

Trends Report 2020: Trends in critical load and critical level exceedances in the UK

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Executive Summary

This contract provides key information to track the effects on ecosystems of policies aimed at meeting national and international air pollution targets, e.g. under the UK Government's Clean Air Strategy 2019 (CAS), the National Emission Ceilings Regulations (NECR), and the United Nations-Economic Commission for Europe Convention on Long-range Transboundary Air Pollution (CLRTAP). It also provides the means to develop targeted action for emission reduction policies to get the maximum improvement.

Exceedance of critical load or critical level indicates that an ecosystem is at risk from potential harmful effects. When pollution decreases to below the critical load or level, there may be delays to recovery, but the risk of harm is reduced. Pollution control measures aimed at meeting CLRTAP targets have reduced the extent and magnitude of critical load and level exceedances across the UK. A new target for reactive nitrogen (N) deposition in England has been developed following the aim of the CAS to reduce impacts on ecosystems further in response to the UK's new emission reduction targets for oxides of nitrogen and ammonia.

- For UK habitats at risk from acidification, the area of acid-sensitive habitats in the UK with exceedance of acidity critical loads has fallen by more than one third, from 77.3% in 1996, to 47.4% in 2012, to 38.8% (27,253 km²) in 2017, due mainly to decreases in sulphur deposition.
- For UK habitats at risk from excess N (eutrophication), the area of N-sensitive habitats in the UK with exceedance of nutrient N critical loads fell from 75.0% in 1996, to 62.5% in 2012, to 57.6% (42,049 km²) in 2017.
- In 2016 just over 5% (12,433 km²) of the UK land area was exposed to ammonia concentrations above the critical level set to protect higher plants (3 µg m⁻³), and just over 60% (153,960 km²) to ammonia at concentrations above the critical level set to protect lichens and mosses (1 µg m⁻³). The area where the critical level for higher plants is exceeded has increased by 1.4% (3,321 km²) of UK land area since 2010. The area where the critical level for lichens and mosses is exceeded has decreased by 1% (2,482 km²) of UK land area since 2010.

Technical Summary

Critical loads define the rates of acid or nitrogen (N) deposition (e.g. in kiloequivalents per hectare per year, $\text{keq ha}^{-1} \text{yr}^{-1}$) below which significant harmful effects are not expected to occur in sensitive habitats. Critical load exceedance is the amount by which acid or N deposition exceeds the critical load. Critical levels are concentrations of pollutants (e.g. in micrograms per cubic metre, $\mu\text{g m}^{-3}$) in the atmosphere above which direct adverse effects on receptors, such as human beings, plants, ecosystems or materials, may occur according to present knowledge. Critical level exceedance is the amount by which concentration exceeds the critical level. Critical load and critical level exceedances are calculated using rolling 3-year mean data sets for deposition rates and gaseous concentrations, which are updated annually. This report describes critical loads and their exceedances for the period from 1996 to 2017¹, and critical levels and their exceedances for the period from 2010 to 2016.

This report presents trends in: a) acidity critical load exceedances for UK habitats at risk from acidification by excess sulphur (S) and/or N; b) nutrient-nitrogen critical load exceedances for UK habitats at risk of eutrophication by excess N; c) critical load exceedances for acid- and N-sensitive habitat features of UK designated sites (Special Areas of Conservation: SACs; Special Protected Areas: SPAs; Sites of Special Scientific Interest: SSSIs); and d) exceedances of ammonia critical levels across the UK.

Summary statistics monitor progress in the area of habitats in the UK at risk from acidification and eutrophication from air pollution over time, and are reported in the annual “UK Biodiversity Indicators” summary produced by the Joint Nature Conservation Committee (<https://jncc.gov.uk/our-work/ukbi-b5a-air-pollution/>; indicator B5a for assessing the pressures from air pollution).

UK habitats at risk from acidification

- The area of acid-sensitive habitats in the UK with exceedance of acidity critical loads continues to decline due mainly to decreases in sulphur (S) deposition, having fallen from 77.3% in 1996 to 38.8% (27,253 km^2) in 2017.
- The magnitude of the acidity exceedance (expressed as the Average Accumulated Exceedance) for all UK habitats combined fell by more than two thirds between 1996 and 2017, from 0.78 to 0.20 $\text{keq ha}^{-1} \text{year}^{-1}$.
- The largest reduction in the area of acid-sensitive habitats with exceedance of acidity critical loads has been in Scotland, where it has fallen by two thirds from 74.4% (31,792 km^2) in 1996 to 23.4% (10,021 km^2) in 2017.
- The smallest reduction in the area of acid-sensitive habitats with exceedance of acidity critical load has been in Northern Ireland, falling from 79.8% (2,674 km^2) in 1996 to 61.4% (2,056 km^2) in 2017.
- Of the terrestrial acid-sensitive habitats mapped, dwarf shrub heath occupies the largest area across the UK (10%); the area of this habitat with exceedance of acidity critical loads has more than halved, from 70.3% (17,370 km^2) in 1996 to 19.7% (4,870 km^2) in 2017.

¹ In this report, time periods are usually (for brevity) referred to using the middle year of the 3 years used to calculate the mean. The example here, “from 1996 to 2015”, means the period from 1995-1997 to 2014-2016.

- The terrestrial habitat with the smallest decrease in acidity critical load exceedance, falling by less than a third between 1996 and 2017, has been acid grassland, where 92.0% (14,106 km²) was exceeded in 1996 to and 64.7% (9,916 km²) in 2017.

UK habitats at risk from eutrophication (i.e. from excessive nutrient availability)

- The area of N-sensitive habitats in the UK with exceedance of nutrient N critical loads decreased from 75.0% (54,785 km²) in 1996 to 57.6% (42,049 km²) in 2017. This smaller reduction (in comparison to acidity) is due to the smaller proportional reductions in N deposition over the time period, compared to S.
- The Average Accumulated Exceedance for nutrient N (also termed Excess Nitrogen) for all UK habitats combined has declined by more than one-third, from 9.5 kg N ha⁻¹ year⁻¹ in 1996 to 5.2 kg N ha⁻¹ year⁻¹ in 2017.
- The largest reduction in the area of N-sensitive habitats with critical load exceedance is in Scotland, falling by almost one-third from 59.4% (25,675 km²) in 1996 to 34.0% (14,685 km²) in 2017.
- The smallest reduction in the area of N-sensitive habitats with critical load exceedance is in England, falling from 98.3% (19,199 km²) in 1996 to 95.1% (18,563 km²) in 2017.
- The nutrient N critical loads are exceeded for more than 80% of the areas of six N-sensitive habitats in all years: calcareous grasslands, unmanaged beech woodland, unmanaged oak woodland, other unmanaged woodland, managed conifer and managed broadleaved woodland.
- Almost 100% of the area of unmanaged beech woodland has exceedance of nutrient N critical loads in all years, however, the magnitude of exceedance (Average Accumulated Exceedance) has halved, from 22.7 kg N ha⁻¹ year⁻¹ in 1996 to 11.4 kg N ha⁻¹ year⁻¹ in 2017.
- There is virtually no exceedance of nutrient N critical loads for saltmarsh in any year, due to a combination of the high critical load for this habitat and lower deposition in coastal areas.

Total N deposition onto protected sensitive habitats

- This year's Trends Report includes a metric against which progress towards the UK Government's Clean Air Strategy target (Defra, 2019) can be measured, i.e. "to reduce damaging deposition of reactive forms of nitrogen by 17% over England's protected priority sensitive habitats by 2030".
- Preliminary calculations show that the mean N deposition rate onto priority habitats in England in 2016 was 20.3 kg N ha⁻¹ yr⁻¹.

Designated sites with acid-sensitive feature habitats

- The percentage of SACs and SPAs in the UK with exceedance of acidity critical loads for one or more features has decreased substantially. It fell from more than 90% (SACs: 443 sites, SPAs: 165 sites) in 1996 to 70.4% (SACs: 343 sites) and 63.4% (SPAs: 111 sites) in 2017.
- The percentage of SSSIs with exceedance of at least one sensitive feature fell from 77.6% (3,632 sites) in 1996 to 55.1% (2,579 sites) in 2017.
- Scotland had the largest reductions (38%) in the percentage of designated sites with exceedance of acidity critical loads between 1996 and 2017.
- Roughly 50% of designated sites in Scotland (and SSSIs in England) currently have exceedance of acidity critical loads for one or more features. For England, Wales and Northern Ireland more than roughly 70% of designated sites have exceedance of acidity critical loads for one or more features.

Designated sites with nitrogen-sensitive feature habitats

- Decreases in the percentage of designated sites in the UK with exceedance of nutrient N critical loads (for one or more features) between 1996 and 2017 are small (7.1% for SACs, 10.1% for SSSIs, 16.0% for SPAs). This reflects the smaller reductions in N deposition, compared to acid deposition, over this time period.
- Scotland had the largest decreases (ca. 13-19%) in the percentage of SACs and SSSIs with exceedance of nutrient N critical loads between 1996 and 2017; Wales had the largest reduction (21.4%) in the percentage of SPAs with nutrient N critical load exceedance over the same time period, however the total number of SPAs in Wales with N critical loads is only 14, and Scotland showed similar percentage decreases (20.2%).
- Of nature conservation sites in England, Wales and Northern Ireland, 78.6-98.0% currently have exceedance of nutrient N critical loads for one or more features. Proportionally fewer sites in Scotland (54.0-76.1% depending on designation) are exceeded in this way.

Exceedance of ammonia critical levels

The trends in ammonia critical levels exceedance are only available for the period 2009 to 2016; there have only been small reductions in ammonia concentrations over this time period.

UK land area

- Over 60% of the UK currently receives ammonia concentrations above the critical level set to protect lichens and bryophytes ($1 \mu\text{g m}^{-3}$); this represents 87.9% of England, 56.3% of Wales, 17.9% of Scotland and 90.8% of Northern Ireland.
- The UK land area with ammonia concentrations above $1 \mu\text{g m}^{-3}$ has shown insignificant change, from 63.9% in 2010 to 62.9% in 2016.
- Just over 5% of the UK receives ammonia concentrations above the critical level set to protect higher plants ($3 \mu\text{g m}^{-3}$); this ranges from 0.1% of Scotland to 27.3% of Northern Ireland.
- The UK land area with ammonia concentrations above $3 \mu\text{g m}^{-3}$ has slightly increased, from 3.7% in 2010 to 5.1% in 2016.

Nitrogen-sensitive habitats

- One-quarter of the mapped area of N sensitive habitats in the UK receive ammonia concentrations above the critical level of $1 \mu\text{g m}^{-3}$; the percentage area exceeded ranges from 3.2% for Scotland to 75.2% for Northern Ireland.
- 88.3% of the area of calcareous grassland, and ~70-80% of the area of some woodland habitats (unmanaged, unmanaged beech, managed broadleaved) are in areas that receive ammonia concentrations above the critical level of $1 \mu\text{g m}^{-3}$. Only 19.1% of acid grassland is in areas exceeding this critical level, but this equates to 2,894 km^2 which is similar in area to the 88.3% (3,140 km^2) of calcareous grassland exceeded.
- 1% of the area of N-sensitive habitats in the UK receives ammonia concentrations above $3 \mu\text{g m}^{-3}$; this ranges from <0.1% in Scotland to 9.2% in Northern Ireland.

Designated sites (SACs, SPAs and SSSIs or ASSIs)

- 52.4% (129) of SPAs, 60.6% (372) of SACs and 70.4% (4,817) of SSSIs (ASSIs in Northern Ireland) in the UK currently receive ammonia concentrations above $1 \mu\text{g m}^{-3}$ anywhere across the site. The

percentage of sites with exceedance of the $1 \mu\text{g m}^{-3}$ critical level has fallen by <5% between 2010 and 2016, for all site types.

- 87-96% of these designated sites in England, 89-92% of sites in Northern Ireland, 53-73% of sites in Wales, and 17-25% of sites in Scotland, currently receive ammonia concentration above $1 \mu\text{g m}^{-3}$.
- 7.7% (47) of SACs, 9.3% (23) of SPAs and 4.7% (319) of SSSIs in the UK currently receive ammonia concentrations above $3 \mu\text{g m}^{-3}$ anywhere across a site. The percentage of designated sites with exceedance of this critical level has risen by 1-4% between 2010 and 2016.
- Less than 2% (<0.1% for SACs) of sites with these conservation designations in Scotland currently receive ammonia concentrations above the critical level of $3 \mu\text{g m}^{-3}$ anywhere across a site, compared with up to 3-5% of sites (0% of SPAs) in Wales, up to 18.4 % of sites in England and up to 30.8 % of sites in Northern Ireland.

Report structure

Section 1 of this report provides an overview of critical loads for acidity and for nutrient N, deposition data, and exceedance calculations and metrics for habitats across the whole area of the UK. This is followed in Section 2 by summaries of these trends for specific habitats and countries, i.e. England, Scotland, Wales, and Northern Ireland. Section 3 focuses on designated sites, the application of “site-relevant critical loads” (SRCL) to these sites, and trends in their exceedances. Finally, Section 4 addresses critical levels for ammonia and their exceedances.

Notes on rounded numbers and percentages

Numbers in tables are shown to one decimal place. Numbers reported in the main text were rounded after calculation, so may not always equate precisely to the differences between the numbers in the table. For example, if there is a change of +0.08 units from 72.06 to 72.14, the real change is $72.14 - 72.06 = +0.08$, which rounds to +0.1, and the rounded numbers would show as $72.1 - 72.1 = 0.1$. This is not an error.

Changes in the area of habitat where critical loads or critical levels are exceeded are always expressed in terms of absolute percentage of the total habitat area, not as a relative percentage change from the previous value, nor as an absolute percentage of total land area for the country. For example, if a habitat occupies 10% of the UK, a change from 40% to 30% of the habitat area being exceeded would be expressed as a decrease of 10% (i.e. 40 minus 30), not as a decrease of 25% (i.e. $100 \times (40 - 30) / 40$), nor as a decrease of 1% (i.e. 4% of UK area minus 3% of UK area).

Section 1. Pollutant deposition, critical loads, and exceedances

1.1 Overview of deposition and critical loads

Pollutant deposition rates, expressed for example in $\text{kg ha}^{-1} \text{yr}^{-1}$, are useful indicators of pressure on ecosystems (Rowe et al., 2017). However, ecosystems are considered able to withstand a certain amount of pollution, and this amount is expressed as the critical load. Critical loads are thus thresholds for effects from atmospheric deposition and are defined as “a quantitative estimate of the 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).

The methods used to calculate and map UK critical loads are described in detail in Hall et al. (2015). Critical loads are calculated and mapped for UK habitats sensitive to acidification and/or eutrophication (Table 1.1). Here and in Section 2, results are presented for the entire mapped extent of habitats; results for designated sites are presented in Section 3. The critical load methods applied in the UK are based on methods approved at international workshops held under the Convention on Long-Range Transboundary Air Pollution (CLRTAP) and published in the “Mapping Manual” (CLRTAP, 2017).

A new metric has been calculated for this 2020 Trends Report, to illustrate progress towards the aim of the UK Government’s Clean Air Strategy (Defra, 2019), to develop a target to achieve a “reduction of damaging deposition of reactive forms of nitrogen by 17% over England’s protected, priority, sensitive habitats by 2030”. For this report, the metric is defined as “total deposition of reactive N onto nutrient-N sensitive priority habitat”, i.e. including priority habitat that is not within protected sites. Total N deposition does not take into account critical load, but is a readily-understood indicator of overall pressure on sensitive ecosystems. The baseline year against which the 17% reduction will be assessed is 2016. The derivation of this metric is discussed further in section 1.4.

The Devolved Administrations are considering whether to develop nitrogen deposition reduction targets for their own countries. Progress towards new country-specific targets will be presented in future Trends Reports.

1.1.1 Habitat mapping

Habitat distribution maps are based on the CEH Land Cover Map 2000 (LCM2000: Fuller et al., 2002) and additional data sets such as species distribution data and altitude. Habitat areas, used for assessing the areas of habitats at risk from acidification and/or eutrophication, are based on the LCM2000 data. Habitat areas have not been updated to use more recent maps, for consistency in reporting, although an update is planned before the next Trends Report in 2021. It should be noted that the habitat distribution maps and areas used to calculate exceedances: a) only include areas where data exist for the calculation or derivation of critical loads; and b) may differ from other national habitat distribution maps or estimates of habitat areas. This may also result in a difference in the total habitat areas mapped for acidity and for nutrient N critical loads.

Published correspondence tables (available from: <http://jncc.defra.gov.uk/page-1425>) are used to relate broad habitats to the European Nature Information System (EUNIS: Moss and Davies, 2002) hierarchical habitat classification scheme, developed for pan-European applications.

Since the 2019 Trends Report, the coastline mask used to separate terrestrial habitats (including coastal habitats such as saltmarsh) from marine habitats has been updated, resulting e.g. in an increase in total area mapped as sensitive to nutrient-nitrogen from 72,494 km² to 73,027 km². Since this change affects both exceeded and non-exceeded areas, effects on the percentage area exceeded are likely to be small.

Table 1.1: Habitat distributions mapped for acidity and for nutrient nitrogen critical loads. See section 1.4 for definition of N_{sens} .

Habitat	EUNIS habitat class(es) assigned ¹	Mapped for acidity	Mapped for nutrient nitrogen	Included in N_{sens} calculation
Acid grassland (wet & dry)	E1.7 & E3.52	Yes	Yes	Yes
Calcareous grassland	E1.26	Yes	Yes	Yes
Dwarf shrub heath (wet & dry)	F4.11 & F4.2	Yes	Yes	Yes
Montane	E4.2	Yes	Yes	Yes
Bog	D1	Yes	Yes	Yes
Managed coniferous woodland	G3	Yes	Yes	No
Managed broadleaved woodland	G1	Yes	Yes	No
Beech woodland (unmanaged)	G1.6	Yes ³	Yes	Yes
Acidophilous oak woodland (unmanaged)	G1.8	Yes ³	Yes	Yes
Scots Pine woodland (unmanaged)	G3.4	Yes ³	Yes	Yes
Other unmanaged woodland	G4	Yes ³	Yes	No
Freshwaters ²	C1 & C2	Yes	No	No
Dune grassland	B1.4	No	Yes	Yes
Saltmarsh	A2.53/54/55	No	Yes	Yes

¹ EUNIS class closest to broad habitat and critical loads habitat; class used for assigning empirical nutrient nitrogen critical loads and for classifying UK critical loads data for submission to the CCE.

² Critical loads are calculated for 1752 freshwater sites across the UK (see Section 1.1.1 below); habitat areas are based on the catchment areas of these sites.

³ Unmanaged woodland classes are mapped together.

1.1.2 Acidity critical loads

Two methods are used in the UK for calculating acidity critical loads for terrestrial habitats: the empirical approach is used to provide estimates for non-woodland habitats and a simple mass balance equation used for woodland habitats.

In the empirical approach used for non-woodland mineral and organomineral soils, critical loads are assigned to each 1km grid square of the UK based on the amount of acid deposition that could be neutralised by the base cations produced by mineral weathering of the dominant soil type in the grid square (Hornung et al., 1995). This approach is inappropriate for peat soils because of the absence of inputs of alkalinity from mineral weathering (Gammack et al., 1995; Smith et al., 1992). Critical loads of acidity for peat soils are set to the value corresponding to the amount of acid deposition that would give rise to an effective rain pH value of 4.4 (Calver, 2003; Calver et al., 2004; Skiba and Cresser, 1989); the choice of threshold pH value reflects the buffering effects of organic acids on peat drainage water pH. This method is applicable to upland and lowland acid peat soils, but not to peats in lowland arable

fen areas that are less sensitive to acidification, where a higher critical load is set than would be applied to acid peats (Hall et al., 2015).

Acidity critical loads for non-woodland habitats are calculated using the soil acidity critical loads outlined above, together with additional habitat-specific data to derive the three acidity critical load values (CL_{maxS}, CL_{minN}, CL_{maxN}, see Section 2) for each habitat, needed for the calculation of acidity critical load exceedances.

For woodland habitats a simple mass balance (SMB) equation, based on balancing the acidic inputs to and outputs from the ecosystem, is used to derive a critical load that ensures that a specified critical chemical limit is not exceeded (Sverdrup and De Vries, 1994; Sverdrup et al., 1990). In the UK, the SMB equation is parameterised using different chemical criteria for woodlands on mineral or organo-mineral soils, and woodlands on peat soils (Hall et al., 2015). Critical loads are calculated for both managed (productive) and unmanaged woodlands to protect the long-term ecosystem function of these woodland habitats; this approach also aims to protect the land under managed conifer forest for possible future non-forest use and reversion to semi-natural land uses. These SMB critical loads are used with additional habitat-specific data to derive the three acidity critical load input values (CL_{maxS}, CL_{minN}, CL_{maxN}) for each woodland type, for use in calculating habitat-specific exceedances (Section 2).

Acidity critical loads for freshwaters are calculated using the catchment-based First-Order Acidity Balance (FAB: Henriksen and Posch, 2001) model. FAB is currently applied to 1752 sites across the UK, comprising a mixture of mainly upland, lakes, reservoirs and first-order streams (i.e. streams that feed into other larger streams, but do not have any other streams draining into them). The critical load calculations are based on the water chemistry of samples collected in the 1990s to provide an estimate of the annual mean water chemistry. The FAB model generates the acidity critical load values CL_{maxS}, CL_{minN} and CL_{maxN} (see Part 2).

1.1.3 Nutrient nitrogen critical loads

Both empirical and mass balance methods can be used for calculating critical loads for eutrophication (i.e. an excess of nutrients, in this case N). The empirical critical loads are based on experimental or field evidence of thresholds for changes in species composition, plant growth, plant tissue chemistry or soil processes. The empirical approach is suited to semi-natural communities for which the long-term protection of biodiversity and/or ecosystem function is the key concern. In the UK the empirical approach is applied to natural and semi-natural habitats, including unmanaged (non-productive) woodland, based on critical load values agreed at international workshops (Bobbink and Hettelingh, 2011; Hall et al., 2015).

In the mass balance approach the long-term inputs and outputs of N from the ecosystem are calculated, with the critical load being exceeded when any excess N input is calculated to lead to an exceedance of a specified critical rate of N leaching. This approach is suited to managed ecosystems with relatively low biodiversity, in which the inputs and outputs can be quantified with some confidence and in which the key concern is nitrate leaching. As with acidity, in the UK this approach is applied to managed (productive) woodlands to ensure that long-term ecosystem functions (e.g. of soils, soil biological resources, trees, or linked aquatic systems) are protected.

1.2 Deposition data and trends

The S, N and base cation deposition data used in the UK calculations of critical loads and their exceedances are based on the “Concentration Based Estimated Deposition” (CBED) methodology (RoTAP, 2012). Site-based measurements of air concentrations of sulphur and nitrogen, as gases and particulates, are interpolated to generate 5 x 5 km maps of concentrations for the UK. Ion concentrations in precipitation from the UK Eutrophying and Acidifying Pollutants (UKEAP) network are combined with the Met Office annual precipitation map to generate maps of wet deposition. The wet deposition values include direct deposition of cloud droplets to vegetation (known as “occult” deposition), and orographic enhancement to take account of the “seeder-feeder” effect in upland regions (Fowler et al., 1988). Gas and particulate concentration maps are combined with spatially distributed estimates of vegetation-specific deposition velocities (Smith et al., 2000) to generate dry deposition. Combining these data sets produces 5 x 5 km maps of total (wet + cloud + dry) deposition of S (non-marine), oxidised N and reduced N; two different sets of deposition values are used in critical load and exceedance applications: i) “moorland”: assumes grassland or moorland vegetation everywhere; ii) “woodland”: assumes forest everywhere, based on the different deposition velocities to different land cover types.

Significant inter-annual variations in deposition can occur due to the natural variability in annual precipitation (which influences wet deposition) as well as the general circulation of air which can increase or decrease the amount of polluted air imported from the European continent. The CBED deposition data used to calculate critical load exceedances is therefore averaged over a three-year period; this has been demonstrated to be a suitable time period to smooth out inter-annual variations in deposition. Figure 1.1 shows the CBED data for 2016-18.

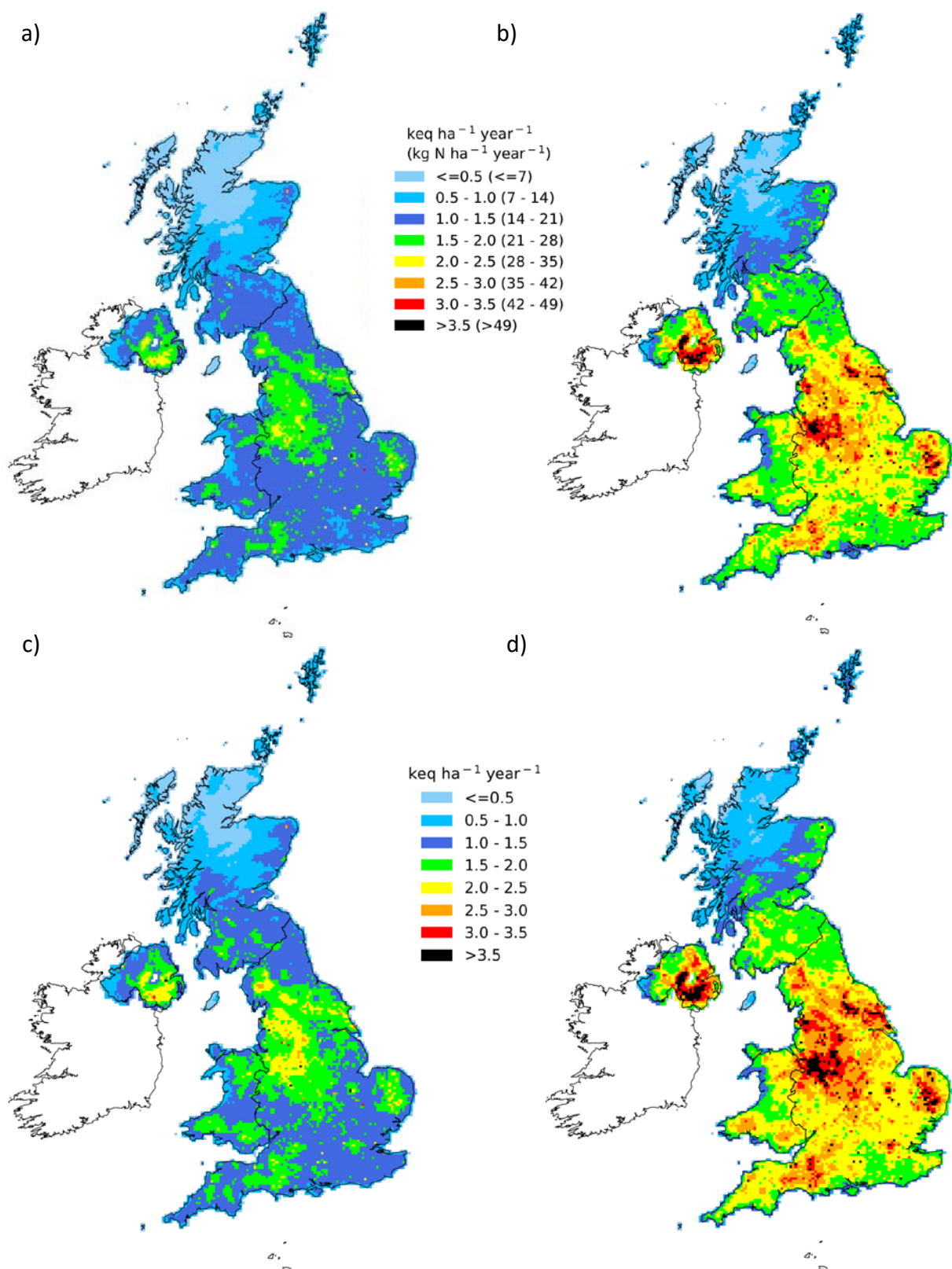


Figure 1.1: CBED deposition for 2016-18: a) nitrogen (oxidised plus reduced) deposition to moorland; b) nitrogen (oxidised plus reduced) deposition to woodland; c) acid (sulphur + nitrogen) deposition to moorland; d) acid (sulphur + nitrogen) deposition to woodland. Deposition is mapped for N and acidity using the same units ($\text{keq ha}^{-1} \text{ yr}^{-1}$) and class intervals. For the N maps, deposition rates are also shown in $\text{kg N ha}^{-1} \text{ yr}^{-1}$.

Since critical loads for terrestrial habitats are mapped on a 1km grid, for exceedance calculations deposition is assumed to be constant for all 1 km squares within each 5km grid square. For freshwater exceedance calculations catchment-weighted mean S and N deposition values are calculated by overlaying the catchment boundary and land cover information (moorland vs forest) onto the 5km² deposition maps.

1.2.1 Summary of trends in CBED deposition

To understand the trends in critical load exceedances it is useful to look at the trends in deposition over time. The CBED deposition data exist for all 3-year rolling intervals from 2002 to 2017 (reminder: in this report, the 3-year time periods are referred to in brief using the *middle year* of the period), plus data for three earlier time periods: 1995-1997, 1998-2000 and 1999-2001. The trends in CBED deposition to moorland and to woodland for the period 1996 to 2017 are summarised in Figure 1.2. Deposition to woodland is higher than that to moorland due to greater deposition velocities onto tall vegetation of gases (e.g. NH₃ and HNO₃) in particular, as well as particulates. Grid-average deposition² of non-marine S (NMS) for the UK decreased by 80% over the study period from 1996 to 2017. Decreases in NMS deposition were greater before 2005, but the NMS deposition rate continues to decline, with a 35% decrease over the most recent five-year period reported, i.e. between 2013 and 2017. Deposition of oxidised N (UK grid-average) decreased by 48% between 1996 and 2017, and also shows an ongoing decline, having decreased by 19% between 2013 and 2017. By contrast, the decline in UK grid-average deposition of reduced N has been smaller (21% between 1996 and 2017) and has slowed in recent years, with only a 15% decrease between 2013 and 2017.

² Grid-average deposition is deposition weighted by the amounts of unfertilised open vegetation (termed “moorland”, woodland, urban land, arable and fertilised grassland within each grid cell Hall, J., Curtis, C., Dore, T., Smith, R., (2015) Methods for the calculation of critical loads and their exceedances in the UK. Report to Defra under contract AQ0826. Centre for Ecology and Hydrology.,

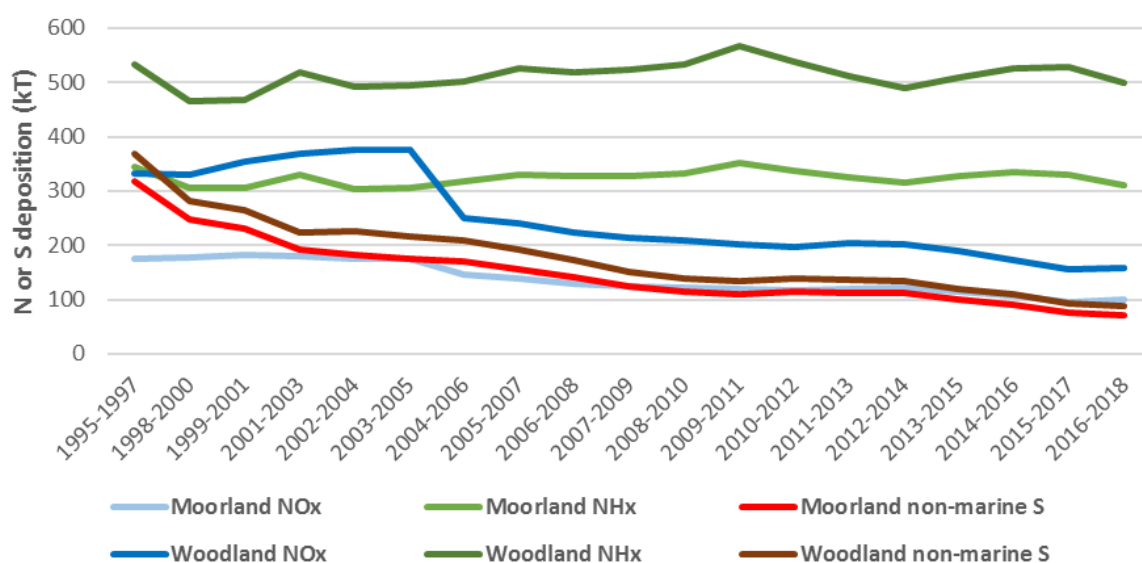


Figure 1.2: Deposition budgets (kilotonnes S or N per year) calculated for the entire UK for CBED deposition to moorland and deposition to woodland. NMS = non-marine sulphur, NOx = oxidised nitrogen, NHx = reduced nitrogen.

1.3 Overview of the calculation of critical load exceedances

Critical load exceedances are the amount of excess deposition above the critical load; for nutrient N the calculation is simply total N deposition (derived from N oxides and ammonia) minus the critical load. For acidification, deposition of both S and N compounds can contribute to the exceedance of critical loads. The Critical Load Function (CLF), developed under the UNECE CLRTAP (Hettelingh et al., 1995; Posch et al., 1999; Posch et al., 1995; Posch and Hettelingh, 1997), defines combinations of S and N deposition that will not cause harmful effects. In its simplest form, an acidity critical load can be defined graphically by a 45 degree diagonal line on a sulphur-nitrogen deposition plot (Figure 1.3a), where both types of deposition are expressed in chemical equivalents, i.e. moles of charge. The line intercepts the x-axis (representing N deposition) and y-axis (representing S deposition) at the same value in equivalents, each representing the N or S deposition equal to the critical load for acidity. Each point along the diagonal line represents the critical load in terms of some combination of S and N deposition.

To allow for the long-term N removal processes by the soil and through harvesting of vegetation, the simple diagonal line is shifted along the N axis to increase the N values across the entire CLF (Figure 1.3b). More N can then be deposited before the acidity critical load is exceeded. There are no similar removal processes that need to be considered for S.

The intercepts of the CLF on the S and N axes (Figure 1.3c) define the following terms:

- The “maximum critical load of S” (CL_{maxS}): the critical load for acidity expressed in terms of S only, i.e. when N deposition is zero.
- The “maximum critical load of N” (CL_{maxN}): the critical load for acidity expressed in terms of N only (when S deposition is zero).
- The “minimum critical load of N” (CL_{minN}): the long-term N removal processes in the soil (e.g. N uptake and immobilisation) and harvesting of vegetation.

These critical loads are calculated from the acidity critical loads described in Section 1.1 and additional soil-specific or habitat-specific data.

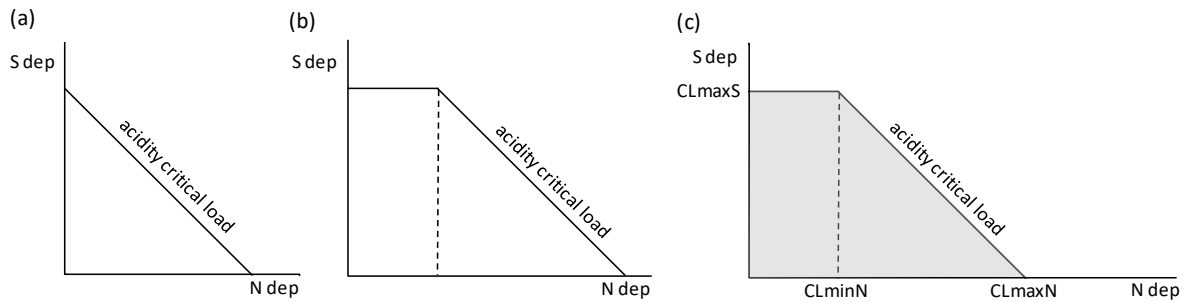


Figure 1.3: Development of the CLF: a) acidity critical load defined by equal amounts of sulphur and nitrogen deposition; b) shifting the acidity critical load diagonal line to allow for nitrogen removal processes; c) the 3 nodes of the CLF: CLmaxS, CLminN, CLmaxN. The area shown in grey represents the combinations of sulphur and nitrogen deposition that are below the critical load (i.e. critical load is not exceeded).

Exceedances are calculated by comparing the values of CLmaxS, CLminN and CLmaxN to the values of S and N (oxidised + reduced) deposition. The actual calculation depends on where the deposition falls in relation to these critical load values; the CLF is divided into five different regions for this purpose (Figure 1.4). The exceedance is defined by the sum of S and N deposition as shown by the red arrows in Figure 1.4 (i.e. not the length of the diagonal line); this is referred to as the “shortest distance” exceedance. Further details on the calculations are given in Hall et al. (2015).

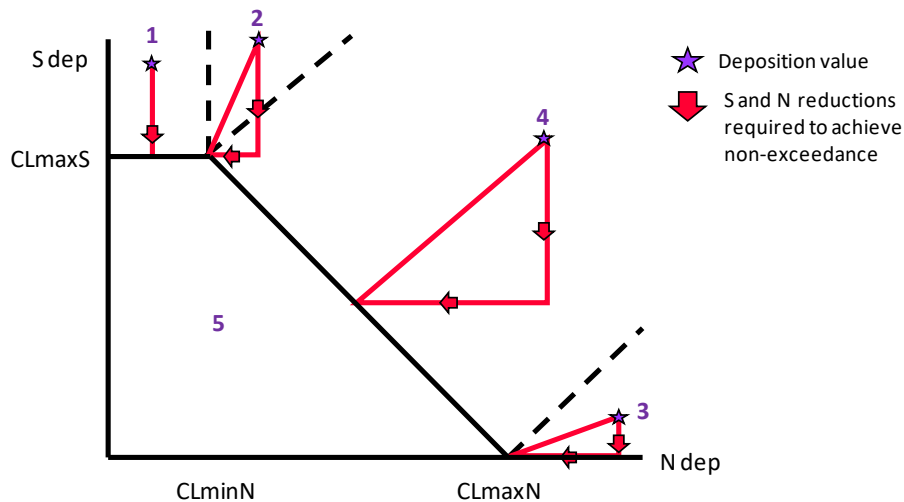


Figure 1.4: Example of S and N deposition reductions required depending on the region of the CLF. Deposition that falls in region 5 is below the critical load (i.e. critical loads not exceeded).

1.3.1 Exceedance and damage

The critical loads data on which exceedance calculations are based are derived from empirical or steady-state mass balance methods, which are used to define critical loads for the long term. Exceedance of critical loads is an indication that an ecosystem is at risk from potential harmful effects

in the long-term. Therefore, exceedance is not a quantitative estimate of damage to the environment; it does not necessarily mean that harmful or adverse effects have already occurred or may be observed, but that there is a risk of damage in the long-term. Reducing deposition to below the critical load does not mean that ecosystems immediately recover. There are time lags before chemical recovery takes place, and further delays before biological recovery. The timescales for both chemical and biological recovery, could be very long, particularly for the most sensitive ecosystems.

1.3.2 Critical load exceedance metrics

Critical load exceedances are calculated for each 1km square of the distributions of each terrestrial habitat, and for each catchment for freshwaters. The results are then summarised by habitat and country using the following exceedance metrics:

(i) Area of habitat exceeded

For terrestrial habitats the area values are based on the LCM2000 data; if the critical load for any individual habitat is exceeded, the exceeded area is set to the habitat area within the 1km square for that particular habitat. For freshwater habitats, if the FAB acidity critical load is exceeded, the whole catchment is assumed to be exceeded and the exceeded area set to the catchment area. The total exceeded areas for individual habitats are summarised by country. In previous trends reports, both terrestrial habitats and catchments upstream from freshwater habitats were included in total habitat area, leading to overlaps. In the current report, areas where acidity critical load is exceeded are reported separately for terrestrial habitats and freshwater catchments, and have been recalculated for previous years. Tables 2.2 and 2.6 and Figures 2.1 and 2.2 are thus internally consistent, although values have changed since the previous Trends Report.

(ii) Percentage area of habitat exceeded

This is calculated from the exceeded areas derived in (i) and the total area of each habitat mapped in each country (Section 1.1). While this is a useful metric for expressing how much habitat is at risk, it does not clearly reflect decreases in the amount of exceedance. For example, when comparing exceedance results from one year to another (or one deposition scenario to another), there may be only small changes in the percentage area of habitat exceeded, particularly in regions with high deposition. This is because the magnitude of the exceedance may have reduced, but the area exceeding the critical load remains the same; the area exceeded will only reduce when the critical load is no longer exceeded. Even when the critical load is still exceeded, decreases in the amount of exceedance are likely to have some benefits (Rowe et al., 2017).

(iii) Accumulated Exceedance (AE)

AE takes account of both the magnitude of exceedance and the habitat area exceeded:

$$AE \text{ (keq year}^{-1}\text{)} = \text{exceedance (keq ha}^{-1} \text{ year}^{-1}\text{)} * \text{exceeded area (ha)}$$

AE is calculated for each 1km square for each habitat and then summarised by habitat and country. AE is set to zero where critical loads are not exceeded. This metric can be useful for comparing results for different years or scenarios, but because the results are expressed in as totals for the country (in keq year⁻¹) they are large numbers and not intuitive to understand.

It should also be noted that the same AE can arise from a large exceedance and small exceeded area, or a small exceedance and a large area.

(iv) Average Accumulated Exceedance (AAE), i.e. Excess Nitrogen

AAE averages the AE across the entire sensitive habitat area:

$$\text{AAE (keq ha}^{-1} \text{ year}^{-1}) = \text{AE (keq year}^{-1}) / \text{total habitat area (ha)}$$

This metric provides an exceedance value averaged across the whole habitat area. In the summary statistics presented (Section 2) it is based on the AE for the habitat (by country) divided by the total habitat area (by country). AAE is set to zero where critical loads are not exceeded. This metric provides a more intuitive value for comparing the exceedance results for different years or scenarios, and gives an indication of the reduction in the magnitude of exceedance even if there is no change in the percentage area of habitat exceeded. However, the name and acronym for this metric have been criticised as not directly understandable, and the term “Excess Nitrogen” has been proposed as a synonym for the AAE of nutrient-N critical loads. In this report we continue to use AAE, but note that this is equivalent (for N) to Excess Nitrogen.

1.3.3 Critical load exceedance maps for all habitats combined

Critical load exceedances are calculated by habitat; exceedance maps can be generated for individual habitats or for all terrestrial habitats combined. The exceedance data for freshwaters are not incorporated into these combination maps because the data are catchment-based rather than for 1km squares and as such may overlap with other habitat data. This section focuses on maps of AAE for all terrestrial habitats combined (Figure 1.5); other maps are presented and discussed in Hall et al. (2015). Maps of AAE provide a good representation of the summary critical load exceedance statistics since they are based on all the critical load values for all habitats and habitat-specific deposition. The AAE for each 1km square is calculated as:

$$\text{AAE} = \sum(\text{AE for all habitats}) / \sum(\text{area for all habitats})$$

AE (and AAE) is set to zero where the critical loads are not exceeded.

The latest AAE maps for acidity and nutrient N (Figure 1.5) clearly show the lower exceedances in Scotland compared to other regions of the UK. High exceedances of acidity critical loads are focused in upland areas of central and north western England, as well as smaller areas in eastern England and the far south-west, as well as parts of Wales and southern Scotland and Northern Ireland. High exceedances of nutrient N critical loads are widespread across England, Wales and Northern Ireland and parts of southern and eastern Scotland, with many areas having exceedances above 14 kg N ha⁻¹ year⁻¹ (1 keq ha⁻¹ year⁻¹).

1.4 Calculation of N deposition onto protected sensitive habitats in England

As noted in section 1.1, this Trends Report includes for the first time an indicator for England, “total deposition of reactive N onto nutrient-N sensitive, protected, priority habitats” (abbreviated as N_{sens}) to illustrate progress towards the target in the UK Government’s Clean Air Strategy (Defra, 2019). In this report, this metric is expressed as the area-weighted mean deposition in kg N ha⁻¹ yr⁻¹ (Equation 1). “Total” refers to the sum of oxidised and reduced N).

$$N_{sensdep} = \frac{\sum_{i=1}^n A_i D_i}{\sum_{i=1}^n A_i} \quad (\text{Equation 1})$$

Where n is the number of habitats included in the calculation, A is the total area of each habitat, and D is the total N deposition onto each habitat.

The priority habitats included in this calculation are a subset of the habitats listed in Table 1.1, as indicated in that table. “Other unmanaged woodland” was not included since this includes areas of non-priority as well as priority habitat; freshwater catchments were not included since they often overlap with priority habitat so this would result in double-counting; and managed woodlands are not considered priority habitat. Habitats included were mapped as described in Section 1.1, and in more detail in Hall et al. (2015).

The definition and mapping of priority habitats is clearly a key consideration when calculating N_{sens} . Not all N-sensitive priority habitats in the UK are currently included in this calculation. Recent efforts to map priority habitats in all UK countries are likely to result in improved data, and we aim to make use of these maps in the next Trends Report in 2021. This will result in changes to the basis of the metric and thus to the calculated numbers. For comparability, it will then be important to recalculate the N_{sens} values reported here (i.e. for 2014-16, 2015-17 and 2016-18) on the basis of the revised maps. The N_{sens} numbers included in the current report should therefore be seen as preliminary and illustrative.

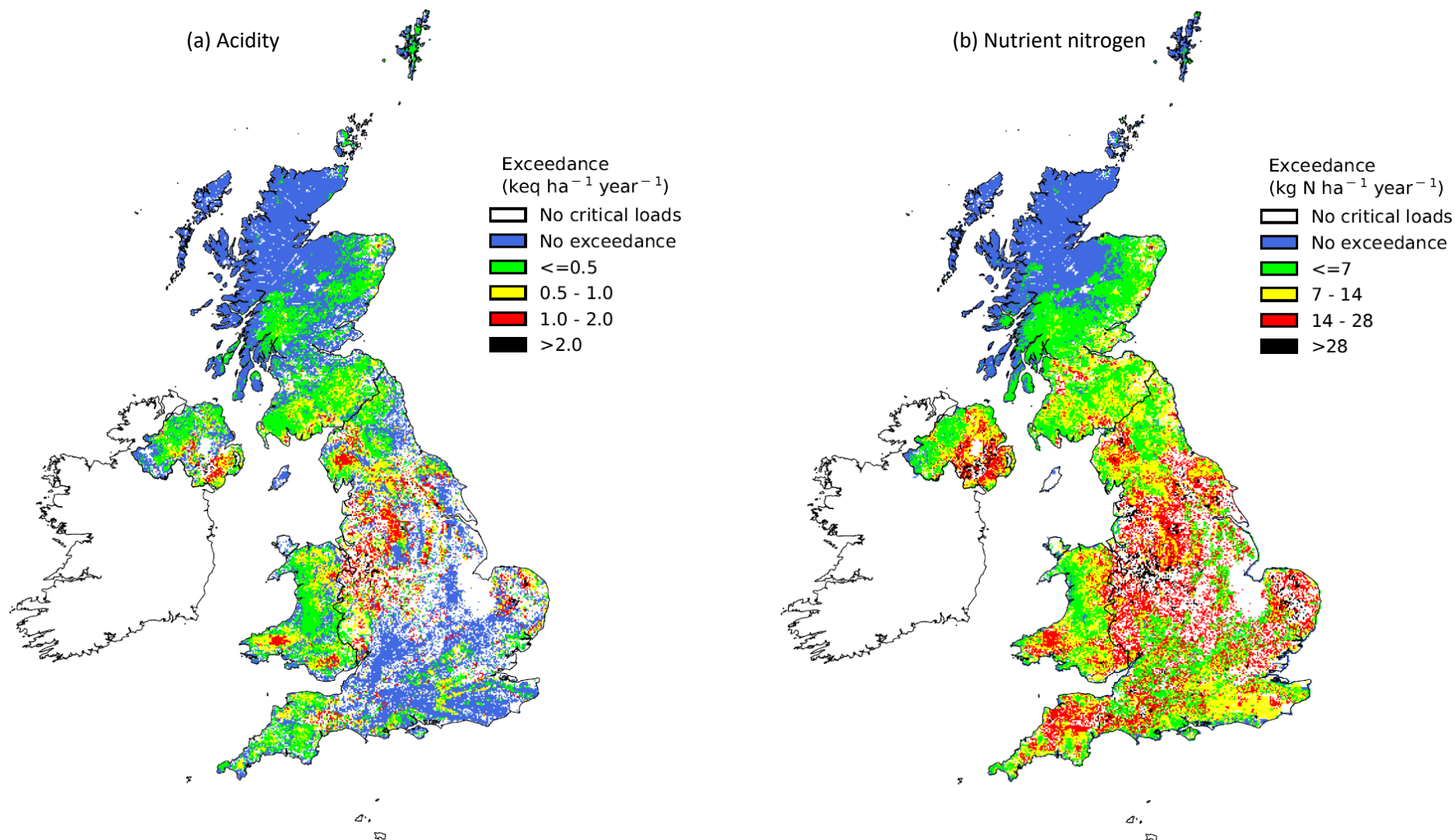


Figure 1.5: Average Accumulated Exceedance (AAE) in 2016-18 of critical loads for a) acidity and b) nutrient nitrogen. Although the legends for the two maps are given in different units, the class intervals are the same (i.e. $7 \text{ kg N ha}^{-1} \text{ year}^{-1}$ is equal to $0.5 \text{ keq ha}^{-1} \text{ year}^{-1}$).

Section 2: Trends in critical loads exceedance by habitat and country

Acidity and nutrient N exceedances by habitat and country are updated annually using the latest 3-year rolling mean CBED deposition data. The summary statistics as described in Section 1.3.1 are made available to Defra and the Devolved Administrations and JNCC; the trends in the percentage area of habitats exceeded are, or have been, used for the following:

- JNCC: Biodiversity Indicator for assessing the pressures from air pollution
- <https://jncc.gov.uk/our-work/ukbi-b5a-air-pollution/>
- Defra: Environmental Statistics – Key Facts
<https://www.gov.uk/government/statistics/environment-statistics-key-facts>

The data used for the trends analysis are described briefly in Section 1 and summarised in Box 1 below; there are a few inconsistencies between years due to changes in methods used to derive deposition estimates, and some minor alterations to the acidity critical loads. This information should be taken into account when interpreting the trends results.

Box 1:

Data used for critical loads trends analysis

Critical loads data

Acidity: data as summarised in Section 1.1.1 of this report were used for all years except results prior to 2004-2006 where: (a) the acidity critical loads for the bog habitat were based on the dominant soil in each 1x1km grid square; later results use critical loads data that assume all areas of bog habitat occur on peat soils; (b) freshwater exceedances were based on catchment-weighted grid-average deposition; the later results are based on catchment-weighted ecosystem-specific deposition. Note that the freshwater results are based on critical loads for 1752 lake or stream sites across the UK, and therefore do not represent all waters in the UK.

Nutrient nitrogen: data as summarised in Section 1.1.2 of this report.

Deposition data

All results based on 5x5 km resolution “concentration based estimated deposition” (CBED) values averaged over a three year period. All data are based on a consistent methodology except:

- (a) Deposition data prior to 2001-2003 exclude nitric acid as the monitoring network for this pollutant was not in operation prior to this time.
- (b) Deposition data prior to 2002-2004 excludes aerosol deposition of NH_4 , NO_3 , SO_4 .
- (c) Data for 2004-06 onwards updated in February 2015 to correct for over-estimate of nitric acid deposition.

CBED moorland values are applied to non-woodland terrestrial habitats, and CBED woodland values are applied to woodland habitats.

Habitat area data

These are based on the habitat distribution maps generated for UK critical loads research (see Section 1.1 of this report). There was a small reduction in the area mapped for acidity for the bog habitat as a result of the change to the critical loads in 2008; results using the updated habitat area apply to all results from 2004-06 onwards.

The trends results are shown as both tables and simple plots; it is worth noting that while the percentage area exceeded for some habitats may not alter from one year to another, the AAE values fluctuate reflecting changes in the national deposition data.

2.1 Trends by country

Table 2.1 shows the total land area by country and the area of habitats sensitive to acidification and eutrophication to which critical loads have been applied; 28% of the UK land area has habitats mapped for acidity critical loads, and 29% for nutrient N. Freshwater habitats are also mapped for acidity, but statistics are reported separately.

Table 2.1: Total land area and terrestrial habitat areas mapped for critical loads by country.

Country	Land area (km ²) [#]	Terrestrial habitat areas mapped for acidity (km ²)	Area mapped for acidity as % of country	Habitat areas mapped for nutrient nitrogen (km ²)	Area mapped for nutrient nitrogen as % of country
England	132938	17526	13	19522	15
Wales	21225	6573	31	6837	32
Scotland	80239	42745	53	43200	54
NI	14130	3349	24	3467	25
UK	248532	70193	28	73027	29

[#]The UK and its countries: facts and figures. Office for National Statistics:

<http://webarchive.nationalarchives.gov.uk/20160105160709/http://www.ons.gov.uk/ons/guide-method/geography/beginner-s-guide/administrative/the-countries-of-the-uk/index.html>

2.1.1 Acidity results

The results for acidity (Table 2.2, Figure 2.1) show that the total percentage area of terrestrial habitats exceeding critical loads in the UK has declined by half, from 77.3% in 1996 to 38.8% in 2017. However, the area exceeded varies between countries (Table 2.2, Figure 2.2), due to: a) geographic location of different sensitive habitats across the country (see Section 2.2); b) variability in critical load values across the country – lower critical loads associated with habitats on more acid soils; and c) higher deposition found in central and south-west England, parts of Wales and Northern Ireland and south-west Scotland (Figure 1.1). The percentage area of habitats exceeded is lowest in Scotland in all years; however as shown in Table 2.1, slightly over 50% of Scotland has habitats mapped for acidity critical loads, and that means the actual areas exceeded are larger than in the other countries (e.g. 10,021 km² exceeded by 2017 deposition). Although only 13% of England has habitats mapped for acidity critical loads, 57.5% of their area is exceeded for 2017, equivalent to 10,085 km². The magnitude of exceedance across the UK, expressed as AAE (Table 2.3, Figure 2.1), has fallen by two-thirds from 0.78 keq ha⁻¹ year⁻¹ in 1996 to 0.20 keq ha⁻¹ year⁻¹ in 2016. The largest reductions in the exceedances were

in the 1990s, although the downward trend has continued in recent years. This pattern of exceedance is consistent with the trends in deposition (Section 1.2.1; Fig 1.2).

Table 2.2: Acid-sensitive terrestrial habitat area and percentage area of habitats where acidity critical loads are exceeded, by country and deposition dataset year. Areas include freshwater catchments, which are likely to include overlaps with terrestrial acid-sensitive habitats.

Year	Percentage acid-sensitive habitat area exceeded by country: <i>[total area (km²) acid-sensitive habitats by country]</i>				
	England	Wales	Scotland	NI	UK
	<i>[17526]</i>	<i>[6573]</i>	<i>[42745]</i>	<i>[3349]</i>	<i>[70193]</i>
1995-1997	77.2	95.7	74.4	79.8	77.3
1998-2000	72.9	91.3	57.2	70.1	64.9
1999-2001	73.2	91.6	56.2	69.7	64.4
2001-2003	73.7	91.3	46.8	70.3	58.8
2002-2004	73.7	91.6	48.8	72.2	60.1
2003-2005	73.2	92.2	48.4	69.9	59.8
2004-2006	67.9	90.2	52.3	71.0	60.6
2005-2007	67.1	90.0	50.3	71.5	59.2
2006-2008	65.3	88.0	44.2	71.6	54.9
2007-2009	64.6	86.1	35.7	72.4	49.4
2008-2010	64.2	83.5	34.2	72.7	48.2
2009-2011	64.8	83.3	36.8	74.1	49.9
2010-2012	63.8	82.7	34.9	70.7	48.3
2011-2013	63.1	83.2	33.5	72.4	47.4
2012-2014	62.1	82.1	33.4	70.1	46.9
2013-2015	61.4	81.4	34.0	69.9	47.0
2014-2016	60.9	80.9	31.9	67.1	45.4
2015-2017	58.7	78.6	24.6	63.8	40.1
2016-2018	57.5	77.5	23.4	61.4	38.8
Reduction in % area exceeded from 1996-2017	19.7	18.3	50.9	18.5	38.5

Table 2.3: Acidity Average Accumulated Exceedance (AAE in keq ha⁻¹ year⁻¹) by country and deposition dataset year.

Year	AAE (keq ha ⁻¹ year ⁻¹) by country:				
	England	Wales	Scotland	NI	UK
1995-1997	1.33	1.36	0.47	0.80	0.8
1998-2000	1.00	0.84	0.28	0.46	0.5
1999-2001	0.98	0.82	0.27	0.46	0.5
2001-2003	1.04	0.82	0.23	0.51	0.5
2002-2004	0.94	0.79	0.24	0.46	0.5
2003-2005	0.93	0.84	0.24	0.42	0.5
2004-2006	0.77	0.74	0.24	0.42	0.4
2005-2007	0.74	0.73	0.21	0.45	0.4
2006-2008	0.68	0.61	0.17	0.44	0.4
2007-2009	0.62	0.54	0.12	0.45	0.3
2008-2010	0.59	0.49	0.12	0.47	0.29
2009-2011	0.62	0.48	0.15	0.53	0.31
2010-2012	0.60	0.47	0.14	0.46	0.30
2011-2013	0.59	0.47	0.13	0.46	0.29
2012-2014	0.55	0.46	0.13	0.39	0.28
2013-2015	0.54	0.45	0.15	0.38	0.28
2014-2016	0.51	0.44	0.13	0.36	0.26
2015-2017	0.44	0.39	0.09	0.33	0.21
2016-2018	0.41	0.42	0.08	0.31	0.20
Reduction in AAE 1996-2017	0.92	0.94	0.39	0.49	0.57

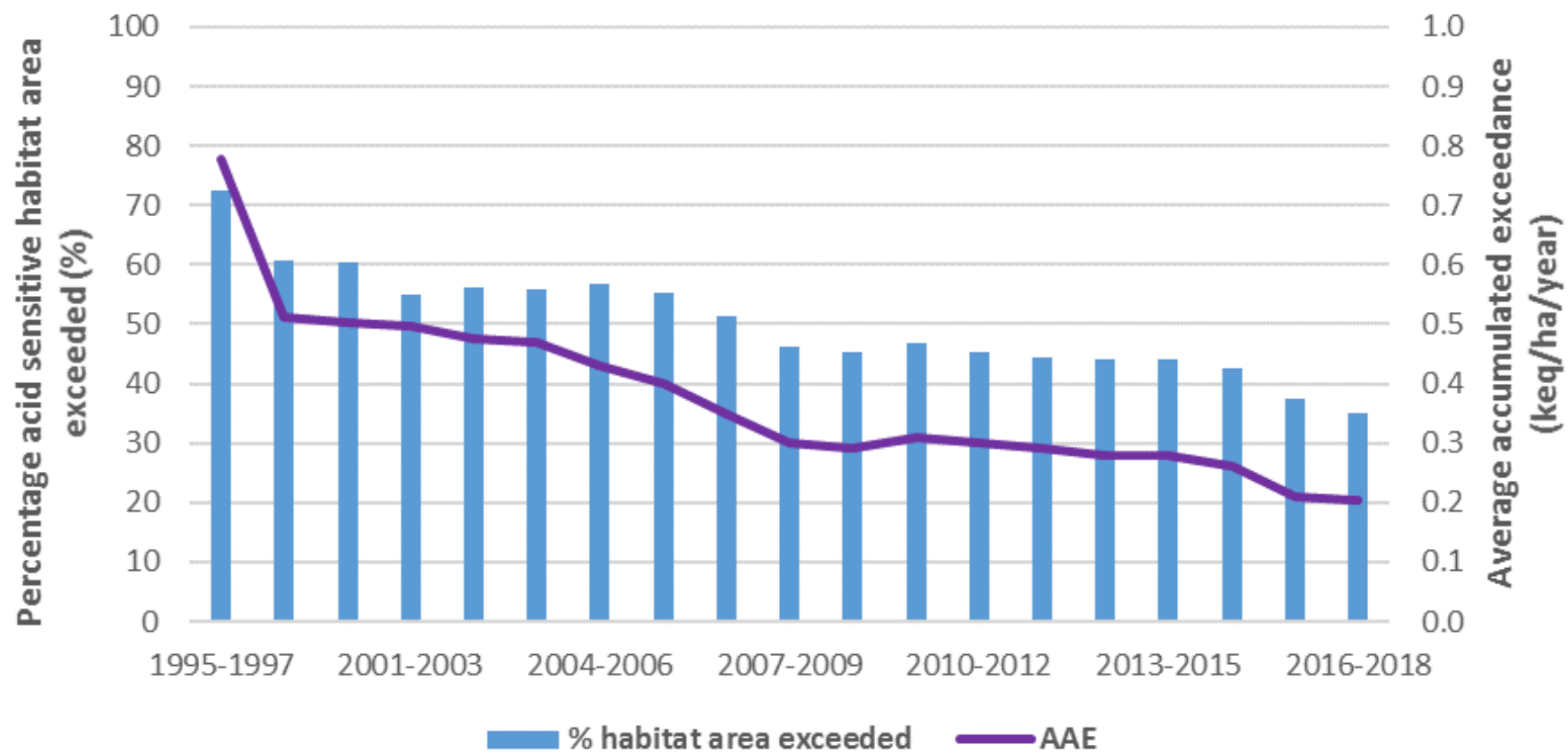


Figure 2.1: Acidity: Percentage area of acid-sensitive habitats with exceedance of acidity critical loads in the UK by year, and AAE in $\text{keq ha}^{-1} \text{ year}^{-1}$.

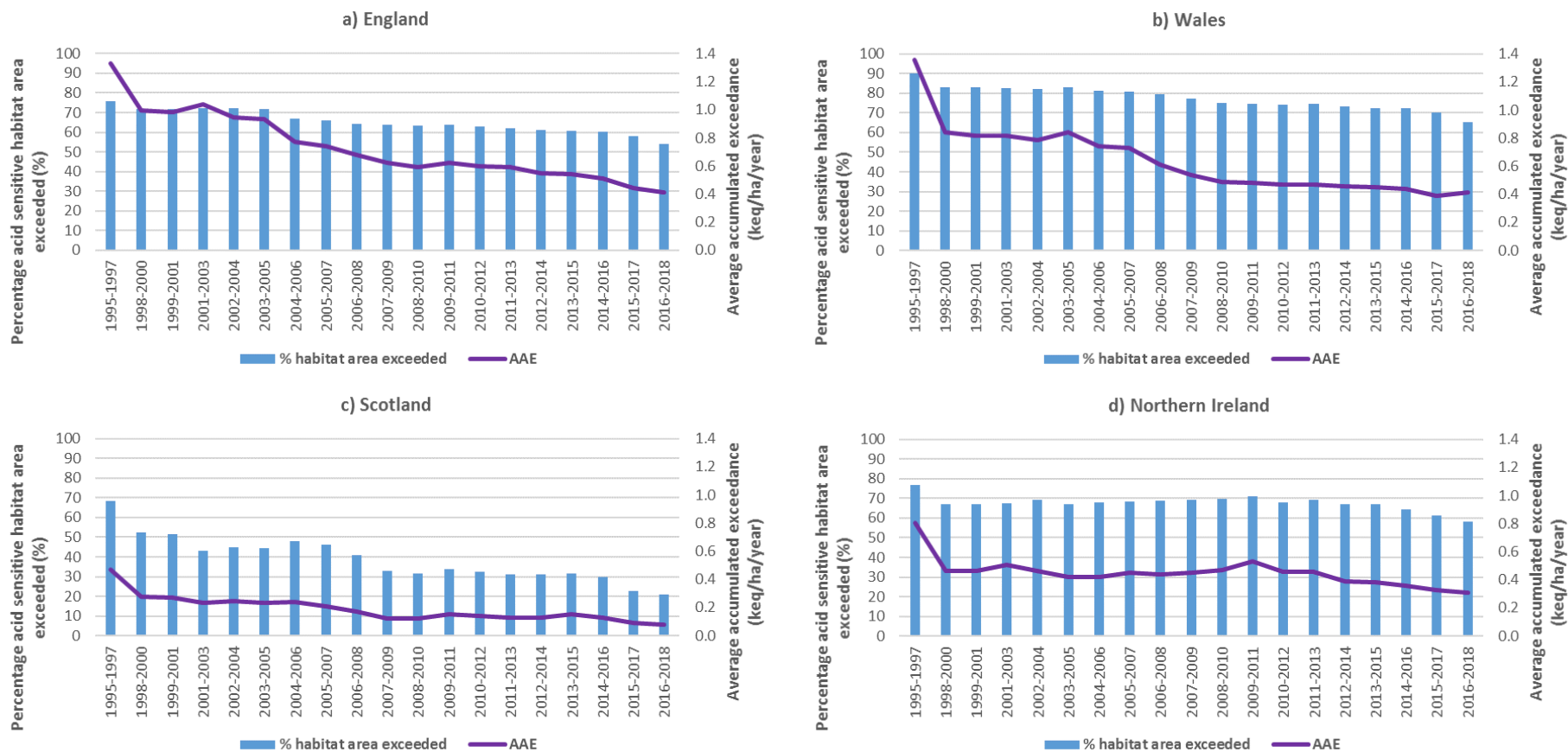


Figure 2.2: Acidity: Percentage area of acid-sensitive habitats with exceedance of acidity critical loads, by country and year, and AAE in keq ha⁻¹ year⁻¹.

2.1.2 Nutrient nitrogen results

The results for nutrient N (Table 2.4 and Figure 2.3) show a decline in the percentage area of habitats exceeded in the UK, from 75.0% in 1996 to 57.6% in 2017. The results for England and Wales remain above, or close to, 90% exceeded over the same time period (Table 2.4, Figure 2.4). Scotland shows the smallest percentage habitat area exceeded of all countries, but the area exceeded (14,688 km² for 2017) is similar to the area exceeded in England (18,565 km² in 2017). The results reflect the smaller reductions in N deposition over the last two decades compared to the reductions in S deposition, which helped reduce the exceedances of acidity critical loads.

Table 2.4: Nitrogen-sensitive habitat area and percentage area of habitats where nutrient nitrogen critical loads are exceeded, by country and deposition dataset year.

Year	Percentage habitat area exceeded by country: <i>[total area (km²) nitrogen-sensitive habitats by country]</i>				
	England <i>[19522]</i>	Wales <i>[6837]</i>	Scotland <i>[43200]</i>	NI <i>[3467]</i>	UK <i>[73027]</i>
1995-1997	98.3	98.0	59.4	92.6	75.0
1998-2000	97.6	92.5	48.9	80.0	67.5
1999-2001	97.7	91.1	50.9	82.5	68.7
2001-2003	97.8	93.5	47.7	85.4	67.1
2002-2004	97.6	93.3	50.2	86.3	68.6
2003-2005	97.5	94.1	50.6	83.8	68.8
2004-2006	96.7	93.2	52.9	84.8	69.9
2005-2007	96.5	93.6	53.6	86.4	70.4
2006-2008	96.1	92.9	49.0	86.8	67.5
2007-2009	96.4	91.7	41.8	88.7	63.3
2008-2010	96.5	89.7	40.7	89.7	62.6
2009-2011	97.0	89.8	44.5	91.4	65.0
2010-2012	96.5	89.6	41.4	88.5	62.9
2011-2013	96.0	90.3	40.7	89.9	62.5
2012-2014	95.9	89.4	40.9	86.4	62.3
2013-2015	95.8	88.5	42.8	87.4	63.4
2014-2016	95.7	88.5	40.8	85.1	62.1
2015-2017	94.8	88.0	34.7	84.2	58.1
2016-2018	95.1	87.6	34.0	81.2	57.6
Reduction in % area exceeded 1996-2017	3.3	10.5	25.4	11.5	17.4

The magnitude of the nutrient-nitrogen exceedance (expressed as AAE) across the UK has decreased by more than one-third, from 9.5 kg N ha⁻¹ year⁻¹ in 1996 to 5.2 kg N ha⁻¹ year⁻¹ in 2017 (Table 2.5, Figure 2.3). The AAE varied among regions, with lowest values in Scotland and highest in England (Table 2.5, Figure 2.4). The UK AAE decreased by 0.9 kg N ha⁻¹ yr⁻¹ in the decade between 2000 and 2010, and by a further 1.6 kg N ha⁻¹ yr⁻¹ between 2010 and 2017.

Table 2.5: Nutrient nitrogen Average Accumulated Exceedance (AAE in kg N ha⁻¹ year⁻¹) i.e. “Excess Nitrogen”, by country and deposition dataset year.

Year	AAE (kg N ha ⁻¹ year ⁻¹) by country:				
	England	Wales	Scotland	NI	UK
1995-1997	19.0	15.8	4.1	10.6	9.5
1998-2000	16.8	10.3	2.7	6.5	7.4
1999-2001	17.4	10.6	2.9	6.8	7.7
2001-2003	19.7	12.2	3.1	8.9	8.7
2002-2004	18.0	12.2	3.3	8.7	8.3
2003-2005	18.2	13.2	3.3	8.3	8.4
2004-2006	14.9	11.4	3.1	7.9	7.2
2005-2007	14.9	11.4	2.9	8.8	7.2
2006-2008	14.1	9.9	2.5	8.8	6.6
2007-2009	13.8	9.5	2.1	9.4	6.3
2008-2010	13.9	9.2	2.2	9.8	6.3
2009-2011	14.6	9.2	2.6	10.9	6.8
2010-2012	13.8	8.8	2.4	9.6	6.4
2011-2013	13.3	8.9	2.3	9.5	6.2
2012-2014	12.6	8.6	2.3	8.3	5.9
2013-2015	12.8	8.9	2.7	8.4	6.2
2014-2016	12.7	8.9	2.6	8.2	6.1
2015-2017	12.2	8.6	1.9	7.9	5.6
2016-2018	11.5	8.1	1.8	7.3	5.2
Reduction (kg N ha ⁻¹ yr ⁻¹) in AAE 1996-2017	7.5	7.7	2.4	3.4	4.3

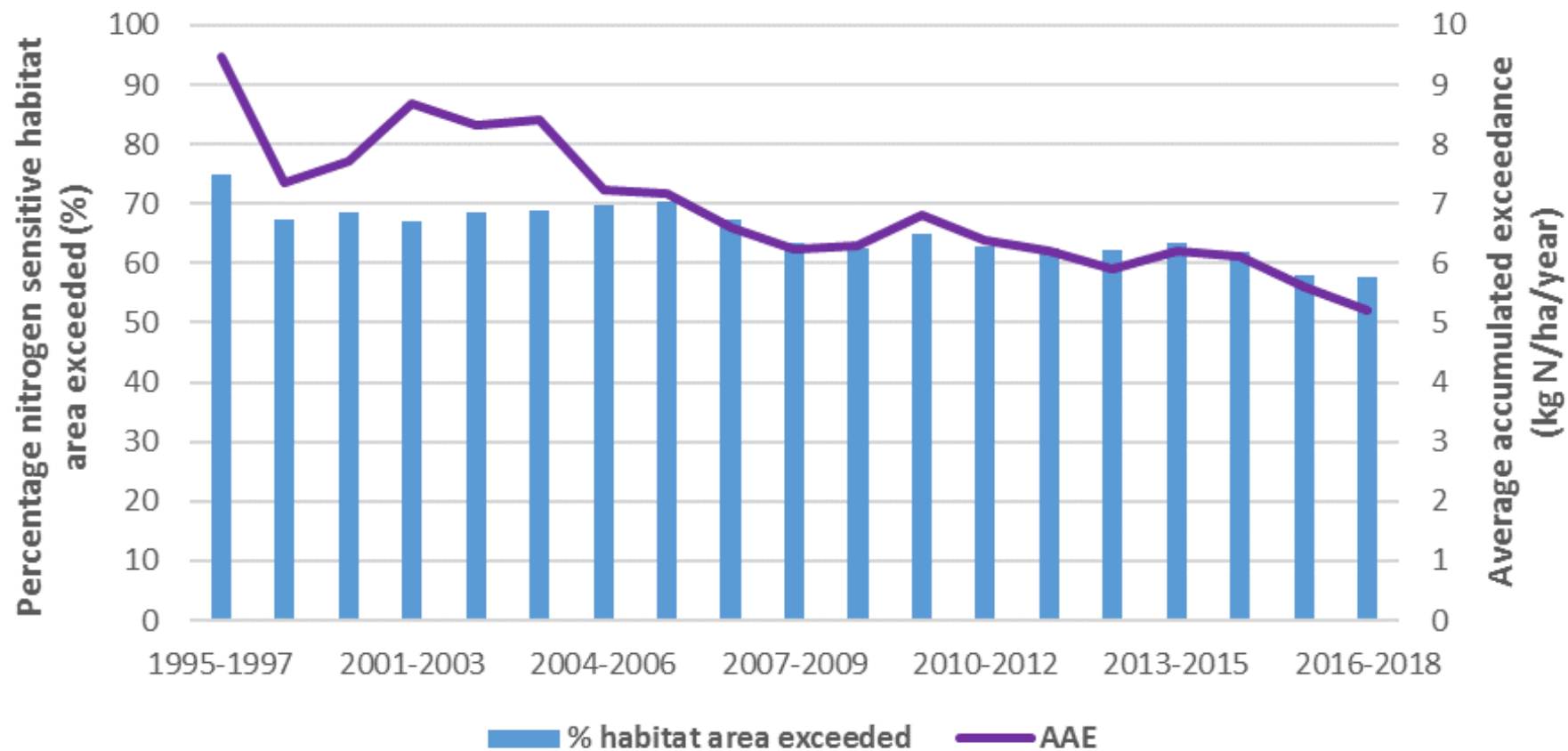


Figure 2.3: Nutrient nitrogen: Percentage area of nitrogen-sensitive habitats with exceedance of nitrogen critical loads in the UK by year, and Average Accumulated Exceedance (AAE in $\text{kg N ha}^{-1} \text{ year}^{-1}$) i.e. “Excess Nitrogen”.

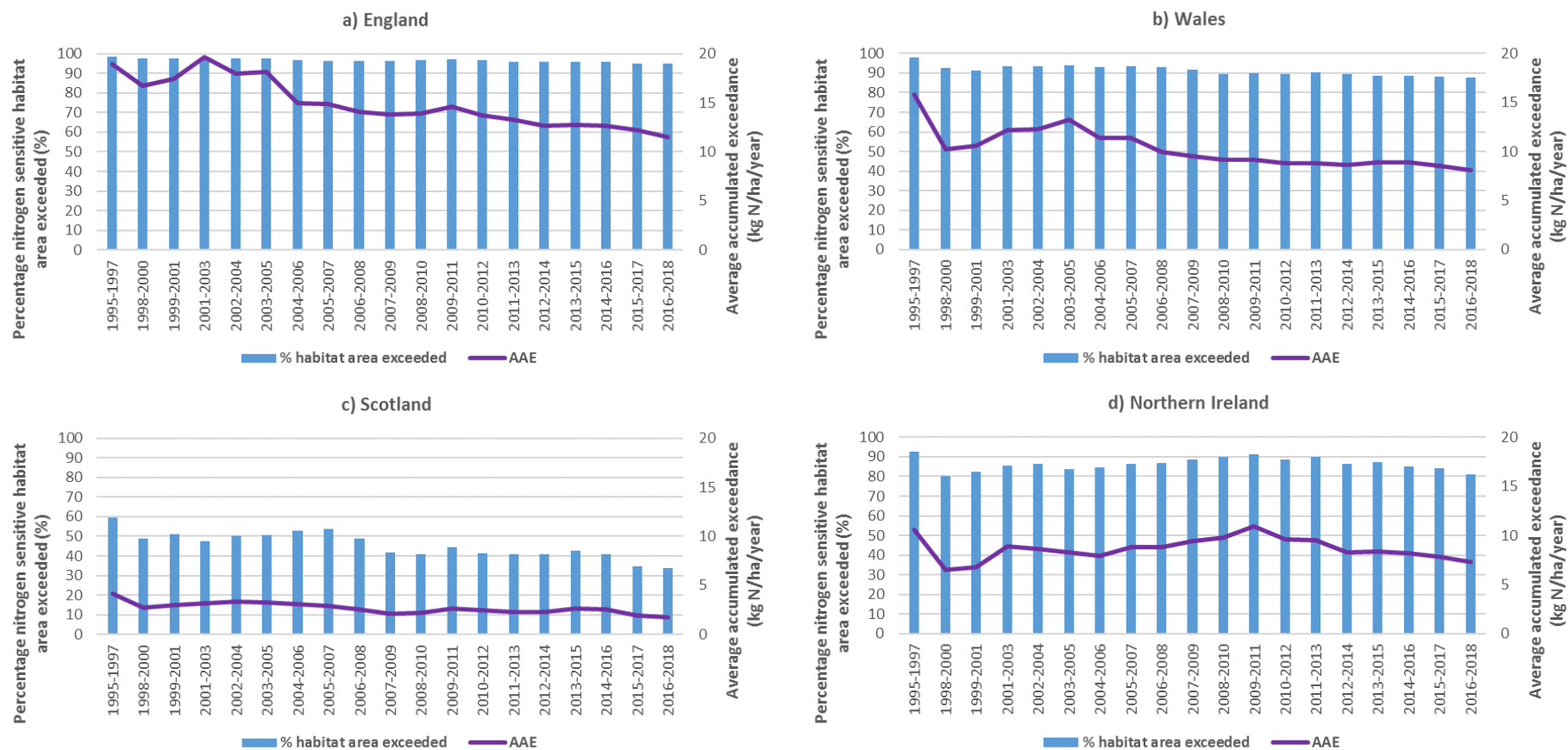


Figure 2.4: Nutrient nitrogen: Percentage area of nitrogen-sensitive habitats with exceedance of nitrogen critical loads, by country and year, and Average Accumulated Exceedance (AAE in $\text{kg N ha}^{-1} \text{ year}^{-1}$) i.e. “Excess Nitrogen”.

2.2 Trends by habitat

This section focuses on the results by habitat for the UK. Habitat results for individual countries are also calculated and tabulated in the Annexe to this report.

2.2.1 Acidity results

Although acidity critical loads are applied to calcareous grassland there has been no exceedance of these critical loads in any year, and therefore this habitat is excluded from Tables 2.6 and 2.7 and Figures 2.5 and 2.6. The habitats with the highest percentage area exceeded are acid grassland, montane, bog and managed woodlands (Table 2.6, Figure 2.5); these habitats also have some of the highest AAE values (Table 2.7, Figure 2.5). Of the habitats mapped for acidity, dwarf shrub heath is the habitat with the largest cover across the UK (10%), and also shows the largest decrease in the area exceeded (more than halved), from 70.3% (17,370 km²) in 1996 to 19.7% (4,867 km²) in 2017. The largest reductions in AAE over the same timescale are for woodland, acid grassland and montane habitats (Table 2.7).

2.2.2 Nutrient nitrogen results

There are six habitats with more than 80% of their area exceeded for nutrient N in all years (Table 2.8, Figure 2.6): calcareous grasslands and different woodland habitats (beech, oak, managed conifer and broadleaf and other unmanaged woodland). The largest reduction in the percentage area exceeded is for dune grassland from 70.6% in 1996 to 19.1% in 2017, however, this habitat only occupies <1% of the total area of N-sensitive habitats mapped. Another coastal habitat, saltmarsh, has virtually no exceedance in any year, due to a combination of its high critical load and the lower deposition in coastal areas. AAE is generally highest for the woodland habitats (Table 2.9, Figure 2.6), with the exception of Scots Pine, which is only found in Scotland where the magnitude of exceedance is generally lower due to the lower deposition in this region. The beech woodland is virtually 100% exceeded in all years, but the AAE has halved from 22.7 kg N ha⁻¹ year⁻¹ in 1996 to 11.4 kg N ha⁻¹ year⁻¹ in 2017.

Table 2.6: Acid-sensitive habitat area in the UK and percentage area of habitats where acidity critical loads are exceeded, by deposition dataset year.

Acid-sensitive habitat areas in the UK and percentage habitat area with exceedance of acidity critical loads:									
Parameter	Acid grassland	Dwarf shrub heath	Bog	Montane	Coniferous woodland (managed)	Broadleaved woodland (managed)	Unmanaged woodland	Freshwaters	All habitats
<i>Habitat area (km²)</i>	15336	24705	5454	3054	8374	7452	4011	7857	70193
1995-1997	92.0	70.3	88.0	95.8	79.4	75.8	69.5	29.9	77.3
1998-2000	84.9	49.5	78.8	91.3	69.9	68.4	57.2	24.2	64.9
1999-2001	84.7	47.9	76.1	93.4	70.2	69.1	58.2	23.9	64.4
2001-2003	79.5	40.7	61.6	82.5	66.5	69.6	58.5	21.9	58.8
2002-2004	80.3	42.3	60.1	89.4	68.4	70.8	60.1	21.3	60.1
2003-2005	80.4	41.5	59.3	92.9	68.2	70.1	59.1	21.7	59.8
2004-2006	82.5	45.1	71.7	96.3	64.2	61.5	48.3	21.7	60.6
2005-2007	81.9	41.5	76.4	94.4	63.6	60.5	46.7	21.3	59.2
2006-2008	78.9	35.4	73.3	85.6	60.5	57.2	43.4	20.6	54.9
2007-2009	73.9	28.5	63.7	71.4	57.1	55.9	42.1	19.0	49.4
2008-2010	72.2	28.1	57.9	70.1	55.6	55.6	42.0	18.5	48.2
2009-2011	74.8	30.6	54.9	71.6	58.0	57.0	43.3	18.9	49.9
2010-2012	73.0	29.3	54.4	65.3	56.7	55.0	41.5	19.0	48.3
2011-2013	73.4	28.5	50.1	62.3	56.2	53.5	40.5	18.8	47.4
2012-2014	72.6	27.8	55.5	62.7	54.9	51.6	38.5	18.6	46.9
2013-2015	73.0	28.1	52.4	65.0	55.8	51.0	37.9	18.2	47.0
2014-2016	71.1	26.4	50.1	62.1	54.7	50.5	36.8	18.5	45.4
2015-2017	65.4	20.7	44.0	43.8	51.1	48.1	34.0	15.6	40.1
2016-2018	64.7	19.7	45.0	41.9	49.0	45.3	31.2	13.7	38.8
Reduction in % area exceeded 1996-2017	27.3	50.6	42.9	54.0	30.4	30.4	38.4	16.3	38.5

Table 2.7: Acidity Average Accumulated Exceedance (AAE in kg N ha⁻¹ year⁻¹) by habitat for the UK by deposition dataset year.

AAE (keq AAE (keq ha ⁻¹ year ⁻¹) by habitat:									
Year	Acid grassland	Dwarf shrub heath	Bog	Montane	Coniferous woodland (managed)	Broadleaved woodland (managed)	Unmanaged woodland	Freshwaters	All habitats
1995-1997	1.15	0.47	0.76	0.81	1.13	1.20	0.87	0.36	0.78
1998-2000	0.80	0.28	0.53	0.57	0.68	0.88	0.58	0.23	0.51
1999-2001	0.77	0.26	0.50	0.59	0.68	0.90	0.61	0.21	0.50
2001-2003	0.70	0.24	0.46	0.60	0.72	1.01	0.68	0.18	0.50
2002-2004	0.67	0.22	0.41	0.64	0.74	0.94	0.65	0.17	0.48
2003-2005	0.68	0.21	0.39	0.62	0.73	0.94	0.65	0.17	0.47
2004-2006	0.68	0.22	0.44	0.66	0.58	0.66	0.44	0.17	0.43
2005-2007	0.64	0.19	0.45	0.53	0.56	0.65	0.43	0.16	0.40
2006-2008	0.57	0.16	0.42	0.39	0.49	0.56	0.36	0.13	0.35
2007-2009	0.49	0.12	0.34	0.28	0.43	0.53	0.34	0.12	0.30
2008-2010	0.47	0.12	0.33	0.28	0.42	0.52	0.34	0.11	0.29
2009-2011	0.51	0.14	0.35	0.31	0.46	0.56	0.36	0.12	0.31
2010-2012	0.50	0.13	0.35	0.26	0.43	0.51	0.32	0.12	0.30
2011-2013	0.51	0.13	0.34	0.25	0.42	0.47	0.30	0.12	0.29
2012-2014	0.48	0.12	0.33	0.25	0.39	0.43	0.27	0.12	0.28
2013-2015	0.49	0.13	0.34	0.26	0.41	0.42	0.26	0.11	0.28
2014-2016	0.47	0.12	0.31	0.23	0.39	0.41	0.25	0.11	0.26
2015-2017	0.38	0.08	0.25	0.14	0.32	0.38	0.23	0.09	0.21
2016-2018	0.35	0.07	0.23	0.12	0.28	0.33	0.20	0.08	0.20
Reduction in AAE 1996-2017	0.80	0.41	0.53	0.69	0.85	0.86	0.67	0.28	0.57

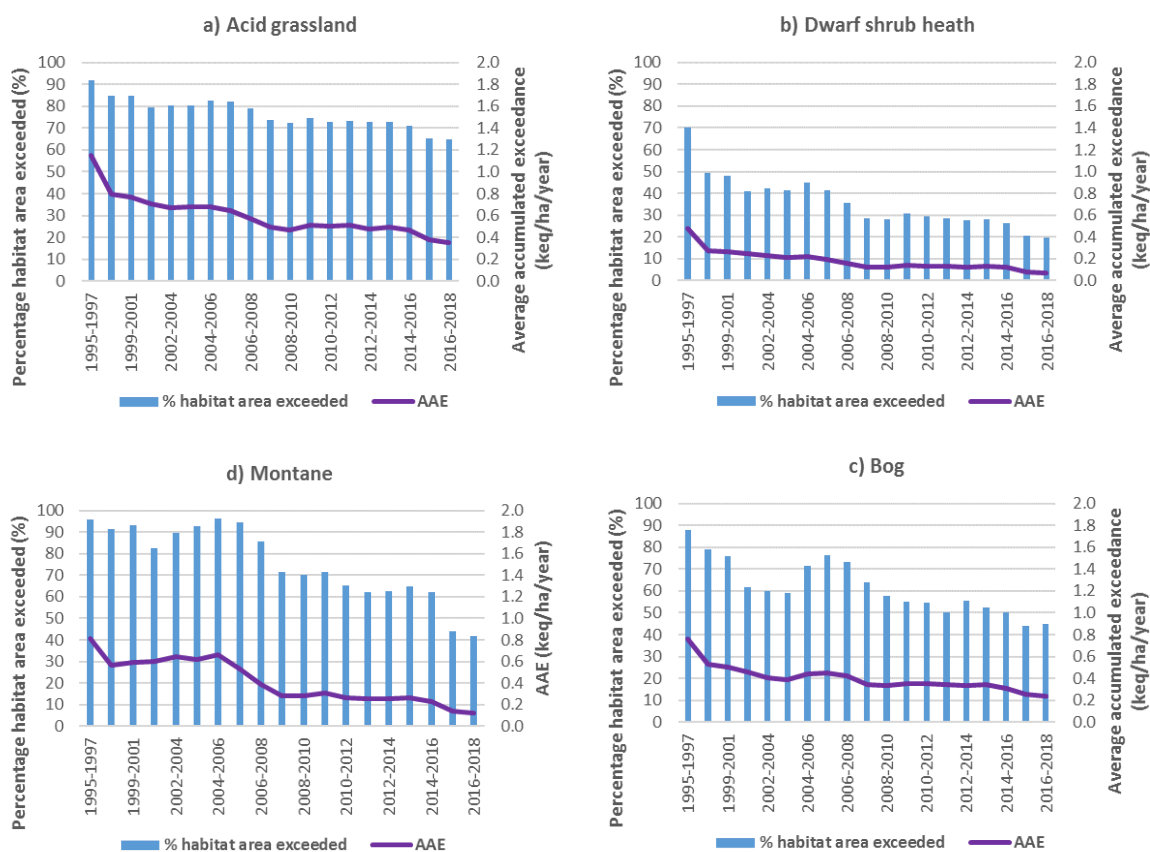


Figure 2.5: Acidity: Percentage area of habitats where acidity critical loads are exceeded, and acidity Average Accumulated Exceedance (AAE in $\text{kg N ha}^{-1} \text{ year}^{-1}$) for the UK by deposition dataset year.

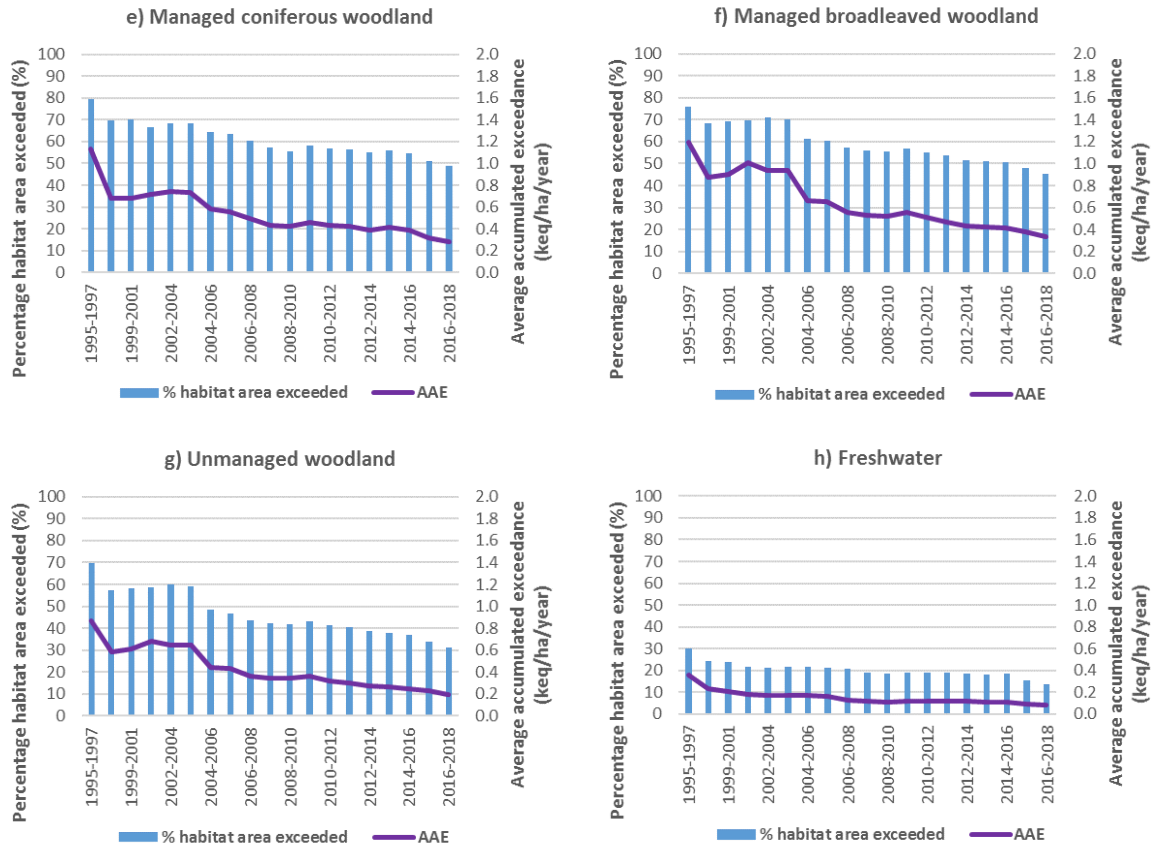


Figure 2.5 (continued): Acidity: Percentage area of habitats where acidity critical loads are exceeded, and acidity Average Accumulated Exceedance (AAE in kg N ha⁻¹ year⁻¹) for the UK by deposition dataset year.

Table 2.8: Nutrient-sensitive habitat area in the UK and percentage area of habitats where nutrient nitrogen critical loads are exceeded, by deposition dataset year.

Nitrogen-sensitive habitat areas in the UK and percentage habitat area with exceedance of nutrient nitrogen critical loads:													
Parameter	Acid grassland	Calcareous grassland	Dwarf shrub heath	Bog	Montane	Coniferous woodland (managed)	Broadleaved woodland (managed)	Beech woodland (unmanaged)	Acidophilous oak (unmanaged)	Scots Pine (unmanaged)	Other unmanaged woodland	Dune grassland	Saltmarsh
<i>Habitat area (km²)</i>	15235	3578	24826	5526	3129	8383	7482	719	1434	204	1761	323	427
1995-1997	72.6	97.5	59.1	54.2	96.7	95.4	98.4	100.0	98.9	61.1	96.5	70.6	2.0
1998-2000	61.3	95.5	49.0	45.1	95.7	90.5	97.4	100.0	97.0	38.9	95.1	44.8	1.1
1999-2001	61.4	95.5	51.1	45.0	97.1	92.8	97.8	100.0	98.1	52.3	95.5	46.9	2.1
2001-2003	63.1	95.5	47.8	44.6	89.0	90.6	97.4	100.0	96.1	49.7	95.5	41.9	1.0
2002-2004	64.3	93.9	49.8	44.9	92.6	93.0	98.1	100.0	98.2	66.5	95.7	36.1	1.1
2003-2005	64.8	93.9	50.6	45.2	90.5	92.1	98.0	100.0	98.1	67.8	95.7	33.5	1.1
2004-2006	64.8	90.6	54.5	45.9	96.6	90.2	97.5	100.0	95.6	58.0	95.5	29.3	0.8
2005-2007	64.2	89.4	54.3	54.6	96.2	91.0	97.4	100.0	95.5	52.6	95.6	31.8	0.8
2006-2008	60.0	87.7	49.5	55.4	95.5	89.4	97.1	100.0	93.8	34.2	95.5	31.1	0.8
2007-2009	56.3	89.6	43.9	47.1	82.7	86.9	96.7	100.0	89.8	30.7	95.2	29.2	0.9
2008-2010	55.7	91.2	42.7	45.6	81.0	86.1	96.7	99.9	88.5	30.5	95.1	34.7	0.9
2009-2011	61.1	92.3	45.0	45.8	82.1	88.2	97.0	99.9	91.5	32.4	95.3	37.6	0.9
2010-2012	59.7	90.4	42.2	44.8	74.4	86.5	96.8	99.9	87.7	26.2	94.7	34.0	0.9
2011-2013	60.8	87.6	41.6	43.1	71.2	86.4	96.8	100.0	88.6	24.2	95.0	29.2	0.8
2012-2014	59.1	88.2	41.6	45.4	74.2	85.6	96.6	99.9	87.6	26.0	95.0	25.3	0.7
2013-2015	60.8	87.5	43.0	45.6	78.4	86.0	96.7	100.0	88.5	26.4	95.0	26.9	0.8
2014-2016	59.5	87.2	41.5	44.5	72.3	84.9	96.4	99.8	87.6	24.0	94.8	26.4	0.8
2015-2017	54.4	86.2	36.8	40.9	62.0	82.0	95.9	99.9	83.0	20.8	93.9	22.4	1.0
2016-2018	54.0	84.4	36.4	40.7	58.9	81.9	95.6	99.8	82.8	18.8	93.4	19.1	0.9
Reduction in % area exceeded 1996-2017	18.6	13.1	22.7	13.5	37.8	13.5	2.8	0.2	16.1	42.3	3.1	51.5	1.0

Table 2.9: Nutrient nitrogen: Average Accumulated Exceedance (AAE in kg N ha⁻¹ year⁻¹) i.e. “Excess Nitrogen” by habitat for the UK by deposition dataset year.

AAE (kg N ha ⁻¹ year ⁻¹) by habitat:													
Year	Acid grassland	Calcareous grassland	Dwarf shrub heath	Bog	Montane	Coniferous woodland (managed)	Broadleaved woodland (managed)	Beech woodland (unmanaged)	Acidophilous oak (unmanaged)	Scots Pine (unmanaged)	Other unmanaged woodland	Dune grassland	Saltmarsh
1995-1997	6.3	7.6	4.5	5.3	5.5	16.8	24.5	22.7	19.9	3.3	23.2	2.7	0.0
1998-2000	3.9	7.3	3.1	3.8	4.4	12.1	21.8	19.5	16.4	2.0	21.1	1.6	0.1
1999-2001	4.0	7.7	3.2	3.9	5.0	12.8	22.7	20.3	17.3	2.8	22.0	1.7	0.1
2001-2003	4.5	8.9	3.6	4.4	5.7	14.4	25.8	22.9	18.8	3.2	25.2	1.5	0.0
2002-2004	4.2	6.9	3.4	3.8	6.1	14.7	24.5	22.1	19.1	4.0	23.8	0.9	1.7
2003-2005	4.4	6.9	3.4	3.8	6.1	14.8	24.8	22.6	19.4	3.7	24.1	0.9	1.7
2004-2006	4.4	5.7	3.4	3.9	6.4	12.2	19.3	15.8	15.5	2.6	18.7	0.8	0.0
2005-2007	4.3	5.7	3.3	4.0	5.5	12.3	19.4	15.4	15.4	2.3	19.1	0.8	0.0
2006-2008	3.9	5.2	3.0	4.0	4.3	11.5	18.2	14.0	14.2	1.9	18.1	0.7	0.0
2007-2009	3.5	5.3	2.6	3.5	3.3	10.8	18.3	14.4	13.9	1.6	18.5	0.8	0.0
2008-2010	3.4	5.5	2.6	3.5	3.3	10.9	18.5	14.6	13.9	1.7	18.9	0.9	0.1
2009-2011	3.9	5.9	3.0	3.9	3.6	11.8	19.4	15.2	14.7	1.9	19.9	1.0	0.1
2010-2012	3.7	5.3	2.8	3.7	2.9	11.2	18.1	13.9	13.7	1.6	18.4	0.9	0.1
2011-2013	3.7	4.9	2.8	3.7	2.9	11.0	17.3	13.3	13.5	1.5	17.5	0.8	0.0
2012-2014	3.5	4.7	2.7	3.6	3.0	10.5	16.3	12.4	12.7	1.6	16.4	0.6	0.0
2013-2015	3.8	4.6	2.9	3.8	3.4	11.2	16.5	12.3	13.1	1.7	16.7	0.7	0.0
2014-2016	3.8	4.7	2.8	3.7	3.1	10.9	16.6	12.1	12.8	1.5	16.7	0.7	0.0
2015-2017	3.2	4.4	2.3	3.2	2.1	10.0	16.4	12.1	12.2	1.0	16.7	0.6	0.0
2016-2018	2.8	3.7	2.2	3.1	2.0	9.4	15.4	11.4	11.5	0.8	15.7	0.5	0.0
Reduction in AAE from 1996 to 2017	3.4	3.9	2.3	2.2	3.5	7.4	9.1	11.3	8.4	2.5	7.4	2.2	0.0

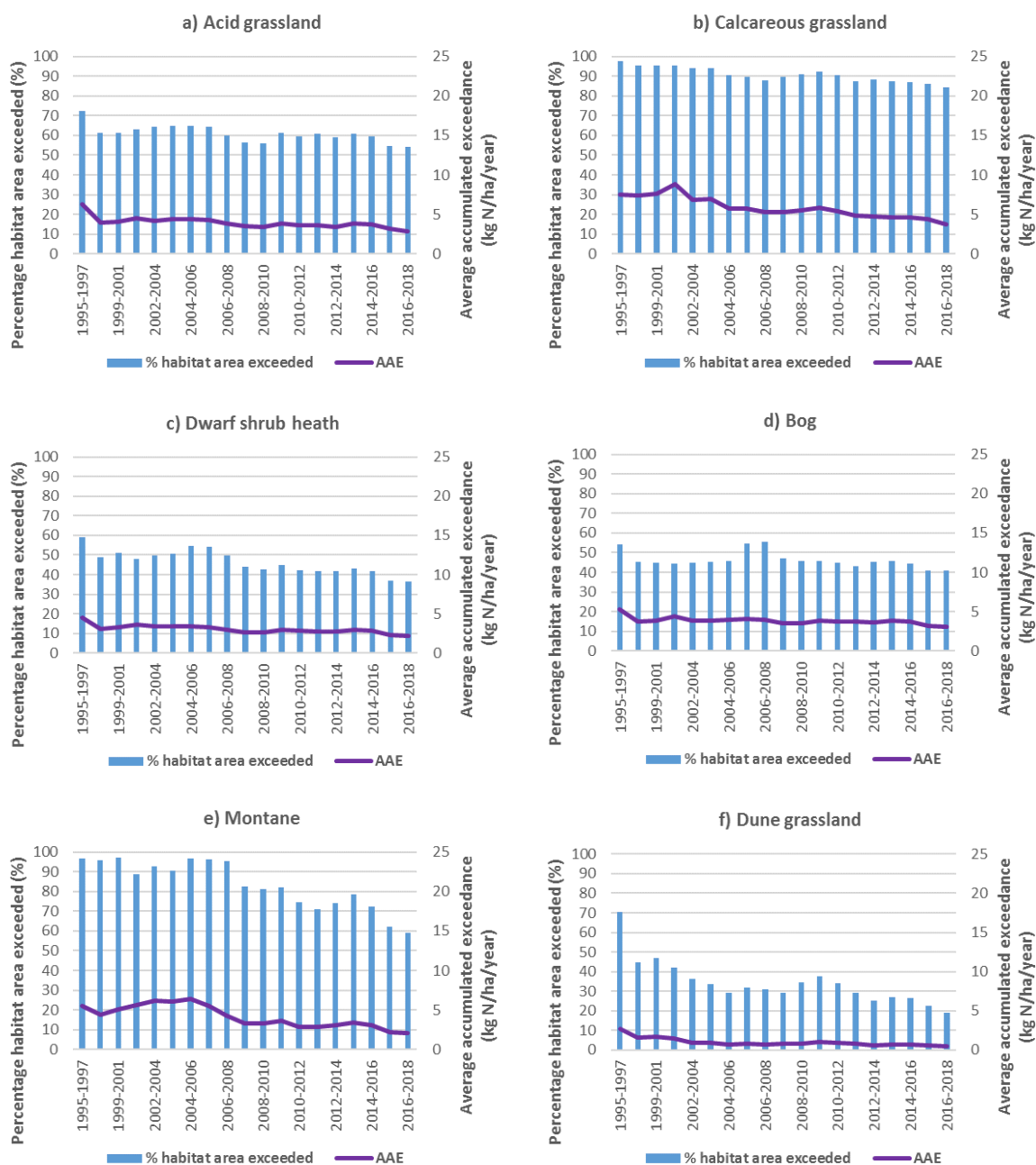


Figure 2.6: Nutrient nitrogen: Percentage area of habitats where nutrient nitrogen critical loads are exceeded and nutrient nitrogen Average Accumulated Exceedance (AAE in kg N ha⁻¹ year⁻¹) i.e. “Excess Nitrogen” in the UK by deposition dataset year.

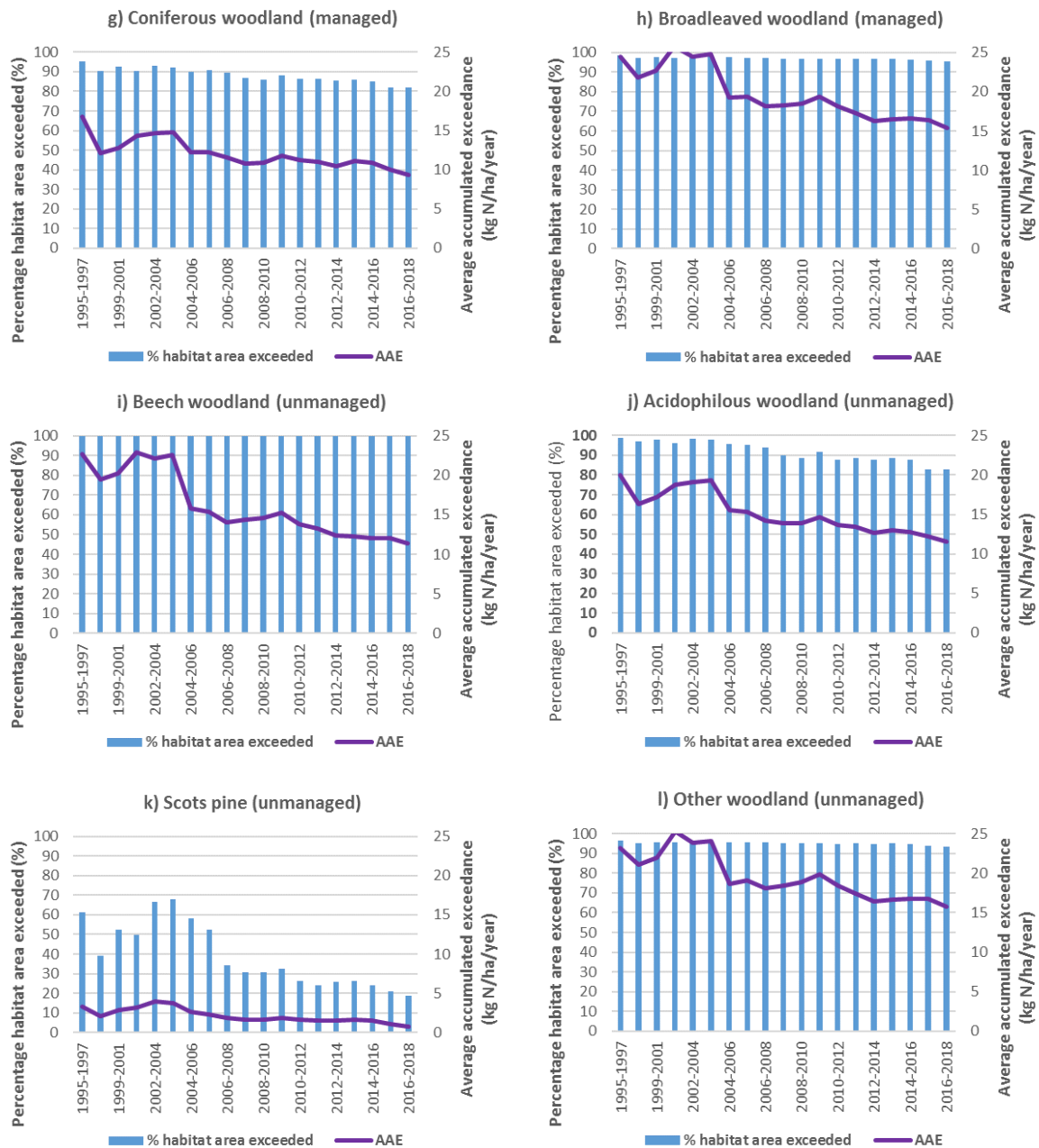


Figure 2.6 (continued): Nutrient nitrogen: Percentage area of habitats where nutrient nitrogen critical loads are exceeded and Average Accumulated Exceedance (AAE in $\text{kg N ha}^{-1} \text{ year}^{-1}$) i.e. “Excess Nitrogen” in the UK by deposition dataset year.

Section 3: Site-relevant critical loads and their exceedances

This section of the report focuses on the application of critical loads to sites designated for their nature conservation importance, hereafter referred to as site-relevant critical loads (SRCL), and their exceedances. The critical loads are based on the same methods applied to UK acid- and N-sensitive habitats described in Section 1 of this report, and are applied to acid- and N-sensitive features within the designated sites. Exceedances of critical loads are also calculated in the same way as the habitats (Section 1) and also based on UK 5x5 km CBED deposition, however, some different metrics are used to describe the exceedance results for SRCL and are explained below.

3.1 Overview of site-relevant critical loads

Site relevant critical loads (SRCL) have been applied to three types of statutory protected sites:

- Special Areas of Conservation (SACs) are protected sites designated under the EC Habitats Directive. Annexes I and II of the Directive identify the habitats and species (excluding birds) to be protected; 78 Annex I habitat types and 41 species are believed to occur in, or be native to the UK.
- Special Protected Areas (SPAs) are sites classified under the EC Birds Directive to protect rare and vulnerable birds (as listed in an Annex to the Directive) and regularly occurring migratory species.
- Sites of Special Scientific Interest (SSSIs in England, Wales and Scotland) and Areas of Special Scientific Interest (ASSIs in Northern Ireland) provide statutory protection to the UK's flora and fauna. There are additional SSSIs designated for geological or physiographic features but these are not included in the SRCL assessments.

Digital boundaries for all sites in the UK have been collated by JNCC, together with tables identifying the designated feature habitats and species associated with each site, but no digital information is currently available on the spatial area of each feature within each site. ***Therefore, for the purposes of the national SRCL work described here, it is assumed that all features recorded for a site, occur across the entire site area. To avoid double counting the area exceeding critical loads for sites with more than one designated feature, the maximum area exceeded for any feature is used when summarising results to the site and country levels (Section 3.2).***

To assign SRCL, the first step is to consider if the interest feature is potentially sensitive to acidification and/or eutrophication. Specialists within Natural England, Scottish Natural Heritage and CEH have used expert judgement to determine this (SNIFFER, 2007). For SPAs where the features are bird species, the broad habitats the birds depend upon for feeding, breeding and roosting are considered.

To assign critical loads to the habitat features of designated sites it is necessary to link the different habitat classifications used. Acidity critical loads are mapped by broad habitat and empirical critical loads of N are based on the European Nature Information System (EUNIS) habitat classification. Look-up tables developed by (Moss and Davies, 2002) and available from the JNCC website (<http://jncc.defra.gov.uk/page-1425>) enable linkages to be made between:

- Annex I habitats and EUNIS classes
- Annex I habitats and broad habitats

- EUNIS habitats and broad habitats

Using the look up tables the most appropriate EUNIS class and broad habitat class can be assigned to each interest feature. It should be noted that some sites may contain features sensitive to acidification and/or eutrophication for which no appropriate critical loads are available.

The critical loads assigned to the habitat features are based on the same methods and data as those outlined in Section 1.1 of this report. However, the national critical load maps are based on national scale data sets appropriate for national scale critical load and critical level assessments. This means they may not include all small areas of sensitive habitats or some coastal habitats; therefore some designated sites and/or feature habitats may not be included in the areas mapped nationally for critical loads. To overcome this, for SRCL a separate database of national critical loads for terrestrial habitats was created, that provides critical loads for every 1x1km square in the UK whether the habitat is known to exist there or not. The appropriate SRCL can then be extracted for terrestrial habitat features of each designated site; the SRCL does not include any acidity critical loads for freshwater habitats. For further information refer to the “Methods” report (Hall et al., 2015).

For nutrient N the empirical critical loads approach is applied to designated feature habitats sensitive to N. The critical load value applied to each habitat are the “Recommended” values agreed by habitat specialists for Article 17 reporting. For more information refer to <http://www.apis.ac.uk/indicative-critical-load-values> and to Hall et al. (2015).

3.2 Overview of SRCL exceedance metrics

Exceedances are calculated separately for SACs, SPAs and SSSIs, for all site features that critical loads and deposition data can be assigned to (Hall et al., 2015). Metrics are calculated by:

a) Feature (within each site):

- Exceedance
- Exceeded area[#]
- Accumulated Exceedance (AE)(i.e. exceedance * exceeded area)
- Average Accumulated Exceedance (AAE)(i.e. AE / total site area)

b) Site:

- Total number of features with SRCL
- Number and percentage of features with exceedance of SRCL.
- Maximum area exceeded^{##} for any feature within a site
- Maximum AE for any feature within a site
- Maximum AAE for any feature within a site

c) Country:

- Total number of sites
- Total number and percentage of sites with SRCL for one or more features
- Total number of features with SRCL
- Total number and percentage of sites with exceedance of SRCL for one or more features

- Total number and percentage of features with exceedance of SRCL
- Total area of all sites
- Total area of all sites with SRCL
- Maximum exceeded area^{###}
- Maximum AE calculated as the sum of the maximum AE for all sites
- Maximum AAE; calculated from the country maximum AE and total area of all sites (with SRCL) within a country.

Feature exceeded area: If the critical load is exceeded and the deposition values are constant across the whole site, the exceeded area equals the site area; if the deposition values vary across the site (e.g. as a result of the site crossing the boundaries between different 5x5km grid squares with different deposition values), then the exceeded area will be the sum of the 1x1 km portions of the site where the deposition exceeds the critical load.

Site maximum exceeded area: is set to the maximum exceeded area for any feature within a site.

Country maximum exceeded area: is calculated as the sum of the site maximum exceeded areas for all sites within a country.

The sections below summarise the key results by country, based on the CBED deposition (Section 1.2) for 1996 to 2017. ***Note that the summary statistics and maps may present the “worst” case, since they are based on sites where at least one feature is exceeded; other features within a site may have a smaller exceedance, or not be exceeded. In addition, the AAE results are based on the maximum exceedance of any feature within a site.***

3.2.1 Acidity results

The trends in acidity critical load exceedances are summarised in Tables 3.1-3.3 and present the percentage of sites (with SRCL) by country, where the SRCL is exceeded for one or more features, together with the maximum AAE.

The percentage of SACs with critical load exceedance decreased between 1996 and 2017 by ~5% in Wales and NI and 41.7% in Scotland, while the AAE fell by between 60% (NI) to over 80 % (Scotland). These trends reflect the changing patterns of acid deposition over this time period. For SPAs the largest reductions in the percentage of exceeded sites were 43.0% (Scotland), 30.8% (Wales) and 30.0% (NI) accompanied by a roughly 80-90% reduction in their maximum AAE values. The reductions in England were slightly less: 15.9% reduction in percentage of exceeded sites, and 61% reduction in maximum AAE.

At the UK level, the trends results show:

(i) for SACs, the percentage of sites with acidity exceedance decreased from 91.0% in 1996 to 70.4% in 2017, and the maximum AAE fell by 69% from 1.51 keq ha⁻¹ year⁻¹ to 0.46 keq ha⁻¹ year⁻¹ over the same time period;

(ii) for SPAs, the percentage of exceeded sites fell by a third from 94.3% in 1996 to 63.4% in 2017, and the maximum AAE decreased by 70% from 1.11 keq ha⁻¹ year⁻¹ in 1996 to 0.34 keq ha⁻¹ year⁻¹ in 2017.

(iii) for SSSIs, the percentage of exceeded sites decreased from 77.6% in 1996 to 55.1% in 2017, and the maximum AAE fell by 71% from 1.18 keq ha⁻¹ year⁻¹ in 1996 to 0.34 keq ha⁻¹ year⁻¹ in 2017.

Maps of the maximum AAE per site (Figure 3.1) based on the latest CBED deposition (2017) show the highest exceedances mainly in northern England and parts of Wales and south-west England and southern Scotland. Some sites in the far north of Scotland, a few SACs and SPAs in southern England, and many small SSSIs across central and eastern England have no exceedance for any site feature.

Table 3.1: Trends in acidity exceedances for SACs; percentage of sites (with SRCL) with exceedance of SRCL for at least one feature, and maximum AAE of all sites/features: a) % of sites with SRCL with exceedance of SRCL for at least one feature; b) [maximum AAE $\text{keq ha}^{-1} \text{year}^{-1}$]. NR = Not recorded.

	England	Wales	Scotland	NI	Eng/Wales*	Eng/Scot*
Number of sites	231	85	236	54	7	3
Number of sites with SRCL for at least one feature	180	71	182	47	6	1
1995-1997	85.0 [2.36]	97.2 [1.87]	92.3 [0.66]	97.9 [1.32]	100.0 [NR]	100.0 [NR]
1998-2000	82.2 [1.80]	97.2 [1.29]	83.5 [0.42]	95.7 [0.76]	100.0 [NR]	100.0 [NR]
1999-2001	81.7 [1.83]	97.2 [1.31]	83.5 [0.44]	95.7 [0.78]	100.0 [NR]	100.0 [NR]
2001-2003	81.1 [1.89]	94.4 [1.31]	75.3 [0.41]	95.7 [0.87]	100.0 [NR]	100.0 [NR]
2002-2004	82.8 [1.77]	95.8 [1.27]	78.0 [0.43]	95.7 [0.77]	100.0 [NR]	100.0 [NR]
2003-2005	82.8 [1.75]	95.8 [1.33]	76.4 [0.42]	95.7 [0.71]	100.0 [NR]	100.0 [NR]
2004-2006	79.4 [1.50]	95.8 [1.08]	79.7 [0.42]	95.7 [0.70]	100.0 [NR]	100.0 [NR]
2005-2007	79.4 [1.45]	95.8 [1.05]	79.7 [0.38]	95.7 [0.73]	100.0 [NR]	100.0 [NR]
2006-2008	77.2 [1.35]	95.8 [0.90]	75.8 [0.31]	95.7 [0.71]	100.0 [NR]	100.0 [NR]
2007-2009	76.7 [1.21]	95.8 [0.82]	69.2 [0.22]	95.7 [0.72]	100.0 [NR]	100.0 [NR]
2008-2010	75.6 [1.16]	95.8 [0.77]	67.6 [0.22]	95.7 [0.75]	100.0 [NR]	100.0 [NR]
2009-2011	76.1 [1.20]	95.8 [0.75]	70.3 [0.23]	95.7 [0.79]	100.0 [NR]	100.0 [NR]
2010-2012	76.1 [1.17]	93.0 [0.75]	68.1 [0.21]	93.6 [0.72]	100.0 [NR]	100.0 [NR]
2011-2013	75.0 [1.18]	93.0 [0.75]	68.1 [0.19]	95.7 [0.72]	100.0 [NR]	100.0 [NR]
2012-2014	74.4 [1.15]	94.4 [0.73]	68.1 [0.19]	95.7 [0.66]	100.0 [NR]	100.0 [NR]
2013-2015	72.2 [1.13]	93.0 [0.67]	67.6 [0.19]	95.7 [0.63]	100.0 [NR]	100.0 [NR]
2014-2016	72.2 [1.07]	93.0 [0.65]	65.4 [0.17]	93.6 [0.60]	100.0 [NR]	100.0 [NR]
2015-2017	71.7 [0.92]	93.0 [0.58]	56.0 [0.12]	93.6 [0.56]	100.0 [NR]	100.0 [NR]
2016-2018	71.7 [0.83]	91.5 [0.57]	53.8 [0.09]	93.6 [0.54]	100.0 [NR]	100.0 [NR]
Reduction in % area exceeded from 1996 to 2017	13.3	5.6	38.5	4.3	0.0	0.0
[Reduction in AAE in same period]	[1.53]	[1.30]	[0.57]	[0.78]	[NR]	[NR]

* Some sites cross the England/Wales or England/Scotland border and have been assigned to these border areas. However, in calculating AAE each 1x1 km square (or part thereof) within each site has been assigned to a single country, so AAE results are calculated for individual countries only.

Table 3.2: Trends in acidity exceedances for SPAs; percentage of sites (with SRCL) with exceedance of SRCL for at least one feature, and maximum AAE of all sites/features: a) % of sites with SRCL with exceedance of SRCL for at least one feature; b) [maximum AAE keq ha⁻¹ year⁻¹]. NR = Not recorded.

	England	Wales	Scotland	NI	Eng/Wales*
Number of sites	78	17	145	14	3
Number of sites with SRCL for at least one feature	63	13	86	10	3
1995-1997	98.4 [1.73]	100.0 [1.85]	89.5 [0.45]	100.0 [1.09]	100.0 [NR]
1998-2000	98.4 [1.41]	100.0 [1.14]	72.1 [0.24]	100.0 [0.43]	100.0 [NR]
1999-2001	98.4 [1.39]	100.0 [1.21]	73.3 [0.24]	90.0 [0.41]	100.0 [NR]
2001-2003	98.4 [1.38]	84.6 [1.24]	62.8 [0.23]	70.0 [0.55]	100.0 [NR]
2002-2004	96.8 [1.24]	92.3 [1.25]	66.3 [0.23]	80.0 [0.32]	100.0 [NR]
2003-2005	96.8 [1.21]	92.3 [1.32]	65.1 [0.19]	80.0 [0.26]	100.0 [NR]
2004-2006	88.9 [1.08]	92.3 [1.01]	62.8 [0.19]	90.0 [0.27]	100.0 [NR]
2005-2007	90.5 [1.04]	92.3 [0.98]	66.3 [0.19]	80.0 [0.25]	100.0 [NR]
2006-2008	90.5 [0.99]	92.3 [0.77]	64.0 [0.16]	80.0 [0.25]	100.0 [NR]
2007-2009	90.5 [0.91]	92.3 [0.66]	55.8 [0.10]	80.0 [0.23]	100.0 [NR]
2008-2010	90.5 [0.87]	92.3 [0.62]	54.7 [0.09]	80.0 [0.25]	100.0 [NR]
2009-2011	88.9 [0.90]	92.3 [0.59]	58.1 [0.11]	80.0 [0.32]	100.0 [NR]
2010-2012	88.9 [0.89]	84.6 [0.59]	58.1 [0.09]	80.0 [0.27]	100.0 [NR]
2011-2013	87.3 [0.86]	84.6 [0.59]	54.7 [0.08]	90.0 [0.28]	100.0 [NR]
2012-2014	87.3 [0.86]	76.9 [0.58]	55.8 [0.08]	90.0 [0.21]	100.0 [NR]
2013-2015	87.3 [0.84]	76.9 [0.52]	53.5 [0.09]	90.0 [0.20]	100.0 [NR]
2014-2016	85.7 [0.81]	76.9 [0.50]	50.0 [0.08]	70.0 [0.16]	100.0 [NR]
2015-2017	85.7 [0.71]	69.2 [0.43]	48.8 [0.05]	70.0 [0.13]	100.0 [NR]
2016-2018	82.5 [0.67]	69.2 [0.39]	46.5 [0.04]	70.0 [0.12]	100.0 [NR]
Reduction in % area exceeded from 1996 to 2017	15.9	30.8	43.0	30.0	0.0
[Reduction in AAE in same period]	[1.06]	[1.45]	[0.41]	[0.97]	[NR]

* Some sites that cross the England/Wales have been assigned to this border area. No SPAs cross the England/Scotland border. However, in calculating AAE each 1x1 km square (or part thereof) within each site has been assigned to a single country, so AAE results are calculated for individual countries only.

Table 3.3: Trends in acidity exceedances for SSSIs (ASSIs in Northern Ireland); percentage of sites (with SRCL) with exceedance of SRCL for at least one feature, and maximum AAE of all sites/features: a) % of sites with SRCL with exceedance of SRCL for at least one feature, b) [maximum AAE $\text{keq ha}^{-1} \text{ year}^{-1}$]. No SSSIs cross the England/Wales or England/Scotland borders, so all SSSIs have been assigned to a single country.

	England	Wales	Scotland	NI
Number of sites	4115	1018	1452	291
Number of sites with SRCL for at least one feature	2924	676	905	178
1995-1997	71.8 [1.66]	91.4 [1.63]	85.1 [0.60]	82.0 [1.18]
1998-2000	68.0 [1.24]	80.9 [1.11]	76.1 [0.37]	75.3 [0.65]
1999-2001	68.2 [1.24]	81.2 [1.09]	75.8 [0.36]	75.3 [0.66]
2001-2003	67.9 [1.27]	79.6 [1.07]	69.7 [0.32]	75.3 [0.77]
2002-2004	66.5 [1.16]	81.8 [1.04]	70.1 [0.33]	77.0 [0.65]
2003-2005	66.3 [1.15]	82.0 [1.10]	69.1 [0.32]	75.8 [0.59]
2004-2006	62.7 [0.99]	79.1 [0.95]	69.8 [0.33]	74.7 [0.58]
2005-2007	62.3 [0.95]	79.4 [0.93]	70.1 [0.31]	75.8 [0.60]
2006-2008	60.7 [0.88]	78.6 [0.80]	67.2 [0.25]	75.3 [0.59]
2007-2009	60.2 [0.79]	77.5 [0.72]	62.9 [0.17]	75.3 [0.59]
2008-2010	60.0 [0.76]	76.0 [0.67]	61.2 [0.16]	75.8 [0.61]
2009-2011	60.1 [0.79]	76.0 [0.65]	63.2 [0.19]	78.1 [0.65]
2010-2012	59.3 [0.77]	74.7 [0.65]	61.8 [0.17]	76.4 [0.60]
2011-2013	58.2 [0.77]	74.9 [0.66]	59.1 [0.16]	77.0 [0.60]
2012-2014	57.7 [0.74]	74.0 [0.65]	58.9 [0.16]	74.2 [0.55]
2013-2015	56.6 [0.73]	73.8 [0.61]	58.7 [0.17]	74.2 [0.52]
2014-2016	55.8 [0.69]	72.6 [0.59]	56.7 [0.16]	73.6 [0.50]
2015-2017	55.2 [0.59]	71.0 [0.53]	49.6 [0.11]	73.6 [0.47]
2016-2018	53.6 [0.54]	68.0 [0.51]	46.7 [0.10]	72.5 [0.45]
Reduction in % area exceeded from 1996 to 2017 [Reduction in AAE in same period]	18.2 [1.11]	23.4 [1.12]	38.3 [0.50]	9.6 [0.73]

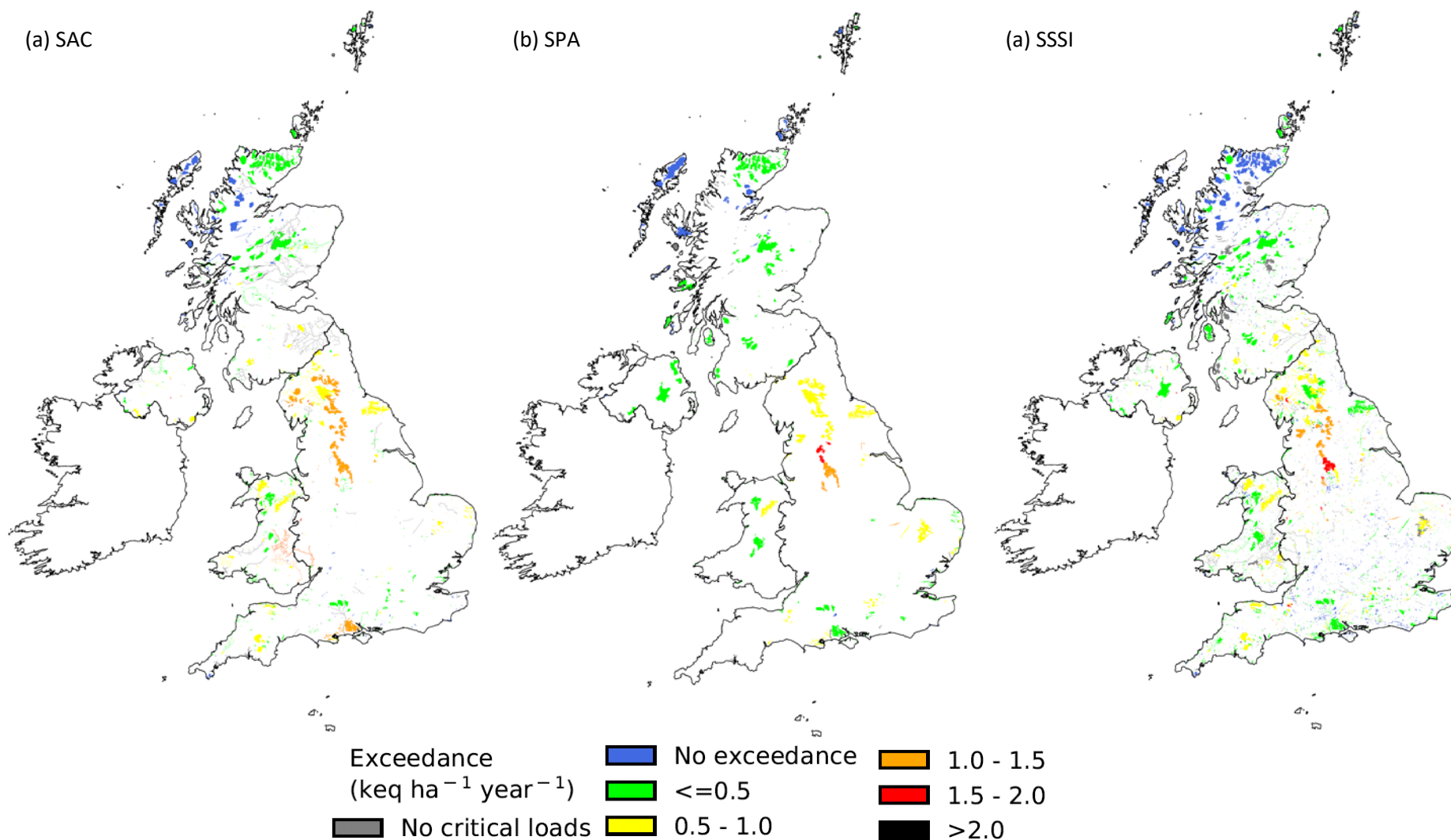


Figure 3.1: Average Accumulated Exceedance (AAE) of acidity critical loads by CBED deposition for 2016-18; maps show the maximum AAE for any feature within each site (other features may have lower or no exceedance).

3.2.2 Nutrient nitrogen results

The trends in nutrient N critical load exceedances from 1996 to 2017 are summarised in Tables 3.4-3.6. The reductions in the percentage of sites with exceedance of nutrient N critical loads for one or more features, and reductions in AAE, are smaller than the reductions seen for acidity, reflecting the smaller decreases in N deposition over time. Reductions vary by country for the different site types. In Northern Ireland there is no reduction in the percentage of SACs or SPAs with critical load exceedance and a 5.9% reduction in the percentage of SSSIs with exceedance, with similar decreases in AAE. The largest reductions in the percentage of sites with exceedance are greatest in Scotland for SACs (13.4% reduction) SPAs (20.2% reduction) and SSSIs (18.6% reduction), and also in Wales (21.4% reduction) for SPAs, though there are fewer SPAs in Wales compared to Scotland and England. There is at least a 25% reduction in the maximum AAE for SACs, SPAs and SSSIs in all countries.

At the UK level the trends results show:

- (i) for SACs, the percentage of sites with nutrient N exceedance decreased from 95.0% in 1996 to 87.9% in 2017, and the maximum AAE declined by 53.2% from 14.1 kg N ha⁻¹ year⁻¹ to 7.5 kg N ha⁻¹ year⁻¹ over the same time period.
- (ii) for SPAs, the percentage of exceeded sites decreased from 84% in 1996 to 68.0% in 2017, and the maximum AAE fell by 56.4% from 13.3 kg N ha⁻¹ year⁻¹ in 1996 to 7.5 kg N ha⁻¹ year⁻¹ in 2017.
- (iii) for SSSIs, the percentage of exceeded sites decreased from 94.9% in 1996 to 84.8% in 2017, and the maximum AAE reduced by 56.4% from 14.9 kg N ha⁻¹ year⁻¹ in 1996 to 8.4 kg N ha⁻¹ year⁻¹ in 2017.

Maps of the maximum AAE per site (Figure 3.2) based on the latest CBED deposition (2015-17) show few sites with no exceedance for any feature. Exceedances are widespread across all countries with generally lower exceedances in Scotland. The maximum AAE is above 7 kg N ha⁻¹ year⁻¹ for the majority of sites, with many sites having maximum AAE up to 28 kg N ha⁻¹ year⁻¹, and a few sites in central England with maximum AAE above this value.

Table 3.4: Trends in nutrient nitrogen exceedances for SACs; percentage of sites (with SRCL) with exceedance of SRCL for at least one feature, and maximum AAE of all sites/features: a) % of sites with SRCL with exceedance of SRCL for at least one feature; b) [maximum AAE kg N ha⁻¹ year⁻¹]. NR = Not recorded.

	England	Wales	Scotland	NI	Eng/Wales*	Eng/Scot*
Number of sites	231	85	236	54	7	3
Number of sites with SRCL for at least one feature	197	79	201	50	7	2
1995-1997	98.5 [20.5]	98.7 [14.1]	89.6 [7.3]	98.0 [14.4]	100.0 [NR]	50.0 [NR]
1998-2000	97.0 [17.4]	96.2 [10.3]	85.1 [5.9]	96.0 [9.8]	100.0 [NR]	50.0 [NR]
1999-2001	97.0 [18.3]	96.2 [10.9]	85.6 [6.3]	96.0 [10.3]	100.0 [NR]	50.0 [NR]
2001-2003	98.0 [19.8]	94.9 [11.9]	84.6 [6.3]	98.0 [12.7]	100.0 [NR]	50.0 [NR]
2002-2004	97.5 [18.4]	93.7 [11.7]	85.6 [6.6]	98.0 [11.3]	100.0 [NR]	50.0 [NR]
2003-2005	97.5 [18.6]	96.2 [12.2]	85.6 [6.4]	98.0 [10.9]	100.0 [NR]	50.0 [NR]
2004-2006	95.9 [15.8]	94.9 [9.7]	84.6 [6.2]	98.0 [11.0]	100.0 [NR]	50.0 [NR]
2005-2007	94.9 [15.7]	94.9 [9.7]	86.1 [6.5]	98.0 [11.9]	100.0 [NR]	50.0 [NR]
2006-2008	94.4 [15.0]	93.7 [8.8]	86.6 [6.1]	98.0 [11.8]	100.0 [NR]	50.0 [NR]
2007-2009	94.9 [14.1]	93.7 [8.5]	83.1 [5.1]	98.0 [12.3]	100.0 [NR]	50.0 [NR]
2008-2010	95.4 [14.0]	93.7 [8.4]	82.6 [4.8]	98.0 [12.7]	100.0 [NR]	50.0 [NR]
2009-2011	95.9 [14.5]	93.7 [8.4]	84.1 [4.9]	98.0 [13.1]	100.0 [NR]	50.0 [NR]
2010-2012	95.4 [14.0]	93.7 [8.2]	83.1 [4.6]	98.0 [12.2]	100.0 [NR]	50.0 [NR]
2011-2013	93.9 [13.9]	93.7 [8.2]	82.6 [4.4]	98.0 [12.2]	100.0 [NR]	50.0 [NR]
2012-2014	94.4 [13.6]	93.7 [8.0]	83.1 [4.6]	98.0 [11.5]	100.0 [NR]	50.0 [NR]
2013-2015	94.9 [13.7]	93.7 [8.1]	84.1 [4.7]	98.0 [11.2]	100.0 [NR]	50.0 [NR]
2014-2016	93.9 [13.5]	94.9 [8.0]	83.1 [4.4]	98.0 [11.0]	100.0 [NR]	50.0 [NR]
2015-2017	94.9 [12.5]	94.9 [7.7]	80.6 [3.4]	98.0 [10.4]	100.0 [NR]	50.0 [NR]
2016-2018	94.4 [11.7]	94.9 [7.5]	76.1 [2.8]	98.0 [9.6]	100.0 [NR]	50.0 [NR]
Reduction in % area exceeded from 1996 to 2017	4.1	3.8	13.4	0.0	0.0	0.0
[Reduction in AAE in same period]	[8.8]	[6.6]	[4.4]	[4.8]	[NR]	[NR]

* Some sites cross the England/Wales or England/Scotland border and have been assigned to these border areas. However, in calculating AAE each 1x1 km square (or part thereof) within each site has been assigned to a single country, so AAE results are calculated for individual countries only.

Table 3.5: Trends in nutrient nitrogen exceedances for SPAs; percentage of sites (with SRCL) with exceedance of SRCL for at least one feature, and maximum AAE of all sites/features: a) % of sites with SRCL with exceedance of SRCL for at least one feature, b) [maximum AAE kg N ha⁻¹ year⁻¹]. NR = Not recorded.

	England	Wales	Scotland	NI	Eng/Wales*
Number of sites	78	17	145	14	3
Number of sites with SRCL for at least one feature	72	14	124	12	3
1995-1997	97.2 [18.7]	100.0 [18.5]	74.2 [6.5]	83.3 [14.9]	100.0 [NR]
1998-2000	94.4 [17.4]	100.0 [13.4]	69.4 [4.9]	83.3 [8.9]	100.0 [NR]
1999-2001	97.2 [17.8]	100.0 [14.4]	69.4 [5.2]	83.3 [9.1]	100.0 [NR]
2001-2003	95.8 [18.7]	85.7 [15.9]	62.9 [5.2]	83.3 [13.6]	100.0 [NR]
2002-2004	93.1 [17.1]	100.0 [16.2]	66.9 [5.2]	83.3 [11.1]	100.0 [NR]
2003-2005	93.1 [17.2]	100.0 [17.0]	65.3 [4.9]	83.3 [10.7]	100.0 [NR]
2004-2006	93.1 [14.3]	92.9 [13.7]	66.9 [4.8]	83.3 [10.1]	100.0 [NR]
2005-2007	90.3 [14.2]	100.0 [13.7]	68.5 [5.2]	83.3 [11.1]	100.0 [NR]
2006-2008	88.9 [13.6]	100.0 [12.4]	69.4 [4.9]	83.3 [11.1]	66.7 [NR]
2007-2009	91.7 [13.3]	100.0 [11.9]	65.3 [4.0]	83.3 [11.6]	100.0 [NR]
2008-2010	91.7 [13.4]	100.0 [11.6]	62.9 [3.8]	83.3 [12.0]	100.0 [NR]
2009-2011	93.1 [13.8]	100.0 [11.3]	68.5 [4.0]	91.7 [13.3]	100.0 [NR]
2010-2012	90.3 [13.3]	92.9 [11.2]	62.9 [3.7]	83.3 [12.2]	100.0 [NR]
2011-2013	90.3 [12.9]	92.9 [11.3]	64.5 [3.4]	83.3 [11.8]	100.0 [NR]
2012-2014	88.9 [12.8]	78.6 [11.2]	62.9 [3.5]	83.3 [10.4]	66.7 [NR]
2013-2015	88.9 [12.9]	78.6 [11.1]	62.9 [3.7]	83.3 [10.5]	66.7 [NR]
2014-2016	88.9 [12.9]	78.6 [10.9]	61.3 [3.5]	83.3 [10.4]	100.0 [NR]
2015-2017	87.5 [12.2]	78.6 [10.6]	56.5 [2.6]	83.3 [10.2]	100.0 [NR]
2016-2018	87.5 [11.8]	78.6 [10.1]	54.0 [2.3]	83.3 [9.7]	66.7 [NR]
Reduction in % area exceeded from 1996 to 2017	9.7	21.4	20.2	0.0	33.3
[Reduction in AAE in same period]	[6.9]	[8.4]	[4.2]	[5.2]	[NR]

* Some sites that cross the England/Wales have been assigned to this border area. No SPAs cross the England/Scotland border. However, in calculating AAE each 1x1 km square (or part thereof) within each site was assigned to a single country, so AAE results are calculated for individual countries only.

Table 3.6: Trends in nutrient nitrogen exceedances for SSSIs (ASSIs in Northern Ireland); percentage of sites (with SRCL) with exceedance of SRCL for at least one feature, and maximum AAE of all sites/features: a) % of sites with SRCL with exceedance of SRCL for at least one feature; b) [maximum AAE kg N ha⁻¹ year⁻¹]. No SSSIs cross the England/Wales or England/Scotland borders, so all SSSIs have been assigned to a single country.

	England	Wales	Scotland	NI
Number of sites	4115	1018	1452	291
Number of sites with SRCL for at least one feature	2954	686	938	188
1995-1997	95.2 [20.9]	100.0 [20.7]	90.1 [7.0]	94.1 [16.3]
1998-2000	94.2 [18.1]	98.8 [15.3]	85.0 [5.3]	86.2 [10.9]
1999-2001	94.8 [18.8]	98.8 [16.0]	85.9 [5.7]	87.8 [11.3]
2001-2003	96.4 [20.4]	97.4 [17.6]	82.9 [5.6]	87.8 [15.2]
2002-2004	92.6 [18.8]	98.8 [17.8]	84.3 [5.9]	88.8 [14.0]
2003-2005	93.2 [19.1]	98.8 [18.7]	83.6 [5.7]	88.8 [13.6]
2004-2006	89.4 [16.2]	98.7 [15.7]	83.2 [5.6]	88.3 [12.8]
2005-2007	89.9 [16.1]	99.0 [15.7]	84.6 [5.8]	89.4 [14.1]
2006-2008	88.6 [15.3]	98.8 [14.2]	83.7 [5.3]	92.0 [14.0]
2007-2009	89.5 [14.6]	98.5 [13.7]	81.2 [4.3]	93.1 [14.7]
2008-2010	89.9 [14.6]	98.4 [13.4]	80.3 [4.1]	93.1 [15.1]
2009-2011	90.0 [15.2]	98.5 [13.4]	81.1 [4.4]	93.1 [16.2]
2010-2012	89.1 [14.6]	98.0 [13.0]	80.1 [4.1]	92.6 [14.8]
2011-2013	87.7 [14.4]	98.1 [13.2]	80.2 [4.0]	93.1 [14.5]
2012-2014	87.8 [13.9]	98.0 [12.9]	79.7 [4.1]	92.6 [13.2]
2013-2015	87.5 [14.1]	98.1 [12.8]	80.3 [4.3]	92.6 [13.3]
2014-2016	87.3 [13.6]	98.1 [12.3]	78.9 [3.0]	88.8 [13.1]
2015-2017	87.1 [13.2]	97.7 [12.2]	72.9 [3.1]	87.2 [13.1]
2016-2018	85.9 [12.5]	97.1 [11.9]	71.5 [2.9]	88.3 [12.1]
Reduction in % area exceeded from 1996 to 2017	9.3	2.9	18.6	5.9
[Reduction in AAE in same period]	[8.4]	[8.8]	[4.1]	[4.2]

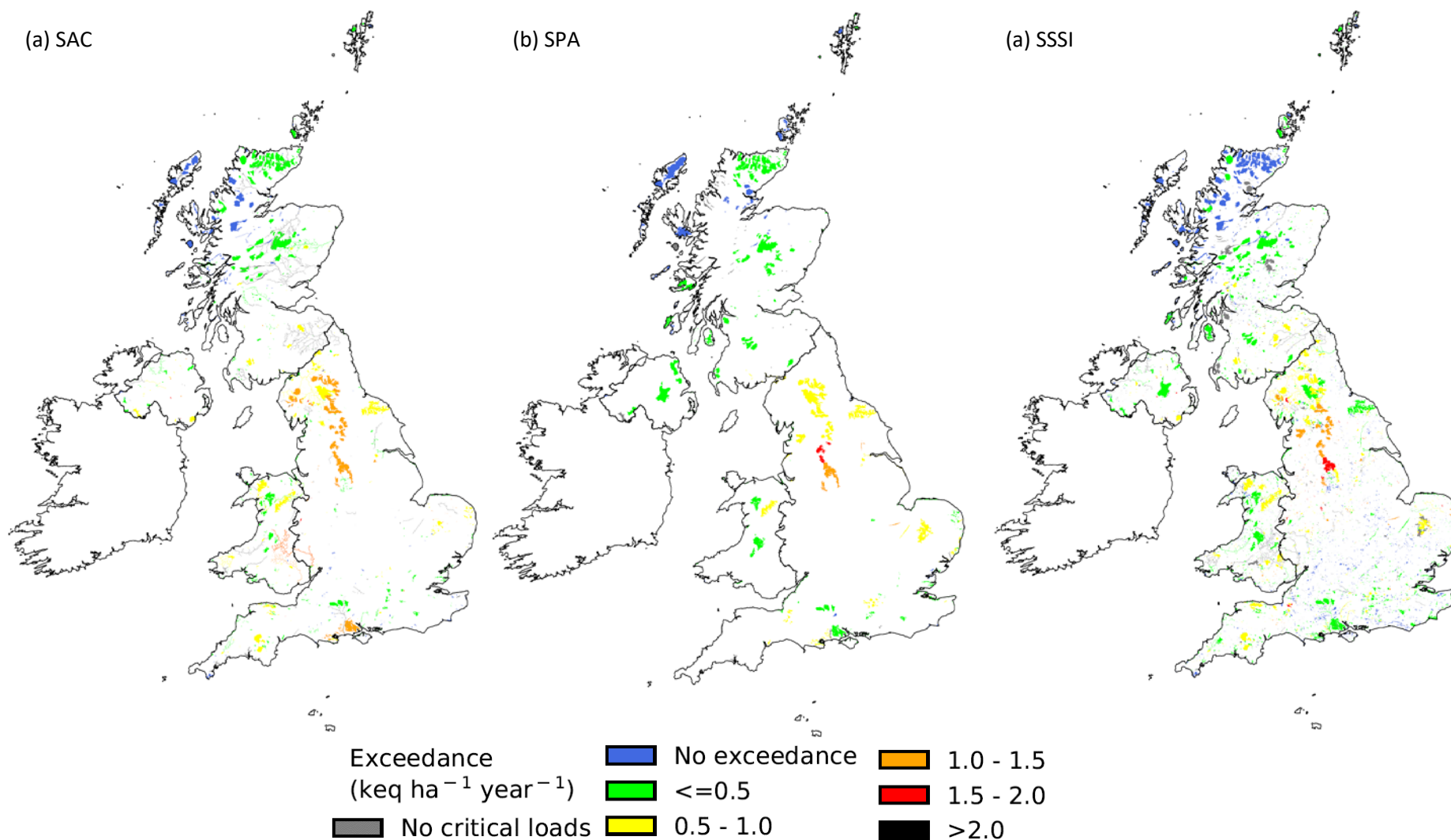


Figure 3.2: Average Accumulated Exceedance (AAE) of nutrient nitrogen critical loads by CBED deposition for 2016-18; maps show the maximum AAE for any feature within each site (other features may have lower or no exceedance).

Section 4: Critical levels and their exceedances

This section of the report focuses on the trends in exceedance of the ammonia critical levels set to protect: a) lichens and bryophytes; b) higher (i.e. vascular) plants. The trends are based on rolling 3-year mean ammonia gaseous concentrations, and only cover the period from 2009-11 to 2015-17 since ammonia concentration estimates are not available for earlier periods. For brevity, the three-year means are mainly referred to in this report using the middle year, for example “2010 to 2015” equates to “2009-11 to 2014-16”. It should be noted that the 1x1 km ammonia concentration data are routinely a year behind the deposition data, due to the timing of availability of the required input data, so the most recent concentration data used for this report are for the period 2015-17.

4.1 Critical levels of ammonia

These critical levels are defined as the concentration of ammonia above which direct adverse effects on sensitive vegetation may occur according to present knowledge (CLRTAP, 2017). Critical levels are also defined for other pollutants: sulphur dioxide, some N oxides, and ozone. These other pollutants are not considered here; further information on these can be found in CLRTAP (2017).

The critical levels for ammonia were reviewed and updated at an international workshop held in 2006 (UN-ECE, 2007) and approved by the Task Forces of the International Cooperative Programmes (ICPs) of the CLRTAP. Unlike the critical loads, critical levels are only defined for two taxonomic groups (Table 4.1), rather than a range of habitats. This means that critical levels of ammonia have not been applied to individual habitats or habitat features of designated sites in the UK. The critical level exceedance metrics used are described in Section 4.3.

Table 4.1: Critical levels of ammonia (CLRTAP, 2014)

Vegetation type	Critical level NH₃ [µg m⁻³]	Time period
Lichens and bryophytes (including ecosystems where lichens and bryophytes are a key part of the ecosystem integrity)	1	Annual mean concentration
Higher plants (including heathland, semi-natural grassland and forest ground flora)	3*	Annual mean concentration

*An explicit uncertainty range of 2-4 µg m⁻³ was set for higher plants; this is intended to be useful when applying the critical level in different assessment contexts (e.g. precautionary approach or balance of evidence).

4.2 Concentrations of ammonia

The UK Fine Resolution Atmospheric Multi-pollutant Exchange (FRAME, version 9-15-0) model (Dore et al., 2007; Fournier et al., 2004; Singles et al., 1998; Vieno et al., 2010) is used to provide 1x1 km resolution ammonia concentration data for the UK. This relatively high resolution is needed to spatially separate source (agricultural) areas from sink (natural ecosystems) areas (Hallsworth et al., 2010). Modelled ammonia concentrations are calibrated relative to annually averaged measurements from the UKEAP National Ammonia Monitoring Network, using the median bias to adjust the concentrations. Data from all stations in the monitoring network are used for the calibration, with the exception of one station very close to a point source that was not representative of the surrounding

area. FRAME requires annual total emissions for NO_x, NH₃ and SO_x, which are provided as both diffuse area emissions (on a 1x1 km grid) and as point source emissions. Emissions are compiled and processed from the National Atmospheric Emissions Inventory (NAEI, 2020). Other required inputs include wind-rose data (frequency and speed), land cover, precipitation and European boundary conditions. The FRAME ammonia concentrations are updated annually using the new emissions data from the NAEI.

4.3 Calculation of critical levels exceedance

The critical level exceedance metrics calculated for this Trends Report are:

- The percentage land area in England, Wales, Scotland, Northern Ireland and UK where ammonia concentrations exceed the critical levels.
- The percentage area of N-sensitive habitats in England, Wales, Scotland, Northern Ireland and UK where ammonia concentrations exceed the critical levels. The habitat areas are based on the habitat distribution maps used for mapping nutrient N critical loads (Section 1.1).
- The percentage of designated sites (SAC, SPA, SSSI) in England, Wales, Scotland, Northern Ireland and the UK, where ammonia concentrations exceed the critical levels anywhere across a site.

4.4 Trends in ammonia critical levels exceedance

This section summarises the results for each of the metrics described above.

4.4.1 UK land area with exceedance of ammonia critical levels

Ammonia concentrations exceed the critical level of $1 \mu\text{g m}^{-3}$ across more than 60% of the UK land area (Table 4.2); this varies spatially with <20% of Scotland, and more than 80% of England and Northern Ireland with ammonia concentrations above $1 \mu\text{g m}^{-3}$. The area of the UK with ammonia concentrations above $1 \mu\text{g m}^{-3}$ has decreased slightly from 63.9% in 2010 to 62.9% in 2016 (Table 4.2).

Table 4.2: Percentages of the UK land area where ammonia concentrations exceed critical levels.

Critical level ($\mu\text{g m}^{-3}$)	Concentration data years	% land area where ammonia concentrations exceed critical levels				
		England	Wales	Scotland	NI	UK
$1 \mu\text{g m}^{-3}$	2009-2011	88.9	58.9	19.7	85.6	63.9
	2010-2012	88.5	59.0	19.8	86.0	63.7
	2011-2013	86.9	57.6	19.4	86.7	62.7
	2012-2014	84.0	55.1	17.0	85.5	60.1
	2013-2015	85.3	56.3	17.8	87.5	61.3
	2014-2016	87.1	57.5	18.9	89.3	62.8
	2015-2017	87.9	56.3	17.9	90.8	62.9
Change in % area exceeded from 2010 to 2016		-1.0	-2.6	-1.8	+5.2	-1.0
$3 \mu\text{g m}^{-3}$	2009-2011	5.3	0.9	0.1	13.4	3.7
	2010-2012	5.5	0.9	0.2	14.7	3.9
	2011-2013	5.2	0.7	0.2	15.6	3.8
	2012-2014	3.6	0.4	0.1	12.4	2.7
	2013-2015	3.9	0.4	0.1	17.2	3.1
	2014-2016	5.3	0.9	0.1	23.0	4.3
	2015-2017	6.3	1.0	0.1	27.3	5.1
Change in % area exceeded from 2010 to 2016		+1.0	+0.1	0.0	+13.9	+1.4

The ammonia critical level of $3 \mu\text{g m}^{-3}$ is exceeded over a much smaller area of the UK, mostly <5%, with the exception of England and NI where 6.3% and 27.3%, respectively, of the land area was exceeded in 2016 (Table 4.2). The main areas of the UK where this critical level is exceeded are parts of Northern Ireland and west/central England, with smaller areas across other regions of England (Figure 4.1).

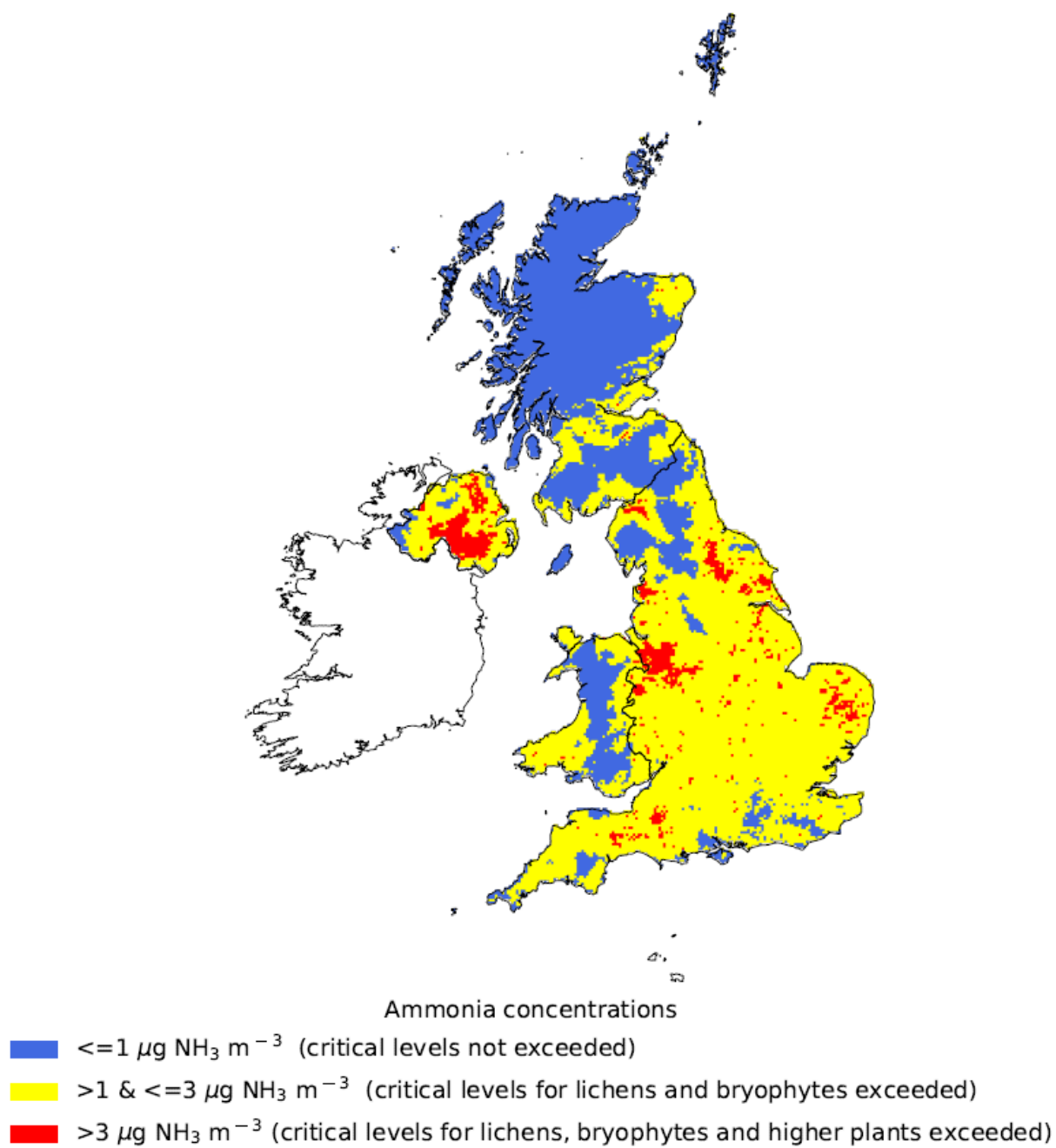


Figure 4.1: FRAME 1x1 km mean ammonia concentrations for 2015-17.

4.4.2 Nitrogen-sensitive habitats with exceedance of ammonia critical levels

One quarter of the mapped area of N-sensitive habitats in the UK receive ammonia concentrations above the critical level of $1 \mu\text{g m}^{-3}$ (Table 4.3). The results vary spatially across the UK depending on the variability in ammonia concentrations (see Figure 4.1), and the distributions of the different N-sensitive habitats. Although 59% of the total UK area of N-sensitive habitats is found in Scotland, because the ammonia concentrations are generally low in this part of the country (Figure 4.1) only 3.2% of the Scottish habitat area coincides with ammonia concentrations above $1 \mu\text{g m}^{-3}$ and there are very few areas in Scotland with concentrations above $3 \mu\text{g m}^{-3}$ (Table 4.3). The highest exceedances are seen in England and Northern Ireland, with ammonia concentrations above $1 \mu\text{g m}^{-3}$ for ~65-75% of their N-sensitive habitat areas and above $3 \mu\text{g m}^{-3}$ for ~2-9%. The percentage area of N-sensitive habitats in the UK with exceedance of the critical level of $1 \mu\text{g m}^{-3}$ has increased from 25.1% in 2010 to 25.4% in 2016. The differences between the years are small and mainly reflect fluctuations in ammonia concentrations from one year to the next due inter-annual variability in meteorology.

Table 4.3: Percentages of the area of nitrogen sensitive habitats in the UK where ammonia concentrations exceed critical levels of $1 \mu\text{g m}^{-3}$ and $3 \mu\text{g m}^{-3}$, by country.

		England	Wales	Scotland	NI	UK
<i>N-sensitive habitat area (km²)</i>		<i>19522</i>	<i>6837</i>	<i>43200</i>	<i>3467</i>	<i>73027</i>
$1 \mu\text{g m}^{-3}$	2009-2011	65.3	28.9	3.6	59.6	25.1
	2010-2012	64.4	29.5	3.6	60.9	25.0
	2011-2013	62.1	28.8	3.6	63.9	24.4
	2012-2014	57.0	26.6	2.9	60.6	22.3
	2013-2015	59.7	28.0	3.2	65.9	23.6
	2014-2016	63.5	29.4	3.5	71.6	25.2
	2015-2017	64.6	28.4	3.2	75.2	25.4
Change in % area exceeded from 2010 to 2016		-0.7	-0.5	-0.4	+15.6	+0.3
$3 \mu\text{g m}^{-3}$	2009-2011	1.6	0.0	0.0	3.1	0.6
	2010-2012	1.7	0.1	0.0	3.6	0.6
	2011-2013	1.6	0.1	0.0	4.0	0.7
	2012-2014	1.1	0.0	0.0	3.2	0.5
	2013-2015	1.2	0.0	0.0	4.7	0.6
	2014-2016	1.7	0.1	0.0	7.3	0.8
	2015-2017	1.9	0.1	0.0	9.2	1.0
Change in % area exceeded from 2010 to 2016		+0.3	+0.1	0.0	+6.1	+0.4

The N-sensitive habitats (Table 4.4) with the highest percentage area of exceedance of the ammonia critical level of $1 \mu\text{g m}^{-3}$ are calcareous grassland (88.3%), unmanaged woodland (81.4%), managed broadleaved woodland (77.0%) and beech woodland (70.7%), which in total equals 14.6% of the total area of N-sensitive habitats. Other habitats have smaller percentage areas where ammonia concentrations are above $1 \mu\text{g m}^{-3}$ but these results need to be interpreted with care, for example, only 19.1% of acid grassland is exceeded, but as this habitat occupies a large area across the UK, this equates to 2910 km², which is not too different from the 88.3% of calcareous grassland (3159 km²).

Table 4.4: Percentages of the area of nitrogen-sensitive habitats where ammonia critical levels of 1 µg m⁻³ and 3 µg m⁻³ are exceeded in the UK, by habitat.

		Acid grassland	Calcareous grassland	Dwarf shrub heath	Bog	Montane	Coniferous woodland (managed)	Broadleaved woodland (managed)	Beech woodland (unmanaged)	Acidophilous oak (unmanaged)	Scots Pine (unmanaged)	Other unmanaged woodland	Dune grassland	Saltmarsh
<i>Habitat area (km²)</i>		15235	3578	34826	5526	3129	8383	7482	719	1434	204	1761	323	427
1 µg m ⁻³	2009-2011	17.9	88.9	6.5	6.6	0.0	18.6	81.3	75.9	43.8	1.4	82.0	14.4	31.6
	2010-2012	18.2	88.1	6.5	6.7	0.0	18.7	80.6	72.9	42.5	1.4	81.8	14.5	31.5
	2011-2013	18.2	85.4	6.5	6.9	0.0	18.7	77.9	66.1	39.2	1.4	79.9	14.4	28.1
	2012-2014	16.4	80.4	5.5	5.8	0.0	16.6	72.7	55.9	35.2	1.2	76.0	11.2	24.5
	2013-2015	17.6	82.9	6.3	6.9	0.0	18.7	74.6	60.0	36.9	1.2	78.4	10.6	27.0
	2014-2016	19.1	86.4	7.2	7.9	0.0	20.5	76.7	65.5	39.4	1.3	80.6	16.2	45.7
	2015-2017	19.1	88.3	7.3	8.1	0.0	19.9	77.0	70.7	40.1	1.3	81.4	16.4	44.8
Change in % area exceeded from 2010 to 2016		+1.2	-0.6	+0.8	+1.6	0.0	+1.3	-4.3	-5.2	-3.8	-0.1	-0.6	+2.0	+13.2
3 µg m ⁻³	2009-2011	0.5	1.7	0.2	0.1	0.0	0.3	2.0	0.6	0.6	0.0	3.0	0.1	0.5
	2010-2012	0.6	1.8	0.2	0.1	0.0	0.4	2.1	0.5	0.7	0.0	3.2	0.1	0.4
	2011-2013	0.6	1.9	0.2	0.1	0.0	0.4	2.1	0.4	0.7	0.0	3.2	0.1	0.3
	2012-2014	0.5	1.4	0.2	0.1	0.0	0.3	1.4	0.3	0.5	0.0	2.2	0.1	0.2
	2013-2015	0.7	1.4	0.2	0.2	0.0	0.3	1.5	0.3	0.5	0.0	2.8	0.0	0.2
	2014-2016	1.0	2.0	0.3	0.3	0.0	0.5	2.1	0.3	0.6	0.0	4.1	0.1	0.3
	2015-2017	1.2	2.2	0.4	0.4	0.0	0.6	2.4	0.4	0.8	0.0	4.4	0.2	0.3
Change in % area exceeded from 2010 to 2016		+0.7	+0.5	+0.2	+0.4	0.0	+0.3	+0.3	-0.2	+0.2	0.0	+1.4	0.1	-0.1

4.4.3 Designated sites with exceedance of ammonia critical levels

These results show the percentage of sites (SACs, SPAs, SSSIs) where ammonia critical levels are exceeded; a site is counted as exceeded if the ammonia concentration exceeds the respective critical level anywhere across a site. SACs may contain one or more SSSIs, and some SACs and SPAs may overlap one another (Figure 4.2), however in this analysis the sites are all assessed independently.

SACs

Approximately 60% of SACs occur in areas of the UK where ammonia concentrations exceed $1 \mu\text{g m}^{-3}$ (Table 4.5); the lowest number of sites with exceedance is in Scotland where ammonia concentrations are $< 1 \mu\text{g m}^{-3}$ at 17.1% of sites. The percentage of UK SACs with exceedance of the $1 \mu\text{g m}^{-3}$ critical level has fallen by 2.1% between 2010 and 2016, but this varies spatially across the UK with an increase seen in Northern Ireland over this time period.

The percentage of SACs with ammonia concentrations above $3 \mu\text{g m}^{-3}$ is small (Table 4.5), mostly $<15\%$ in 2016, except in Northern Ireland where almost 20% of sites exceed the higher critical level. Increases in Northern Ireland sites exceeding this critical level between 2010 and 2016 are up to 15%, reflecting the changes seen in the ammonia concentrations over this time period.

Table 4.5: Percentage of SACs where ammonia concentrations exceed critical levels of $1 \mu\text{g m}^{-3}$ and $3 \mu\text{g m}^{-3}$ anywhere across a site.

		England	Wales	Scotland	NI	UK
<i>Number of sites</i>		<i>[231]</i>	<i>[85]</i>	<i>[234]</i>	<i>[54]</i>	<i>[614*]</i>
$1 \mu\text{g m}^{-3}$	2009-2011	94.4	72.9	20.9	85.2	62.7
	2010-2012	93.5	75.3	19.7	87.0	62.4
	2011-2013	90.0	72.9	20.1	87.0	60.9
	2012-2014	86.6	70.6	17.5	85.2	58.1
	2013-2015	88.3	71.8	18.0	85.2	59.1
	2014-2016	90.0	74.1	18.4	90.7	60.7
	2015-2017	91.3	72.9	17.1	90.7	60.6
Change in % no. sites exceeded from 2010 to 2016		-3.0	0.0	-3.8	+5.6	-2.1
$3 \mu\text{g m}^{-3}$	2009-2011	10.0	0.0	0.9	3.7	4.9
	2010-2012	10.0	1.2	1.3	3.7	5.1
	2011-2013	13.4	4.7	1.7	5.6	7.5
	2012-2014	9.5	2.4	1.3	3.7	5.4
	2013-2015	7.8	2.4	0.4	5.6	4.4
	2014-2016	8.7	2.4	0.4	13.0	5.7
	2015-2017	11.3	4.7	0.0	18.5	7.7
Change in % no. sites exceeded from 2010 to 2016		+1.3	+4.7	-0.9	+14.8	+2.8

*includes 7 sites on the England/Wales border and 3 on the England/Scotland border.

SPAs

The results show a 15.4% increase in the number of sites in Wales exceeding the critical level of $1 \mu\text{g m}^{-3}$ though it should be noted there are only 16 sites in Wales. There are small decreases in the percentage of exceeded sites in England (-1.3%) and Scotland (-4.4%) and no change in Northern Ireland (Table 4.6). Over 90% of the SPAs in England and 12 of the 13 sites in Northern Ireland receive ammonia concentrations above $1 \mu\text{g m}^{-3}$.

The critical level of $3 \mu\text{g m}^{-3}$ is not exceeded for any SPAs in Wales; this is consistent with the fact that <1% of the land area in Wales has ammonia concentrations above $3 \mu\text{g m}^{-3}$ (Table 4.6). Overall, the percentage of sites with ammonia concentrations above $3 \mu\text{g m}^{-3}$ is considerably smaller than the number exceeding the critical level of $1 \mu\text{g m}^{-3}$. In Northern Ireland, three extra SPAs showed exceedance of the ammonia critical level of $3 \mu\text{g m}^{-3}$, representing roughly a 20% increase since 2010 of the percentage of sites exceeded to 30.8%.

Table 4.6: Percentage of SPAs with ammonia concentrations exceeding critical levels of $1 \mu\text{g m}^{-3}$ and $3 \mu\text{g m}^{-3}$ anywhere across a site.

<i>[number of sites]</i>		England <i>[76]</i>	Wales <i>[16[#]]</i>	Scotland <i>[137]</i>	NI <i>[13]</i>	UK <i>[245*]</i>
$1 \mu\text{g m}^{-3}$	2009-2011	97.4	37.5	27.7	92.3	54.3
	2010-2012	97.4	43.8	27.0	92.3	54.3
	2011-2013	96.1	37.5	27.0	92.3	53.5
	2012-2014	90.8	43.8	23.4	92.3	50.2
	2013-2015	92.1	50.0	22.6	92.3	50.6
	2014-2016	94.7	52.9	24.8	92.3	52.8
	2015-2017	96.1	52.9	23.4	92.3	52.4
Change in % no. sites exceeded from 2010 to 2016		-1.3	+15.4	-4.4	0.0	-1.9
$3 \mu\text{g m}^{-3}$	2009-2011	11.8	0.0	1.5	7.7	5.3
	2010-2012	14.5	0.0	2.2	15.4	6.9
	2011-2013	19.7	0.0	2.2	30.8	9.4
	2012-2014	13.2	0.0	2.2	15.4	6.1
	2013-2015	10.5	0.0	0.7	15.4	4.5
	2014-2016	11.8	0.0	1.5	23.1	6.9
	2015-2017	18.4	0.0	1.5	30.8	9.3
Change in % no. sites exceeded from 2010 to 2016		+6.6	0.0	0.0	+23.1	+4.0

*includes 3 sites on the England/Wales border.

[#] A single additional SPA in Wales is included in this 2020 report compared to the 2019 Trends Report. This site was previously excluded erroneously because part of the site's area fell outside the area for which NH_3 concentrations are available.

SSSIs

The percentage of SSSIs in the UK in areas where ammonia concentrations exceed the critical level of $1 \mu\text{g m}^{-3}$ decreased by 2.8% between 2010 and 2016, to 70.4% (Table 4.7). Over 80% of the sites in England and Northern Ireland are in locations where this critical level is currently exceeded, as well as 61.8% of sites in Wales and 24.5% of sites in Scotland.

There was a small increase in the number of UK SSSIs/ASSIs showing exceedance of the $3 \mu\text{g m}^{-3}$ Critical Load for ammonia, with the number of sites exceeded increasing in every country. In particular, it is worth noting that between 2010 and 2016 there has been a 10% increase in the percentage of SSSIs in Northern Ireland that received ammonia concentrations above the critical level of $3 \mu\text{g m}^{-3}$. England and Wales showed small increases around 1-2%, and Scotland showed a very slight increase.

Table 4.7: Percentage of SSSIs with ammonia concentrations exceeding critical levels of $1 \mu\text{g m}^{-3}$ and $3 \mu\text{g m}^{-3}$ anywhere across a site.

		England	Wales	Scotland	NI	UK
<i>[number of sites]</i>		[4106]	[1014]	[1430]	[289]	[6839]
$1 \mu\text{g m}^{-3}$	2009-2011	89.8	66.9	28.1	83.7	73.2
	2010-2012	89.3	66.9	28.0	84.4	72.9
	2011-2013	87.7	64.4	27.9	85.8	71.7
	2012-2014	84.2	60.2	24.6	83.0	68.1
	2013-2015	84.9	61.6	24.0	84.4	68.7
	2014-2016	86.8	63.3	26.0	86.5	70.6
	2015-2017	87.3	61.8	24.5	88.6	70.4
Change in % no. sites exceeded from 2010 to 2016		-2.5	-5.1	-3.6	+4.8	-2.8
$3 \mu\text{g m}^{-3}$	2009-2011	4.9	1	0.4	6.2	3.4
	2010-2012	5	1.0	0.6	8.0	3.6
	2011-2013	5.5	0.7	0.7	8	3.9
	2012-2014	3.7	0.4	0.5	6.6	2.7
	2013-2015	3.7	0.7	0.1	8.7	2.7
	2014-2016	5.0	1.8	0.3	13.1	3.9
	2015-2017	5.8	2.7	0.4	16.3	4.7
Change in % no. sites exceeded from 2010 to 2016		+1.0	+1.7	+0.1	+10.0	+1.3

Two additional SSSIs, one in Wales and one in Scotland, are included in this 2020 report compared to the 2019 Trends Report. These sites were previously excluded erroneously because part of their area fell outside the area for which NH_3 concentrations are available.

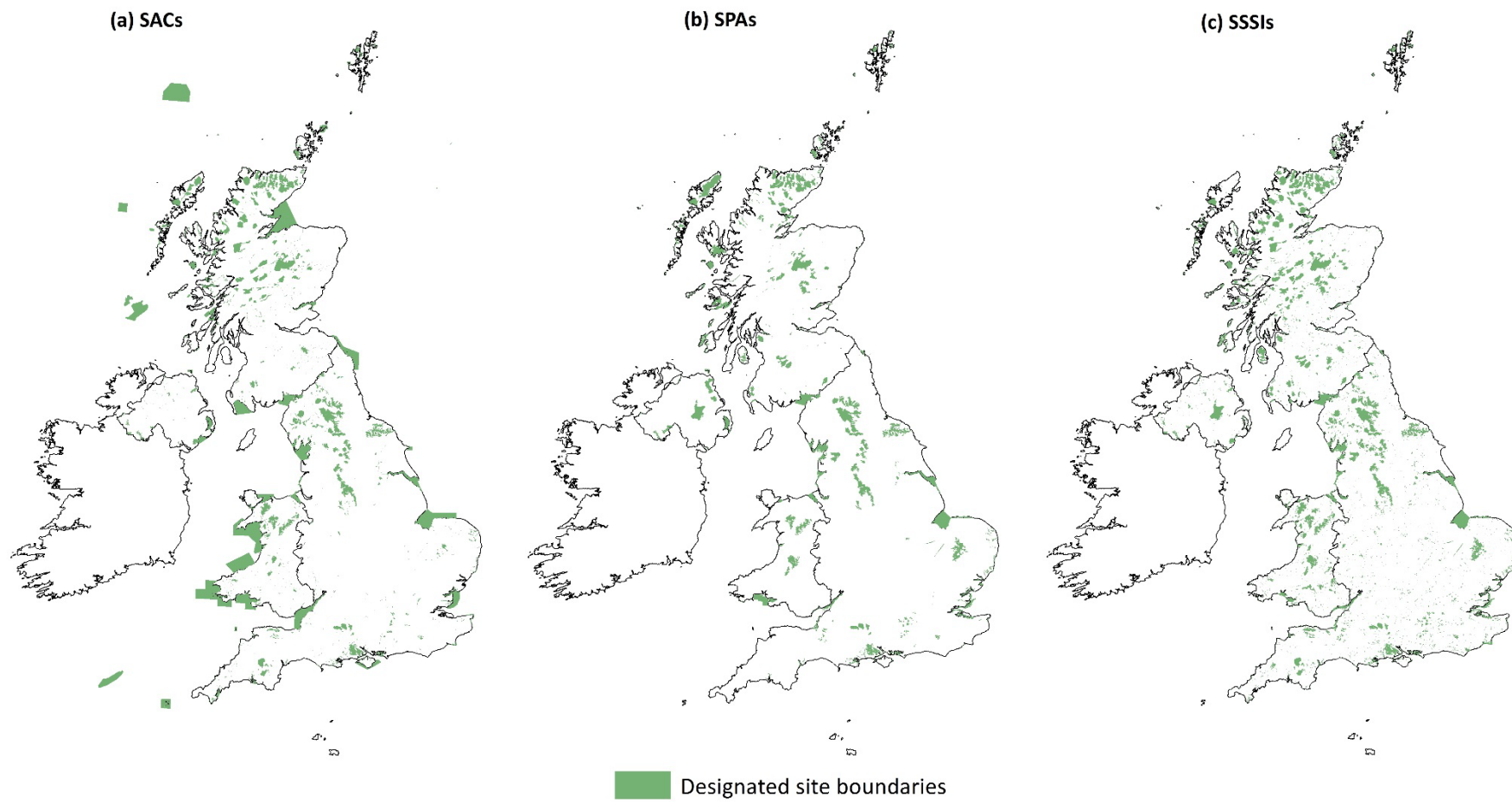


Figure 4.2: Distribution of SACs, SPAs and SSSIs / ASSIs in the UK

Section 5: Nitrogen deposition onto protected sensitive habitats

As noted in sections 1.1 and 1.4, this Trends Report includes for the first time (in Table 5.1) an indicator, “total deposition of reactive N onto nutrient-N sensitive, protected, priority habitat” (abbreviated as N_{sens}) to illustrate progress towards the target for England in the UK Government’s Clean Air Strategy (Defra, 2019). This indicator has only been calculated for the most recent 3-year periods for which deposition data are available, i.e. periods centred on 2015, 2016 and 2017. Progress towards the target will be assessed relative to a baseline year of 2016. The data presented should be considered preliminary until the UK’s priority habitat maps have been updated. We aim to make use of improved maps in the next Trends Report.

Although the CAS target applies to England only, the Devolved Administrations have agreed for their countries’ data to be compared to it as well this year. Furthermore, the Devolved Administrations are considering whether to develop nitrogen deposition reduction targets for their own countries, which will be presented in future Trends Reports.

Table 5.1: Total deposition of reactive N onto nutrient-N sensitive priority habitat (N_{sens} in $\text{kg ha}^{-1} \text{ year}^{-1}$, mean for 3-year periods) by country.

Year	N_{sens} ($\text{kg N ha}^{-1} \text{ year}^{-1}$) by country:				
	England (target)	Wales (comparison)	Scotland (comparison)	NI (comparison)	UK (comparison)
2014-2016	21.0	18.2	9.5	17.4	13.0
2015-2017	20.3	17.9	8.4	17.0	12.0
2016-2018	19.7	17.6	8.3	16.4	11.8

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Annex: Critical load exceedances by habitat and country

This Annex contains the summary critical load exceedance statistics for acidity and for nutrient nitrogen by habitat and country, with separate tables for each country.

Acidity results: Tables A1-A8

Nutrient nitrogen results: Tables N1-N8

Table A1: Acid-sensitive habitat area in England and percentage area of habitats where acidity critical loads are exceeded, by deposition dataset year

Parameter	Acid-sensitive habitat areas in England and percentage habitat area with exceedance of acidity critical loads:								
	Acid grassland	Dwarf shrub heath	Bog	Montane	Coniferous woodland (managed)	Broadleaved woodland (managed)	Unmanaged woodland	Freshwaters	All habitats
<i>Habitat area (km²)</i>	2669	2462	1006	2	1716	5565	2392	1109	18635
1995-1997	96.9	95.7	99.3	99.8	91.6	76.1	74.4	54.2	75.8
1998-2000	95.6	93.8	99.1	99.8	87.5	70.3	62.6	51.8	71.6
1999-2001	95.6	93.5	99.1	99.8	88.9	70.9	63.3	51.6	71.9
2001-2003	95.5	93.8	99.1	100.0	89.3	71.6	64.2	51.4	72.3
2002-2004	95.2	92.7	98.9	99.8	89.2	72.5	64.0	50.4	72.3
2003-2005	94.9	92.6	98.9	99.8	88.6	71.9	62.6	49.2	71.8
2004-2006	94.8	92.0	99.8	99.8	84.5	62.5	48.6	49.5	66.8
2005-2007	94.5	91.8	99.8	99.8	84.0	61.2	47.2	49.7	66.1
2006-2008	93.9	91.0	99.8	99.8	82.6	57.8	44.0	49.6	64.3
2007-2009	93.6	89.9	99.8	99.8	81.6	56.7	43.7	47.5	63.6
2008-2010	93.3	88.9	99.8	99.8	81.3	56.3	43.5	47.6	63.2
2009-2011	93.6	89.3	99.8	99.8	81.8	57.3	44.1	48.2	63.8
2010-2012	93.4	89.1	99.8	99.8	81.4	55.4	42.1	47.5	62.8
2011-2013	93.3	88.3	99.8	99.8	81.1	54.1	40.9	47.8	62.1
2012-2014	93.0	88.2	99.8	99.8	80.4	52.5	38.9	47.3	61.3
2013-2015	92.7	87.5	99.8	99.8	80.2	51.4	37.6	46.9	60.6
2014-2016	92.4	84.7	99.8	99.8	79.3	49.7	35.0	46.7	59.2
2015-2017	90.8	77.7	99.8	99.8	77.7	49.4	36.1	44.4	57.9
2016-2018	90.5	77.9	99.8	99.8	77.9	46.9	33.4	45.0	54.1
Reduction in % area exceeded from 1996 to 2017	6.4	17.8	-0.5	0.0	13.7	29.2	41.0	9.2	21.7

Table A2: Acidity AAE (in keq ha⁻¹ year⁻¹) by habitat for England by deposition dataset year.

Year	AAE (keq ha ⁻¹ year ⁻¹) by habitat:								
	Acid grassland	Dwarf shrub heath	Bog	Montane	Coniferous woodland (managed)	Broadleaved woodland (managed)	Unmanaged woodland	Freshwaters	All habitats
1995-1997	1.89	1.47	2.09	2.83	1.84	1.29	1.01	1.18	1.33
1998-2000	1.39	1.07	1.63	1.83	1.38	0.99	0.72	0.86	1.00
1999-2001	1.34	1.02	1.56	1.70	1.38	1.02	0.74	0.80	0.98
2001-2003	1.32	1.01	1.53	1.64	1.48	1.15	0.84	0.77	1.04
2002-2004	1.19	0.87	1.33	1.37	1.48	1.05	0.76	0.68	0.94
2003-2005	1.18	0.83	1.30	1.41	1.45	1.05	0.76	0.65	0.93
2004-2006	1.19	0.82	1.33	1.55	1.17	0.72	0.48	0.64	0.77
2005-2007	1.15	0.77	1.28	1.53	1.10	0.71	0.47	0.58	0.74
2006-2008	1.10	0.73	1.24	1.47	1.02	0.62	0.40	0.55	0.68
2007-2009	0.97	0.61	1.08	1.35	0.90	0.59	0.38	0.49	0.62
2008-2010	0.92	0.58	1.02	1.23	0.88	0.58	0.37	0.48	0.59
2009-2011	0.96	0.61	1.07	1.33	0.94	0.61	0.39	0.49	0.62
2010-2012	0.95	0.62	1.09	1.28	0.90	0.56	0.35	0.50	0.60
2011-2013	0.98	0.62	1.10	1.34	0.86	0.52	0.33	0.50	0.59
2012-2014	0.93	0.60	1.08	1.27	0.81	0.47	0.29	0.52	0.55
2013-2015	0.91	0.58	1.07	1.26	0.80	0.46	0.28	0.48	0.54
2014-2016	0.84	0.52	0.99	1.20	0.73	0.42	0.25	0.45	0.49
2015-2017	0.73	0.40	0.83	1.08	0.66	0.42	0.25	0.39	0.44
2016-2018	0.67	0.37	0.79	1.07	0.62	0.38	0.21	0.37	0.41
Reduction in AAE from 1996 to 2017	1.21	1.10	1.29	1.75	1.22	0.92	0.79	0.81	0.92

Table A3: Acid-sensitive habitat area in Wales and percentage area of habitats where acidity critical loads are exceeded, by deposition dataset year

Parameter	Acid-sensitive habitat areas in Wales and percentage habitat area with exceedance of acidity critical loads:								
	Acid grassland	Dwarf shrub heath	Bog	Montane	Coniferous woodland (managed)	Broadleaved woodland (managed)	Unmanaged woodland	Freshwaters	All habitats
Habitat area (km ²)	3143	1078	56	18	1048	790	395	1225	7798
1995-1997	98.9	97.2	98.4	100.0	98.0	86.4	89.4	59.1	90.0
1998-2000	96.5	94.0	97.7	100.0	95.7	74.0	75.5	38.8	83.1
1999-2001	96.6	93.5	97.7	100.0	96.2	75.1	76.5	37.2	83.0
2001-2003	96.0	92.1	97.6	100.0	96.0	76.1	78.2	34.7	82.4
2002-2004	95.9	90.7	97.7	100.0	96.9	77.8	82.2	32.4	82.3
2003-2005	96.1	92.7	97.7	100.0	97.0	79.1	83.3	34.4	83.2
2004-2006	95.3	91.9	100.0	100.0	94.4	73.7	75.1	33.0	81.2
2005-2007	95.2	91.6	100.0	100.0	94.1	73.2	75.0	32.6	81.0
2006-2008	94.5	87.9	99.9	100.0	90.3	70.9	72.9	32.0	79.2
2007-2009	93.7	85.3	98.7	100.0	84.2	70.3	71.8	30.3	77.4
2008-2010	93.0	81.9	98.4	100.0	75.3	69.0	69.8	28.5	74.9
2009-2011	93.0	80.8	98.4	100.0	75.1	69.1	69.5	27.2	74.5
2010-2012	93.1	81.1	98.4	100.0	72.8	67.6	67.8	28.4	74.2
2011-2013	93.2	80.9	98.4	100.0	75.0	67.9	68.3	27.5	74.4
2012-2014	92.7	80.8	97.5	100.0	71.8	66.6	66.3	26.3	73.4
2013-2015	92.3	78.0	94.2	100.0	71.2	67.7	64.9	24.3	72.4
2014-2016	92.0	77.1	95.9	100.0	68.5	64.7	59.3	23.5	71.1
2015-2017	91.6	73.9	96.2	100.0	66.2	62.9	58.1	23.6	70.0
2016-2018	91.7	72.3	95.3	100.0	63.2	60.4	55.3	20.6	65.3
Reduction in % area exceeded from 1996 to 2017	7.2	24.9	3.1	0.0	34.9	26.1	34.1	38.5	24.6

Table A4: Acidity AAE (in keq ha⁻¹ year⁻¹) by habitat for Wales by deposition dataset year.

Year	AAE (keq ha ⁻¹ year ⁻¹) by habitat:								
	Acid grassland	Dwarf shrub heath	Bog	Montane	Coniferous woodland (managed)	Broadleaved woodland (managed)	Unmanaged woodland	Freshwaters	All habitats
1995-1997	1.56	1.33	1.77	2.38	1.87	1.31	1.30	0.50	1.36
1998-2000	1.07	0.81	1.15	1.99	1.00	0.75	0.71	0.24	0.84
1999-2001	1.04	0.75	1.06	1.70	1.00	0.78	0.74	0.21	0.82
2001-2003	1.00	0.70	1.03	1.58	1.12	0.84	0.83	0.20	0.82
2002-2004	0.92	0.61	0.93	1.42	1.17	0.93	0.90	0.18	0.79
2003-2005	0.96	0.69	1.02	1.48	1.28	0.98	0.96	0.20	0.84
2004-2006	0.92	0.68	0.83	1.42	0.93	0.76	0.72	0.19	0.74
2005-2007	0.91	0.67	0.82	1.37	0.92	0.74	0.70	0.18	0.73
2006-2008	0.80	0.53	0.69	1.25	0.72	0.60	0.55	0.15	0.61
2007-2009	0.72	0.43	0.59	1.17	0.61	0.55	0.50	0.13	0.54
2008-2010	0.67	0.38	0.53	1.12	0.55	0.51	0.46	0.10	0.49
2009-2011	0.65	0.34	0.51	1.14	0.54	0.52	0.47	0.10	0.48
2010-2012	0.66	0.35	0.52	1.13	0.51	0.47	0.42	0.11	0.47
2011-2013	0.65	0.37	0.53	1.13	0.52	0.46	0.40	0.11	0.47
2012-2014	0.64	0.38	0.53	1.06	0.49	0.42	0.37	0.09	0.46
2013-2015	0.62	0.38	0.52	0.97	0.50	0.44	0.38	0.08	0.45
2014-2016	0.60	0.35	0.50	0.92	0.44	0.40	0.35	0.08	0.43
2015-2017	0.56	0.28	0.44	0.84	0.42	0.39	0.33	0.07	0.39
2016-2018	0.53	0.25	0.39	0.84	0.37	0.33	0.28	0.06	0.42
Reduction in AAE from 1996 to 2017	1.04	1.08	1.38	1.54	1.49	0.98	1.02	0.44	0.94

Table A5: Acid-sensitive habitat area in Scotland and percentage area of habitats where acidity critical loads are exceeded, by deposition dataset year

Parameter	Acid-sensitive habitat areas in Scotland and percentage habitat area with exceedance of acidity critical loads:								
	Acid grassland	Dwarf shrub heath	Bog	Montane	Coniferous woodland (managed)	Broadleaved woodland (managed)	Unmanaged woodland	Freshwaters	All habitats
Habitat area (km ²)	8336	20190	3955	3034	5111	1096	1016	5338	48083
1995-1997	88.6	65.2	85.3	95.8	72.1	66.4	54.4	18.4	68.2
1998-2000	77.9	40.6	73.1	91.3	60.2	54.8	40.2	15.3	52.6
1999-2001	77.7	38.8	69.4	93.3	60.3	55.7	42.0	15.3	51.6
2001-2003	68.5	30.1	49.5	82.4	53.6	54.7	40.3	12.9	43.0
2002-2004	69.5	32.3	47.3	89.4	56.3	57.2	44.8	12.8	44.8
2003-2005	69.8	31.3	46.3	92.9	56.3	54.4	44.0	13.2	44.5
2004-2006	74.2	35.9	61.4	96.3	52.0	47.4	37.9	13.5	48.0
2005-2007	73.1	31.4	68.1	94.3	51.1	47.7	34.9	13.0	46.1
2006-2008	68.1	24.3	63.7	85.5	47.3	44.1	30.0	12.2	40.7
2007-2009	59.1	16.0	50.5	71.2	43.4	41.3	25.9	10.6	32.9
2008-2010	56.4	15.9	42.4	69.9	42.8	42.4	26.7	10.2	31.5
2009-2011	60.9	18.7	38.5	71.4	46.5	46.6	30.2	11.1	33.9
2010-2012	58.0	17.4	38.1	65.1	45.3	44.0	28.7	11.0	32.2
2011-2013	58.6	16.5	31.8	62.1	44.0	40.0	27.4	10.9	31.0
2012-2014	57.8	15.8	39.1	62.5	42.9	36.6	25.7	11.0	31.0
2013-2015	58.7	16.4	35.1	64.8	44.6	36.8	26.7	11.0	31.4
2014-2016	55.5	14.8	32.0	61.8	43.1	35.8	24.4	10.9	29.5
2015-2017	46.1	9.4	23.9	43.5	39.1	30.6	18.0	7.8	22.7
2016-2018	45.1	8.4	25.5	41.5	36.6	26.5	14.3	5.6	20.8
Reduction in % area exceeded from 1996 to 2017	43.5	56.8	59.8	54.3	35.5	40.0	40.1	12.8	47.3

Table A6: Acidity AAE (in keq ha⁻¹ year⁻¹) by habitat for Scotland by deposition dataset year.

Year	AAE (keq ha ⁻¹ year ⁻¹) by habitat:								
	Acid grassland	Dwarf shrub heath	Bog	Montane	Coniferous woodland (managed)	Broadleaved woodland (managed)	Unmanaged woodland	Freshwaters	All habitats
1995-1997	0.81	0.29	0.40	0.80	0.76	0.63	0.42	0.16	0.47
1998-2000	0.54	0.14	0.25	0.56	0.40	0.37	0.24	0.10	0.28
1999-2001	0.51	0.14	0.22	0.58	0.40	0.38	0.26	0.09	0.27
2001-2003	0.41	0.12	0.17	0.60	0.39	0.38	0.26	0.06	0.23
2002-2004	0.43	0.12	0.15	0.64	0.42	0.41	0.29	0.06	0.24
2003-2005	0.43	0.11	0.15	0.61	0.40	0.36	0.26	0.07	0.24
2004-2006	0.45	0.12	0.19	0.66	0.32	0.28	0.19	0.07	0.24
2005-2007	0.40	0.09	0.22	0.52	0.31	0.28	0.18	0.06	0.21
2006-2008	0.33	0.06	0.19	0.38	0.27	0.26	0.15	0.05	0.17
2007-2009	0.25	0.03	0.12	0.28	0.22	0.23	0.12	0.03	0.12
2008-2010	0.24	0.04	0.11	0.28	0.22	0.25	0.13	0.03	0.12
2009-2011	0.30	0.06	0.13	0.31	0.27	0.29	0.16	0.04	0.15
2010-2012	0.29	0.05	0.13	0.26	0.26	0.26	0.14	0.04	0.14
2011-2013	0.29	0.05	0.11	0.24	0.24	0.22	0.12	0.04	0.13
2012-2014	0.28	0.05	0.12	0.24	0.23	0.18	0.11	0.04	0.13
2013-2015	0.32	0.06	0.12	0.26	0.27	0.19	0.12	0.05	0.15
2014-2016	0.30	0.05	0.11	0.22	0.24	0.18	0.11	0.04	0.13
2015-2017	0.21	0.02	0.08	0.13	0.18	0.14	0.07	0.02	0.09
2016-2018	0.18	0.02	0.07	0.12	0.15	0.12	0.06	0.02	0.08
Reduction in AAE from 1996 to 2017	0.63	0.28	0.33	0.68	0.62	0.51	0.36	0.14	0.39

Table A7: Acid-sensitive habitat area in NI and percentage area of habitats where acidity critical loads are exceeded, by deposition dataset year

Parameter	Acid-sensitive habitat areas in NI and percentage habitat area with exceedance of acidity critical loads:								
	Acid grassland	Dwarf shrub heath	Bog	Montane	Coniferous woodland (managed)	Broadleaved woodland (managed)	Unmanaged woodland	Freshwaters	All habitats
<i>Habitat area (km²)</i>	1189	974	437	0	500	0	208	186	3537
1995-1997	86.1	83.0	84.5	0.0	73.4	0.0	49.9	24.0	76.8
1998-2000	78.9	71.3	81.1	0.0	54.1	0.0	43.3	17.6	67.2
1999-2001	77.7	70.3	80.9	0.0	55.3	0.0	43.7	17.6	66.8
2001-2003	77.6	71.1	79.8	0.0	58.5	0.0	45.6	17.6	67.4
2002-2004	81.5	69.8	82.0	0.0	62.0	0.0	47.6	17.6	69.2
2003-2005	80.0	66.4	80.5	0.0	58.7	0.0	46.8	17.6	67.1
2004-2006	78.9	66.0	96.1	0.0	57.1	0.0	44.7	15.9	68.1
2005-2007	79.9	67.0	93.7	0.0	57.6	0.0	45.9	15.9	68.5
2006-2008	79.9	67.0	95.1	0.0	57.5	0.0	45.7	15.9	68.6
2007-2009	80.3	68.4	96.4	0.0	57.3	0.0	46.3	15.9	69.4
2008-2010	80.3	69.2	96.4	0.0	57.5	0.0	46.6	15.9	69.6
2009-2011	81.1	72.8	94.9	0.0	58.7	0.0	48.9	15.9	71.0
2010-2012	79.0	67.5	92.0	0.0	54.2	0.0	46.8	15.9	67.8
2011-2013	80.0	69.3	95.4	0.0	57.1	0.0	46.4	15.9	69.4
2012-2014	77.8	65.1	96.5	0.0	55.5	0.0	43.5	14.3	67.1
2013-2015	77.8	64.7	95.3	0.0	55.1	0.0	44.3	14.3	66.9
2014-2016	76.5	59.7	92.0	0.0	51.5	0.0	43.5	14.3	64.1
2015-2017	74.5	52.2	91.3	0.0	51.2	0.0	43.3	14.3	61.2
2016-2018	72.4	49.2	89.5	0.0	47.7	0.0	42.0	14.3	58.2
Reduction in % area exceeded from 1996 to 2017	13.7	33.8	-5.1	0.0	25.7	0.0	7.9	9.7	18.6

Table A8: Acidity AAE (in keq ha⁻¹ year⁻¹) by habitat for NI by deposition dataset year.

Year	AAE (keq ha ⁻¹ year ⁻¹) by habitat:								
	Acid grassland	Dwarf shrub heath	Bog	Montane	Coniferous woodland (managed)	Broadleaved woodland (managed)	Unmanaged woodland	Freshwaters	All habitats
1995-1997	0.86	0.76	0.88	0.00	0.98	0.00	0.66	0.34	0.80
1998-2000	0.57	0.39	0.53	0.00	0.44	0.00	0.49	0.18	0.46
1999-2001	0.55	0.38	0.53	0.00	0.46	0.00	0.50	0.18	0.46
2001-2003	0.56	0.42	0.56	0.00	0.60	0.00	0.63	0.21	0.51
2002-2004	0.54	0.34	0.50	0.00	0.55	0.00	0.66	0.17	0.46
2003-2005	0.50	0.29	0.45	0.00	0.51	0.00	0.63	0.15	0.42
2004-2006	0.49	0.29	0.60	0.00	0.45	0.00	0.57	0.15	0.42
2005-2007	0.52	0.30	0.60	0.00	0.48	0.00	0.64	0.16	0.45
2006-2008	0.51	0.30	0.60	0.00	0.47	0.00	0.64	0.16	0.44
2007-2009	0.53	0.30	0.60	0.00	0.48	0.00	0.67	0.16	0.45
2008-2010	0.55	0.33	0.62	0.00	0.50	0.00	0.70	0.17	0.47
2009-2011	0.62	0.38	0.70	0.00	0.57	0.00	0.78	0.17	0.53
2010-2012	0.53	0.32	0.61	0.00	0.49	0.00	0.68	0.15	0.46
2011-2013	0.54	0.32	0.64	0.00	0.49	0.00	0.63	0.15	0.46
2012-2014	0.46	0.26	0.55	0.00	0.41	0.00	0.54	0.14	0.39
2013-2015	0.46	0.24	0.55	0.00	0.41	0.00	0.54	0.13	0.38
2014-2016	0.43	0.22	0.49	0.00	0.37	0.00	0.54	0.12	0.36
2015-2017	0.40	0.20	0.44	0.00	0.34	0.00	0.55	0.12	0.33
2016-2018	0.36	0.18	0.41	0.00	0.30	0.00	0.49	0.12	0.31
Reduction in AAE from 1996 to 2017	0.50	0.58	0.47	0.00	0.67	0.00	0.17	0.22	0.49

Table N1: Nutrient-sensitive habitat area in England and percentage area of habitats where nutrient nitrogen critical loads are exceeded, by deposition dataset year.

Parameter	Nitrogen-sensitive habitat areas in England and percentage habitat area with exceedance of nutrient nitrogen critical loads:													
	Acid grassland	Calcareous grassland	Dwarf shrub heath	Bog	Montane	Coniferous woodland (managed)	Broadleaved woodland (managed)	Beech woodland (unmanaged)	Acidophilous oak (unmanaged)	Scots Pine (unmanaged)	Other unmanaged woodland	Dune grassland	Saltmarsh	All habitats
<i>Habitat area (km²)</i>	2620	3312	2466	1007	2	1719	5588	650	601	0	1152	93	312	19522
1995-1997	99.8	99.7	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	96.7	2.5	98.3
1998-2000	96.2	98.7	99.9	100.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	83.1	1.3	97.6
1999-2001	96.7	98.8	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	89.4	2.6	97.7
2001-2003	98.4	98.6	99.6	100.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	72.0	1.4	97.8
2002-2004	98.4	97.1	99.9	100.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	72.5	1.5	97.6
2003-2005	98.5	97.0	99.9	100.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	63.6	1.5	97.5
2004-2006	97.6	93.5	99.8	100.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	50.4	1.1	96.7
2005-2007	97.5	92.2	99.9	100.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	50.7	1.1	96.5
2006-2008	97.0	90.4	99.8	100.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	45.6	1.1	96.1
2007-2009	96.1	92.6	99.9	100.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	45.7	1.1	96.4
2008-2010	95.3	93.9	99.9	100.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	58.4	1.1	96.5
2009-2011	97.4	94.8	99.9	100.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	57.3	1.2	97.0
2010-2012	96.7	93.1	99.9	100.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	45.8	1.1	96.5
2011-2013	96.6	90.4	99.9	100.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	40.2	1.1	96.0
2012-2014	94.8	91.3	99.9	100.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	35.4	1.0	95.9
2013-2015	95.1	90.5	99.9	100.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	34.1	1.1	95.8
2014-2016	94.4	89.0	99.9	100.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	29.9	1.1	95.4
2015-2017	89.7	89.1	99.7	100.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	27.7	1.4	94.8
2016-2018	94.2	87.4	99.7	100.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	25.3	1.3	95.1
Reduction in % area exceeded from 1996 to 2017	5.6	12.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	71.4	1.2	3.3

Table N2: Nutrient nitrogen: AAE (in kg N ha⁻¹ year⁻¹) by habitat for England by deposition dataset year.

Parameter	AAE (kg N ha ⁻¹ year ⁻¹) by habitat:													
	Acid grassland	Calcareous grassland	Dwarf shrub heath	Bog	Montane	Coniferous woodland (managed)	Broadleaved woodland (managed)	Beech woodland (unmanaged)	Acidophilous oak (unmanaged)	Scots Pine (unmanaged)	Other unmanaged woodland	Dune grassland	Saltmarsh	All habitats
1995-1997	12.5	7.8	14.4	16.3	24.6	25.5	27.2	22.7	28.5	0.0	27.2	4.2	0.0	19.0
1998-2000	8.9	7.7	11.7	13.5	16.6	21.8	25.1	19.8	25.3	0.0	25.7	3.5	0.1	16.8
1999-2001	9.2	8.0	12.1	14.0	16.7	22.5	26.2	20.6	26.4	0.0	26.7	3.7	0.1	17.4
2001-2003	10.3	9.3	13.2	15.2	17.5	25.3	29.9	23.3	28.9	0.0	30.6	3.1	0.0	19.7
2002-2004	8.8	7.2	11.7	13.0	14.9	24.7	27.7	22.4	27.8	0.0	27.8	1.8	2.3	18.0
2003-2005	9.2	7.2	11.7	13.2	15.7	24.9	28.1	22.8	28.0	0.0	28.3	1.9	2.3	18.2
2004-2006	9.5	6.0	11.6	13.5	17.6	20.5	21.7	15.7	22.4	0.0	21.2	1.1	0.0	14.9
2005-2007	9.4	6.0	11.4	13.4	17.9	20.2	21.8	15.3	22.4	0.0	21.4	1.1	0.1	14.9
2006-2008	9.2	5.5	11.1	13.2	17.6	19.3	20.4	13.9	21.3	0.0	20.0	1.0	0.1	14.1
2007-2009	8.0	5.6	10.1	11.9	16.4	18.2	20.7	14.4	21.3	0.0	20.5	1.1	0.1	13.8
2008-2010	7.8	5.8	10.1	11.5	15.4	18.3	20.9	14.6	21.3	0.0	20.8	1.2	0.1	13.9
2009-2011	8.4	6.2	10.7	12.2	16.6	19.3	21.9	15.2	22.2	0.0	21.7	1.2	0.1	14.6
2010-2012	8.1	5.6	10.5	12.1	16.0	18.5	20.4	13.9	20.8	0.0	20.2	1.1	0.1	13.8
2011-2013	8.3	5.1	10.4	12.1	16.5	17.9	19.5	13.3	20.3	0.0	19.2	0.9	0.0	13.3
2012-2014	7.6	4.9	10.2	12.0	15.7	17.0	18.5	12.4	19.1	0.0	18.2	0.8	0.0	12.6
2013-2015	7.9	4.9	10.4	12.4	16.0	17.3	18.6	12.2	19.2	0.0	18.3	0.6	0.0	12.8
2014-2016	7.5	4.7	10.1	12.0	15.8	16.6	18.0	11.3	18.4	0.0	17.7	0.6	0.0	12.3
2015-2017	6.7	4.6	9.0	10.7	15.2	16.4	18.6	12.0	18.8	0.0	18.5	0.6	0.1	12.2
2016-2018	6.0	3.9	8.7	10.4	15.2	15.7	17.6	11.3	17.7	0.0	17.6	0.6	0.0	11.5
Reduction in AAE from 1996 to 2017	6.5	3.9	5.7	5.8	9.3	9.8	9.7	11.4	10.8	0.0	9.7	3.7	0.0	7.5

Table N3: Nutrient-sensitive habitat area in Wales and percentage area of habitats where nutrient nitrogen critical loads are exceeded, by deposition dataset year.

Parameter	Nitrogen-sensitive habitat areas in Wales and percentage habitat area with exceedance of nutrient nitrogen critical loads:													
	Acid grassland	Calcareous grassland	Dwarf shrub heath	Bog	Montane	Coniferous woodland (managed)	Broadleaved woodland (managed)	Beech woodland (unmanaged)	Acidophilous oak (unmanaged)	Scots Pine (unmanaged)	Other unmanaged woodland	Dune grassland	Saltmarsh	All habitats
<i>Habitat area (km²)</i>	3146	171	1094	56	18	1052	798	65	251	0	81	37	68	6837
1995-1997	98.3	95.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	89.7	0.1	98.0
1998-2000	88.4	71.3	99.7	95.8	100.0	100.0	100.0	100.0	100.0	0.0	100.0	31.1	0.2	92.5
1999-2001	85.6	70.3	99.3	95.2	100.0	100.0	100.0	100.0	100.0	0.0	100.0	31.3	0.3	91.1
2001-2003	90.8	73.0	99.4	95.8	100.0	100.0	99.9	100.0	100.0	0.0	99.9	20.9	0.0	93.5
2002-2004	90.4	68.8	99.6	96.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	24.6	0.1	93.3
2003-2005	91.8	73.5	99.7	96.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	29.9	0.1	94.1
2004-2006	90.1	73.6	99.4	96.0	100.0	100.0	100.0	100.0	100.0	0.0	99.9	23.7	0.1	93.2
2005-2007	90.7	73.3	99.5	96.0	100.0	100.0	100.0	100.0	100.0	0.0	99.9	24.3	0.1	93.6
2006-2008	89.5	70.1	99.5	96.0	100.0	100.0	99.9	100.0	100.0	0.0	99.9	23.7	0.1	92.9
2007-2009	87.1	69.6	99.4	96.0	100.0	100.0	99.9	100.0	100.0	0.0	99.9	16.2	0.1	91.7
2008-2010	82.8	71.9	98.9	95.4	100.0	100.0	99.9	98.4	100.0	0.0	99.9	16.2	0.0	89.7
2009-2011	82.8	72.5	98.7	95.4	100.0	100.0	99.9	98.4	100.0	0.0	99.9	23.6	0.1	89.8
2010-2012	82.4	71.3	99.0	95.4	100.0	100.0	99.9	98.4	100.0	0.0	99.9	22.2	0.0	89.6
2011-2013	84.0	68.4	99.4	96.0	100.0	100.0	99.9	99.6	100.0	0.0	99.9	15.0	0.0	90.3
2012-2014	82.6	64.4	99.0	95.4	100.0	100.0	99.9	99.2	100.0	0.0	99.8	14.3	0.0	89.4
2013-2015	80.6	64.7	98.6	95.2	100.0	100.0	99.8	99.6	100.0	0.0	99.8	23.9	0.0	88.5
2014-2016	79.9	66.9	98.4	95.4	100.0	100.0	99.6	98.2	100.0	0.0	99.8	25.7	0.0	88.2
2015-2017	79.5	65.9	98.5	95.4	100.0	100.0	99.6	98.6	100.0	0.0	99.8	25.6	0.0	88.0
2016-2018	79.0	61.7	98.4	95.4	100.0	100.0	99.7	97.3	100.0	0.0	99.7	16.5	0.0	87.6
Reduction in % area exceeded from 1996 to 2017	19.3	33.2	1.6	4.6	0.0	0.0	0.3	2.7	0.0	0.0	0.3	73.2	0.1	10.5

Table N4: Nutrient nitrogen: AAE (in kg N ha⁻¹ year⁻¹) by habitat for Wales by deposition dataset year.

Parameter	AAE (kg N ha ⁻¹ year ⁻¹) by habitat:													
	Acid grassland	Calcareous grassland	Dwarf shrub heath	Bog	Montane	Coniferous woodland (managed)	Broadleaved woodland (managed)	Beech woodland (unmanaged)	Acidophilous oak (unmanaged)	Scots Pine (unmanaged)	Other unmanaged woodland	Dune grassland	Saltmarsh	All habitats
1995-1997	10.6	6.9	14.8	13.9	21.7	26.1	23.2	22.7	25.6	0.0	24.6	3.0	0.0	15.8
1998-2000	6.2	3.7	9.7	8.2	17.6	17.5	16.3	16.5	18.2	0.0	18.3	0.6	0.0	10.3
1999-2001	6.4	4.3	9.6	7.8	15.2	18.3	17.2	17.6	19.0	0.0	19.8	0.7	0.0	10.6
2001-2003	7.3	4.2	10.6	9.1	16.2	21.6	19.6	19.7	22.3	0.0	22.2	0.5	0.0	12.2
2002-2004	6.8	3.9	10.0	8.4	14.9	22.5	21.3	20.3	23.9	0.0	23.5	0.3	0.0	12.2
2003-2005	7.5	4.2	11.3	9.6	15.9	24.0	22.3	21.5	25.1	0.0	24.3	0.4	0.0	13.2
2004-2006	7.0	3.6	10.9	9.3	15.2	19.0	18.2	17.4	20.7	0.0	19.2	0.4	0.0	11.4
2005-2007	7.0	3.4	11.0	9.4	15.2	19.2	18.1	17.1	20.7	0.0	18.9	0.4	0.0	11.4
2006-2008	5.9	2.5	9.5	8.2	14.3	17.0	16.1	14.9	18.6	0.0	16.8	0.2	0.0	9.9
2007-2009	5.5	2.6	8.8	7.6	13.8	16.3	15.9	14.8	18.3	0.0	17.0	0.2	0.0	9.5
2008-2010	5.2	2.7	8.4	7.2	13.7	15.8	15.7	14.7	17.9	0.0	17.1	0.2	0.0	9.2
2009-2011	5.2	2.9	8.1	7.0	14.1	15.7	16.1	15.2	18.2	0.0	17.6	0.3	0.0	9.2
2010-2012	5.1	2.4	8.1	7.0	13.9	15.1	15.0	14.0	17.2	0.0	16.3	0.2	0.0	8.8
2011-2013	5.1	2.0	8.3	7.3	14.0	15.4	14.7	13.7	17.0	0.0	15.7	0.2	0.0	8.9
2012-2014	5.0	1.9	8.5	7.2	13.1	14.9	13.9	12.9	16.3	0.0	15.1	0.1	0.0	8.6
2013-2015	5.1	2.2	8.8	7.4	12.5	15.2	14.7	13.5	17.1	0.0	15.4	0.4	0.0	8.9
2014-2016	5.1	2.4	8.5	7.4	12.1	14.5	14.3	13.0	16.6	0.0	15.1	0.4	0.0	8.7
2015-2017	5.0	2.5	8.0	7.1	11.9	14.6	14.4	12.9	16.6	0.0	15.3	0.4	0.0	8.6
2016-2018	4.7	2.2	7.8	6.7	12.0	13.9	13.4	12.0	15.6	0.0	14.5	0.2	0.0	8.1
Reduction in AAE from 1996 to 2017	5.9	4.7	7.1	7.2	9.6	12.2	9.8	10.7	10.0	0.0	10.1	2.8	0.0	7.7

Table N5: Nutrient-sensitive habitat area in Scotland and percentage area of habitats where nutrient nitrogen critical loads are exceeded, by deposition dataset year.

Parameter	Nitrogen-sensitive habitat areas in Scotland and percentage habitat area with exceedance of nutrient nitrogen critical loads:													
	Acid grassland	Calcareous grassland	Dwarf shrub heath	Bog	Montane	Coniferous woodland (managed)	Broadleaved woodland (managed)	Beech woodland (unmanaged)	Acidophilous oak (unmanaged)	Scots Pine (unmanaged)	Other unmanaged woodland	Dune grassland	Saltmarsh	All habitats
<i>Habitat area (km²)</i>	8283	24	20284	3993	3109	5111	1096	4	581	204	282	184	45	43200
1995-1997	52.4	45.7	50.0	36.7	96.6	92.4	89.1	100.0	97.3	61.1	78.1	53.0	1.2	59.4
1998-2000	40.0	32.4	37.9	25.4	95.7	85.0	82.4	100.0	92.6	38.9	72.4	28.0	1.2	48.9
1999-2001	40.6	33.5	40.6	24.7	97.1	88.4	85.2	100.0	95.3	52.3	74.2	28.5	1.2	50.9
2001-2003	40.0	48.6	36.5	24.2	88.9	84.8	82.4	100.0	90.5	49.7	73.4	31.9	0.0	47.7
2002-2004	42.3	41.2	38.9	24.5	92.6	88.6	87.1	100.0	95.6	66.5	74.2	19.3	0.0	50.2
2003-2005	43.7	25.6	39.8	24.9	90.5	87.2	86.6	100.0	95.4	67.8	74.0	18.2	0.0	50.6
2004-2006	44.2	16.1	44.6	25.8	96.5	84.1	83.1	100.0	89.1	58.0	73.5	18.7	0.0	52.9
2005-2007	42.2	24.0	44.4	37.8	96.2	85.5	82.5	100.0	88.8	52.6	74.0	24.1	0.0	53.6
2006-2008	35.1	24.1	38.6	38.8	95.5	82.8	80.1	100.0	84.6	34.2	72.6	25.6	0.0	49.0
2007-2009	28.8	15.3	31.7	27.2	82.6	78.6	77.7	100.0	74.8	30.7	70.8	23.7	0.0	41.8
2008-2010	29.3	43.3	30.1	25.2	80.9	77.4	77.3	100.0	71.7	30.5	70.4	26.9	0.0	40.7
2009-2011	37.8	51.8	33.1	25.5	82.0	80.9	79.6	100.0	79.1	32.4	71.4	29.9	0.0	44.5
2010-2012	36.4	48.7	29.6	24.3	74.2	78.2	78.1	100.0	69.7	26.2	68.2	29.7	0.0	41.4
2011-2013	37.6	22.9	28.8	21.6	71.0	77.8	77.9	100.0	71.8	24.2	69.9	25.4	0.0	40.7
2012-2014	37.1	23.4	28.8	24.9	74.1	76.5	76.9	100.0	69.5	26.0	69.5	22.3	0.0	40.9
2013-2015	40.5	25.4	30.5	25.2	78.3	77.3	77.4	100.0	71.7	26.4	69.7	23.9	0.0	42.8
2014-2016	38.9	25.4	28.9	23.8	73.1	75.7	76.0	100.0	70.5	23.9	69.3	23.2	0.0	41.0
2015-2017	31.8	14.7	23.0	19.0	61.7	70.8	72.6	100.0	58.0	20.8	63.7	19.1	0.0	34.7
2016-2018	30.6	14.7	22.7	19.0	58.6	70.7	70.6	100.0	57.6	18.8	62.3	16.3	0.0	34.0
Reduction in % area exceeded from 1996 to 2017	21.8	31.0	27.3	17.7	38.0	21.8	18.5	0.0	39.7	42.3	15.9	36.7	1.2	25.4

Table N6: Nutrient nitrogen: AAE (in kg N ha⁻¹ year⁻¹) by habitat for Scotland by deposition dataset year.

Parameter	AAE (kg N ha ⁻¹ year ⁻¹) by habitat:													
	Acid grassland	Calcareous grassland	Dwarf shrub heath	Bog	Montane	Coniferous woodland (managed)	Broadleaved woodland (managed)	Beech woodland (unmanaged)	Acidophilous oak (unmanaged)	Scots Pine (unmanaged)	Other unmanaged woodland	Dune grassland	Saltmarsh	All habitats
1995-1997	2.7	1.4	2.4	1.9	5.4	11.7	11.6	14.1	8.6	3.3	10.2	1.8	0.1	4.1
1998-2000	1.6	0.7	1.5	1.1	4.3	7.9	8.8	7.1	6.4	2.0	8.1	0.8	0.1	2.7
1999-2001	1.6	0.9	1.6	1.1	5.0	8.5	9.3	7.5	7.1	2.8	8.6	0.9	0.1	2.9
2001-2003	1.6	1.3	1.7	1.2	5.6	9.1	9.8	9.2	6.9	3.2	9.3	0.8	0.0	3.1
2002-2004	1.7	0.6	1.8	1.1	6.1	9.6	10.3	9.4	8.1	4.0	9.7	0.5	0.0	3.3
2003-2005	1.8	0.5	1.7	1.1	6.0	9.5	9.8	9.5	7.9	3.7	9.5	0.4	0.0	3.3
2004-2006	1.9	0.4	1.8	1.2	6.3	7.9	7.8	7.2	6.2	2.6	7.7	0.5	0.0	3.1
2005-2007	1.7	0.5	1.7	1.3	5.4	7.9	8.3	8.4	5.9	2.3	8.0	0.6	0.0	2.9
2006-2008	1.3	0.4	1.4	1.2	4.2	7.4	8.0	8.4	5.0	1.9	7.6	0.6	0.0	2.5
2007-2009	1.0	0.2	1.0	0.9	3.2	6.7	7.7	8.3	4.4	1.6	7.1	0.6	0.0	2.1
2008-2010	1.1	0.6	1.1	0.9	3.2	6.8	8.2	8.5	4.4	1.7	7.4	0.7	0.0	2.2
2009-2011	1.5	0.9	1.4	1.2	3.5	7.9	9.3	9.7	5.4	1.9	8.3	0.9	0.0	2.6
2010-2012	1.5	0.8	1.3	1.1	2.8	7.5	8.6	9.1	4.8	1.6	7.8	0.8	0.0	2.4
2011-2013	1.4	0.3	1.2	1.1	2.8	7.3	7.7	8.2	4.8	1.5	7.2	0.6	0.0	2.3
2012-2014	1.4	0.2	1.2	1.1	3.0	7.1	6.9	7.2	4.6	1.6	6.6	0.5	0.0	2.3
2013-2015	2.0	0.4	1.5	1.2	3.4	7.9	7.4	7.7	5.0	1.7	7.4	0.6	0.0	2.7
2014-2016	1.9	0.3	1.4	1.2	3.1	7.6	7.3	7.9	4.7	1.5	7.3	0.6	0.0	2.5
2015-2017	1.3	0.3	0.9	0.9	2.1	6.6	6.7	7.5	3.6	1.0	6.7	0.5	0.0	1.9
2016-2018	1.0	0.1	0.8	0.9	2.0	6.0	6.0	6.7	3.3	0.8	6.0	0.4	0.0	1.8
Reduction in AAE from 1996 to 2017	1.7	1.3	1.6	1.0	3.5	5.7	5.6	7.3	5.3	2.5	4.2	1.4	0.1	2.4

Table N7: Nutrient-sensitive habitat area in NI and percentage area of habitats where nutrient nitrogen critical loads are exceeded, by deposition dataset year.

Parameter	Nitrogen-sensitive habitat areas in England and percentage habitat area with exceedance of nutrient nitrogen critical loads:													
	Acid grassland	Calcareous grassland	Dwarf shrub heath	Bog	Montane	Coniferous woodland (managed)	Broadleaved woodland (managed)	Beech woodland (unmanaged)	Acidophilous oak (unmanaged)	Scots Pine (unmanaged)	Other unmanaged woodland	Dune grassland	Saltmarsh	All habitats
<i>Habitat area (km²)</i>	1186	70	983	470	0	502	0	0	0	0	246	9	1	3467
1995-1997	84.7	20.2	99.0	99.1	0.0	99.9	0.0	0.0	0.0	0.0	100.0	84.4	0.0	92.6
1998-2000	60.7	23.8	91.9	88.7	0.0	94.8	0.0	0.0	0.0	0.0	96.8	49.7	0.0	80.0
1999-2001	64.4	22.6	92.8	93.6	0.0	96.8	0.0	0.0	0.0	0.0	97.7	49.8	0.0	82.5
2001-2003	73.3	24.2	92.5	92.7	0.0	96.9	0.0	0.0	0.0	0.0	97.9	24.9	16.5	85.4
2002-2004	73.1	24.0	94.2	94.0	0.0	98.3	0.0	0.0	0.0	0.0	99.0	49.7	8.2	86.3
2003-2005	66.3	23.2	93.8	93.7	0.0	98.1	0.0	0.0	0.0	0.0	99.0	49.7	8.2	83.8
2004-2006	69.3	23.2	93.9	94.1	0.0	97.5	0.0	0.0	0.0	0.0	98.2	49.7	11.1	84.8
2005-2007	73.4	23.6	94.0	95.7	0.0	98.0	0.0	0.0	0.0	0.0	98.5	24.9	11.1	86.4
2006-2008	73.5	24.0	94.6	96.4	0.0	98.1	0.0	0.0	0.0	0.0	98.9	24.9	11.1	86.8
2007-2009	78.4	25.8	95.0	96.5	0.0	98.3	0.0	0.0	0.0	0.0	99.0	24.9	11.1	88.7
2008-2010	81.4	27.0	95.0	96.5	0.0	98.3	0.0	0.0	0.0	0.0	99.0	24.9	11.1	89.7
2009-2011	85.7	34.3	95.1	96.6	0.0	98.1	0.0	0.0	0.0	0.0	99.0	49.7	16.5	91.4
2010-2012	80.0	24.8	94.1	94.2	0.0	97.5	0.0	0.0	0.0	0.0	98.4	49.7	11.1	88.5
2011-2013	81.7	27.1	95.1	96.6	0.0	98.3	0.0	0.0	0.0	0.0	99.0	49.7	11.1	89.9
2012-2014	71.7	23.9	95.0	96.7	0.0	98.4	0.0	0.0	0.0	0.0	99.0	24.9	11.1	86.4
2013-2015	74.8	23.6	95.0	96.5	0.0	98.1	0.0	0.0	0.0	0.0	99.0	24.9	11.1	87.4
2014-2016	69.4	23.6	94.1	94.2	0.0	97.5	0.0	0.0	0.0	0.0	98.4	24.9	11.1	84.8
2015-2017	67.9	23.6	93.6	94.1	0.0	97.5	0.0	0.0	0.0	0.0	98.3	22.4	11.1	84.2
2016-2018	61.5	23.5	93.0	92.0	0.0	96.2	0.0	0.0	0.0	0.0	96.3	22.5	0.0	81.2
Reduction in % area exceeded from 1996 to 2017	23.1	-3.3	6.1	7.1	0.0	3.7	0.0	0.0	0.0	0.0	3.7	61.9	0.0	11.5

Table N8: Nutrient nitrogen: AAE (in kg N ha⁻¹ year⁻¹) by habitat for NI by deposition dataset year.

Parameter	AAE (kg N ha ⁻¹ year ⁻¹) by habitat:													
	Acid grassland	Calcareous grassland	Dwarf shrub heath	Bog	Montane	Coniferous woodland (managed)	Broadleaved woodland (managed)	Beech woodland (unmanaged)	Acidophilous oak (unmanaged)	Scots Pine (unmanaged)	Other unmanaged woodland	Dune grassland	Saltmarsh	All habitats
1995-1997	5.9	1.6	11.3	9.5	0.0	19.1	0.0	0.0	0.0	0.0	18.5	3.7	0.0	10.6
1998-2000	3.0	1.4	7.1	5.3	0.0	11.1	0.0	0.0	0.0	0.0	15.2	2.5	0.0	6.5
1999-2001	3.2	1.4	7.3	5.6	0.0	11.7	0.0	0.0	0.0	0.0	15.7	3.0	0.0	6.8
2001-2003	4.4	2.6	9.4	7.3	0.0	15.8	0.0	0.0	0.0	0.0	19.6	3.6	0.3	8.9
2002-2004	4.4	1.6	8.6	6.7	0.0	15.6	0.0	0.0	0.0	0.0	21.4	3.8	0.1	8.7
2003-2005	4.1	1.4	8.2	6.2	0.0	15.1	0.0	0.0	0.0	0.0	21.0	3.5	0.0	8.3
2004-2006	4.0	1.5	8.0	6.3	0.0	13.8	0.0	0.0	0.0	0.0	19.2	3.4	0.2	7.9
2005-2007	4.8	1.7	8.8	6.8	0.0	15.1	0.0	0.0	0.0	0.0	21.5	3.9	0.4	8.8
2006-2008	4.8	1.7	8.8	6.9	0.0	15.2	0.0	0.0	0.0	0.0	21.4	3.8	0.4	8.8
2007-2009	5.3	1.9	9.3	7.3	0.0	15.8	0.0	0.0	0.0	0.0	22.7	4.1	0.5	9.4
2008-2010	5.6	2.0	9.8	7.6	0.0	16.3	0.0	0.0	0.0	0.0	23.4	4.2	0.5	9.8
2009-2011	6.6	2.4	10.9	8.7	0.0	17.7	0.0	0.0	0.0	0.0	25.3	4.3	0.6	10.9
2010-2012	5.4	2.1	9.7	7.5	0.0	15.9	0.0	0.0	0.0	0.0	22.9	3.9	0.4	9.6
2011-2013	5.4	1.9	9.7	7.8	0.0	15.9	0.0	0.0	0.0	0.0	21.8	4.0	0.4	9.5
2012-2014	4.3	1.6	8.5	6.6	0.0	14.4	0.0	0.0	0.0	0.0	19.6	3.8	0.3	8.3
2013-2015	4.3	1.6	8.5	6.7	0.0	14.5	0.0	0.0	0.0	0.0	19.9	3.4	0.2	8.4
2014-2016	4.2	1.6	8.2	6.2	0.0	13.8	0.0	0.0	0.0	0.0	19.9	3.3	0.2	8.1
2015-2017	4.0	1.6	8.0	5.8	0.0	13.5	0.0	0.0	0.0	0.0	20.2	3.2	0.1	7.9
2016-2018	3.5	1.4	7.5	5.4	0.0	12.6	0.0	0.0	0.0	0.0	18.7	2.8	0.0	7.3
Reduction in AAE 1996 to 2017	2.3	0.3	3.8	4.0	0.0	6.5	0.0	0.0	0.0	0.0	-0.2	0.9	0.0	3.4