cross-compliance requirements for direct support, and can support measures for improved nitrogen use efficiency through the European Agricultural Fund for Rural Development (provided that the Member States give priority to this in their respective Partnership Agreement and Rural Development Programme). Reducing nitrates is also an integral part of the EU Water Framework Directive (2000), which establishes a comprehensive approach to water protection, organised around river basin districts, with the aim of achieving good status for European bodies of water by 2015. The Water Framework Directive has implications for farming practices and land management as well as water management.

The European Nitrogen Assessment (2011) concluded that there is still a large potential for increased nitrogen efficiency (and reduced nitrogen emissions) in European agriculture. Of the seven key actions recommended to further develop an integrated approach to nitrogen management, three were related to the agricultural sector:

- i. improving nitrogen use efficiency³⁷ in crop production;
- ii. improving nitrogen use efficiency in animal production; and
- iii. increasing the fertiliser nitrogen equivalence value³⁸ of animal manure.

Technologies are available, and are being increasingly employed, to reduce the impact of nitrogen emissions from farming in Europe. These include management strategies involving nitrogen-conserving field practices (e.g. catch crops, reduced soil tillage, better timing of nitrogen inputs), modifications to livestock diets (decreasing nitrogen-excretion rates), and enhanced manure nitrogen use efficiency through improved environmental technologies (e.g. the management, recycling and field application of manures). Many different technologies to reduce livestock stable/housing and manure/slurry storage emissions have been tested and are increasingly being implemented. These include reducing the fouled surface areas in animal houses, covering manure stores, acidification of slurry to reduce pH, slurry separation, biogas digestion, use of heat exchangers and ammonia scrubbers. The positive effect of drying poultry manure on lowering emissions has been demonstrated in pilot studies and on farms. Increasingly, a whole farm/system approach is being considered (i.e. considering the entire nitrogen cycle and the potential for emissions at different stages, for example by developing nitrogen budgets at the farm level). Tree buffers, whilst not reducing ammonia emissions, have been shown to capture ammonia and/or reduce dispersion.

For many farms, in particular arable and mixed farms, there are clear economic benefits (ammonia emissions represent a loss of valuable nitrogen) and environmental benefits of more-efficient nitrogen use in farming. Some of the techniques aimed at reducing nitrogen losses have been shown to have other advantages for farmers, such as providing energy, reducing fuel costs or increasing the total fertiliser value. This is in addition to the benefits of protecting water quality and limiting emissions of greenhouse gases.

³⁶ <http://ec.europa.eu/environment/pubs/pdf/factsheets/nitrates.pdf>

³⁷ The ratio of nitrogen input and output of a system. The nitrogen use efficiency (NUE) at farm level indicates how well the imported N on the farm is used to produce crops and animal products (milk, meat and eggs).

³⁸ The fertiliser nitrogen (N) equivalence values for manure (and crop residues) indicate how well manure N (and N from crop residues) are used relative to the reference fertiliser (NH₄NO₃ based fertilisers), which is set at 1 (100%). A high value indicates a high N use efficiency; a low value indicates a low N use efficiency. The fertiliser N equivalence value depends on the type and origin of manure, crop type, environmental conditions, and management (i.e. the time and method of application).

UNECE provides detailed guidance to the Parties of the Gothenburg Protocol on identifying options and techniques for preventing or reducing releases of ammonia from the agricultural sector (UNECE 2012) (prepared by the Task Force on Reactive Nitrogen, adopted by Parties in December 2012), covering dairy, beef, pig and poultry farming. The European Commission also produces a Best Available Techniques reference document (BREF 2013) for intensive livestock, which must be taken into account when determining 'best available techniques' under the Industrial Emissions Directive (BAT conclusions) and provides information on emerging techniques. The current agriculture BREF from 2001, which is currently under review, covers feeding strategies, housing systems, storage, on-farm treatment and land spreading of manure and slurry for poultry and pigs. BAT is a dynamic concept and so the review of BREFs is a continuing process. The International Nitrogen Initiative and Nitrogen in Europe (NinE) also provides guidance on how to reduce nitrogen pollution and protect human health and the environment.³⁹

At the end of December 2013, and after the Nitrogen Deposition and the Nature Directives Workshop, the European Commission published its clean-air policy package,⁴⁰ which includes proposed new ammonia emission ceilings for 2020 and 2030, along with an annex with agricultural measures that should be implemented to the extent necessary to achieve the ceilings. The Commission has also published a study on manure management as part of the air policy review. This includes an appendix listing measures used in a number of countries and policy recommendations.⁴¹

Working Group 4 discussed *what* measures and techniques countries are adopting and *how* they are being implemented, in the context of biodiversity protection.

Farming systems within the Europe Union are diverse, occupying wide ranges of climate, soil type, topography and management practices. Member States have different national legislation and policies, and may face different political and societal pressures. However, there are important similarities, and common goals, and this workshop provided a valuable opportunity for sharing knowledge and experience of implementing approaches to manage nitrogen emissions from agricultural sources.

A4.2 Objectives of the working group

The aim of this working group was to share knowledge and experience of implementing measures and programmes to reduce atmospheric ammonia emissions (and the associated nitrogen deposition) from agricultural sources. Noting the work already undertaken by expert groups under CLRTAP and the EU, it also aimed to share experience of how Member States were taking this work forward.

The objectives were:

- to explore what range of measures have been implemented to reduce nitrogen emissions/deposition from agriculture, whether these have been delivered through regulatory, voluntary or incentive and grant schemes, and how effective they have been at driving down emissions/deposition at the national and local levels;
- to examine how the need for sustainable agricultural practices can be delivered alongside the need for agricultural growth and increased production, and other

³⁹ Nitrogen in Europe: Assessment of current problems and future solutions (NinE). European Science Foundation. <http://www.nine-esf.org/>

⁴⁰ http://ec.europa.eu/environment/air/clean_air_policy.htm

⁴¹ http://ec.europa.eu/environment/air/pdf/clean_air/Final%20Report.pdf

challenges around the uptake and implementation of measures to reduce ammonia emissions; and

- to share information and thinking on any innovative techniques and approaches being explored or piloted in this area.

A4.3 Discussion points

Discussion was based on presentations given by representatives from **Germany, Belgium, the Netherlands and the UK**⁴².

A4.3.1 Shared drivers

In considering how and why to mitigate nitrogen emissions and deposition from agriculture, Member States acknowledged a range of common drivers, including:

- increased pressures on nature and the natural environment;
- the contribution of greenhouse gases from agriculture to climate change;
- the need to comply with a range of environmental EU directives, including: National Emission Ceilings Directive (NECD); Nitrates Directive; Habitats Directive; Water Framework Directive (WFD); Industrial Emissions Directive (IED);
- a difficult economic climate and associated focus on growth;
- spatial drivers for agriculture (for example, soil type, climate or proximity to source of animal food?); and
- animal welfare.

A4.3.2 Differing circumstances

Member States also acknowledged some important differences that influenced the types of approaches and policy decisions taken, for example:

- the diversity of farming systems within the European Union, occupying wide ranges of climate, soil type, topography and management practices; and
- the different national legislation and policies within Member States, and different political and societal pressures.

A4.3.3 What methods have proved to be effective?

There was a general consensus that the following methods were effective in reducing ammonia emissions to air and were cost effective for farmers. They have been used to varying degrees across Member States:

- livestock feeding strategies;
- low-emission livestock housing;
- low-emission manure/slurry storage techniques; and
- low-emission manure/slurry application techniques (and reduced incorporation times).

⁴²http://ec.europa.eu/environment/nature/natura2000/platform/action_results/102_nitrogen_deposition_and_nature_directives_en.htm

A4.3.4 What new and innovative methods are emerging?

A range of new and emerging technologies and methods have been used within Member States. For example:

- heat exchangers;
- ammonia scrubbers;
- acidification of slurry;
- separation technologies;⁴³ and
- precision farming/livestock management.⁴⁴

The uptake and use of new and innovative technologies is often in response to particular drivers such as the need to meet permit conditions (under IED) or comply with national legislation. For example, all new intensive livestock housing (stables for poultry and pigs) in Belgium are now required to be low emission. Some countries provide funding to incentivise new techniques; for example, in the Netherlands a government Innovation Fund was established. New and innovative methods often have additional benefits. For example, in response to permitting requirements, an England poultry farm trial of heat exchangers demonstrated improved energy efficiency as well as ammonia reduction.

A4.3.5 What approaches have been used to tackle the problem of emissions from agriculture?

Member States have used a variety of approaches and tools to reduce emissions of ammonia.

Prioritising actions to tackle emissions

i. *Identifying the main activity source of ammonia emissions and tackling that first*

In Flanders, the agricultural activity giving rise to the greatest proportion of ammonia emissions was identified. Almost 60% of agricultural ammonia emissions arose from manure application and so actions were prioritised to reduce emissions from this source by introducing mandatory low-emission application techniques (and/or obligatory manure incorporation within two hours on arable land). These actions resulted in a 50% reduction of the share of ammonia emissions from manure application (29% of agricultural emissions in 2010). Overall, total agricultural ammonia emissions were reduced by over 50% in this period, due to this and other measures.

ii. *Spatially targeted emissions reductions around Natura 2000 sites*

Belgium and the UK have obtained evidence from modelling studies to demonstrate the relative effectiveness of some ammonia emission reduction strategies around Natura 2000 sites compared to national-scale strategies. These studies indicate that spatially targeted strategies can be more cost effective in terms of protecting Natura 2000 sites.

⁴³ Separation techniques – separation of solid and liquid fractions of manure/slurry – using mechanical separators, sedimentation, centrifugation or membranes. Occasionally, separation is enhanced by the use of chemical flocculants. The treatment system may involve mechanical separation of the solids and subsequent separate treatment of solids and liquids.

⁴⁴ Precision farming: management concept based on observing, measuring and responding to inter and intra-field variability in crops (spatially and temporally) using technology such as GPS, GIS and variable-rate farming equipment) on agricultural equipment (e.g. tractors, sprayers, and harvesters). The approach could also apply to other agricultural practices such as feeding regimes.

Decision-making tools

i. AERIUS and the Programmatic Approach to Nitrogen (PAN)

In the Netherlands, government authorities and sectors (agriculture, industry, traffic and transport) are working together to reduce levels of nitrogen deposition in Natura 2000 sites as part of a collaborative programme. The aim of the programme is to lower nitrogen emission levels and also to make room for new economic development in the area, whilst maintaining or improving the biodiversity. In order to achieve this aim, the AERIUS web-based instrument has been developed using open-source software.⁴⁵ This enables the user to interactively evaluate a range of legislative scenarios to lower nitrogen emission levels with the main sources of emissions (farms, factories and transportation) being visible and editable on an individual facility level. This makes it possible for the user to evaluate the contribution of each facility and/or sector to the deposition of nitrogen.

Measuring/accounting systems

i. Manure tracing systems using GPS and administrative approaches

In Member States where, in certain circumstances, manure processing (treatment) is required for manure surplus management (e.g. the Netherlands and Belgium), systems are in place to trace manure spatially, either through GPS or other administrative systems.

ii. Indicators to measure nitrogen use efficiency at different points in the cycle

In the Netherlands, a set of indicators are used to measure nitrogen use efficiency throughout the cycle. Indicators for manure production, efficiency of feeding, ammonia emissions, yields from grassland and maize, efficiency of fertiliser, soil surplus nitrogen, phosphorus and carbon, greenhouse gas emissions, farm surplus and farming efficiency have been used.

A.4.3.6 What levers and mechanisms are deployed

Member States use or have used a combination of different levers and mechanisms to reduce emissions. The different approaches reflected the particular drivers and circumstances that operated within each Member State and included:

- **Permitting/ legislation**

- Permitting regimes under IED operated in all Member States.
- National mandatory measures, e.g. requirement for low-emission spreading in Denmark, the Netherlands and Flanders; National Action Programmes under the Nitrates Directive.
- Fertiliser ordinance (Germany).
- Environmental Impact Assessment Regulations and Town and Country Planning (the UK).

- **Incentives**

- National Innovation fund (the Netherlands).
- Rural Development Programme schemes, e.g. environmental stewardship and Catchment Sensitive Farming (starting to be considered in relation to reducing ammonia emissions in England).

⁴⁵ <http://www.aerius.nl/en>

- VLIF (Flemish agricultural investment fund) provides amongst others financial incentives for investments that benefit the environment (e.g. specified list of low-emission housing, Belgium).
- Communication of cost-benefits to farmers through improved nitrogen use efficiency in manure application.
- **Advice schemes**
 - Catchment Sensitive Farming (England).
- **Voluntary schemes and agreements**
 - Campaign for the Farmed Environment, Tried & Tested and the Greenhouse Gas Action Plan (England).
 - Nutrient efficiency plan - an agreement between farmers, unions, milk cooperatives, agricultural contractors (the Netherlands).

A4.3.7 What are the challenges?

Discussions highlighted a number of challenges to tackling the issue of ammonia emissions.

i. Role of regulation

- a. In other sectors, it has been accepted that emissions are managed through regulation (e.g. transport, combustion). In agriculture, regulation is considered less acceptable in some Member States.
- b. The Industrial Emissions Directive (IED) focuses on pig and poultry but not cattle, and in many countries cattle are the largest source of ammonia emissions. However, the adopted UNECE guidance document for preventing and abating ammonia emissions from agriculture does cover cattle (dairy as well as beef).
- c. The focus of the IED is on large livestock units (above a specified size threshold) but action is also needed to address emissions from smaller farms.

ii. Monitoring and measures of success

- a. In a mandatory system, measuring compliance effectively is difficult and there may be significant administrative costs involved.
- b. Some reduction techniques are hard to verify, e.g. keeping yards clean. There is a need to capture the achievement as a result of farmer's good practice so that it counts towards emissions reductions by developing administrative returns/compliance sampling that could be used to trace these types of actions.
- c. It can be difficult to attribute success in reducing emissions to particular initiatives (e.g. can advice schemes be linked to quantifiable reductions in emissions?). Better attribution of success might improve uptake.
- d. There was a discussion on the indicators of success and whether these should be focused on emissions reductions or improved environmental quality. For example, the NECD sets country emission ceilings rather than environmental outcomes. Meeting ceilings does not necessarily lead to improved environmental quality. The principle of environmental quality should be considered in NECD negotiations in a similar way to the outcome-focused objectives ('good ecological status') in the Water Framework Directive.

- e. Linked to the previous two points, the group discussed the need to link reduced emissions to the monitoring of improved environmental quality, taking into account the time lags in environmental response.

iii. *Funding*

- a. Common Agricultural Policy (CAP) funding is used for nitrogen emission reduction incentives in some Member States and not others. The recent agreement on a new Rural Development Programme (RDP) includes a specific reference to ammonia (under priority area 5), making it clear that such measures are eligible for funding if Member States wish to do so.
- b. Consideration of regulatory changes needs to be aligned with investment cycles, especially in regard to potential retrofitting (e.g. of animal housing, equipment, etc.).
- c. Longer-term investment cycles are needed for certain activities such as establishing tree buffers; and associated outcomes will only be seen over longer timescales.

iv. *Level of awareness and knowledge exchange*

- a. Awareness of the atmospheric ammonia issue and the potential for win-win solutions varies across sectors and stakeholders *within and between* Member States.
- b. Member States do not currently have access to the full range of information and evidence available on emission reduction solutions and strategies (challenges include evidence only in 'grey literature'⁴⁶, language barriers).

v. *Other risks*

- a. Anaerobic digestion (AD): variable accounting in national NECD inventories (AD is not currently included in all national inventories but will still be a source of emissions); ensuring good practice in management of AD at the unit level to ensure that ammonia emissions are minimised.
- b. Nitrogen use and potential increased emissions in the context of growth (e.g. Food Harvest 2020 strategy proposes higher livestock numbers in Ireland).
- c. Managing future risks from urea fertilisers. Use of urea fertilisers can potentially result in higher ammonia emissions compared with the use of ammonium nitrate fertilisers. If use of urea products rises in the future, it would be necessary to mitigate this risk, e.g. by promoting the use of urea inhibitors.
- d. Ammonia scrubbers can cause problems in the implementation phase.

There is strong evidence that the scrubbers are not always installed, used, or properly maintained, which means that emission reductions could be (heavily) overestimated).

⁴⁶ Informally published written material that may be difficult to trace via conventional channels because it is not published commercially or is not widely accessible.

Moreover, caution is required with the acid input and output streams of the ammonia scrubbers: hazardous sulphuric acid has to be transported to farms on rural roads and stored on farm, and the end product still contains a lot of unreacted sulphuric acid in order to capture all the NH_3 .

A4.3.8 What opportunities can be gained from tackling ammonia emissions?

Discussions highlighted opportunities that could be gained from tackling the problem, for example:

- Multiple environmental benefits can be achieved through good nitrogen management (water quality; air quality; climate change; biodiversity; and soil).
- A range of win-win technologies and good practice management can be used to tackle ammonia emissions and also improve animal welfare, energy efficiency, climate change policies, the fertiliser value of manure and full-chain nutrient use efficiency (e.g. crop, manure, consumer food choices).
- Cost savings can be achieved by better matching nitrogen inputs to needs (e.g. in feeding regimes and fertiliser use).
- Soil benefits can be achieved through integrated soil management and appropriate use of organic fertilisers.
- Air and ammonia are featured in the latest Rural Development Regulations so there is opportunity to use RDP funding to support measures that will help to reduce ammonia emissions.
- The value of products (and attractiveness to consumers) could be enhanced through green labelling linked to low-emission farms helping to protect Natura 2000 sites.

A4.5 Conclusions

The key conclusions from the working group were as follows:

- **Making the case for action by demonstrating win-wins**
There are a number of win-win solutions that could be used to make the case for action to tackle ammonia emissions. These include:
 - cost benefits to farmers through improved nitrogen use efficiency, animal welfare and energy efficiency; and
 - a range of environmental benefits as a result of reduced emissions and lower nitrogen deposition (water quality; air quality; climate change; biodiversity; and soil).
- **The importance of communication and advice**
Effective communication of the issues and advice on actions that can be taken are vital if we are to be successful in reducing emissions. The problems, potential solutions and benefits from taking action need to be communicated to all relevant sectors and stakeholders. In Member States that chose to operate a voluntary approach, farmers need to have access to trusted advice on what actions they could take. In all cases, the sectors responsible for designing animal housing and agricultural equipment need to be aware, so that their products seek to minimise emissions. There also needs to be joined up messaging in relation to communications on water and soil issues.

As part of these communications, it is recommended there should be a change of emphasis from a focus on pollution swapping towards a new focus on synergies and co-benefits and overall (full-chain) nitrogen use efficiency.

- **Monitoring and measuring success**

It is important at an early stage to consider the evidence that will be needed to demonstrate the success of any actions/strategies to reduce agricultural ammonia emissions and the timescale that might be required in order to see/detect results. Evidence may be provided through farm survey results, emissions inventories, air-quality monitoring and/or modelling, and Natura 2000 site or feature (habitat) survey at the national and local levels – if designed appropriately.

A4.6 Recommendations

- Develop mechanisms for sharing best practice information between Member States on reducing emissions and increasing overall nitrogen use efficiency so that farmers have access to integrated solutions. It is suggested that this is achieved through existing groups such as the Task Force on Reactive Nitrogen or Expert Group on Ammonia Abatement. Information should be available via the Internet and in different languages.
- Consider development of an EU-wide standards/certification system for particular technologies based on their effectiveness in reducing emissions.
- A more-integrated agricultural approach with increased awareness of the air quality issue in addition to water and soil quality issues within the agricultural sector itself, including advisers and associated sectors such as animal housing and machinery designers at both the country and EU levels. The European Innovation Partnership in Agriculture⁴⁷ and Horizon 2020⁴⁸ could be used to promote best practice in this area.
- Individual Member States to make better use of mandatory commitments (under the Gothenburg Protocol) for national codes of good practice for reducing ammonia emissions, and any obligations under the revised NECD, and consider use of Rural Development Programme funding where appropriate.
- Better integrate the monitoring of Natura 2000 sites and the monitoring of air quality/emissions, especially in relation to atmospheric ammonia.
- The NECD is developed in relation to minimizing environmental impact. Once in force, performance is measured against achieving emission ceilings. It is recommended that additionally, performance is measured against reducing *critical load exceedance or some other ecological indicator(s)*, so the emission reductions put in place to meet national ceilings are targeted for the greatest benefits. A parallel example would be that of the 'good ecological status' requirement of the Water Framework Directive.

⁴⁷<http://ec.europa.eu/agriculture/eip/>

⁴⁸ <http://ec.europa.eu/programmes/horizon2020/en/h2020-section/food-security-sustainable-agriculture-and-forestry-marine-maritime-and-inland-water>

A5. List of participating countries

Belgium
Denmark
Germany
Ireland
The Netherlands
United Kingdom

Also
European Commission

APPENDIX 5

Theme 2 – Knowledge sharing of practical solutions to reduce nitrogen impacts

Working Group 5 – Measures to reduce nitrogen deposition from sources other than localised agriculture (e.g. transport, power generation, industry and long-range emissions)

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Summary

Nitrogen deposition from a range of emission sources is currently has an adverse impact on many habitats across Europe. This is forecast to continue into the foreseeable future despite the provisions of existing pollution legislation.

The sources of nitrogen emissions can lead to impacts locally or over long distances. The focus of this working group was on measures to reduce nitrogen deposition from sources other than local agriculture, for example transport, power generation and industry.

The working group assessed what measures exist at a regional or local scale to reduce nitrogen impacts on protected sites drawing on existing practice and proposals for future strategies or plans.

While the emission reduction policy is most usually aimed at achieving national ceilings, greater effort should be made to target emission reduction to benefit habitats at a national and local level. There needs to be integration between national emission strategies and local plans to target the reduction in nitrogen deposition.

Working Group 5 concluded that:

- although nitrogen deposition across Europe is dominated by agricultural ammonia emissions, other emissions of oxides of nitrogen remain a concern at both a national and local level;
- the countries that have made most progress with tackling nitrogen deposition have both national strategies and local plans that are integrated;
- there was some concern that within Member States the devolved autonomy of regional administrations could present barriers to developing a fully integrated nitrogen emission approach; and
- control of water pollution across the EU is delivered under the auspices of an overarching Water Framework Directive. There are many separate directives and drivers to tackle air pollution but there is no analogous overarching Air Framework Directive to govern air pollution reductions.

A5.1 Background

There are a number of directives and protocols in place across Europe to reduce the impacts of air pollution to benefit human health and biodiversity. Some directives, such as the Industrial Emissions Directive (IED), prescribe specific emission limits for a range of industrial processes e.g. large combustion plants. However, other directives, such as the National Emissions Ceilings Directive (NECD), prescribe a national limit (ceiling) on a Member State's emissions. The Member States have some flexibility on how to reduce their emissions to deliver the national ceiling.

The NECD also sets specific targets for the reduction of acidification (Article 5) with an expectation to also reduce critical load exceedance for nitrogen by 'about' 30% from the situation in 1990, by 2010 (see Annex A5.1 below). However, by 2010, critical load exceedance for nutrient nitrogen had only been reduced by approximately 23% (Posch *et al* 2012). As a result critical loads for nutrient nitrogen are currently exceeded on 62% of the area of national and semi-natural habitats in the EU-27 countries (Posch *et al* 2012).

In December 2013, after the Nitrogen Deposition and the Nature Directives Workshop, the European Commission published its clean-air policy package,⁴⁹ which includes proposals for a revised NECD, including new emission ceilings for 2020 and 2030.

Working Group 5 considered measures for non-agricultural sources to address local impacts from NO_x and measures or strategies for long-range pollution (including oxidised and reduced forms of nitrogen). The aim was to share examples of good practice by Member States that have been implemented to reduce nitrogen deposition from non-agricultural sources at local or national level and to outline future plans or proposals. This built on the presentations from Member State representatives described in Section 4.

A5.2 Objectives of the working group

The aim of this working group was to share knowledge and experience of measures for non-agricultural sources (i.e. transport, electricity production, industry) to address local impacts from NO_x and measures or strategies for long-range pollution (including oxidised and reduced forms of nitrogen). In advance, working group members were asked to gauge the relative national contribution of these sources of nitrogen deposition to provide an overview of their relative magnitude.

The objectives were to:

- Identify measures or programmes that have been implemented to reduce nitrogen deposition from non-agricultural sources at local or national level. To provide these as case studies for discussion by the group and also, specifically, to discuss if consideration is given to long-range reduced-nitrogen emissions.
- Outline current thinking on proposals under consideration to reduce future emissions/deposition – for example, in the form of regional or national plans or specific measures to target and reduce nitrogen emissions.
- Describe the drivers behind nitrogen reduction measures and proposals, with specific consideration to their objectives – for example, are the objectives to improve air quality for human health, or are water quality and ecosystem protection incorporated?

⁴⁹ http://ec.europa.eu/environment/air/clean_air_policy.htm

Discuss the merits of exploring the potential synergies between integrating these drivers.

A5.3 Results and discussion

There was broad agreement from all participants that deposition across Europe was dominated by reduced nitrogen from agricultural sources. However, it was also agreed that emissions of oxides of nitrogen from sources such as transport and industry, were also of major concern.

Most Member States rely on EU-wide policies to bring about national reductions in emissions of nitrogen. For example, compliance with the new Euro 6 standards for vehicle emissions, the use of Best Available Technology (BAT) applied to industrial processes covered under the IED, and the provision through the International Maritime Organization to regulate emissions from shipping.⁵⁰ While such measures will result in emission reductions that will help achieve national NECD ceilings, they are not targeted in a manner that maximises benefits for human health and ecosystem protection.

However, in the Netherlands a national plan to reduce emissions is linked to regional and local plans, in which the requirements of the Habitats and Birds Directives are also considered. This linked 'top-down–bottom-up' approach applied in the Netherlands was considered as the best example within the group, which other Member States would be advised to follow.

It was agreed that a national nitrogen strategy or framework is an effective means to deliver local measures and plans to maximise ecosystem protection. In the Netherlands, the Programmatic Approach to Nitrogen (PAN) to reduce nitrogen deposition at protected sites within the framework of a co-ordinated national programme is supported by the use of sophisticated user-friendly modelling (the AERIUS tool⁵¹ (see Annex A5.1 below). The tool allows land developers and regulators to assess the best options for nitrogen reductions and thus create 'headroom' for new developments in an economically and environmentally efficient manner where that could be possible. The approach provides a robust and transparent framework in which all parties can assess the options and the decisions made. It was noted that in the Netherlands the government also makes financial provision available to support outcomes. For example, if a new road passes close to a Natura 2000 site, it may mean that some livestock farms may have to relocate or close, but in these cases the owner is compensated.

While recognising the value of the Dutch approach, the members of Working Group 5 also acknowledged that this may be hard to achieve, given the devolved autonomy of regional municipalities or states in many countries. However, as emission ceilings become more challenging – for example, as proposed for the revision to the NECD – it was felt that closer cooperation will be required by regional and local authorities within Member States to ensure that local actions support the national plan, and vice versa. Measures to reach National Emission Ceilings could be spatially targeted to those locations where they also contribute to resolving local air quality issues, including in and around protected sites.

The working group also observed that while there are a range of policies covering emissions of nitrogen pollutants, such as the NECD, IED and the MARPOL, there is no overarching EU-wide framework to integrate the benefits of the separate drivers. The need for an air-quality framework directive analogous to the Water Framework Directive was discussed. Such an integrated framework would encourage Member States to look more holistically at the

⁵⁰ MARPOL 73/78. 1997 Protocol – Annex V1 Regulations for the Prevention of Air Pollution from Ships.

⁵¹ <http://www.aerius.nl/en>

interlinked effects of air pollution on human health, air and water quality, and biodiversity. At present, these outcomes tend to be treated in isolation, although some Member States, such as Belgium, Germany and Denmark, are considering the mutual co-benefits of an integrated approach.

The group considered the questions set out in the background paper and reached the following main conclusions and observations:

- a. *Does your country have a national air quality plan or strategy to control nitrogen emissions? Is this simply to implement the requirements of the NECD or does it make provisions beyond this? What consideration is given to ecosystem protection?*

As required by the NECD, all countries represented in the working group had developed national plans or measures and actions to meet the emission ceilings. However, with the exception of the Netherlands, these plans do not specifically consider the benefits of emission reductions on ecosystems (as set out in Annex 1 of the NECD). It was felt that the 2020 and 2030 emission ceilings proposed in the clean air policy package will be a useful driver to promote a more integrated approach to assess co-benefits for human health and biodiversity.

Some countries update their national plans annually. This ensures that decisions are made on the basis of accurate and up-to-date information, ensuring that policy outcomes are auditable. It was felt that this provided a level playing field understood by both regulators and potential developers.

On the basis of the Dutch example, it was felt that Member States should be encouraged to develop greater integration between national and regional plans, in particular to explore where efforts could be maximised to benefit biodiversity outcomes.

- b. *Does your country have regional or local plans to control nitrogen emissions and, if so, what consideration is given to ecosystem protection?*

All Member States have regional planning strategies, but the extent to which biodiversity benefits are considered is highly variable in different countries: this ranges from full consideration to practically no consideration at all. In the Netherlands, the protection of ecosystems is an important part of the plans, whilst Belgium and Germany are actively considering similar approaches. The Netherlands also directly links local planning decisions to the national plan.

- c. *In terms of practical measures, are there provisions to assess new nitrogen impacts on sites in a structured manner, e.g. limit on amounts of new development/growth in transport in an area?*

With the exception of the Netherlands, most Member States rely solely on Article 6.3 assessments to address potential consequences of new plans and projects which are sources of air pollution, i.e. there is no integrated approach to assessing and controlling new sources of nitrogen pollution from a Natura 2000 perspective.

In the Netherlands, there is a detailed and structured approach to link local decisions with the national plan. The concept is to divide the 'nitrogen operating space' among a number of sources, including from both existing and new permissions. Belgium is seeking to adopt such an approach when looking at motorway expansion or major new roads.

- d. Is control of industrial emissions simply based on established Best Available Techniques (BAT) or are provisions made to go beyond BAT to protect Natura 2000 habitats, for example, new biomass developments close to protected sites?*

Permit conditions going beyond BAT are applied in some countries with regard to new intensive livestock units to control ammonia emissions. They are also used to control emissions to protect human health. However, there are no examples with regard to biodiversity outcomes. In the Netherlands, ammonia emissions from intensive livestock units may have to go beyond BAT, but for other sectors, BAT is the standard. However, developers may be required to go beyond BAT to protect health in certain circumstances.

- e. Are there examples of joined-up approaches between various permitting and planning bodies to consider air pollution impacts on Natura 2000 sites from a range of pollution sources?*

From the countries represented in this working group, the Netherlands is the only country where an integrated approach is practised via a collaborative approach between permitting bodies. This collaborative approach is supported by agreeing a standard modelling tool, and sharing accurate, robust and up-to-date air pollution data via the AERIUS tool (see Annex A5.1). The AERIUS tool supports consideration in areas such as Rotterdam to assess where there is 'space' for new development, and has saved individual developers significant costs in commissioning air pollution assessments.

- f. Although our focus is on approaches to tackle air pollution impacts, are there parallel examples of such measures that you are aware of that have been applied to emissions of, say, phosphates and nitrates into the aquatic environment? For example, under consideration of implementing the Water Framework Directive. Such examples could give an insight into similar approaches/ measures that could be adopted for the control of atmospheric nitrogen releases.*

In the Netherlands, the Programmatic Approach to Nitrogen (PAN) takes full account of all environmental media and outcomes. This means that pollution is not simply swapped from one environmental medium to another, so it links very closely to the aims of the Water Framework Directive.

This approach is also being adopted in Belgium with the development of a manure action plan.

A5.4 Conclusions

Working Group 5 concluded that although nitrogen deposition across Europe is dominated by agricultural ammonia emissions, other emissions of oxides of nitrogen remain a concern at both a national and local level.

The countries that have made most progress with tackling nitrogen deposition have both national strategies and local plans which are integrated. Whilst there was some concern that within Member States the devolved autonomy of regional administrations could present barriers to developing a fully integrated nitrogen emission approach.

The control of water pollution across the EU is delivered under the auspices of an overarching Water Framework Directive. There are many separate directives and drivers to tackle air pollution but there is no analogous overarching Air Framework Directive to govern air pollution reductions.

A5.5 Recommendations

Greater integration and linkage between international, European, national and local plans will help deliver greater protection for Natura 2000 sites.

Benefits to human health and biodiversity can be optimised in national plans by spatially targeting measures to gain the greatest protection. For example, development of measures to reach National Emission Ceilings could also be applied at locations where they deliver most benefit to Natura 2000 sites.

There is a need to raise awareness among decision-makers to include consideration of nitrogen pollution impacts in their planning frameworks.

An integrated approach (similar to that in the Netherlands) is encouraged in all Member States to address the impacts of planning and permitting on Natura 2000 sites, including the impacts of both new and existing sources. Detailed models such as the Dutch AERIUS tool ensure that a transparent and consistent approach is adopted. This can help developers assess opportunities for sustainable growth.

Nitrogen pollution affects multiple receptors, including human health, semi-natural habitats and water quality. There is potential for better integration of policies and plans to optimise benefits to these receptors and prevent the swapping of impacts from one environmental medium to another.

Nitrogen action plans could be developed for Natura 2000 sites where nitrogen deposition is a concern. These plans could evaluate the long-range and local nitrogen sources, together with habitat measures in an integrated manner. These should then be linked back to regional and national planning processes.

A5.6 List of participating countries

Belgium
Germany
The Netherlands
United Kingdom

A5.7 A short introduction to the AERIUS tool

For the Netherlands, high nitrogen deposition levels form one of the main barriers to achieving European nature conservation targets. To solve the issues around nitrogen and nature, the Netherlands is developing new policy. The Programmatic Approach to Nitrogen (PAN) will help to achieve the Natura 2000 objectives, while kickstarting the deadlocked permits issuing process for new economic activities using an inter-governance approach, across all sectors and areas. The PAN will be implemented in 2014.

AERIUS is the online calculation tool of the PAN. It calculates both emissions and deposition levels for nature areas, caused by new or expanding economic activity. Once the PAN has been implemented, project initiators will be legally obligated to use AERIUS to calculate the nitrogen impact of their projects. The calculation results then serve as the foundation for permit applications. This applies to all nitrogen-emitting sectors, such as agriculture, industry, and traffic and transport.

There are important preconditions attached to AERIUS. The tool not only has to represent the scientific 'state-of-the-art' modelling, but it should also be user-friendly.

One of the products is the AERIUS Calculator. Users may start a calculation by entering one or more sources onto a map, or uploading a file containing the sources of ammonia (NH_3) and nitrogen oxide (NO_x) emissions. AERIUS then uses the Operational Priority Substances model (Van Jaarsveld 2012) to calculate the spatial dispersion of the emissions and the deposition locations. Dispersion and deposition largely depend on meteorological factors and land use in the dispersion area. For its calculations on nitrogen dispersion from road traffic, AERIUS is implementing the Standard calculation method 2 (SRM2) of the Dutch air quality assessment regulation. This means that AERIUS calculations for roads will be in line with the national air quality plan.

To become a user of AERIUS Calculator beta, register at <http://www.AERIUS.nl/en>

APPENDIX 6

Theme 2 – Knowledge sharing of practical solutions to reduce nitrogen impacts

Working Group 6 – Approaches to assessing the impacts of air pollution emissions from plans/projects for Article 6.3 assessments

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Summary

Article 6.3 of the Habitats Directive provides a mechanism by which plans and projects can only be permitted if they are shown to have no adverse effects on the integrity of a Natura 2000 site (subject to certain provisions).

The main focus of this working group was to understand how each Member State represented makes a decision on what level of additional nitrogen deposition, as a consequence of a plan or project, can be considered as having no adverse effect on integrity, as required under Article 6.3.

Also discussed, was the 'test of likely significant effect' and how a plan or project is assessed in combination with other plans or projects.

With the exception of the Republic of Ireland, each of the Member States use nutrient nitrogen critical loads (and sometimes critical levels) as a benchmark against which to assess the potential impacts of additional contributions of nitrogen deposition from new plans and projects. In such cases, the countries represented at this workshop have set an amount of nitrogen deposition to a Natura 2000 site, arising from the plan or project, above which it would be considered to have a likely significant effect. The application of the concept of 'in combination' varies between the countries, making direct comparison of screening thresholds problematic. Despite this, approaches to assessing the overall impact are broadly comparable in that they require an assessment of current nitrogen inputs and the consequence of the additional nitrogen contribution from the plan or project. There was uncertainty in how to incorporate activities that are not regulated and outside of Article 6.3 assessments.

In most cases, Member States represented in the group have established thresholds below which 'no adverse effect on integrity' can be concluded. These are based on either an absolute amount of nitrogen (e.g. 1 kg N/ha/yr) or a value relative to the critical load (e.g. 3% of the critical load for the site/interest feature). There is considerable variation in the thresholds established by Member States.

The approach in the Netherlands has been to move away from establishing a single threshold for 'no adverse effect on integrity'. The ability to permit any additional amount of nitrogen, where critical load was already exceeded, had been challenged in the courts. The Programmatic Approach to Nitrogen (PAN) supported by AERIUS, aims to achieve a continued reduction in nitrogen deposition. Part of the deposition reduction is used to create

'headroom' for the development of new or expanding economic activities for which permits are required. A similar approach is being developed in Flanders.

It was concluded that such integrated approaches provide greater certainty for industry, in terms of providing some security in proposed investment and from the variability on what constitutes no adverse effect. A level of security for the authorities is also provided in that the risk of adverse effects is greatly lessened.

A6.1 Introduction

Nitrogen impacts are considered a serious threat to biodiversity. The eutrophying and acidifying effects of nitrogen compounds have been subject to international air pollution policy for more than three decades. With the establishment of the Habitats Directive, which assigns legal obligations to all EU Member States, more-localized site-based approaches to reducing nitrogen have come into focus as well. Increasing links between air pollution abatement actions, combined with nature protection measures, are seen to be increasingly required in order to establish and meet targets aiming at achieving favourable conservation status (FCS) for nitrogen sensitive habitats.

Article 6.3 of the Habitats Directive requires strict site safeguard measures for Natura 2000 sites. It requires that plans and projects are only permitted if they are shown to have no adverse effect on the integrity of a Natura 2000 site (subject to certain provisions). Specifically Article 6.3 states that: *"Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public."*

Critical loads⁵² (or, in a similar way, critical levels⁵³) have become increasingly common as measures of sensitivity, not only on a wider national scale, but also for sensitive habitats within Natura 2000 sites (Hicks *et al* 2011). Currently, background⁵⁴ deposition in many areas is relatively high compared with the critical loads for sensitive habitats. Robust evaluation methods are required to enable plans or projects to proceed, whilst meeting the obligations of Article 6.3, for nearby Natura 2000 sites, and provide legal certainty for project developers.

Legal judgements of the European Court (e.g. C 127/02 – Cackle fishing in the Waddenzee⁵⁵) have made it clear that, if a plan or project can be proven to exert no or only negligible effects, only then may it be permitted under Article 6.3 of the Habitats Directive. Courts in the Netherlands and Germany have adopted these decisions and made it necessary to establish sophisticated evaluation procedures to fulfil the requirements of Article 6.3. Similar approaches have been applied in Denmark, where National Green Growth plans have been established. In the UK, various bodies (conservation and

⁵² Defined as: "a quantitative estimate of 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". Nilsson and Grennfelt (1988). Source: <http://www.unece.org/env/lrtap/WorkingGroups/wge/definitions.htm>

⁵³ Defined as "concentrations of pollutants in the atmosphere above which direct adverse effects on receptors, such as human beings, plants, ecosystems or materials, may occur according to present knowledge". Source: <http://www.unece.org/env/lrtap/WorkingGroups/wge/definitions.htm>

⁵⁴ Meaning the total or ambient amount of the pollutant of concern.

⁵⁵ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:62002CJ0127:EN:PDF> (in English)

regulatory) are working together in order to maintain or make possible favourable conservation status of Natura 2000 habitats.

At the Nitrogen Deposition and Natura 2000 workshop in 2009 (Hicks *et al* 2011), delegates presented and discussed the approaches to appropriate assessments to evaluate impacts of nitrogen deposition undertaken in their country. Although each participating country presented a different evaluation concept, a number of recommendations were made and conclusions drawn – for example, that critical loads can be used as a measure of sensitivity within appropriate assessments, or that use of a staged assessment approach is advocated (Le Gall *et al* 2011). Since preconditions varied greatly between countries, a uniform best-practice approach would not have been a realistic target at that time. However, by understanding each approach taken and their contexts, and by discussing issues that many countries have in common, further steps towards best practice may be expected in time.

Since the 2009 workshop (Hicks *et al* 2011), new developments in understanding have occurred – for instance, new research has provided further evidence, new aspects have emerged within expert discussions, and new court decisions require to be accounted for in assessing plans and projects.

A6.2 Objectives of the working group

The main objective of this working group was to understand how each country makes the decision on what is considered an adverse effect (in the context of Article 6.3 assessments). The following objectives were considered:

- **Objective 1:** To understand the types of plans and projects assessed under the Habitats Directive in each country and the reasons why;
- **Objective 2:** To understand the methods used to assess 'likely significant effect'
- **Objective 3:** To discuss how 'in-combination' effects are considered in each country;
- **Objective 4:** To discuss what criteria are applied to decide about no adverse effect (for example, a threshold (maximum deposition input) under which plans or projects do not have an adverse effect on site integrity).

Using the delegates' contributions, the aim was to update progress since the COST 2009 workshop (Hicks *et al* 2011).

A6.3 Report on the working group discussions

Table A6.1, summarises the approaches used by Member States represented in the working group, in relation to each of the objectives.

The Republic of Ireland is excluded from the Table A6.1. In Ireland, at the time of this workshop, nitrogen critical loads were not applied when assessing plans or projects under Article 6.3. From January 2014, Ireland's Environmental Protection Agency is funding a three year project 'AmmoniaN2K'⁵⁶ investigating ammonia impacts from the intensive livestock (IED) installations on Natura 2000 sites.

⁵⁶ University College Dublin, Smart Systems Unit (<http://ssu.ie/research/ammonian2k/>)

Table A6.1. Summary of national approaches to the nitrogen impact assessments for Article 6.3 assessments.

Objectives Discussed	Belgium	Denmark	Germany	Netherlands	UK
1. What plans and projects are assessed under the Habitats Directive in each country and why	Any plan or project that has a likely significant effect on a Natura 2000 site has to be considered in assessments under Article 6.3 of the Habitats Directive. Regardless of which European or national legislation applies the plan or project is additionally subject to the requirements of the Habitats Directive. For example new roads, extensions to existing roads, housing and industrial developments governed by national planning legislation, permits under Industrial Emissions Directive (IED) (2010/75/EU) for industrial installations, plans or projects under the Environmental Impact Assessment Directive (EIA) (85/337/EEC).				
2. To understand methods used to assess likely significant effects	A cut-off criterion of 0.174kgN/ha/yr is applied to <i>all</i> plans and projects alone or in combination. Contributions of up to this value from a plan or project are regarded as not significant and will not require further assessment. Contributions above this value are considered significant and require an appropriate assessment.	For the agricultural sector only a maximum permissible nitrogen deposition ranging from 0.2 to 0.7 kgN/ ha/yr determined through a combination of distance from Natura 2000 site, the number of livestock holdings and their size. By setting the deposition limits this low it is considered that likely significant effects will be avoided.	<p>A cut-off criterion of 0.3kgN/ ha/ yr is applied to <i>all</i> plans and projects alone or in combination across Germany with one exception (see below). Contributions of up to this value from a plan or project are regarded as not significant and will not require further assessment. Contributions above this value are considered significant and require an appropriate assessment.</p> <p>The Bundesland of Northrhine-Wesphalia applies a cut-off criteria of 0.1kgN/ha/yr. Contributions of up to this value from a plan or project are regarded as not significant and will not require further assessment. Contributions above this value are considered significant.</p>	<p>A cut-off criterion of 1mol N/ ha/ yr (0.014kgN/ ha/ yr) is applied to <i>all</i> plans and projects alone or in combination. Contributions of up to this value from a plan or project are regarded as not significant and will not require further assessment. Contributions above this value are considered significant and are assessed through the Programmatic Approach to Nitrogen (PAN) which incorporates in combination assessments. However, when contributions from plans or projects are below this value they are not totally excluded from any future assessments, since they contribute to background deposition.</p> <p>An initial distance screen is used for highways 3km which must also include any roads that have 500 vehicle movements per day that link into the highway being assessed.</p> <p>Inland shipping has an initial distance screen of 5km.</p>	<p>An initial distance screen (based on type and size of plan or project) is used to determine whether a test of likely significant effect is required. After this step a slightly different approach is taken in Scotland than the rest of the UK.</p> <p>Scotland: This approach is applied for <i>all</i> plans and projects. If it is within this distance and if the process contribution (PC) is equal to or below 1% of the relevant minimum nitrogen critical load/level, it is regarded as not significant and no further assessment is required. If the PC is above 1% of the minimum nitrogen critical load/level, then an additional step is taken by examining the Predicted Environmental Concentration or Deposition (PEC) which takes into account the background added to the PC. So, if the PC is above 1% and the PEC is also above 100% of the minimum nitrogen critical load/level the plan or project is considered significant.</p> <p>England, Northern Ireland & Wales: For all plans and projects other than intensive livestock under IED, if the process contribution (PC) is equal to or below 1% of the relevant minimum nitrogen critical load/level, it is regarded as not significant and no further assessment is required. If the PC is >1% of the critical load/level and Predicted Environmental Concentration or Deposition (PEC which = background + PC) is <i>also</i> above 70% of the critical load/level the plan or project is considered significant.</p>

Objectives Discussed	Belgium	Denmark	Germany	Netherlands	UK
					For intensive livestock under IED a higher PC of 4% is accepted when it is based on a particular, very conservative, screening tool developed specifically by the regulator to assess ammonia concentrations and nitrogen deposition from this sector. If the PC is above 4% and the PEC is also above 70% of the ammonia critical level or nitrogen critical load the intensive livestock unit is considered likely to have a significant effect.
3. To discuss how in-combination effects are considered in each country	The in-combination assessment must consider any plan or project that could impact on the Natura 2000 site.				
	It is assumed that all permitted plans and projects are incorporated into the (VL)OPS model and their contributions are added to the PC of the plan or project under evaluation.	The Danish process automatically considers other intensive livestock units in combination; other sources are considered diffuse sources. The maximum allowable nitrogen deposition from any one farm will depend on the number of neighbouring livestock units and their size within certain distances of the Natura 2000 site. The fixed ceilings are 0.2kgN/ha/yr if there is more than one other livestock holding, 0.4kgN/ha/yr if there is only one other holding, or 0.7kgN/ha/yr if there are no other holdings. . In addition to these fixed ceilings all livestock units that produce in excess of 7500kgN/ha/yr require an environmental approval before they can operate. All new buildings must meet a maximum ammonia emission of 30% <i>below</i> the 2005/2006 limits which will result in time in a reduction of overall ammonia. Furthermore, through Danish land use regulation where there is an overall aim to limit total nitrogen deposition at all Natura 2000 sites to 1kgN/ha/yr in <i>total</i> from all sources the in-combination effect from industrial and agricultural sources are effectively	The Umweltbundesamt (UBA) provides background data in Germany. The UBA data include all known contributors as background ⁵⁷ . It is a matter of on-going debate in Germany which projects have to be considered in combination. Most experts adopt the court decision (of the OVG Münster, 1 December 2012), which stated that all projects that were planned or completed after designation of Natura 2000 sites have to be considered relevant for inclusion of in-combination impacts. Some experts prefer only projects that have not been included in the latest UBA dataset of background deposition to be subject to in-combination assessment.	All plans and projects already approved by the authorities that can have effects on the same habitats and / or species are to be taken into account. In the Netherlands, the National Institute for Public Health and the Environment (RIVM) produces background data annually and there is confidence that the in-combination assessment includes all relevant emissions. Emissions that have been granted since the background dataset became available are also factored into the assessment. Once the emission from a plan or project is over the 1 molN/ha/yr contribution the PAS proceeds systematically; being an integrated system, other developments are routinely incorporated.	All plans/projects that have already been permitted are considered to be in the background. Those that are still not permitted are added to the PC of the application in question. England, Northern Ireland & Wales: For all plans and projects that are not intensive livestock if the combined PCs are above 1% and the PEC is also above 70% of the minimum critical load then the in-combination effect is considered significant. For the livestock sector, the principle is the same except that if the combined PC is above 20% and if the PEC is also above 70% of the ammonia critical level or nitrogen critical load then the in combination effect is considered significant. Scotland: This approach is applied for all plans and projects. When the PC is above 1% and the PEC is also above 100% of the minimum critical load then other plans and projects are considered in the appropriate assessment.

⁵⁷ Since spatial resolution is limited, background values may need to be corrected for contributions of strong emitters (new or old) if those are located very close to the habitat. Smaller contributions of new projects not yet included in the background data set do not have to be added, because nitrogen deposition is overall expected to decrease rather than increase in Germany.

Objectives Discussed	Belgium	Denmark	Germany	Netherlands	UK
		avoided.			
4. To discuss what criteria are applied to decide about adverse effects(e.g. threshold)	<p>A contribution from a plan or project of above 3% of the relevant nitrogen critical load is considered an adverse effect either alone or in combination.</p> <p>The view from Belgium is that a contribution from plan or project alone or in combination of more than 3% of the critical load is considered an adverse effect. Although in practice some projects have commenced where the contributions have been between 3 and 10% as a means of controlling the total nitrogen deposition across the Natura 2000 network within the country.</p>	<p>The integrated approach is based on the total nitrogen deposition of 1kgN/ha/yr from all sources on the Natura 2000 site. Total deposition of below this value at the Natura 2000 site are regarded as having no adverse effect (Bjerregaard 2011).</p>	<p>A contribution from a plan or project of above 3% of the relevant nitrogen critical load is considered an adverse effect either alone or in combination.</p> <p>Germany uses a contribution alone or in combination of 3% or less of the critical load to determine no adverse effect on site integrity. If the contribution is over 3% of the critical load further investigation is prompted before determining adverse effects. This further investigation considers 'permissible small area loss' and 'gradual function loss' and is described in greater detail by Lambrecht & Trautner (2007). If after this further investigation that adverse effects are not avoided then the plan or project being evaluated is refused.</p>	<p>Under the PAN a specific threshold is not necessary because the holistic approach to reducing nitrogen on <i>all</i> Natura 2000 sites rather than applying thresholds for plans or projects.</p>	<p>In all cases if the PEC is equal to or below 100% of the relevant nitrogen critical load then a conclusion of no adverse effect is concluded. If PEC is above the critical load and the new process contribution causes an additional small increase a decision will have to be made based on the individual circumstances, taking account of the information outlined above. If the PC is large then it is not possible to conclude 'no adverse effect'.</p> <p>Specific thresholds have only been set for the intensive livestock sector. Where background/PEC is greater than the critical level or load, currently thresholds of between 10 and 20% (for PC alone and in combination) are used (depending on the circumstance). This is currently under review.</p>

Objective 1: To understand the types of plans and projects assessed under the Habitats Directive in each country and the reasons why.

Any plan or project that has a likely significant effect on a Natura 2000 site has to be considered in assessments under Article 6.3. This includes applications for permits under the Industrial Emissions Directive (IED) (2010/75/EU) for industrial installations, plans or projects requiring consideration under the EIA Directive (85/337/EEC), or those covered by national planning legislation. This list is not exhaustive but illustrates that, regardless of which European or national legislation applies, the plan or project is additionally subject to the legislative requirements of the Habitats Directive.

To date, fewer plans have been subject to assessments under Article 6.3. The reasons for this may be that fewer plans have come forward or that by their very nature they tend to be less explicit than projects, thereby making assessments more difficult. Regardless, it is clear from the Member States represented that assessments are a legal requirement. In some cases, when the plan has firm details, it has been sufficient for the plan to state that specific projects will undergo the relevant assessments.

An issue raised by each Member State is the problems that arise from activities that are outside of Article 6.3 assessments, or are not otherwise regulated. For instance, spreading of manure on land adjacent to a sensitive Natura 2000 site can occur with little or no consideration of the impacts. Other examples could be small industrial combustion plants, or animal rearing units that are currently considered too small for consideration, but if examined more closely, their emissions may exceed criteria for likely significant effect. In Germany, animal rearing units with fewer than 15,000 hens are not considered a project in the sense of Environmental Impact Assessment or air pollution control, but could contribute high amounts of ammonia if located close to a Special Area of Conservation.

Objective 2: To understand the methods used to assess 'likely significant effect'

Each Member State, with the exception of the Republic of Ireland, uses the nutrient nitrogen critical loads, or critical levels, as a benchmark to assess the potential impacts of additional contributions from new plans and projects.

Some Member States apply an initial distance screen as part of the test of likely significant effect. Any plans or projects beyond this distance are not considered further, only those that are within that distance. Most of the Member States represented then apply criteria for an amount of nitrogen (a 'cut-off value') to determine whether a plan or project is likely to have a significant effect on a Natura 2000 site. Providing the contribution is below this 'cut-off value' the plan or project can be considered to be not having a likely significant effect and can be completed.

The Supreme Court in the Netherlands had ruled that *any* exceedance of the critical load should be considered as a significant effect and, as such, the development should not be allowed. This resulted in the need for appropriate assessments in each situation, and often a deadlock situation. Consequently, the Programmatic Approach to Nitrogen (PAN) has been developed. In the process of developing the PAN, 1 mol N/ha/yr⁵⁸ (equivalent to 0.014 kg N/ha/yr) was agreed as a generic threshold (for agriculture, roads and industry) below which *specific* judicial permission is not needed.

⁵⁸ Some provinces apply a threshold of 0.05mol N/ha/yr and contributions above this enter the PAN.

Objective 3: To discuss how ‘in-combination’ effects are considered in each country

There was consensus that an in-combination assessment is required and must consider *any* plan or project that could impact on the Natura 2000 site, not just an assessment with those plans or projects that are from the same sector. For example, an application for a permit under IED for a livestock installation must be considered in combination with an anaerobic digester, a nearby combustion plant or a chemicals factory, not just with other proposed livestock installations.

To undertake an air pollution impact assessment, consideration must be given to the new process contribution and existing environmental conditions (e.g. current pollution inputs to a site). Background nitrogen deposition or concentrations are generally estimated from national datasets that are based on either, or a combination of, modelled and monitored data. These data theoretically incorporate all contributions from plans and projects already ‘operational’. In practice, depending on the modelling method and frequency of updates, very recent new sources may not be included. In these cases, they must be added to the background to provide a true reflection of background deposition.

Member State approaches for the ‘in combination’ assessment are documented in Table A6.1. The approach varies. For example, in some cases, contributions from other sources are considered by taking into account background deposition (which includes contributions from permitted plans and projects as well as other sources). In other cases, ‘in combination’ specifically refers only to those plans and projects that are at the application stage, and not operational. In these cases, those plans or projects that are already permitted are accounted national background data (providing it is updated regularly) and assessment against background is considered a cumulative impact.

These apparent differences in what specifically is defined as ‘in combination’, and of the terminology used, makes direct comparison of thresholds for significant effect (and no adverse effects) difficult. However, despite this the assessment approach is broadly consistent, whereby Process Contribution (PC) are added to the background to derive the Predicted Environmental Concentration/Deposition (PEC). This provides a wider picture of potential impact on the Natura 2000 site. In practice, it seems that in-combination effects and consideration of background inputs may be conducted in parallel, rather than sequentially.

There was some concern that not all plans and projects are being assessed in combination due to incompleteness of national lists of all plans and projects that are operational or otherwise. There is growing awareness that some kind of national inventory is required listing plans and projects within each Member State to assess the contributions of those defined as ‘in-combination’ as well as measures that can be taken into account as mitigating the pressure on the SAC.

Objective 4: To discuss what criteria (threshold) are applied to decide about no adverse effect

In many cases, background deposition exceeds critical loads for a site and a new plan or project will provide a further increment of nitrogen deposition. In these cases, establishing a threshold for when this additional contribution can be deemed to have ‘no adverse effect’ has proved extremely challenging for all Member States represented. Their approaches are documented in Table A6.1.

Approaches vary between countries. Established thresholds range from 3% of the critical load up to 20%. However, in the Netherlands there is no specific threshold value, because this is not necessary in the PAN. This approach considers wide-ranging proposals, not just from new developments but also from existing ones, to reduce nitrogen deposition. Thus, it aims to create headroom for economically and nationally important new developments to proceed whilst achieving an overall reduction in nitrogen deposition over the Natura 2000 site.

A6.4 Conclusions

At the Nitrogen Deposition and Natura 2000 workshop in 2009, one of the main recommendations from Theme 1 was a staged approach to air pollution impacts assessments of plans and projects under Article 6.3 (Le Gall *et al* 2011). It is apparent that such an approach has been adopted by Member States represented in the working group, but that there are differences in the technical application.

Critical loads, and sometimes critical levels, are used as a basis for assessments of nitrogen impacts across the Member States present in the working group, with the exception of the Republic of Ireland, even though these are not statutory standards.

There are some specific cases where the use of critical loads in assessments have been challenged. For example in Belgium, their use is fully accepted for the agricultural sector but less so for industrial sites that are under planning legislation. Also, Frankfurt Airport (Germany), although deposition above the critical loads had been occurring for many years, there had been no visible damage at a nearby Natura 2000 site. Low-nitrogen indicator plants were still present and excess nitrogen input could be shown to be leached without harm to the SAC; the critical loads were discounted for use in the assessment of the Airport.

There was a wide range of views on what constituted a 'no adverse effect' and how this is determined in practice. The conservation objectives are important in determining what can be regarded as an adverse effect: this point is clearly stipulated in Article 6.3. It is clear that there is no single 'threshold' that can be prescribed for appropriate assessments across all European Member States. This reflects the need to take into account the specific sensitivities of individual Natura 2000 sites in each Member State. For Member States which have set or used 'thresholds', there was some consistency in that a relatively low total contribution was required to avoid adverse effects. The thresholds range from 3% to 20% of the relevant critical load.

Given the difficulty with establishing a 'threshold' which is compatible with the test of Article 6.3 and yet allows some development, the Netherlands has developed its PAN. Belgium is developing its own integrated system along similar lines as the Dutch example. Denmark also considers total deposition at Natura 2000 site level. These integrated approaches provide greater certainty for industry, in terms of providing some security in proposed investment and from variability on what constitutes an adverse effect. A level of security for the authorities is also provided in that the risk of adverse effects is greatly lessened.

A6.5 Recommendations

- The application of an integrated approach to Article 6.3 assessments, such as the PAN, avoids the requirements to set generic thresholds for adverse effects. Such approaches provide greater certainty for industry, and for the authorities. It also provides a mechanism for addressing sources that are not 'plans and projects' and hence not covered the provisions of Article 6.3.
- The group agreed there should be further clarification about, or guidance on:

- which plans and projects are required to be considered in combination;
- assessing plans, as opposed to projects;
- how to take into account non-regulated activities; and
- the application of measures on sites to mitigate impacts.

Since the workshop, the Commission has published a report on Article 6.3 operates in different parts of the EU. It also offers a wide range of good practice techniques and examples that have been used up to now to improve the efficiency of the procedure http://ec.europa.eu/environment/nature/natura2000/management/docs/AA_final_analysis.pdf). The recommendation from Working Group 6 is to ensure in future when such projects are commissioned, that the permitting of installations under IED are considered within the scope of the project.

- It is helpful to have accessible national inventory of all plans and projects, updated regularly, to enable more accurate and thorough Article 6.3 assessments. Similarly, assessment are more accurate if national deposition data is available at a high resolution, based on high quality emissions data and is regularly updated.
- Greater clarity between the link between conservation objectives and critical load would be beneficial (see Appendix 2).
- The working group participants recommended that there would be benefits from further exchange on best practice for appropriate assessments (including thresholds for adverse effects) and integrated approaches.

A6.6 List of participating countries

Belgium
Germany
Ireland
The Netherlands
United Kingdom

APPENDIX 7

Theme 2 – Knowledge sharing of practical solutions to reduce nitrogen impacts

Working Group 7 – The effectiveness of on-site (intensified) habitat management measures and restoration measures to mitigate nitrogen deposition impacts and to promote recovery

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Summary

In cases where critical loads remain exceeded, (intensified) on-site habitat management measures may offer a means to reduce the impacts of nitrogen deposition either through removal of nitrogen from the system or through maintaining habitat structure. However, this is only the case if these measures were not (fully) performed in the past, because regular maintenance like mowing or grazing is already taken into account for setting the critical load.

Even if the most stringent air pollution control policies were to be applied, some ecosystems would not fully recover within a reasonable time period. In these cases, active restoration has to be considered as a necessary management tool to preserve habitats.

This working group aimed to share knowledge and experience of using intensified habitat management to reduce nitrogen impacts and in cases of 'damaged' habitats then use restoration measures.

It was concluded that each Natura 2000 site is unique in terms of its habitats, species, geographical location, the mix of stakeholders and the dynamics of the natural and human interactions that take place in or around that site. Therefore, effective site management requires management of the science, the practical techniques to be deployed, well-thought through nature conservation objectives and appropriate measures, engagement of stakeholders and monitoring to ensure effectiveness.

In the UK, there has been a recent review of the effectiveness of on-site habitat management to reduce atmospheric nitrogen deposition. In the Netherlands, a handbook of management and restoration measures for nitrogen effects has been produced.

These studies show that the potential for reducing the impacts of nitrogen deposition varies greatly between habitats and also management practices. Intensifying habitat management may result in further associated problems. Therefore, managing for any single issue in isolation may result in unintended and undesirable outcomes and there is a need to consider the conservation objectives of the site and the possible outcomes of a change in management practices.

The working group concluded that there is no substitute for reducing the amount of nitrogen deposited onto a site which can only be achieved through emission controls.

The value of sharing experience and methods was agreed and recommendations were made for how to enhance this in future.

A7.1 Background

The adverse impacts of elevated inputs of reactive nitrogen on terrestrial ecosystems include decreased species diversity, changes to plant communities and habitat structure, the homogenisation of vegetation types, changes in soil chemistry, and an increased sensitivity to biotic and abiotic stresses. The most notable findings related to the threat to European terrestrial biodiversity have been identified in the European Nitrogen Assessment (Dise *et al* 2011).

Even if the most stringent air-pollution control policies are enacted some ecosystems may have been so damaged by chronic nitrogen loading that pollution reduction by itself would not lead to full recovery within a reasonable time frame. In these cases, active management could be considered as a restoration tool to accelerate the natural processes of nitrogen removal. In addition, on-site management options may also provide a valuable tool to offset or reduce the impacts of nitrogen deposition. This could include mitigation of background nitrogen inputs, or specifically from politically or economically important projects that would otherwise have detrimental impacts on biodiversity. Current management for nature conservation on sites may be partially off-setting nitrogen deposition impacts (Stevens *et al* 2013). Note, however, that critical loads implicitly take the (positive) effects of habitat measurements into account for those habitats that can only exist as a consequence of management, such as grazing in case of grassland and heathlands. In concluding that many existing management practices will reduce the impacts of nitrogen Stevens *et al* (2013) recommended that it was important to ensure that practices these were at least continued.

As the impacts of climate change take effect, habitat sensitivity to nitrogen deposition will also alter. It is therefore essential to understand how habitat management measures can be used to mitigate the impacts of nitrogen deposition and which management options are likely to be most effective.

A diagram showing the effects of nitrogen deposition and the possible recovery measures on a landscape and local (habitat/site) scale is shown in Figure A7.1. Nitrogen deposition impacts on two main processes, namely acidification and eutrophication, both on the local scale and the landscape scale. Eutrophication and acidification are directly influenced by factors such as drought, rigidity (loss of dynamics) and ageing (succession). It is possible to compensate for the effects of nitrogen deposition, whereby different measures can be taken at a landscape and local scale. In the diagram this is indicated by arrows, decreasing and increasing in size (restoring dynamics for example is a measure on the landscape scale and removing nutrients a measure on the local scale).

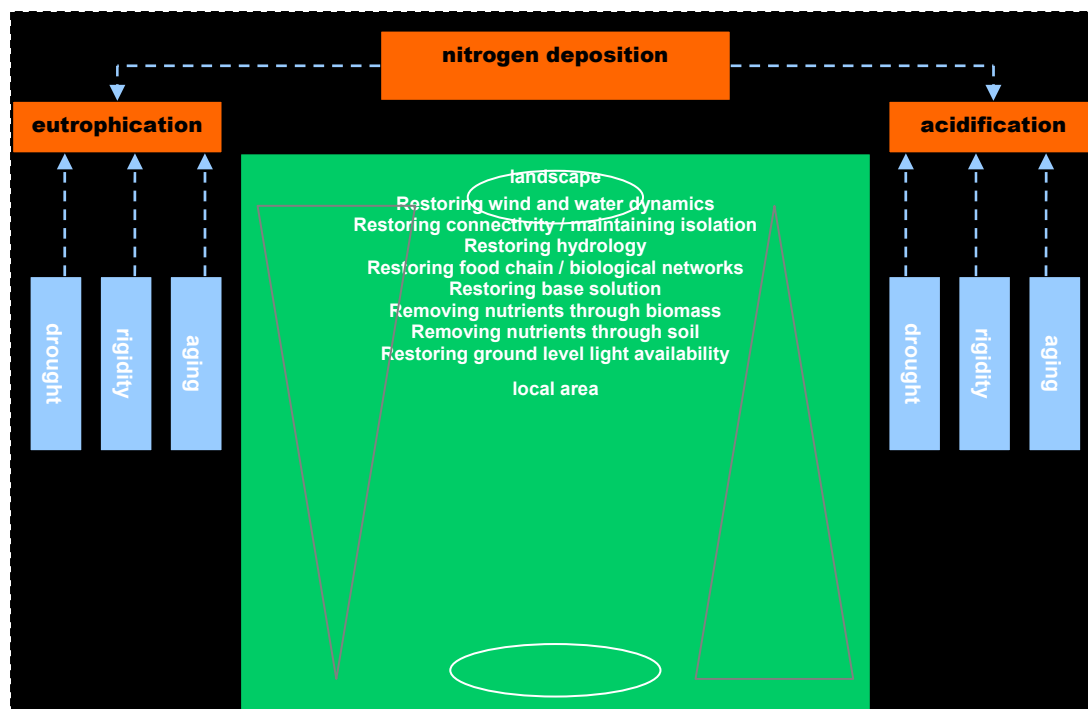


Figure A7.1. Diagram showing the effects of nitrogen deposition and the possible recovery measures at a landscape and local scale.

A7.2 Objectives of the working group

The aim of this working group was:

- **Objective 1:** To share knowledge and experience of (intensified) habitat management measures to reduce the impacts of nitrogen deposition.
- **Objective 2:** To share knowledge and experience of restoring nitrogen-sensitive habitats using restoration measures.
- **Objective 3:** To identify successful habitat management restoration measures, both at the local and landscape scale and, where possible, pull together some case studies in evidence.
- **Objective 4:** To discuss challenges and barriers to implementation and share solutions.

A7.3 Results and discussion

Objective 1: To share knowledge and experience of (intensified) habitat management measures to reduce the impacts of nitrogen deposition.

In the UK, a project from the statutory nature conservation bodies has reviewed the effectiveness of on-site habitat management to reduce atmospheric nitrogen deposition impacts on terrestrial habitats. Six broad habitats were covered in detail (woodland, calcareous grassland, dwarf shrub heath, bog, coastal dunes, acid grassland) and nine management techniques reviewed (grazing, cutting, burning, fertilization, liming, hydrological management, scrub removal, tree removal, disturbance) (Stevens *et al* 2013).

In terms of woodland, well-managed sites in favourable condition will be more resilient to the negative impacts of nitrogen deposition. Recommended (intensified) management options include leaf litter removal, which is a traditional practice in some woodlands. However, this may be unsuitable in upland woodland sites where the litter layer is essential for soil

formation and conservation. Further investigation is needed into the impacts of nitrogen cycling and unintended consequences on ground flora, litter and soil fauna.

In acid and calcareous grasslands, grazing is currently the main technique used. Cutting (with removal of clippings) removes nitrogen from the sites, but it is not practical in larger sites and in some terrain. Recommended (intensified) management options include changes in stock management, for example moving stock off land at night and greater use of mixed stock grazing. For acid grasslands liming at low levels could reduce impacts of acidification in areas damaged by acid deposition. However, this alters many aspects of soil nitrogen cycling, causes changes in species composition, can increase leaching of dissolved organic carbon, which impacts water quality and may increase eutrophication effects.

Dwarf shrub heath is commonly managed with grazing and burning in uplands and lowlands. Recommended (intensified) management options are cutting, which provides an alternative method for reducing impacts of nitrogen deposition (all clippings must be removed) and turf stripping, which may provide a method to reduce nitrogen deposition impacts, especially in areas of extreme damage. However, turf stripping is a very expensive solution and it may have a number of unintended consequences unless carefully managed. In all cases the management should be considered on a site-by-site basis.

In coastal dunes and slacks, shrub control is important. Shrubs increase the organic matter content of the soil and a number of the dominant shrub species are nitrogen fixing. Some species are particularly invasive and may spread faster in nitrogen impacted sites. Recommended (intensified) management options are that all cuttings should be collected and removed, the use of grazing should be increased because the disturbance is beneficial and the re-mobilisation of dunes – to reinstate natural processes.

From other discussions under this objective group participants agreed that it is also important to know the following for each habitat type and sub-type: the ecological requirements, the adverse effects of nitrogen, other circumstances that coincide, measures against nitrogen effects, measures for system recovery, effectiveness and sustainability. A handbook has been compiled and reviewed internationally⁵⁹. Publication is expected next year, but draft information is already available. Part 1 has been translated into English. Examples of the measures covered in the handbook include wet heath with *Erica tetralix* (H4010) and tall sedge marsh - the habitat for *Vertigo* snails ('HS 5'). There is also a summary table of the measure, the habitat type, the goal, potential effectiveness and success factors. The text covers all species and habitat types, appropriate ecological requirements, landscape ecological processes and regular maintenance measures.

Regular maintenance measures such as mowing grasslands are necessary but not enough in themselves – they are only part of a solution. Intensifying nature management may help, but we should be aware of associated problems that may result. For example, more mowing and sod cutting results in less fauna. Mitigating nitrogen effects by solving other problems such as drought and not enough erosion or sedimentation in dunes creates more time to solve the nitrogen problems. Measures have to be supported with research and monitoring, especially those methods which do not have the highest status of 'proven'.

⁵⁹ N.A.C. Smits & D. Bal, ed. *Recovery strategies for nitrogen-sensitive habitats, Ecological underpinnings of the Programmatic Approach to Nitrogen (PAN), Part I*. Alterra Wageningen UR & Natura 2000 Programme Directorate of the Ministry of Economic Affairs, Agriculture and Innovation. The Netherlands. (http://ec.europa.eu/environment/nature/natura2000/platform/action_results/recovery-strategies-for-nitrogen-sensitive-habitats_en.htm).

Objective 2: To share knowledge and experience of restoring nitrogen-sensitive habitats using restoration measures.

In the Netherlands, the critical loads for nitrogen deposition have been exceeded for more than 60 years. Severely damaged habitats were observed all over the country. Since 1980, a lot of scientific and practical knowledge on ecological restoration has developed. Strict EU legislation has been applied including the requirement to reach favourable conservation status and avoiding deterioration at site level. As a consequence, there are strict Dutch court rulings: no permits are given when projects lead to critical loads being further exceeded.

Specific measures require specific actions by different stakeholders. Permissions are authorised by provincial regions and compensation is offered where appropriate, for example, when certain activities have to be stopped.

When the critical load is projected to be far exceeded, the main aim is to ensure that appropriate measures are taken now. Although it may be unclear what the exact impacts may be, the timescale involved is not the primary focus – the effectiveness of the measure in reducing nitrogen impacts is the key. For example, in most Natura 2000 sites in the Netherlands, the key priority is to solve drought problems. Once this is tackled, mineral levels are restored in the buffer zone and this is a means to buy time to achieve nitrogen deposition reductions through other appropriate measures.

New legislation includes a change to stakeholder involvement in management– the Nature Conservation Act has been revised to allow, for example, landowners or farmers to become managers. This requires a new sound knowledge base. Two books have been written to facilitate this, one published two years ago, and a final edit of management for Natura 2000 species will be published soon. Both books focus on regular management, with restoration activities being mainly delivered through LIFE projects or specialist measures – the restoration measures are being largely delivered by government agencies or NGOs.

A similar approach is used in Belgium as in the Netherlands and UK. In many cases, the focus is to restore primary hydrological function and reduce nutrient levels by active biological management measures. One of the largest projects is being delivered in conjunction with the military whose land covers 80% of Belgian heathlands. Again, a LIFE restoration project has been developed and is being used to deliver this. Great emphasis is placed on continuous learning and there is an acknowledged weak point in terms of monitoring activity – Belgian's look with envy at the way the Dutch have mobilised 200 scientific individuals within the 'Ontwikkeling en Beheer Natuurkwaliteit' knowledge network. The NGO Natuurpunt is also doing well in mobilising volunteers, but the majority of their activities focus on management activities rather than monitoring.

There is some concern about mistakes being made at site level – for example, in respect of liming of heathlands and use of sod-cutting. This has been used on one site, but there were tendencies to apply approaches in a blanket manner. A key message is that there is no single, universal solution, and lack of knowledge brings some risk. Therefore, the lack of a knowledge network is felt sharply in Belgium. It is also important to learn from failures.

Objective 3: To identify successful habitat management restoration measures, both at the local and landscape scale and, where possible, pull together some case studies in evidence.

Practical Case Study 1: Management of Western Gorse Heath, UK

More than ⅔ heathland vegetation in lowland Wales is a mixture of common heather, bell heather and western gorse or, on damper sites, purple moor-grass. There is a recent trend

towards tall rank and more-mesotrophic heathland vegetation, often dominated by western gorse, European gorse and increasingly by bramble. There are various causes for this change including warmer winters, changing management, reduced stock grazing and atmospheric nitrogen deposition.

Natural Resources Wales are working with conservation partners to restore gorse-dominated rank heathlands using nutrient stripping. The aim is to improve structural heterogeneity, promote and increase ericoid regeneration and cover and to control gorse re-growth. The cutting process uses a flail collector, for example Ryttec, and usually requires three passes of the machine, adjusting the height of the cut down each time. This removes surface vegetation and the build-up of leaf litter, particularly gorse litter. The result is a fresh cut, clear area with no or few remaining stalks of heather or gorse, no loose litter and the exposure of underlying soil or peat. Regeneration of ericoids can be very rapid, therefore follow-up management is required, such as control over grazing levels to protect young ericoid growth, whilst controlling the re-growth of gorse.

Local buy-in from farmers makes the technique economically sustainable. Cut material can sometimes be used for animal bedding as an alternative to straw. Encouraging more farmers to trial the straw alternative may allow for the transfer of cutting from conservation organisations to local farmers.

Practical Case Study 2: Mega-scale restoration of Alkaline fen, UK

The Anglesey and Llyn Fens LIFE+ Project will recreate 4.8 hectares of hydro-environmental conditions supporting Alkaline fen (<http://www.angleseyandllynfens.com/project.aspx>).

Alkaline fen is rare in Wales and the UK. Cae Gwyn forms part of a large rich-fen site on Anglesey that is notified as an SAC. There is a low water table due to extensive drainage. It is no longer supported by calcareous groundwater discharge from Carboniferous limestone.

With an increase in soil depth, there is increase in calcium content and a decrease in nitrogen content. This had been subject to agricultural improvement. Restoration work removed 50,000 tonnes of improved/enriched material. Marl and calcium rich peat was exposed and the hydrological conditions were restored. Early-stage results showed that water levels have risen, hydro-environmental conditions are typical of established Alkaline fens and species indicative of calcareous conditions have been recorded. In the longer-term, detailed hydrological and ecological monitoring are required. Re-creation of this habitat has never been attempted on this scale before in the UK; therefore this example is a significant case study for similar work elsewhere.

At this site, the critical load was exceeded, but nitrogen deposition was not the main driver for the project measures. However, the measures are yielding positive results for tackling nitrogen levels. It is possible to make an economic argument to keep levels of nitrogen deposition low in ways that will enable farmers to maintain sustainable levels of economically viable farming. The economic case for tackling nitrogen deposition can be made in ways that also yield maximum gains for ecology.

Objective 4: To discuss challenges and barriers to implementation and share solutions.

Timing of appropriate measures is often crucial, especially when seeking to engage support from local stakeholders, for example farmers.

The experience in Wales demonstrates that cutting management for other reasons, such as rural depopulation, can have a positive effect in tackling nitrogen deposition.

It is important to think through the appropriateness of the measures for specific sites. Integrated approaches with diversity of management techniques will often be required and will bring maximum benefits.

In the case study site at Anglesey, (<http://www.angleseyandllynfens.com/project.aspx>) critical load was exceeded but nitrogen deposition was not the main driver for the project measures, however, the measures are yielding positive results for tackling nitrogen levels.

For agriculture sectors, there is a very limited margin of movement in terms of aiming to achieve changes that are necessary to stabilise habitat types. Changing cutting practices as well as grazing practices can help tackle nitrogen levels – for example, in France, late cutting in June has greater nitrogen export effects.

In the UK report the approach is a suggestion to follow, whilst in Netherlands the report the approach is obligatory to follow – this is a big difference. In the UK, there is probably an ambition to move towards more prescribed approaches and use of defined techniques within management plans.

There are limited management techniques appropriate for different habitat types. It is not possible to simply compensate nitrogen by shifting mowing in terms of time or frequency. The input of nitrogen in the first place needs to be tackled, for example, by stopping fertilizing.

We are not particularly successful in documenting our approaches and there is an observed tendency for a ‘domino effect’, where one approach is copied and used across different sites irrespective of the needs and condition of individual sites. Also, this is compounded by lack of funds to undertake proper monitoring, so that the effects are not known. Traditional funding, for example through LIFE, is project based and has a start and end point. One key concern is that there is then, after the end of the project, no funds are available for sustained monitoring activities. The links between the research community and government agencies (academics and practitioners) can be improved. Access to data is problematic and there is a lack of awareness about who is doing what. Lack of funding and complicated governance structures are two contributing factors. How do we raise this to the attention of national governments, so that expertise can be mobilised? There is a noted lack of interest within national governments about taking action and mobilising expertise and knowledge sharing, especially at a European level.

There is a view within the research community that Natura 2000 and protected area networks are simply a source of data. From the other side, local practitioners focus on the factors that they can drive and use for management – they may know that research is available, but they do not access it. There would be great value in practitioners making a clear demand to the research community to specify what data and research they would value most for practical management priorities. A key recommendation would be to find ways to move beyond silo approaches. One proposal could be to establish a ‘think-tank’ to ensure that integrated approaches are developed and can be realised where there is a focus on how to harness the respective knowledge bases for the benefit of improved management of Natura 2000.

There are also recognised problems in ensuring that other key stakeholders are integrated to this approach, for example, the farming community. This is a particular problem in Belgium where the highest nitrogen sources are often close to the most sensitive ecological areas. Licensing and granting of permissions are key issues to manage this situation. There is also a need to use highly participative approaches. In Belgium, a model for this is used, whereby every stakeholder can record two optimum wishes. Ultimately it is not an ‘either-or’ decision, but the focus is on arriving at a globally optimum outcome. Attention is directed towards local

solutions at local levels, avoiding abstract conflicts at regional or national levels. Good stakeholder involvement and use of the appropriate tools is bearing fruit.

In Germany management is at the level of 16 Lander and each of the Lander has a different concept of how to manage Natura 2000. Procedures to establish management plans also differ. However, there is usually a consultative basis, which continues throughout the process, backed-up with a public consultation process on the eventual management plan. In some Lander, there is a specific approach to ensure diverse stakeholders; including farmers are targeted for involvement. An advisory group is established in some Lander. In other areas there is a local body established with state funding, for example in Schleswig Holstein, which is proven to work quite well. At central level there is a species handbook and habitat handbook, which was developed some time ago and are copied at Lander level. Funds for regular management have to come from the Lander level. Initiatives to tackle favourable conservation status can be funded from national level funds. There is a range of complementary approaches used, for example, thematic workshop with the military, and topic specific workshops on heathland restoration. In addition, there are web-based information resources. However, the gap between the research community and government agency-based staff (policy and practitioners) is widening.

A7.4 Conclusions

Each Natura 2000 site is unique in terms of its habitats, species populations, geographical location, mix of stakeholders and the dynamics of the natural and human interactions that take place in or around that site. Therefore, effective site management requires management of the science, the practical techniques to be deployed, well-thought through nature conservation objectives and appropriate measures, and monitoring to ensure effectiveness. Also, site management involves and requires people management such as stakeholder relationship building and maintenance, and good communication to provide key messages about each site in ways that are meaningful for the different audiences.

(Intensified) habitat management measures

- Intensive habitat management measures include grazing, cutting, burning, fertilization, liming, hydrological management, scrub removal, tree removal and disturbance.
- A review of the effectiveness of on-site habitat management to reduce atmospheric nitrogen deposition in the UK is available:
(<http://jncc.defra.gov.uk/pdf/ccwsciencereport1037.pdf>).
- A handbook with much information including measures against nitrogen effects is being compiled and draft information is available.
http://ec.europa.eu/environment/nature/natura2000/platform/action_results/recovery-strategies-for-nitrogen-sensitive-habitats_en.htm).
- Intensifying nature management may result in further associated problems. Appropriate site-specific measures must be thought through, supported with research, and their effectiveness subject to routine monitoring.

Restoring nitrogen-sensitive habitats using restoration measures

- In the Netherlands, a strict EU legislative framework has been developed to take into account scientific and practical knowledge on ecological restoration.
- In most Natura2000 sites in the Netherlands the priority is to solve drought problems, in order to restore mineral levels and buy time to achieve nitrogen deposition reductions through other measures.
- In Belgium the focus is often to restore the hydrological function and reduce nutrient levels.

- There is not one solution that will work for every site; lack of knowledge can create some risks, as there can be a temptation to apply (inappropriately) certain site-specific measures across other sites.

Successful habitat management restoration measures

- The potential for reducing the impacts of nitrogen deposition varies greatly between habitats and also management practices.
- Managing for any single issue in isolation may result in unintended and undesirable outcomes.
- There is a need to consider the conservation objectives of the site and the possible outcomes of a change in management practices.
- Novel management techniques should be considered, but adapted for circumstances.
- There is no substitute for reducing the amount of nitrogen deposited onto a site which can only be achieved through emission controls.

Challenges and barriers to implementation and solutions.

- Some Natura 2000 sites are too small to be restored for their SAC features without taking measures in the surrounding areas. In such cases, and more generally, landscape scale spatial planning approaches are seen to be beneficial.
- There are limited management techniques appropriate for different habitat types.
- Access to data can be problematic and there may be a lack of awareness and funding.
- Within the research and scientific community, there is a need to foster a broader view and proactively reach out and engage wider stakeholders - Natura 2000 sites are more than simply a source of data; equally, local practitioners may not access research or scientific data. Establishing a think-tank to ensure that integrated approaches are developed could improve the management of Natura 2000.
- Within Belgium, specific attention is paid to ensuring that key stakeholders are integrated into applied management approaches – for example, through licensing and permission granting schemes.
- In Germany, management is at the Lander level, and each Lander has a different concept of how to manage Natura 2000. A range of complementary approaches are used, for example thematic workshops with the military and workshops about heathland restoration.

A7.5 Recommendations

Taking into account the presentations of the Dutch approach and the project initiative in the UK, backed up with case studies, as well as the group discussions, the following recommendations were formulated:

- Use the Natura 2000 platform as a primary resource for sharing and gathering useful information. The Platform includes:
 - A forum for dialogue (questions, answers, debate and learning).
 - A library for useful guidance, reports and reference materials (e.g. available literature and publications).
 - An events calendar for workshops, seminars and conferences that can be promoted and attended – equally, even if you can't attend, it can function as a gateway for presentations, reports and other materials made available at an event.
- Sharing of experience and information through face-to-face networking is proven to build knowledge and develop insights about approaches that work (or do not work)

elsewhere. Learning about previous experience, work and projects provides the opportunity to see whether they can be useful for other sites. New methods, techniques or approaches to management of habitats can be tailored to the priorities and needs of other Natura 2000 sites.

- Develop a suite of integrated site management techniques for each site to reflect its condition and its dynamics, including stakeholder interactions, as that is useful in ensuring maximum gains for nature. There is value in developing management plans to express the nature conservation objectives, appropriate measures and stakeholder inputs with interactions or expectations as factors and conditions affecting site management possibilities. When developed to take into account the condition of a site, this can, and may need to, incorporate appropriate management actions required to restore a site. Different habitat management techniques should be checked and balanced for complementarity and compatibility in achieving the desired nature conservation objectives.

A7.8 List of participating countries

Belgium
France
Ireland
Germany
The Netherlands
United Kingdom

Also
ECNC
Co-ordination Centre for Effects
European Topic Centre on Biological Diversity