The one-hundred-and-first meeting of the Joint Nature Conservation Committee to be held at 0900 hours on 20 November 2014, at JNCC, Monkstone House, City Road, Peterborough, PE1 1JY

This paper was provided to the Joint Committee for discussion. Please refer to the minutes of the meeting for Committee's position on the paper.

Joint Nature Conservation Committee

Nitrogen deposition impacts on biodiversity

Paper by Clare Whitfield

1. Introduction

1.1. Nitrogen is a natural component of the earth's atmosphere, making up 78% of it. This form of nitrogen (N_2) is unreactive and cannot be directly processed by organisms. They need reactive forms of nitrogen[1] which are usually limited under natural circumstances. Anthropogenic production of reactive forms through, for example, industrial production of ammonia (Haber-Bosch process) and emissions from combustion have resulted in large amounts of reactive nitrogen entering the environment. This has doubled the total fixation of reactive nitrogen globally, and more than tripled it in Europe.

1.2. The European Nitrogen Assessment (ENA) (Sutton *et al.*, 2011) identified five key societal threats of reactive nitrogen (water quality, air quality, greenhouse gases, ecosystem impacts and soil impacts), and called for integrated policy solutions.

2. Nitrogen deposition impacts on biodiversity

2.1. Nitrogen deposition is recognised as a major pressure on biodiversity and there is a growing body of evidence showing widespread impacts on semi-natural habitats in the UK (Emmett *et al.*, 2011; ROTAP, 2012). This issue is not unique to the UK; it is recognised as a risk to biodiversity across Europe (Dise *et al.*, 2011; EEA, 2014; Whitfield & McIntosh, 2014).

2.2. Nitrogen critical loads[2] for ecosystem protection are exceeded over about two-thirds of sensitive habitat area of the UK[3].

2.3. The negative impacts include: loss of sensitive species, changes to habitat structure and function, the homogenisation of vegetation types, changes in soil chemistry, and an increased sensitivity to abiotic and biotic stresses (such as pests and climate).

2.4. The evidence shows that nitrogen deposition is compromising the achievement of biodiversity policy commitments and as such, air pollution is recognised as a pressure in, for example, the biodiversity strategies of England and Scotland.

2.5. Nitrogen deposition was identified as a "high" pressure and threat to 34 out of 77 Annex I habitats in the UK's report on implementation of the Habitats

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[1] Reactive nitrogen is collectively any chemical form of nitrogen other than di-nitrogen (N_2). Reactive nitrogen compounds include ammonia (NH_3), oxides of nitrogen (NOx), nitrous oxide, nitrates and many other chemical forms, and are involved in a wide range of chemical, biological and physical processes. In this paper the term 'nitrogen' is used to mean 'reactive nitrogen.

[2] Critical loads and levels are defined under the auspices of the Convention on Long-Range Transboundary Air Pollution. They are derived from empirical evidence from experiments and field studies across Europe and are used in the UK and internationally as a risk-based method for estimating the levels of pollutants (e.g. nitrogen compounds) above which there are likely to be adverse impacts on particular ecosystems

[3] http://jncc.defra.gov.uk/page-4245

Directive in 2013. For these habitats, nitrogen deposition is likely to be one of the causes of unfavourable status.

2.6. It is also recognised that nitrogen pollutants can have both positive and negative effects on a wide range of ecosystem services (Jones *et al.*, 2014).

3. Emissions and exposure

3.1. Atmospheric nitrogen pollution may lead to effects on an ecosystem through exposure to elevated concentrations of oxides of nitrogen (NOx) (principally from industry and transport sources) or ammonia (NH_3) (principally from agricultural sources), or through deposition of these gases or the compounds they form (referred to as nitrogen deposition).

3.2. As a result of atmospheric chemistry, the transport of air pollutants can vary greatly. Emissions can impact at a highly localised level (particularly ammonia), as well as contributing to effects at long-ranges. Pollutant aerosols can travel long distances and pollutants can be deposited in the form of wet or dry deposition. Wet deposition is highest in upland areas (areas with high precipitation) whereas dry deposition occurs close to sources such as urban areas, major roads and livestock areas.

3.3. UK emissions of NOx and NH_3 have reduced significantly over the last few decades (greater than 50% and around 20% respectively), together with substantial reductions in sulphur dioxide (greater than 90%) (ROTAP, 2012). Whilst the UK is committed to further emission reductions by 2020 (under the Gothenburg Protocol, see 4.2 below), this will only lead to a relatively small decline in nitrogen deposition. Consequently there remains a significant and continuing threat to biodiversity in the UK (ROTAP, 2012).

3.4. Future policy action needs to be targeted at reducing NH_3 emissions. Many of the potentially cost beneficial measures that could reduce reactive nitrogen emissions occur in agriculture, for example through more effective fertiliser and manure management, and improved animal housing. However, anaerobic digestion, an increase in the UK herd size and growth in the agricultural sector also have the potential to increase NH_3 emissions.

4. Air pollution policy

4.1. The framework for air pollution policy in the UK is governed by international, European and UK policies and legislation. A range of other policy areas, including agriculture, transport and climate change policies, also influence emissions of nitrogen.

4.2. The UK is signatory to the UNECE Convention on Long-Range Transboundary Air Pollution (CLRTAP). The Convention addresses transboundary air pollution through eight protocols. These include the Gothenburg Protocol (1999, amended 2012) which sets out country-based emission limits for reactive nitrogen pollutants (amongst others) to be achieved by 2020.

4.3. Air pollution policies in Europe can be divided into three broad categories:

- National emissions targets (known as “ceilings”, e.g. for ammonia and oxides of nitrogen).

- Air Quality Standards (which set exposure limits for protection of human health from a range of pollutants, including nitrogen dioxide).
- Sector-specific legislation and process regulation.

4.4. The UK's obligations under EU legislation and CLRTAP are transposed through a range of implementing legislation and policies. Air pollution policy is a devolved responsibility (although UK-level air pollution research is managed by Defra on behalf of the devolved administrations).

4.5. Within the EU, the 7th Environmental Action Programme aims to ensure that by 2020 air pollution and its impacts on ecosystems and biodiversity are further reduced with the long-term aim of not exceeding critical loads and levels. Towards this aim, in December 2013, the European Commission published an Air Quality Package[4]. This includes:

- a new Clean Air Programme for Europe (replacing the 2005 Thematic Strategy for Air Pollution) which sets the direction for EU air quality policy up to 2030;
- a revised National Emission Ceilings Directive (NECD) with stricter national emission ceilings; and
- a proposal for a new Directive to reduce pollution from medium-sized combustion installations.

4.6. The proposal for the revised NECD includes ambitious targets for the UK for NH_3 emissions in 2030. It also includes requirements for monitoring impacts of air pollution on ecosystems. The UK Government is currently developing its position on these proposals.

4.7. The NECD negotiations offer potential benefits for biodiversity by decreasing the UK's ceiling limits for NH_3 and NOx emissions. Such a decrease would act as a driver for the UK to reduce its national ammonia emissions, and ultimately lower nitrogen deposition.

5. References

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

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