Trends Report 2021: 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 in air quality.

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 further reduce impacts on ecosystems in response to the UK's new emission reduction targets for oxides of nitrogen and ammonia.

- UK habitats at risk from acidification: The area of acid-sensitive habitats with exceedance of acidity critical loads has fallen by more than one third, from 77.3% in 1996, to 47.4% in 2012, to 40.4% (28,353 km^2) in 2018, due mainly to decreases in sulphur deposition.
- UK habitats at risk from excess N (eutrophication): The area of N-sensitive habitats with exceedance of nutrient N critical loads fell from 75.0% in 1996, to 62.5% in 2012, to 58.9% (42,994 km^2) in 2018.
- UK habitats at risk of exceeding the critical levels for gaseous ammonia: In 2017, 7.8% (19,195 km^2) of the UK land area was exposed to ammonia concentrations above the critical level set to protect higher plants (3 $\mu g\ m^{-3}$), and 64.7% (158,426 km^2) to ammonia at concentrations above the critical level set to protect lichens and mosses (1 $\mu g\ m^{-3}$). The area where the critical level for higher plants is exceeded has increased by 4.1% (10,087km^2) of UK land area since 2010. The area where the critical level for lichens and mosses is exceeded has decreased by 0.8% (1,977km^2) 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, keq ha^{-1} 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, µg m^{-3}) in the atmosphere below which direct adverse effects on receptors, such as human beings, plants, ecosystems or materials, are not expected to 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. A 3-year mean is used to smooth out inter-annual variability due to the influence of weather on atmospheric chemistry. This report describes critical loads and their exceedances for the period from 1996 to 2018, and critical levels and their exceedances for the period from 2010 to 2017.

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 40.4% (28,353 km^2) in 2018.
- 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 2018, from 0.78 to 0.23 keq ha^{-1} $year^{-1}$.
- 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 24.4% (10,415 km^2) in 2018.
- 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 68.9% (2,306 km^2) in 2018.
- 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% (17,370km^2) in 1996 to 20.4% (5,035 km^2) in 2018.

- The terrestrial habitat with the smallest decrease in acidity critical load exceedance, falling by less than a third between 1996 and 2018, has been acid grassland, where 92.0% (14,106 km^2) was exceeded in 1996 to and 66.3% (10,171 km^2) in 2018.

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 km^2) in 1996 to 58.9% (42,994 km^2) in 2018. 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 5.9 kg N ha^{-1} $year^{-1}$ in 2018.
- 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 km^2) in 1996 to 35.2% (15,195 km^2) in 2018.
- The smallest reduction in the area of N-sensitive habitats with critical load exceedance is in England, falling from 98.3% (19,199 km^2) in 1996 to 95.6% (18,670 km^2) in 2018.
- 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 decreased, from 22.7 kg N ha^{-1} $year^{-1}$ in 1996 to 13.4 kg N ha^{-1} $year^{-1}$ in 2018.
- 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

- Since 2020, the 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".
- The mean N deposition rate onto priority habitats in England was 20.3 kg N ha^{-1} yr^{-1} in 2016, and 20.8 kg N ha^{-1} yr^{-1} in 2018, representing a 2.5 % increase.
- The increase appears at odds with the relatively stable trend in ammonia emissions. Increased concentrations may have resulted from changes in the spatial pattern of ammonia emissions, interactions with SO2 and NOx, or meteorological variations.

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 72.9% (SACs: 355 sites) and 67.4% (SPAs: 118 sites) in 2018.
- The percentage of SSSIs with exceedance of at least one sensitive feature fell from 77.6% (3,632 sites) in 1996 to 58.1% (2,722 sites) in 2018.
- Scotland had the largest reductions (34.6%) in the percentage of designated sites with exceedance of acidity critical loads between 1996 and 2018.

- Roughly 50% of designated sites in Scotland and more than 70% of designated sites in other countries currently have exceedance of acidity critical loads, with the exception of SSSIs in England, 57% of which were exceeded.

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 2018 are small (4.9% for SACs, 9.2% for SSSIs, 12.9% for SPAs). This reflects the smaller reductions in N deposition, compared to acid deposition, over this time period.
- Scotland had the largest decreases (ca. 9-16%) in the percentage of SACs and SSSIs with exceedance of nutrient N critical loads between 1996 and 2018; Wales had the largest reduction (21.4%) in the percentage of SPAs with nutrient N critical load exceedance over the same time period.
- 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 (74-81% 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 2017; there have only been small reductions in ammonia concentrations over this time period.

UK land area

- Nearly 65% of the UK currently receives ammonia concentrations above the critical level set to protect lichens and bryophytes (1 $\mu g\ m^{-3}$); this represents 90.0% of England, 60.2% of Wales, 18.7% of Scotland and 92.9% of Northern Ireland.
- There has been negligible change in the UK land area with ammonia concentrations above 1 $\mu g\ m^{-3}$, from 63.9% in 2010 to 64.7% in 2017.
- Just under 8% of the UK receives ammonia concentrations above the critical level set to protect higher plants (3 $\mu g\ m^{-3}$); this ranges from 0.2% of Scotland to 36.6% of Northern Ireland.
- The UK land area with ammonia concentrations above 3 $\mu g\ m^{-3}$ has increased, from 3.7% in 2010 to 7.8% in 2017.

Nitrogen-sensitive habitats

- 27.1% of the mapped area of N sensitive habitats in the UK received ammonia concentrations above the critical level of 1 $\mu g\ m^{-3}$; the percentage area exceeded ranges from 3.4% for Scotland to 80.3% for Northern Ireland.
- 91.6% of the area of calcareous grassland, and ~70-84 % 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 $\mu g\ m^{-3}$. Only 21.1 % of acid grassland is in areas exceeding this critical level, but this equates to 3,208 km^2 which is similar in area to the 91.6 % (3,257 km^2) of calcareous grassland exceeded.
- 1.6 % of the area of N-sensitive habitats in the UK receives ammonia concentrations above 3 $\mu g\ m^{-3}$; this ranges from < 0.1 % in Scotland to 13.5 % in Northern Ireland.

Designated sites (SACs, SPAs and SSSIs or ASSIs)

- 55.7% (137) of SPAs, 63% (387) of SACs and 73.7 % (5,043) of SSSIs (ASSIs in Northern Ireland) in the UK currently receive ammonia concentrations above 1 $\mu g\ m^{-3}$ anywhere across the site. The percentage of sites with exceedance of the 1 µg m^{-3} critical level has fallen by <2% between 2010 and 2017, for all site types.

- 90-97% of the designated sites in England, 92-96% of sites in Northern Ireland, 67-69% of sites in Wales, and 18-27% of sites in Scotland, currently receive ammonia concentration above 1 µg m^{-3}.
- 9.4% (58) of SACs, 10.2% (25) of SPAs and 7.6% (523) of SSSIs in the UK currently receive ammonia concentrations above 3 µg m^{-3} anywhere across a site. The percentage of designated sites with exceedance of this critical level has risen by almost 5% between 2010 and 2017.
- Less than 2% of sites with these conservation designations in Scotland (and no SACs) currently receive ammonia concentrations above the critical level of 3 µg m^{-3} anywhere across a site, compared with 0-6% of sites in Wales, up to 22% of sites in England and up to 38.5% 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. Section 4 addresses critical levels for ammonia and their exceedances. Finally, Section 5 focuses on N deposition onto sensitive habitats, which is the basis of a target in the UK Government's Clean Air Strategy (Defra, 2019).

Notes on rounded numbers, percentages and reporting years

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 x (40 – 30) / 40), nor as a decrease of 1% (i.e. 4% of UK area minus 3% of UK area).

The time series of deposition and critical-load exceedance data lengthens each year. It is no longer possible to include data for all years without making the text very small or extending tables over multiple pages, so the critical-load tables now only report results every five years for the early part of the study period. Data are included in these tables from the first three periods for which exceedances have been calculated (1996, 1999 and 2000, referring to the middle of each three-year averaging period as noted above), and annually from 2005. Data points from the whole time-series are still included in the figures.

Section 1. Pollutant deposition, critical loads, and exceedances

1.1 Overview of deposition and critical loads

Pollutant deposition rates, expressed for example in kg ha^{-1} 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 2022. 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.

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-N	Included in Nsens 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 is used for woodland habitats.

In the empirical approach used for non-woodland mineral and organomineral soils, critical loads are assigned to each 1 x 1 km 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 (CLmaxS, CLminN, CLmaxN, 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 (CLmaxS, CLminN, CLmaxN) 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 CLmaxS, CLminN and CLmaxN (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 (Tang et al, 2018a, 2018b), 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 (Conolly et al., 2015, Braban et al., 2021) 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 2017-19.

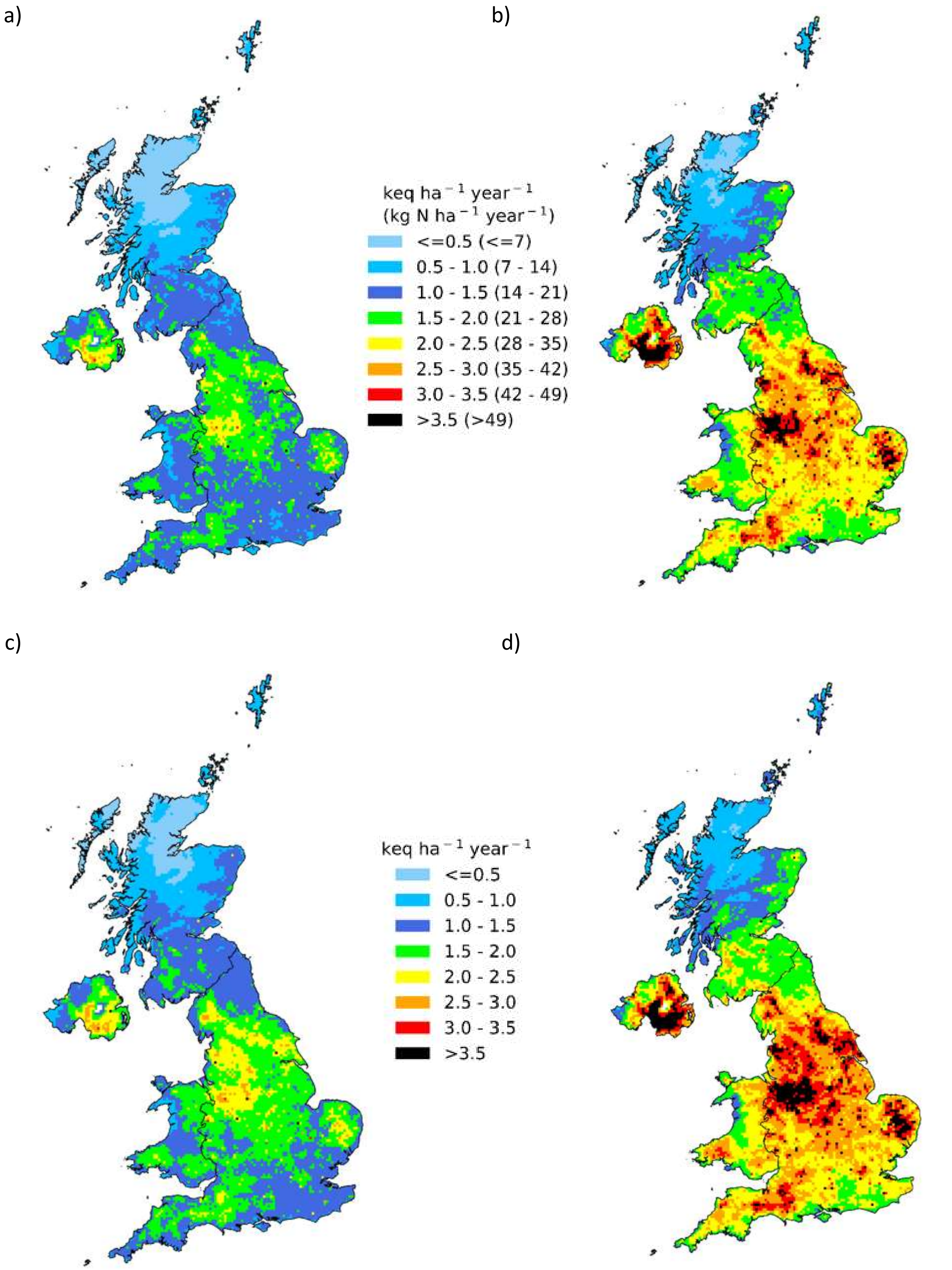

Figure 1.1: CBED deposition for 2017-2019: a) nitrogen (oxidised plus reduced) deposition to moorland; b) nitrogen (oxidised plus reduced) deposition to woodland; c) acid (sulphur + nitrogen) deposition to moorland; d) acid (sulphur + nitrogen) deposition to woodland. Deposition is mapped for N and acidity using the same units (keq ha^{-1} yr^{-1}) and class intervals. For the N maps, deposition rates are also shown in kg N ha^{-1} yr^{-1}.

Since critical loads for terrestrial habitats are mapped on a 1 km grid, for exceedance calculations deposition is assumed to be constant for all 1 km squares within each 5 km square. For freshwater exceedance calculations catchment-weighted mean S and N deposition values are calculated by overlaying land cover (moorland *vs*. forest) and catchment boundaries onto the 5 km 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 2018 (reminder: 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 2018 are summarised in Figure 1.2. Deposition to woodland is higher than that to moorland due to greater deposition velocities of gases (e.g. NH_3 and HNO_3), as well as particulates, onto tall vegetation. Grid-average deposition[1] of non-marine S (NMS) for the UK decreased by 80% over the study period from 1996 to 2018. Decreases in NMS deposition were greater before 2005, but the NMS deposition rate continues to decline, with a 43% decrease over the five year period from 2013 to 2018. Grid-average deposition is less suitable as an indicator of pressure from N, since some habitats are net N emitters. Deposition of oxidised N onto UK woodland decreased by 52% between 1996 and 2018, and also shows an ongoing decline, having decreased by 21% between 2013 and 2018. By contrast, deposition of reduced N onto UK woodland has increased by 5% since 1996, and there was a 15% increase between 2013 and 2018. Percentage changes in N deposition into UK moorland (i.e. unfertilised open habitats) were similar to trends for woodland, with a 20% decline in NOx and a 9.1% increase in NHy in the five years from 2013 to 2018.

Several factors may have contributed to the recent increase in deposition of reduced N: changes in the spatial pattern of ammonia emissions, chemical interaction with atmospheric SO2 and NOx; and somewhat higher average temperatures in 2018. Further analysis is required to identify the relative contribution of the different possible factors, and data from additional years will be needed to confirm whether this represents a long-term trend.

[1] 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, See 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.

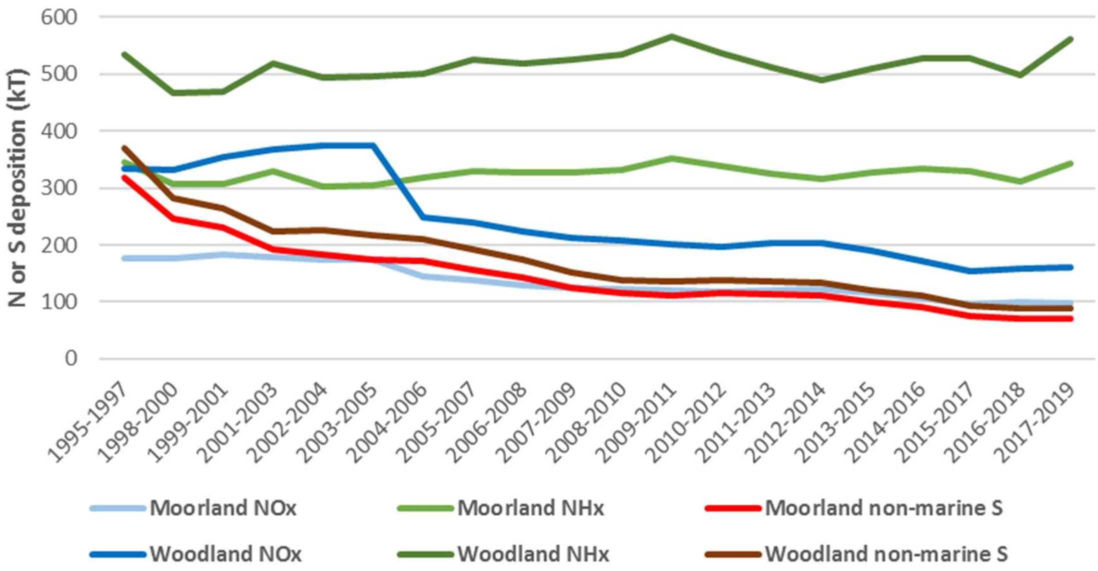

Figure 1.2: Deposition budgets (kilotonnes S or N per year) calculated for the entire UK for CBED deposition to moorland and deposition to woodland. NMS = non-marine sulphur, NOx = oxidised nitrogen, NHx = reduced nitrogen.

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:

1. The “maximum critical load of S” (CLmaxS): the critical load for acidity expressed in terms of S only, i.e. when N deposition is zero.

2. The “maximum critical load of N” (CLmaxN): the critical load for acidity expressed in terms of N only (when S deposition is zero).

3. The "minimum critical load of N" (CLminN): 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.

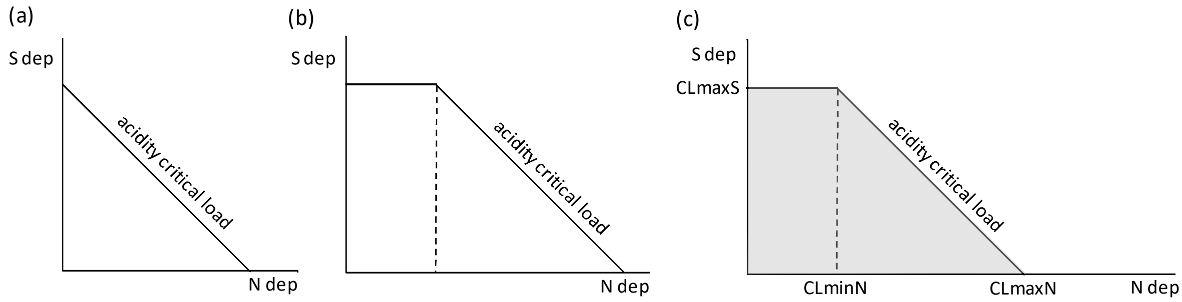

Figure 1.3: Development of the CLF: a) acidity critical load defined by equal amounts of sulphur and nitrogen deposition; b) shifting the acidity critical load diagonal line to allow for nitrogen removal processes; c) the 3 nodes of the CLF: CLmaxS, CLminN, CLmaxN. The area shown in grey represents the 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. <u>not</u> 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).

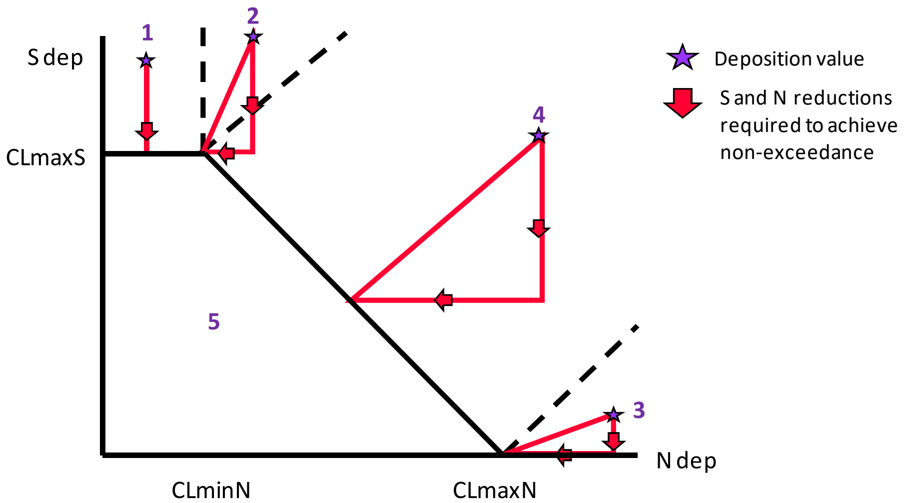

Figure 1.4: Example of S and N deposition reductions required depending on the region of the CLF. Deposition that falls in region 5 is below the critical load (i.e. critical loads not exceeded).

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 the Trends Report 2019 and previous reports, both terrestrial habitats and catchments upstream from freshwater habitats were included in total habitat area, leading to overlaps. From 2020, areas where acidity critical load is exceeded have been reported separately for terrestrial habitats and freshwater catchments, and 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 Trends Report 2019.

(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:

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

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:

AAE (keq ha^{-1} year^{-1}) = AE (keq year^{-1}) / 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:

AAE = ∑(AE for all habitats)/∑(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 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.

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

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 update these maps in time for the next Trends Report in 2022. 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 on the basis of the revised maps. However, the changes are unlikely to substantially affect mean deposition onto the overall area of sensitive habitats. The trend in reported N_{sens} is therefore likely to be very similar after this update.

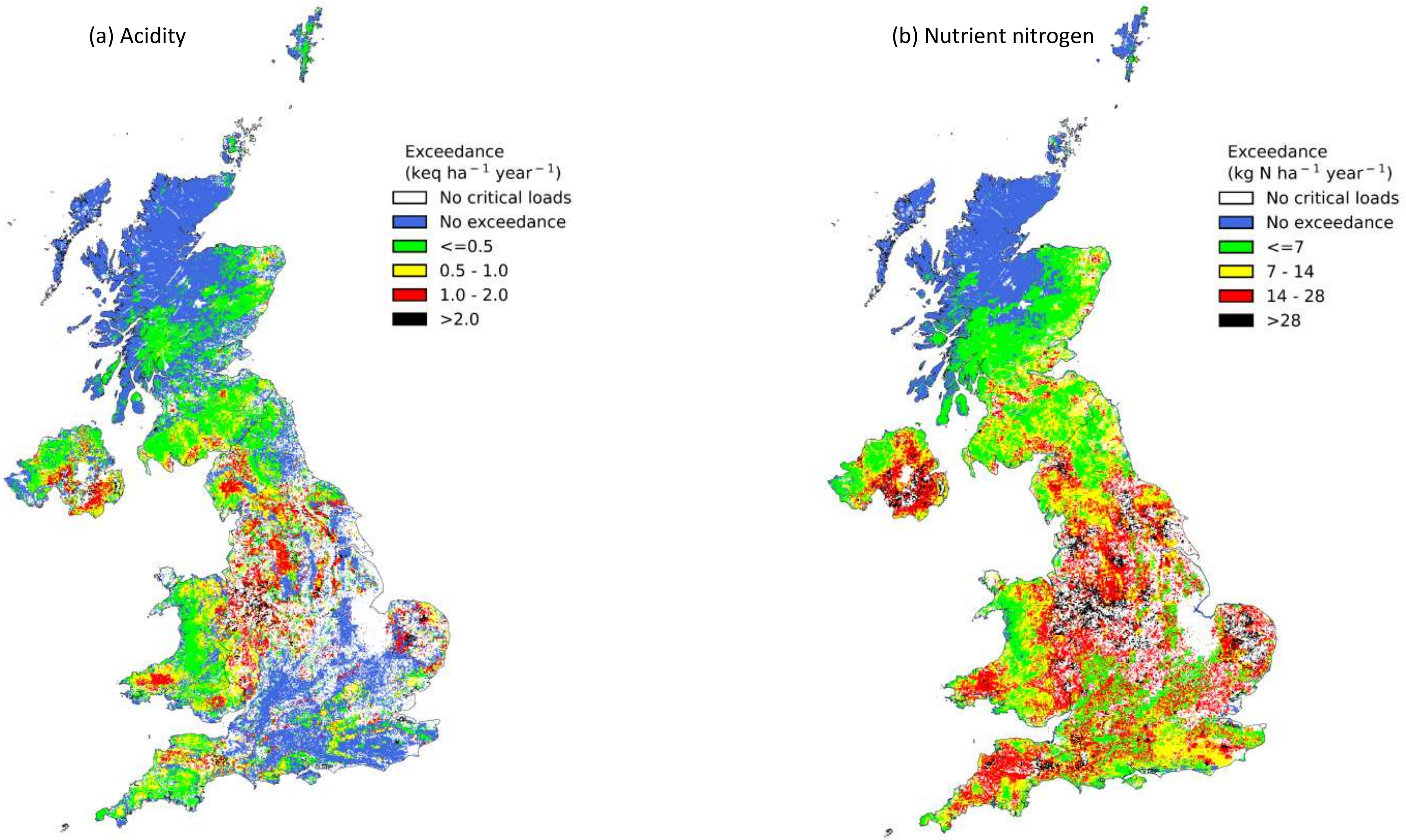

Figure 1.5: Average Accumulated Exceedance (AAE) in 2017-19 of critical loads for a) acidity and b) nutrient nitrogen. Although the legends for the two maps are given in different units, the class intervals are the same (i.e. 7 kg N ha^{-1} year^{-1} is equal to 0.5 keq ha^{-1} year^{-1}).

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 three-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	132,938	17,526	13	19,522	15
Wales	21,225	6,573	31	6,837	32
Scotland	80,239	42,745	53	43,200	54
NI	14,130	3,349	24	3,467	25
UK	248,532	70,193	28	73,027	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 40.4% in 2018. 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. 10,415 km^2 exceeded by 2018 deposition). Although only 13% of England has habitats mapped for acidity critical loads, 59.8% of their area is exceeded for 2018, equivalent to 10,475 km^2. 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 0.23 keq ha^{-1} $year^{-1}$ in 2018. The largest reductions in the exceedances were in the 1990s. The downward trend has continued in recent years, although the latest year of data show a small increase in area exceeded. Sulphur deposition continued to decline between 2017 and 2018, so this increase is due only to the increase in N deposition. 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.

	Percentage acid-sensitive habitat area exceeded by country *[total area (km^2) acid-sensitive habitats by country]*				
Year	England *[17526]*	Wales *[6573]*	Scotland *[42745]*	NI *[3349]*	UK *[70193]*
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
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
2017-2019	59.8	78.4	24.4	68.9	40.4
Reduction in % area exceeded, 1996-2018	16.1	11.5	43.8	7.9	32.2

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
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
2017-2019	0.47	0.45	0.08	0.43	0.23
Reduction in AAE, 1996-2018	0.86	0.91	0.39	0.37	0.55

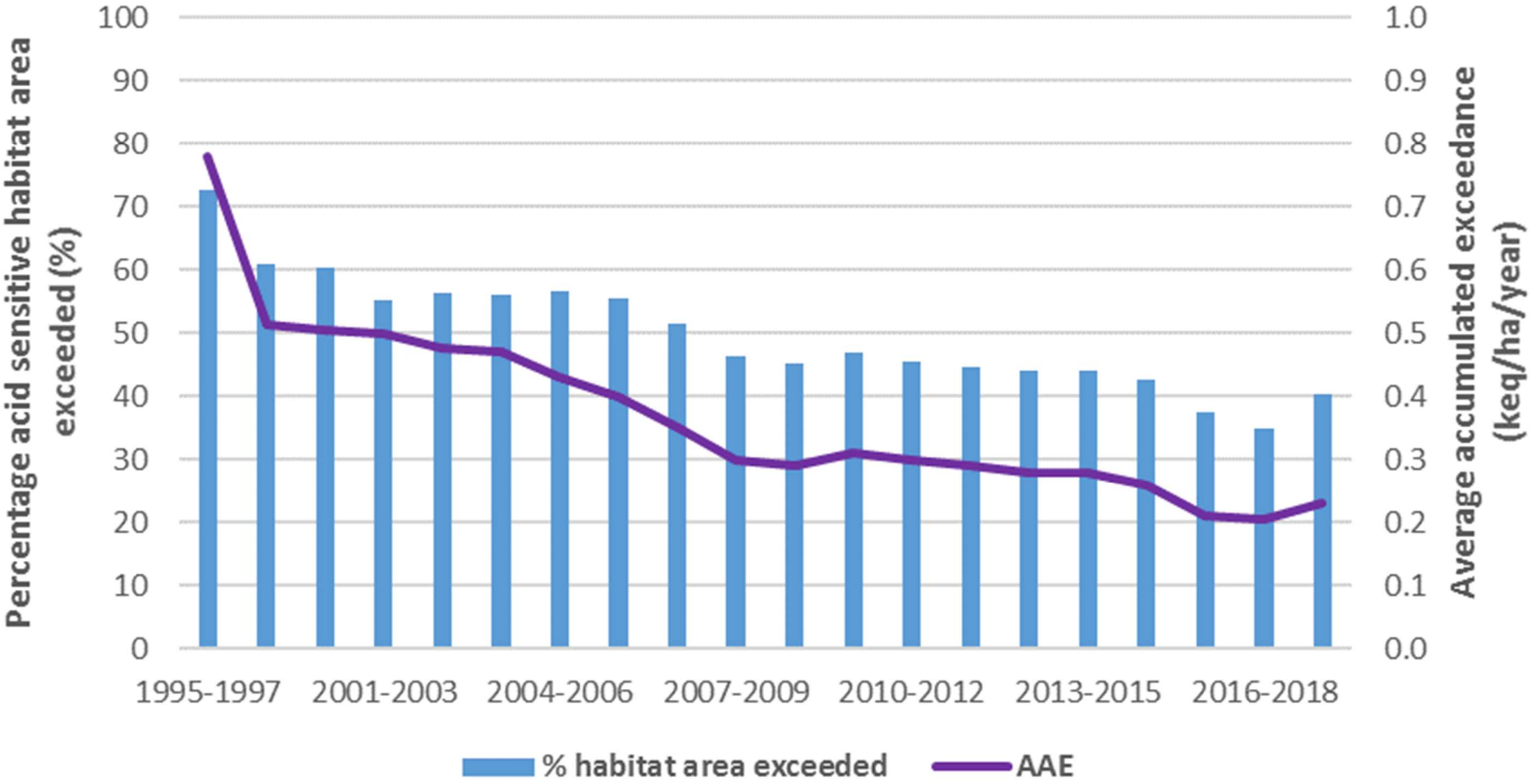

Figure 2.1: Acidity: Percentage area of acid-sensitive habitats with exceedance of acidity critical loads in the UK by year, and AAE in keq ha^{-1} $year^{-1}$.

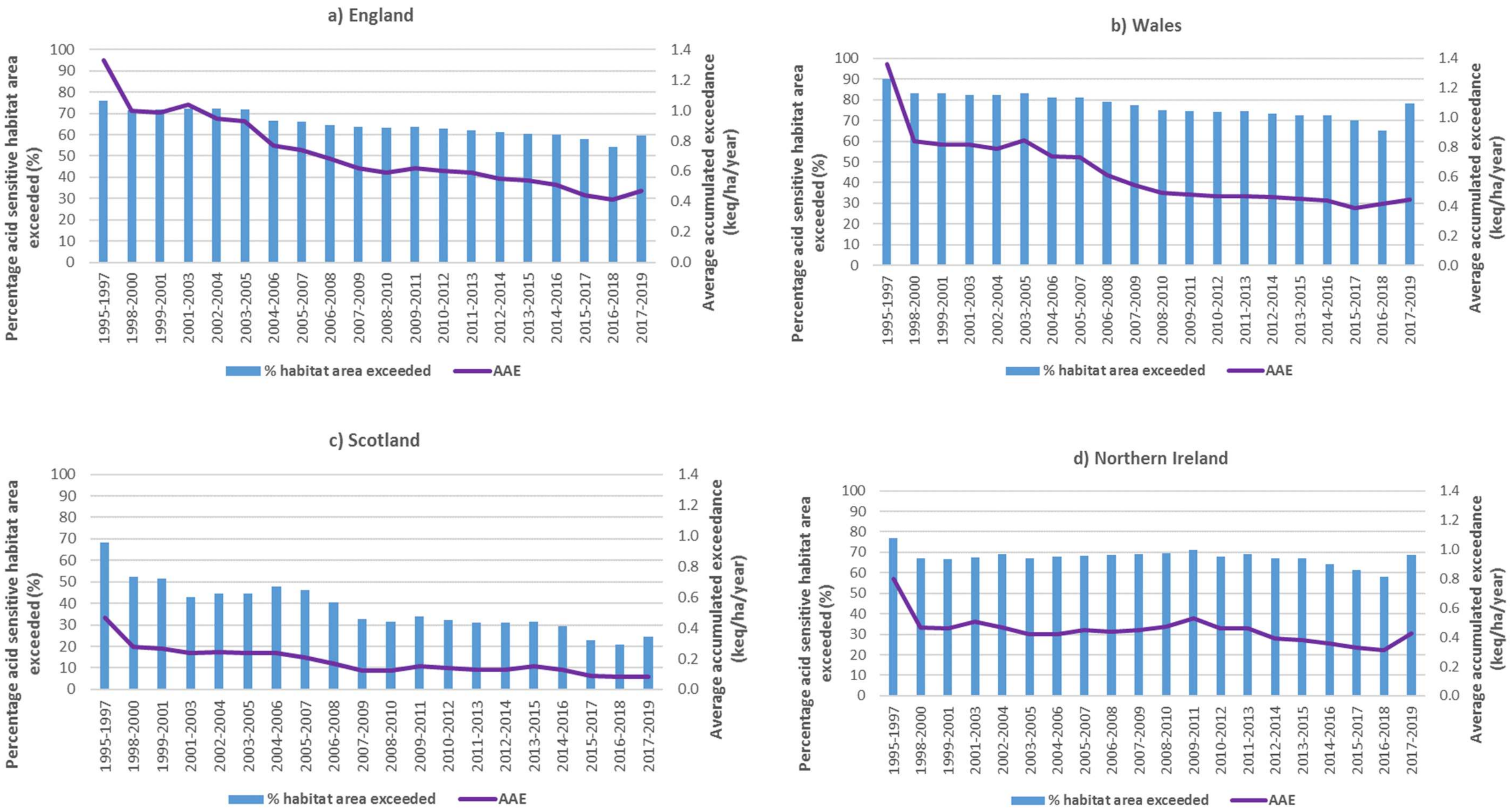

Figure 2.2: Acidity: Percentage area of acid-sensitive habitats with exceedance of acidity critical loads, by country and year, and AAE in keq ha^{-1} year^{-1}.

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 58.9% in 2018. 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 (15,195 km^2 for 2018) is similar to the area exceeded in England (18,670 km^2 in 2018). 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.

	Percentage habitat area exceeded by country *[total area (km^2) nitrogen-sensitive habitats by country]*				
	England	Wales	Scotland	NI	UK
Year	*[19522]*	*[6837]*	*[43200]*	*[3467]*	*[73027]*
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
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
2017-2019	95.6	88.5	35.2	88.9	58.9
Reduction in % area exceeded, 1996-2017	2.7	9.6	24.3	3.7	16.1

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 5.9 kg N ha^{-1} $year^{-1}$ in 2018 (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 0.9 kg N ha^{-1} yr^{-1} between 2010 and 2018.

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.

	AAE (kg N ha^{-1} $year^{-1}$) by country				
Year	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
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
2017-2019	13.2	8.7	1.8	9.6	5.9
Reduction (kg N ha^{-1} yr^{-1}) in AAE 1996-2018	5.8	7.1	2.3	1.0	3.6

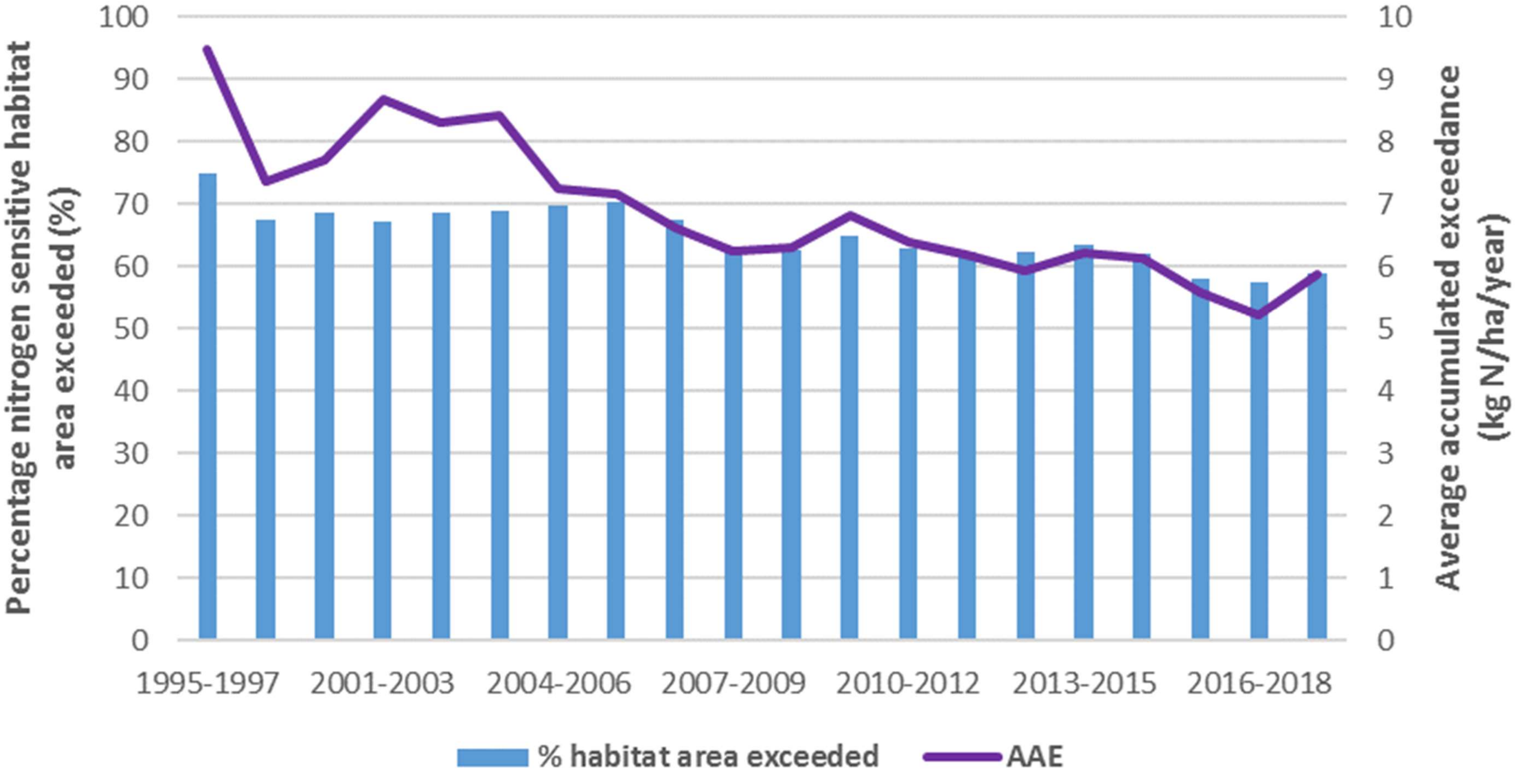

Figure 2.3: Nutrient nitrogen: Percentage area of nitrogen-sensitive habitats with exceedance of nitrogen critical loads in the UK by year, and Average Accumulated Exceedance (AAE in kg N ha^{-1} $year^{-1}$) i.e. "Excess Nitrogen".

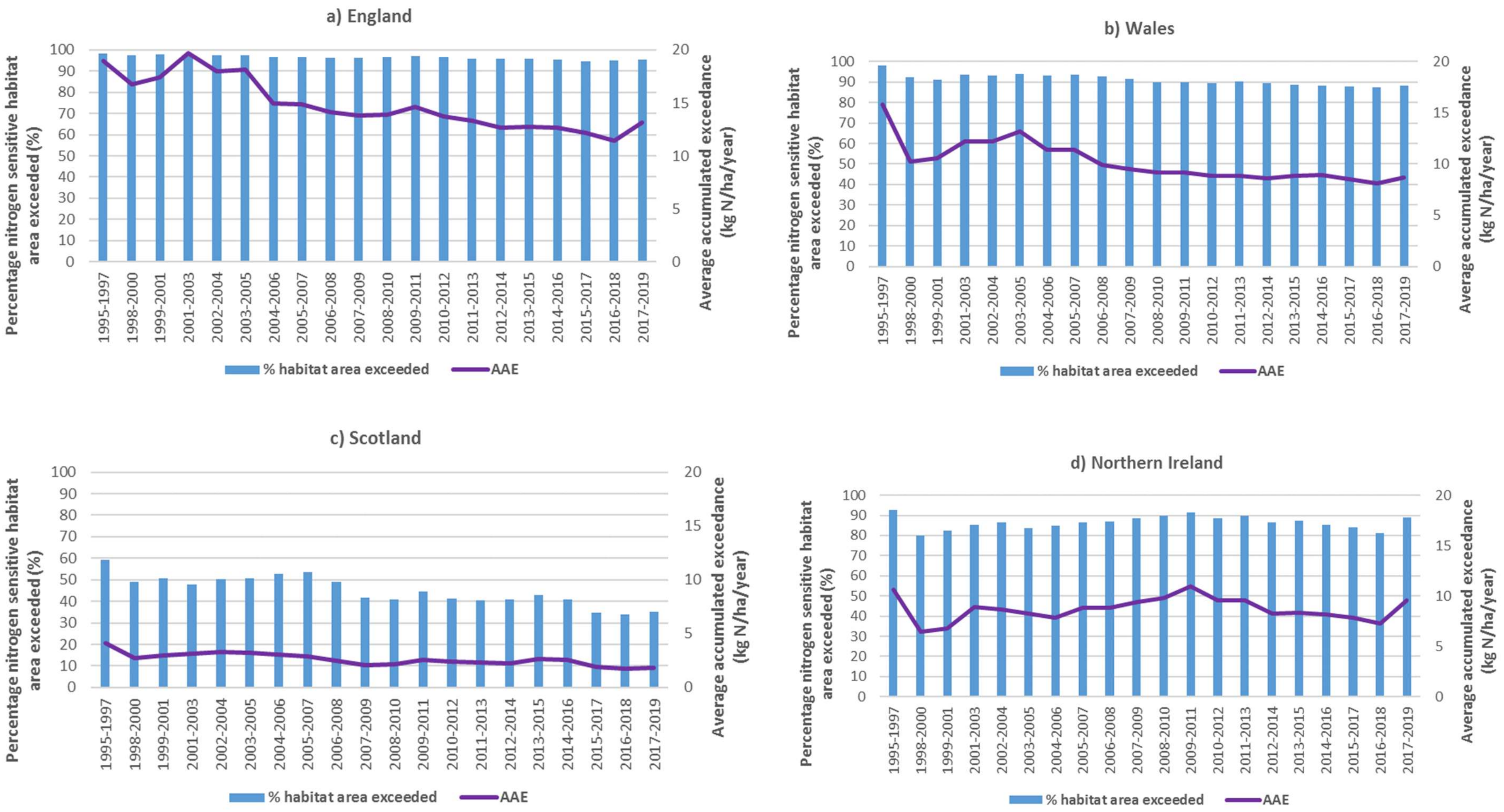

Figure 2.4: Nutrient nitrogen: Percentage area of nitrogen-sensitive habitats with exceedance of nitrogen critical loads, by country and year, and Average Accumulated Exceedance (AAE in kg N ha^{-1} $year^{-1}$) i.e. "Excess Nitrogen".

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, from 70.3% (17,370 km^2) in 1996 to 20.4% (5,035 km^2) in 2018. 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 29.8% in 2018, 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 13.4 kg N ha^{-1} $year^{-1}$ in 2018.

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	Fresh-waters	All habitats
Habitat area (km^2)	*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
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
2017-2019	66.3	20.4	44.6	44.6	50.2	50.0	35.6	14.0	40.4
Reduction in % area exceeded, 1996-2018	25.7	49.9	43.4	51.2	29.2	25.8	33.9	15.9	36.9

Table 2.7: Acidity Average Accumulated Exceedance (AAE in keq ha^{-1} $year^{-1}$) by habitat for the UK by deposition dataset year.

	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
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
2017-2019	0.37	0.07	0.25	0.13	0.32	0.42	0.26	0.08	0.23
Reduction in AAE, 1996-2018	0.78	0.40	0.51	0.68	0.81	0.78	0.61	0.28	0.55

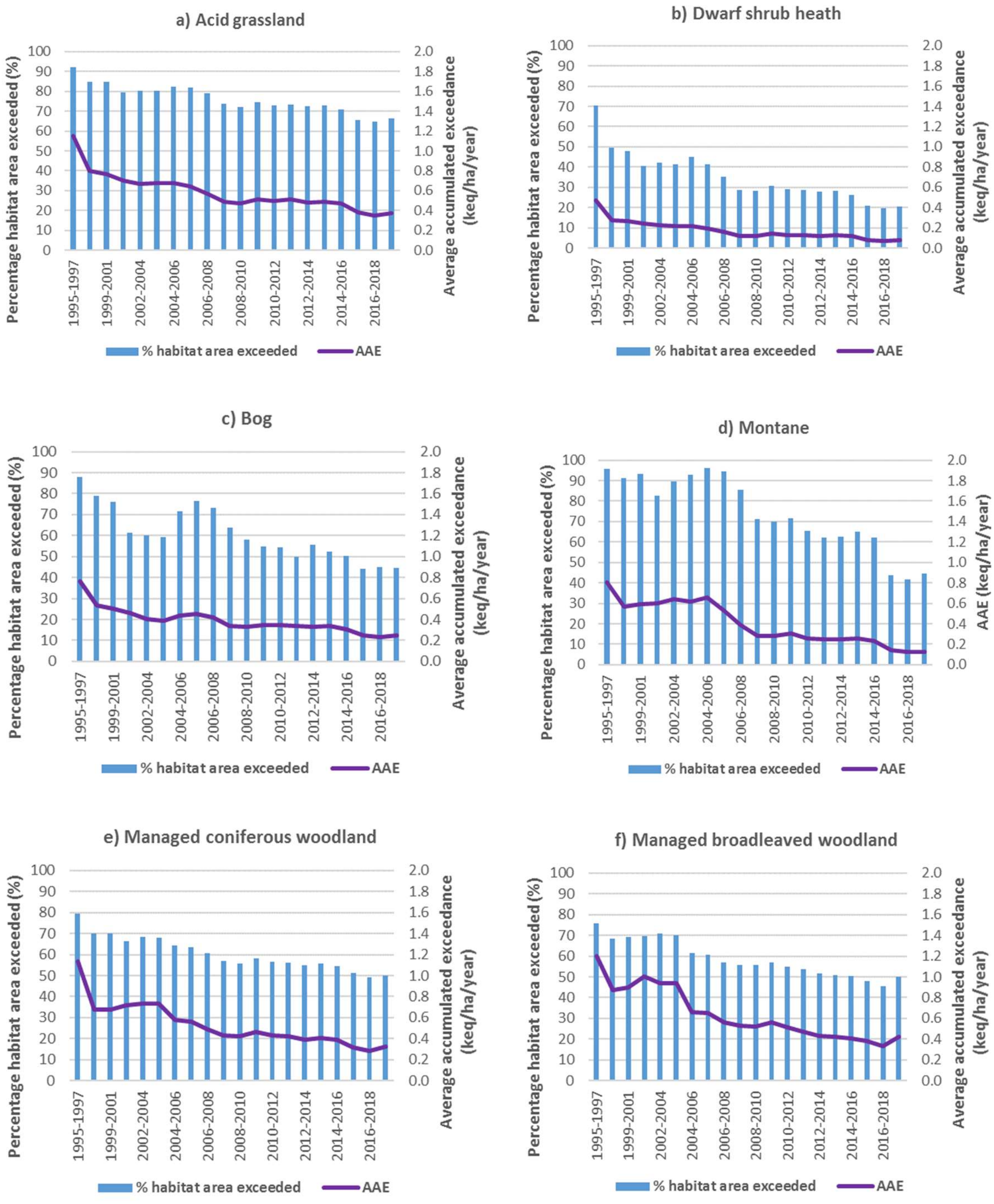

Figure 2.5: Acidity: Percentage area of habitats where acidity critical loads are exceeded, and acidity Average Accumulated Exceedance (AAE in kg N ha^{-1} year^{-1}) for the UK by deposition dataset year.

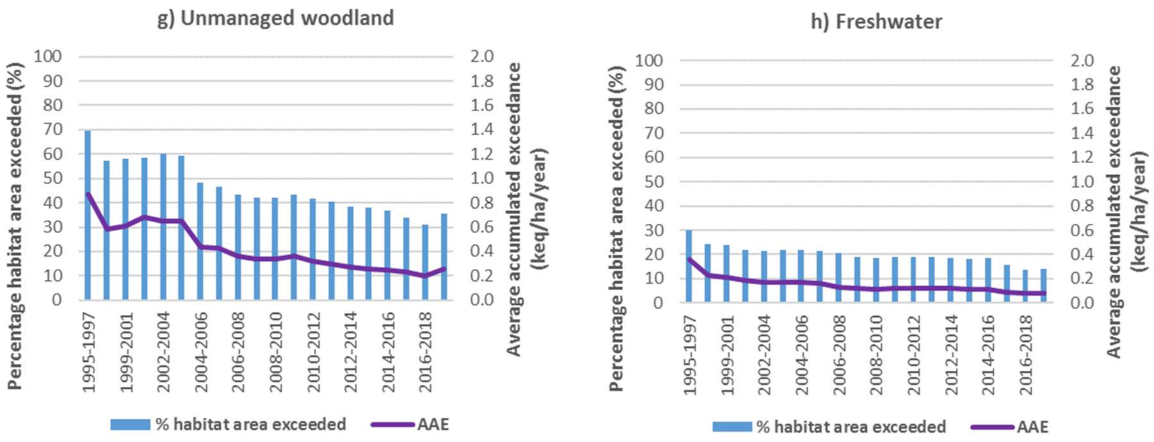

Figure 2.5 (continued): Acidity: Percentage area of habitats where acidity critical loads are exceeded, and acidity Average Accumulated Exceedance (AAE in kg N ha^{-1} year^{-1}) for the UK by deposition dataset year.

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
Habitat area (km²)	*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
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
2017-2019	55.0	89.0	37.1	41.1	63.4	84.1	96.0	99.9	85.9	21.1	94.0	29.8	1.1
Reduction in % area exceeded, 1996-2018	17.6	8.5	22.0	13.1	33.3	11.3	2.4	0.1	13.0	40.0	2.5	40.8	0.9

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
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
2017-2019	3.2	5.1	2.3	3.3	2.1	10.3	17.8	13.4	12.9	0.9	18.6	0.8	0.1
Reduction in AAE, 1996-2018	3.1	2.5	2.2	2.0	3.4	6.5	6.7	9.3	7.0	2.4	4.6	1.9	-0.1

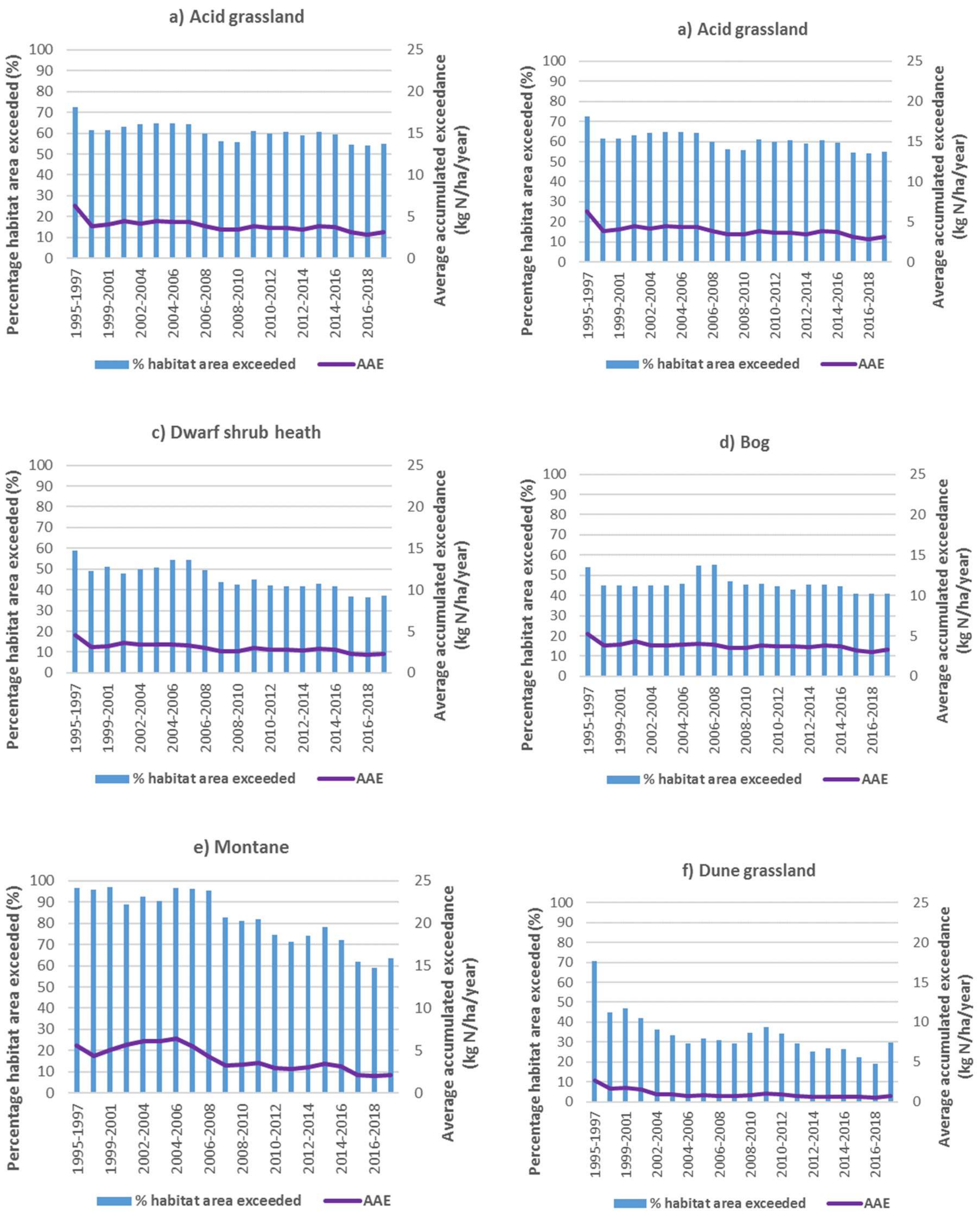

Figure 2.6: Nutrient nitrogen: Percentage area of habitats where nutrient nitrogen critical loads are exceeded and nutrient nitrogen Average Accumulated Exceedance (AAE in kg N ha^{-1} year^{-1}) i.e. "Excess Nitrogen" in the UK by deposition dataset year.

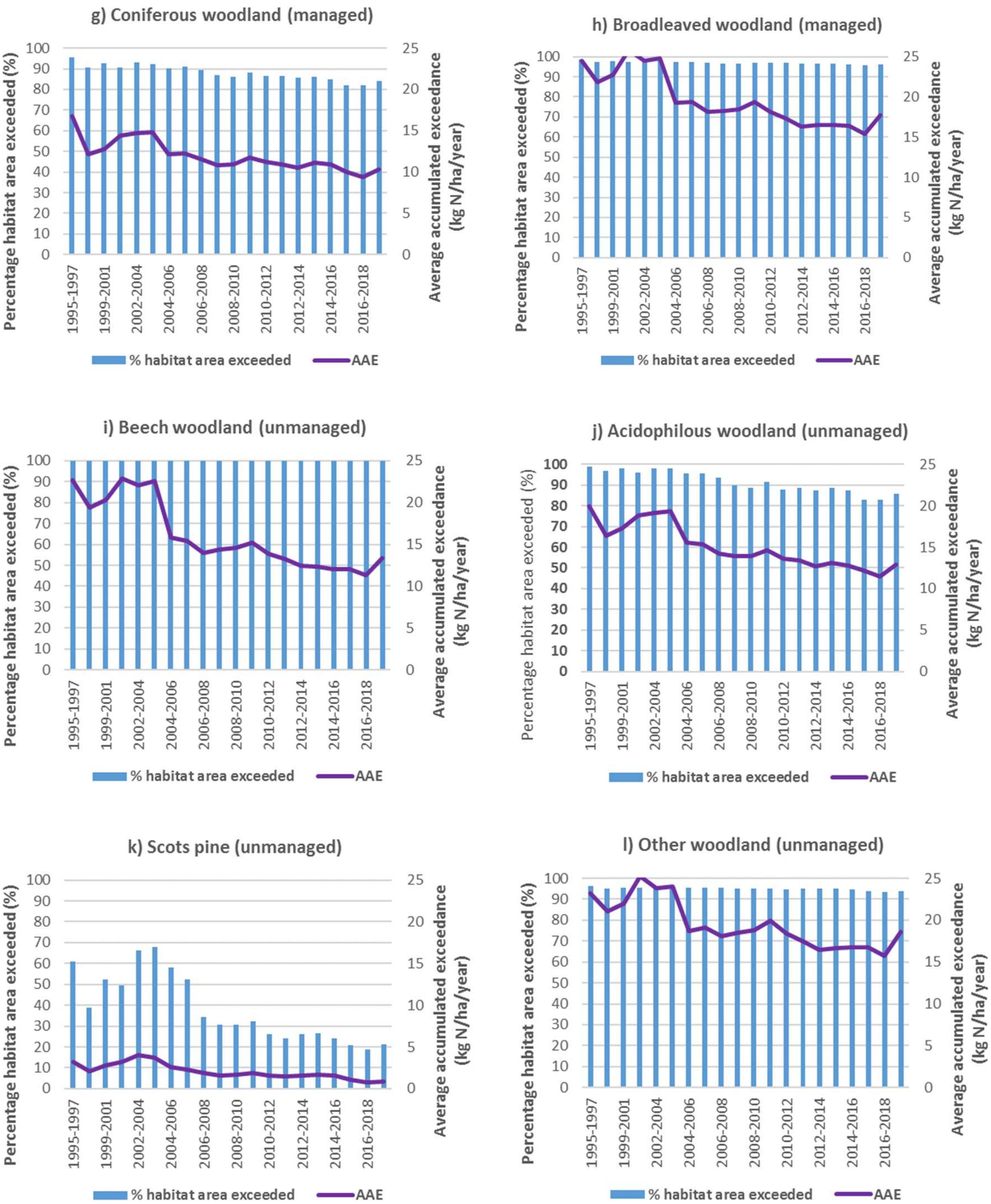

Figure 2.6 (continued): Nutrient nitrogen: Percentage area of habitats where nutrient nitrogen critical loads are exceeded and Average Accumulated Exceedance (AAE in kg N ha^{-1} year^{-1}) i.e. "Excess Nitrogen" in the UK by deposition dataset year.

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:

1. 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.
2. 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.
3. 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 1 x 1 km 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 5 x 5km grid squares with different deposition values), then the exceeded area will be the sum of the 1 x 1 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 2018 by ~5% in Wales and NI and 37.5% in Scotland, while the AAE fell by between 49.5% (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 40.7% (Scotland), 23.1% (Wales) and 20.0% (NI) accompanied by a roughly 80-90% reduction in their maximum AAE values. The reductions in England were slightly less: 11.1% reduction in percentage of exceeded sites, and 57.5% reduction in maximum AAE.

At the UK level, the trends results show:

- for SACs, the percentage of sites with acidity exceedance decreased from 91.0% in 1996 to 72.9% in 2018, and the maximum AAE fell by 69% from 1.51 keq ha^{-1} $year^{-1}$ to 0.5 keq ha^{-1} $year^{-1}$ over the same time period;
- for SPAs, the percentage of exceeded sites fell by nearly a third from 94.3% in 1996 to 67.4% in 2018, and the maximum AAE decreased by 67% from 1.11 keq ha^{-1} $year^{-1}$ in 1996 to 0.37 keq ha^{-1} $year^{-1}$ in 2018.
- for SSSIs, the percentage of exceeded sites decreased from 77.6% in 1996 to 58.1% in 2018, and the maximum AAE fell by 68.5% from 1.18 keq ha^{-1} $year^{-1}$ in 1996 to 0.37 keq ha^{-1} $year^{-1}$ in 2018.

Maps of the maximum AAE per site (Figure 3.1) based on the latest CBED deposition (2018) 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 keq 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	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]
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]
2017-2019	73.3 [0.90]	93.0 [0.56]	57.7 [0.11]	95.7 [0.67]	100.0 [NR]	100.0 [NR]
Reduction in % of sites exceeded, 1996-2018	11.7	4.2	34.6	2.1	0.0	0.0
[Reduction in AAE in same period]	[1.46]	[1.30]	[0.56]	[0.65]	[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 1 x 1 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]
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]
2017-2019	87.3 [0.73]	76.9 [0.39]	48.8 [0.05]	80.0 [0.20]	100.0 [NR]
Reduction in % of sites exceeded, 1996-2018	11.1	23.1	40.7	20.0	0.0
[Reduction in AAE in same period]	[0.99]	[1.46]	[0.40]	[0.89]	[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 1 x 1 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 keq 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	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]
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]
2017-2019	56.6 [0.60]	71.3 [0.52]	49.7 [0.10]	75.3 [0.55]
Reduction in % of sites exceeded, 1996-2018 [Reduction in AAE in same period]	15.1 [1.06]	20.1 [1.11]	35.4 [0.63]	6.7 [0.80]

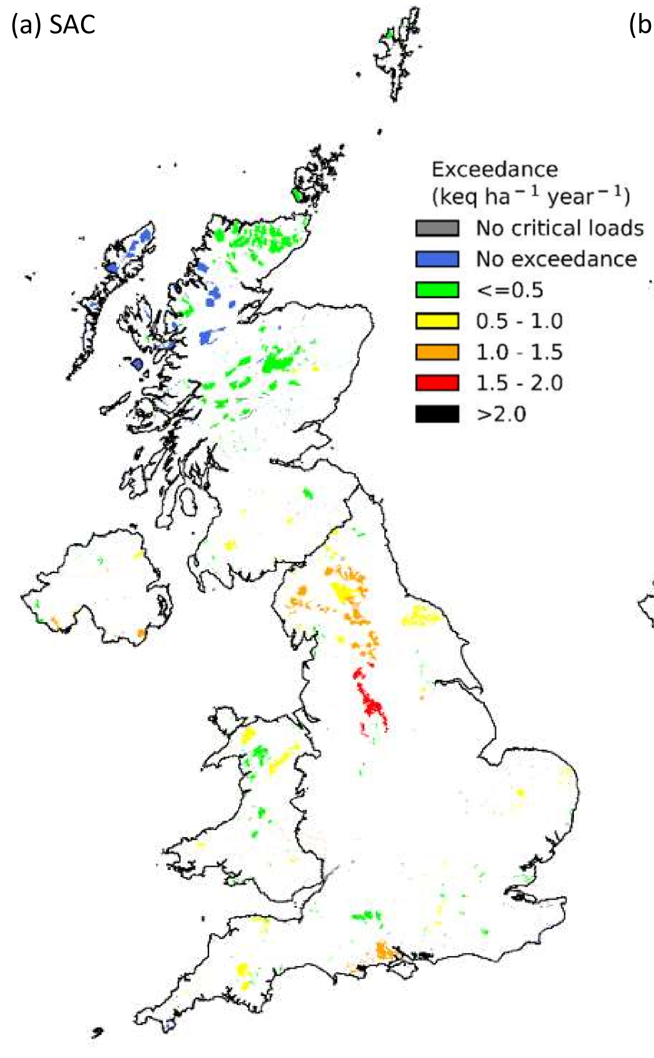

Figure 3.1: Average Accumulated Exceedance (AAE) of acidity critical loads by CBED deposition for 2016-18; maps show the maximum AAE for any feature within each site (other features may have lower or no exceedance).

3.2.2 Nutrient nitrogen results

The trends in nutrient N critical load exceedances from 1996 to 2018 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 1.6% 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 (9% reduction), SPAs (16.1% reduction) and SSSIs (15.7% reduction), and also in Wales (21.4% reduction) for SPAs, though there are fewer SPAs in Wales compared to Scotland and England. For all countries except NI, there has been at least a 25% reduction since 1996 in the maximum AAE for SACs, SPAs and SSSIs. In Northern Ireland, 11.7% of SSSIs and 21% of SACs showed reduction in the percentage of sites with exceedance.

At the UK level the trends results show:

- for SACs, the percentage of sites with nutrient N exceedance decreased from 95.0% in 1996 to 90.1% in 2018, and the maximum AAE declined by 42% from 14.1 kg N ha^{-1} $year^{-1}$ to 8.2 kg N ha^{-1} $year^{-1}$ over the same time period.
- for SPAs, the percentage of exceeded sites decreased from 84% in 1996 to 71.1% in 2018, and the maximum AAE fell by 37.7% from 13.3 kg N ha^{-1} $year^{-1}$ in 1996 to 8.2 kg N ha^{-1} $year^{-1}$ in 2018.
- for SSSIs, the percentage of exceeded sites decreased from 94.9% in 1996 to 88.1% in 2018, and the maximum AAE reduced by 38.2% from 14.9 kg N ha^{-1} $year^{-1}$ in 1996 to 9.2 kg N ha^{-1} $year^{-1}$ in 2018.

Maps of the maximum AAE per site (Figure 3.2) based on the latest CBED deposition (2017-2019) 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]
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]
2017-2019	95.9 [12.9]	94.9 [7.7]	80.6 [3.1]	98.0 [11.4]	100.0 [NR]	50.0 [NR]
Reduction in % of sites exceeded, 1996-2018	2.5	3.8	9.0	0.0	0.0	0.0
[Reduction in AAE in same period]	[7.6]	[6.3]	[4.2]	[3.0]	[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 1 x 1 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]
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]
2017-2019	88.9 [13.2]	78.6 [10.0]	58.1 [2.5]	83.3 [11.5]	100.0 [NR]
Reduction in % of sites exceeded, 1996-2018	8.3	21.4	16.1	0.0	0.0
[Reduction in AAE in same period]	[5.5]	[8.5]	[4.0]	[3.4]	[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 1 x 1 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]
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]
2017-2019	89.7 [13.9]	98.7 [12.3]	74.4 [3.1]	92.6 [14.4]
Reduction in % of sites exceeded from 1996 to 2018 [Reduction in AAE in same period]	5.5 [7.0]	1.3 [8.4]	15.7 [3.9]	1.6 [1.9]

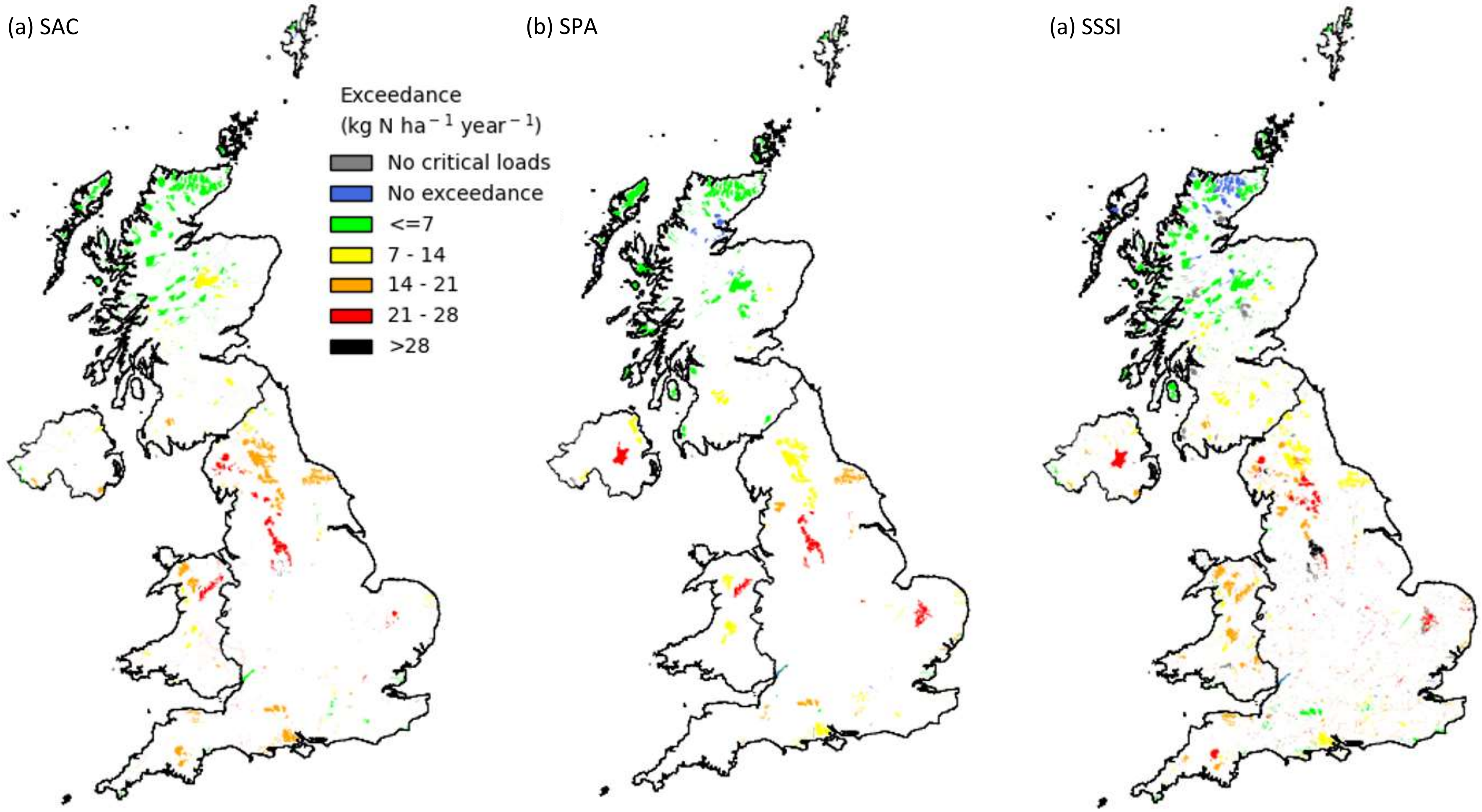

Figure 3.2: Average Accumulated Exceedance (AAE) of nutrient nitrogen critical loads by CBED deposition for 2016-18; maps show the maximum AAE for any feature within each site (other features may have lower or no exceedance).

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 2016-18 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 1 x 1 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 2016-18.

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 NH_3 [$\mu g\ m^{-3}$]	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 $\mu g\ m^{-3}$ was set for higher plants; this was intended to be used 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 9-15-17) model (Dore et al., 2007; Fournier et al., 2004; Singles et al., 1998; Vieno et al., 2010) is used to provide 1 x 1 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 (Tang et al, 2021), using the median bias to adjust the concentrations. Data from all monitoring stations that have a temporal coverage of measurements data for at least 50% of the year 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, and one site in central

London. FRAME requires annual total emissions for NO_x, NH_3 and SO_x, which are provided as both diffuse area emissions (on a 1 x 1 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 exceeded the critical level of 1 µg m^{-3} (set to protect sensitive bryophytes and lichens) across 64.7% of the UK land area in 2017, compared to 63.9% in 2010 (Figure 4.1a; Table 4.2). Exceedance varies spatially, with <20% of Scotland, but 90% or more of England and Northern Ireland having ammonia concentrations above 1 µg m^{-3}.

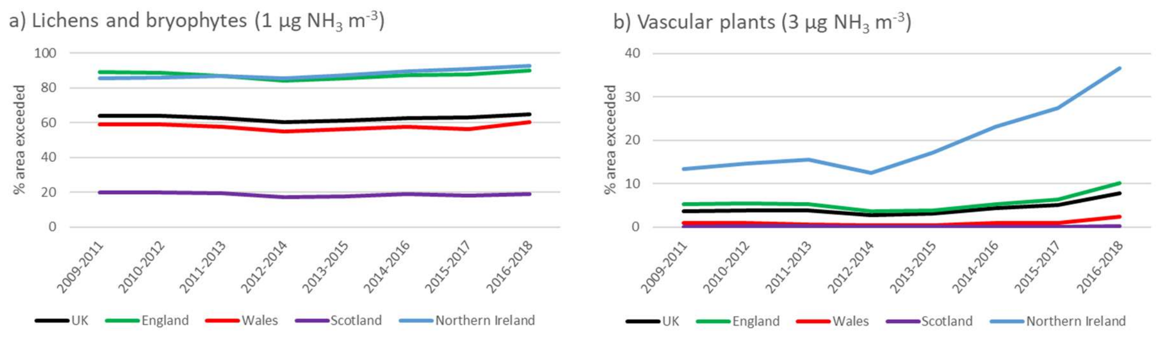

Figure 4.1: Percentages of the UK land area where ammonia concentrations exceed critical levels: for a) vascular plants; b) bryophytes and lichens.

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

Critical level ($\mu g\ m^{-3}$)	Concentration data years	% land area where ammonia concentrations exceed critical levels England	Wales	Scotland	NI	UK
1 $\mu g\ m^{-3}$	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
	2016-2018	90.0	60.2	18.7	92.9	64.7
Change in % area exceeded from 2010 to 2017		-+1.1	+1.3	-0.9	+7.4	+0.8
3 $\mu g\ m^{-3}$	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
	2016-2018	10.2	2.4	0.2	36.6	7.8
Change in % area exceeded from 2010 to 2017		+4.9	+1.5	+0.1	+23.2	+4.1

The ammonia critical level of 3 $\mu g\ m^{-3}$ (set to protect sensitive vascular plants) is exceeded over a much smaller area of the UK, < 2.5 % for Scotland and Wales, 10.2% for England and 36.6% for NI. (Figure 4.1b; Table 4.2). The main areas of the UK where this higher critical level is exceeded are parts of Northern Ireland and west/central England, with smaller areas across other regions of England (Figure 4.2).

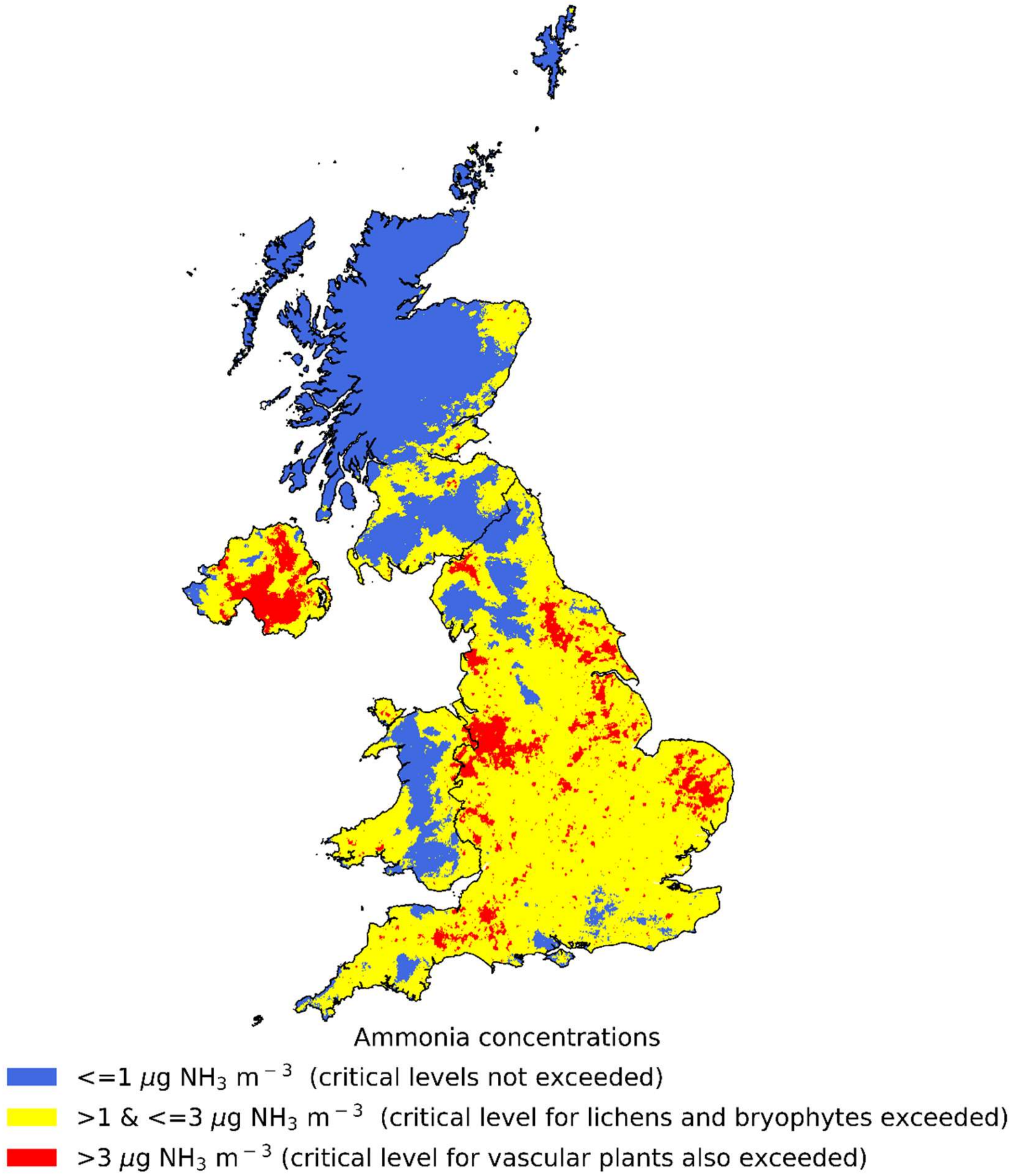

Figure 4.1: FRAME 1 x 1 km mean ammonia concentrations for 2016-18.

4.4.2 Nitrogen-sensitive habitats with exceedance of ammonia critical levels

Around a quarter of the mapped area of N-sensitive habitats in the UK receives ammonia concentrations above the critical level of 1 µg 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 3.4% of the Scottish habitat area coincides with ammonia concentrations above 1 µg m^{-3} and there are very few areas in Scotland with concentrations above 3 µg m^{-3} (Table 4.3). The highest exceedances are seen in England and Northern Ireland, with ammonia concentrations above 1 µg m^{-3} for 68.5-80.3% of their N-sensitive habitat areas and above 3 µg m^{-3} for 3.3-13.5%. The percentage area of N-sensitive habitats in the UK with exceedance of the critical level of 1 µg m^{-3} has increased from 25.1% in 2010 to 27.1% in 2017.

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

		England	Wales	Scotland	NI	UK
N-sensitive habitat area (km^2)		*19522*	*6837*	*43200*	*3467*	*73027*
1 µg 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
	2016-2018	68.5	31.5	3.4	80.3	27.1
Change in % area exceeded from 2010 to 2016		+3.2	+2.6	-0.2	+20.7	+2.0
3 µg 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
	2016-2018	3.3	0.4	0.0	13.5	1.6
Change in % area exceeded from 2010 to 2017		+1.7	+0.3	0.0	+10.4	+1.0

The N-sensitive habitats (Table 4.4) with the highest percentage area of exceedance of the ammonia critical level of 1 µg m^{-3} are calcareous grassland (91.6%), unmanaged woodland (83.7%), managed broadleaved woodland (80.4%) and beech woodland (79.3%), 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 µg m^{-3} but these results need to be interpreted with care, for example, only 21.1% of acid grassland is exceeded, but as this habitat occupies a large area across the UK, this equates to 2910 km^2, which is not too different from the 91.6% of calcareous grassland (3257 km^2).

Differences between years are small, and reflect fluctuations in ammonia concentrations due inter-annual variability in meteorology. However, there is no evidence of a decline in the areas where critical levels are exceeded.

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
Habitat area (km^2)		*15,235*	*3,578*	*34,826*	*5,526*	*3,129*	*8,383*	*7,482*	*719*	*1,434*	*204*	*1,761*	*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
	2016-2018	21.1	91.6	8.2	9.4	0.0	20.8	80.4	79.3	44.8	1.3	83.7	19.9	46.0
Change in % area exceeded from 2010 to 2017		+3.2	+2.7	+1.7	+2.8	0.0	+2.2	-0.9	+3.4	+1.0	-0.1	+1.7	+5.5	+14.4
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
	2016-2018	1.8	4.4	0.6	0.8	0.0	0.9	4.1	1.0	1.2	0.0	6.7	0.3	0.7
Change in % area exceeded from 2010 to 2017		+1.3	+2.7	+0.4	+0.7	+0.0	+0.6	+2.0	+0.4	+0.6	0.0	+3.7	+0.2	+0.3

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

63% of SACs occur in areas of the UK where ammonia concentrations exceed 1 μg m^{-3} (Table 4.5); the lowest number of sites with exceedance is in Scotland, where ammonia concentrations are < 1 μg m^{-3} at 18.4% of sites. The percentage of UK SACs with exceedance of the 1 μg m^{-3} critical level increased by 0.3% between 2010 and 2017, but this varies spatially across the UK with an increase seen in Wales and Northern Ireland, and decrease in England and Scotland over this time period.

The percentage of SACs with ammonia concentrations above 3 μg m^{-3} is smaller, mostly <15% in 2017 (Table 4.5). However, in Northern Ireland there has been a steady increase in the number of SACs where this higher critical level is exceeded, with ~24% of sites now exceeded.

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

		England	Wales	Scotland	NI	UK
Number of sites		*[231]*	*[85]*	*[234]*	*[54]*	*[614*]*
1 μg 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
	2016-2018	93.1	78.8	18.4	96.3	63.0
Change in % of sites exceeded, from 2010 to 2017		-1.3	+5.9	-2.6	+11.1	+0.3
3 μg 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
	2016-2018	14.3	5.9	0.0	24.1	9.4
Change in % of sites exceeded, from 2010 to 2017		+4.3	+5.9	-0.9	+20.4	+4.6

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

SPAs

The results show an over 33% increase from 2010 to 2017 in the number of sites in Wales exceeding the critical level of 1 µg m^{-3} though it should be noted there are only 16 SPAs in Wales. There was a small decrease in the percentage of exceeded sites in Scotland (-1.5%) and no change in England and Northern Ireland (Table 4.6). Over 97% of the SPAs in England and 12 of the 13 sites in Northern Ireland are exposed to ammonia concentrations above 1 µg m^{-3}.

The critical level of 3 µg 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 µg m^{-3} (Table 4.6). Overall, the percentage of sites with ammonia concentrations above 3 µg m^{-3} is considerably smaller than the number exceeding the critical level of 1 µg m^{-3}. In Northern Ireland, five SPAs showed exceedance of the ammonia critical level of 3 µg m^{-3}, representing roughly a 30% increase since 2010 of the percentage of sites exceeded, to 38.5%.

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

		England	Wales	Scotland	NI	UK
[number of sites]		*[76]*	*[16]*	*[137]*	*[13]*	*[245*]*
1 µg 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
	2016-2018	97.4	70.6	26.3	92.3	55.7
Change in % of sites exceeded, from 2010 to 2017		0.0	+33.1	-1.5	0.0	+1.4
3 µg 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
	2016-2018	21.1	0.0	1.5	38.5	10.2
Change in % of sites exceeded, from 2010 to 2017		+9.2	0.0	0.0	+30.8	+4.9

*includes 3 sites on the England/Wales border.

SSSIs

The percentage of SSSIs in the UK in areas where ammonia concentrations exceed the critical level of 1 µg m^{-3} increased by 0.5% between 2010 and 2017, to 73.7% (Table 4.7). Over 90% of the sites in England and Northern Ireland are in locations where this critical level is currently exceeded, as well as 67.1% of sites in Wales and 27.3% of sites in Scotland.

There was a small increase in the number of UK SSSIs/ASSIs showing exceedance of the 3 µg 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 2017 there has been an 18% increase in the percentage of SSSIs in Northern Ireland that received ammonia concentrations above the critical level of 3 µg m^{-3}. England and Wales showed small increases <5%, and Scotland showed a very slight increase (0.2%).

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

		England	Wales	Scotland	NI	UK
[number of sites]		[4106]	[1014]	[1430]	[289]	[6839]
1 µg 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
	2016-2018	90.2	67.1	27.3	92.7	73.7
Change in % of sites exceeded, from 2010 to 2017		+0.5	+0.2	-0.9	+9.0	+0.5
3 µg 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
	2016-2018	9.7	4.4	0.6	24.2	7.6
Change in % of sites exceeded, from 2010 to 2017		+4.9	+3.4	+0.2	+18.0	+4.3

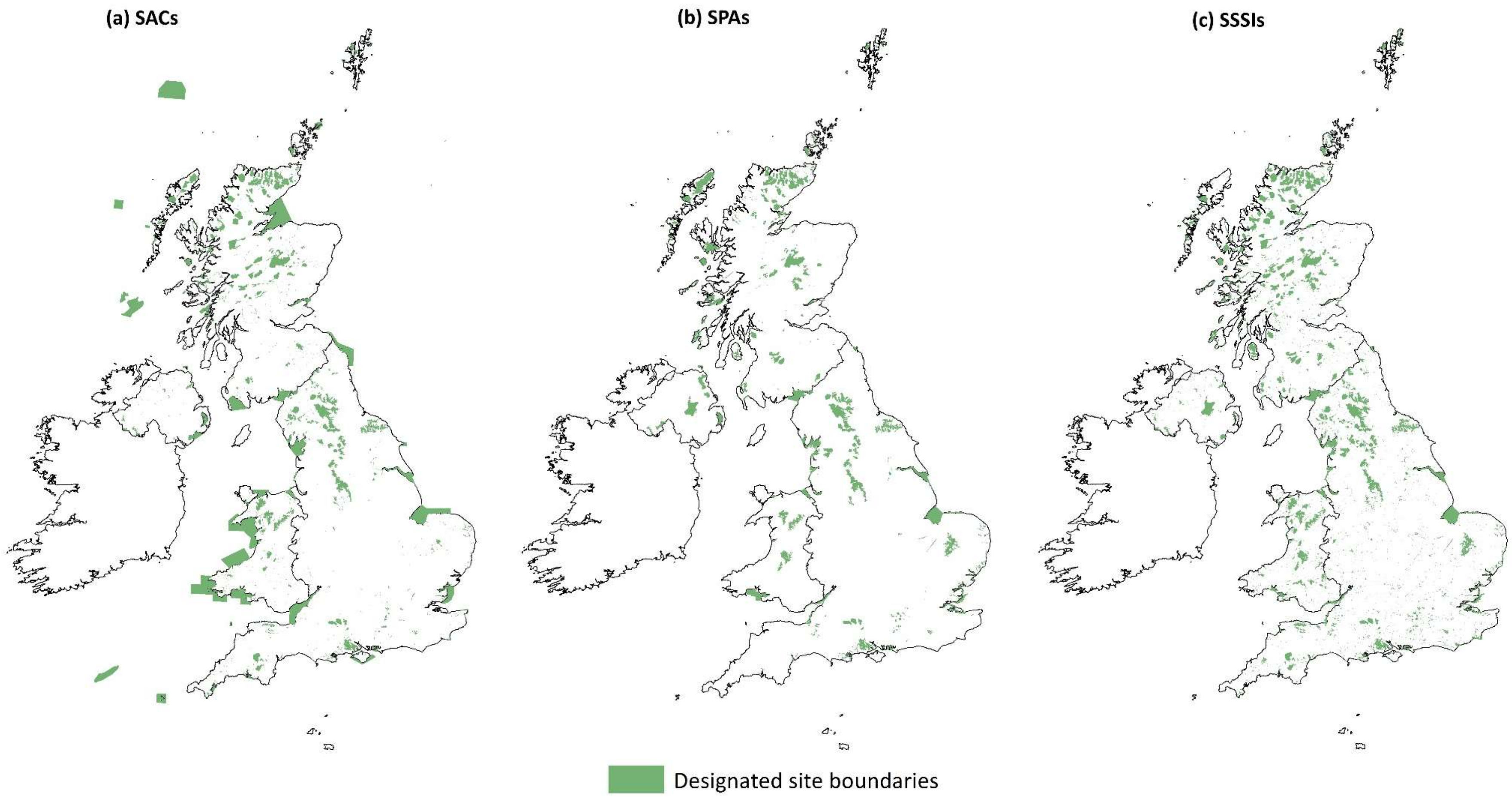

Figure 4.2: Distribution of SACs, SPAs and SSSIs / ASSIs in the UK

Section 5: Nitrogen deposition onto protected sensitive habitats

An indicator of air pollution pressure, "total deposition of reactive N onto nutrient-N sensitive, protected, priority habitat" (abbreviated as N_{sens}) is included (Table 5.1) to illustrate progress towards the target for England in the UK Government's Clean Air Strategy (Defra, 2019). See sections 1.1 and 1.4. This indicator has only been calculated for the most recent 3-year periods for which deposition data are available, i.e. periods centred on 2016, 2017 and 2018. Progress towards the target will be assessed relative to a baseline year of 2016. As noted in Section 1.4, planned revisions of the underlying habitat maps are unlikely to affect the reported trend. Currently, this indicator is showing a 2.5 % increase during the period 2016 to 2018. There are several potential explanations for the increased deposition, and these are being investigated. Ammonia emissions are lower than they were in the 1990s, but there was an increase in emissions between 2012 and 2016. Emissions have showed a slight decrease in the most recent data (Churchill et al., 2021). Measured NHx concentrations have shown marked decreases at the most polluted sites, but have increased at many less-polluted sites, resulting in an overall increase. This is likely to be due to a combination of factors: changes in the spatial pattern of ammonia emissions; chemical interaction with atmospheric SO_2 and NOx; and increasing temperatures causing greater ammonia emissions than the inventory predicts.

The CAS target applies only to England, but N_{sens} is also calculated for the Devolved Administrations, for comparison. The Devolved Administrations are considering atmospheric nitrogen pollution indicators and targets for their own countries, and these will be presented in future Trends Reports.

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

Year	N_{sens} (kg N ha^{-1} year^{-1})				
	England (target)	Wales (comparison)	Scotland (comparison)	NI (comparison)	UK (comparison)
2016	20.3	17.9	8.4	17.0	12.0
2017	19.7	17.6	8.3	16.4	11.8
2018	20.8	18.0	8.5	18.5	12.3
Percent change, 2016-2018	+2.5	+0.5	+0.9	+8.8	+2.5

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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
Habitat area (km^2)	*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
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
2017-2019	91.3	78.7	99.8	99.8	74.4	51.9	38.9	45.2	59.8
Reduction in % area exceeded, 1996-2018	5.6	17.0	-0.5	0.0	17.2	24.2	35.5	9.0	16.0

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
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
2017-2019	0.72	0.40	0.83	1.13	0.71	0.47	0.29	0.38	0.47
Reduction in AAE, 1996-2018	1.17	1.07	1.26	1.70	1.13	0.82	0.72	0.80	0.86

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
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
2017-2019	91.2	75.3	95.8	100.0	63.4	64.1	59.4	21.5	78.4
Reduction in % area exceeded, 1996-2018	7.7	21.9	2.6	0.0	34.6	22.3	30.0	37.6	11.6

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
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
2017-2019	0.55	0.26	0.39	0.83	0.40	0.41	0.37	0.06	0.45
Reduction in AAE, 1996-2018	1.01	1.07	1.38	1.55	1.47	0.90	0.93	0.44	0.91

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
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
2017-2019	47.3	8.4	24.7	44.3	38.7	30.0	16.2	5.7	24.4
Reduction in % area exceeded, 1996- 2017	41.3	56.8	60.6	51.5	33.4	36.4	38.2	12.7	43.8

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
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
2017-2019	0.18	0.02	0.07	0.12	0.16	0.15	0.07	0.02	0.08
Reduction in AAE, 1996-2018	0.63	0.27	0.33	0.68	0.60	0.48	0.35	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
Habitat area (km^2)	*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
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
2017-2019	78.3	61.6	92.1	0.0	55.7	0.0	46.5	15.8	68.9
Reduction in % area exceeded, 1996-2018	7.8	21.4	-7.6	0.0	17.7	0.0	3.4	8.2	7.9

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
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
2017-2019	0.49	0.27	0.53	0.00	0.45	0.00	0.66	0.14	0.43
Reduction in AAE, 1996-2018	0.37	0.49	0.35	0.00	0.53	0.00	0.00	0.20	0.37

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
Habitat area (km²)	*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
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
2017-2019	91.9	91.7	99.9	100.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	47.0	1.5	95.6
Reduction in % area exceeded, 1996-2018	7.9	8.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.7	1.0	2.7

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
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
2017-2019	6.8	5.3	9.2	10.9	15.8	17.4	20.3	13.3	19.9	0.0	20.5	1.1	0.1	13.2
Reduction in AAE, 1996-2018	5.7	2.5	5.2	5.4	8.8	8.1	6.9	9.4	8.6	0.0	6.7	3.1	-0.1	5.8

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
Habitat area (km²)	*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
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
2017-2019	80.2	72.2	98.4	95.4	100.0	100.0	99.8	99.0	100.0	0.0	99.8	24.0	0.0	88.5
Reduction in % area exceeded, 1996-2018	18.1	22.8	1.6	4.6	0.0	0.0	0.2	1.0	0.0	0.0	0.2	65.7	0.1	9.5

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
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
2017-2019	5.0	3.4	8.0	6.6	11.7	14.4	15.3	14.0	17.3	0.0	17.4	0.4	0.0	8.7
Reduction in AAE, 1996-2018	5.6	3.5	6.8	7.3	10.0	11.7	7.9	8.7	8.3	0.0	7.2	2.6	0.0	7.1

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
Habitat area (km²)	*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
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
2017-2019	30.3	32.1	23.3	19.0	63.1	74.0	73.0	100.0	65.2	21.1	63.3	22.8	0.0	35.2
Reduction in % area exceeded, 1996-2018	22.1	13.6	26.7	17.7	33.5	18.4	16.1	0.0	32.1	40.0	14.8	30.2	1.2	24.2

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
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
2017-2019	1.0	0.3	0.8	0.9	2.0	6.5	6.9	8.9	3.7	0.9	6.7	0.5	0.0	1.8
Reduction in AAE, 1996-2018	1.7	1.1	1.6	1.0	3.4	5.2	4.7	5.2	4.9	2.4	3.5	1.3	0.1	2.3

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
Habitat area (km^2)	*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
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
2017-2019	78.9	25.2	94.8	96.6	0.0	99.0	0.0	0.0	0.0	0.0	99.4	22.5	11.1	88.9
Reduction in % area exceeded, 1996-2018	5.8	-5.0	4.2	2.5	0.0	0.9	0.0	0.0	0.0	0.0	0.6	61.9	-11.1	3.7

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
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
2017-2019	5.4	1.8	9.5	7.2	0.0	16.3	0.0	0.0	0.0	0.0	23.4	3.3	0.2	9.6
Reduction in AAE, 1996-2018	0.5	-0.2	1.8	2.3	0.0	2.8	0.0	0.0	0.0	0.0	-4.9	0.4	-0.2	1.0