August 2017

Trends Report 2017: Trends in critical load and critical level exceedances in the UK

Report to Defra under Contract AQ0843

CEH Project: NEC05708

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Executive Summary

Critical loads define the amount of acid or nitrogen deposition above which significant harmful effects are expected to occur to sensitive habitats. An "exceedance" is the amount of excess acid or nitrogen deposition above the critical load; exceedances are calculated using rolling 3-year mean deposition data sets, updated annually and covering the period from 1995 to 2015. Critical levels refer to the concentrations of gaseous pollutants above which direct adverse effects on sensitive vegetation may occur; critical level exceedances are the amount of gaseous pollutant above the critical level and are calculated using rolling 3-year mean concentration data sets, updated annually and covering the period from 2009 to 2014.

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

Summary statistics monitor progress in the areas of habitats in the UK at risk from acidification and eutrophication from air pollution over time, and are, or have been, used for:

- UK Biodiversity Indicators in Your Pocket: JNCC; biodiversity indicator for assessing the pressures from air pollution
  http://jncc.defra.gov.uk/page-4233
- Defra: Environmental Statistics – Key Facts
  https://www.gov.uk/government/statistics/environment-statistics-key-facts
- Welsh Government: Sustainable Development Indicators for Wales
  http://wales.gov.uk/topics/statistics/headlines/sustaindev/120829/?lang=en
- Scottish Government: Key Scottish Environment Statistics
  http://www.scotland.gov.uk/Topics/Statistics/Browse/Environment/

UK habitats at risk from acidification

- The area of acid-sensitive habitats in the UK with exceedance of acidity critical loads has fallen by over a third, from 72.6% in 1995-97 to 44.1% in 2013-15 due mainly to decreased emissions of SO_2.
- The magnitude of the acidity exceedance (expressed as the Average Accumulated Exceedance) for all UK habitats combined more than halved, from 0.78 to 0.28 keq ha^{-1} $year^{-1}$ between 1995-97 and 2013-15.
- The largest reduction in the area of acid-sensitive habitats with exceedance of acidity critical loads is in Scotland, where it has more than halved, from 68.2% in 1995-97 to 31.4% in 2013-15.
- The smallest reduction in the area of acid-sensitive habitats with exceedance of acidity critical loads is in Northern Ireland, falling from 76.8% in 1995-97 to 66.9% in 2013-15.
- Of the 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% in 1995-97 to 28.1% in 2013-15.
- The habitat with the smallest decrease in acidity critical load exceedance between 1995-97 and 2013-15, is freshwaters, falling from 29.9% in 1995-97 to 18.2% in 2013-15; this habitat only

represents the catchment areas of 1752 freshwater sites, mainly upland streams or lakes, selectively sampled in acid-sensitive areas of the UK in the 1990s and, therefore, do not represent all waters in the UK.

UK habitats at risk from eutrophication (i.e. excess nitrogen)

- The reduction in the areas of nitrogen-sensitive habitats in the UK with exceedance of nutrient nitrogen critical loads, decreased by 11.6%, from 75% in 1995-97 to 63.4% in 2013-15.
- The Average Accumulated Exceedance for all UK habitats combined for nutrient nitrogen has declined by one-third, from 9.5 kg N ha^{-1} $year^{-1}$ in 1995-97 to 6.2 kg N ha^{-1} $year^{-1}$ in 2013-15.
- The largest reduction in the area of nitrogen-sensitive habitats with critical load exceedance is in Scotland, falling from 59.4% in 1995-97 to 42.8% in 2013-15.
- The smallest reduction in the area of nitrogen-sensitive habitats with critical load exceedance is in England, falling from 98.3% in 1995-97 to 95.8% in 2013-15.
- The nutrient nitrogen critical loads are exceeded for more than 80% of the areas of six nitrogen-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 nitrogen 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 1995-97 to 12.3 kg N ha^{-1} $year^{-1}$ in 2013-15.
- There is virtually no exceedance of nutrient nitrogen 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.

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 decreased from >90% in 1995-97 to 76.2% (SACs) and 70.3% (SPAs) in 2013-15; the percentage of SSSIs with exceedance fell from 77.6% in 1995-97 to 60.2% in 2013-15.
- Scotland had the largest reductions (>25%) in the percentage of designated sites with exceedance of acidity critical loads between 1995-97 and 2013-15.
- The smallest reductions in the percentage of designated sites with exceedance of acidity critical loads was in Northern Ireland, with reductions typically <=10% for all site types.
- More than 50% of designated sites in England and Scotland, and more than 70% of designated sites in Wales and Northern Ireland currently have exceedance of acidity critical loads for one or more features.

Designated sites with nitrogen-sensitive feature habitats

- Reductions in the percentage of designated sites in the UK with exceedance of nutrient nitrogen critical loads (for one or more features) between 1995-97 and 2013-15 are small (4.1% for SACs, 7.1% for SSSIs, 10.7% for SPAs), reflecting the smaller reductions in nitrogen deposition, compared to acid deposition, over this time period.
- Scotland had the largest reductions (5-10%) in the percentage of SACs and SSSIs with exceedance of nutrient nitrogen critical loads between 1995-97 and 2013-15; Wales had the largest reduction

(21.4%) in the percentage of SPAs with nutrient nitrogen critical load exceedance over the same time period.

- Northern Ireland had the smallest reduction (1.6%) in the percentage of SSSIs with exceedance of nutrient nitrogen critical loads, and no change in the percentage of SACs and SPAs with exceedance between 1995-97 and 2013-15.
- 63-84% of designated sites in Scotland, and 83-98% of designated sites in England, Wales and Northern Ireland currently have exceedance of nutrient nitrogen critical loads for one or more features.

Exceedance of ammonia critical levels

The trends in ammonia critical levels exceedance are only available for the period 2009 to 2014.

UK land area

- Over 60% of the UK land area currently receives ammonia concentrations above the critical level set to protect lichens and bryophytes (1 μg m^{-3}); this represents about 85% of England and Northern Ireland, 55% of Wales and 17% of Scotland.
- The UK land area with ammonia concentrations above 1 μg m^{-3} has slightly decreased, from 63.9% in 2009-11 to 60.1% in 2012-14.
- Less than 3% of the UK land area receives ammonia concentrations above the critical level set to protect higher plants (3 μg m^{-3}); this ranges from 0.1% of Scotland to 12.4% of Northern Ireland.
- The UK land area with ammonia concentrations above 3 μg m^{-3} has slightly decreased, from 3.7% in 2009-11 to 2.7% in 2012-14.

Nitrogen-sensitive habitats

- The area of nitrogen-sensitive habitats receiving ammonia concentrations above 1 μg m^{-3} varies from <3% in Scotland to 60.6% in Northern Ireland.
- Less than 1% of the area of nitrogen-sensitive habitats in the UK receive ammonia concentrations above 3 μg m^{-3}. In Wales and Scotland it is <0.1%, in England it is just over 1% and in Northern Ireland just over 3% of the area of nitrogen-sensitive habitats with concentrations above 3 μg m^{-3}.
- The largest reductions in the area of nitrogen-sensitive habitat with exceedance of ammonia critical levels are for unmanaged beech woodland: from 75.9% in 2009-11 to 55.9% in 2012-14 for exceedance of the critical level of 1 μg m^{-3}, and from 0.56% in 2009-11 to 0.30% in 2012-14 for exceedance of the critical level of 3 μg m^{-3}.

Designated sites

- Between 50% (SPAs) and 68% (SSSIs) of designated sites in the UK currently receive ammonia concentrations above 1 μg m^{-3} anywhere across a site. The percentage of sites with exceedance of the 1 μg m^{-3} critical level has fallen by <=5.2% between 2009-11 and 2012-14 for all site types.
- More than 83% of designated sites in England and Northern Ireland, and 44-71% of sites in Wales, and 17-24% of sites in Scotland, currently receive ammonia concentration above 1 μg m^{-3}.
- Between 2.7% (SSSIs) and 6.1% (SPAs) of designated sites 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 changed by less than ±1% between 2009-11 and 2012-14.
- Less than 2.5% of designated sites in Scotland and Wales currently receive ammonia concentrations above the critical level of 3 μg m^{-3} anywhere across a site, compared with 3-15% of sites in England and Northern Ireland.

Part 1: Critical loads and their exceedances

1. Introduction

Part 1 of this report provides an overview of critical loads, deposition data, and exceedance calculations and metrics, followed by summaries of the trends in critical load exceedances for acidity and for nutrient nitrogen, by habitat and country. The application of "site-relevant critical loads" (SRCL) for designated sites, and trends in their exceedances are described in Part 2.

1.1 Overview of UK critical loads

Critical loads are thresholds for effects from atmospheric deposition and 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 & 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). 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, 2014).

Table 1.1: Habitat distributions mapped for acidity and for nutrient nitrogen critical loads

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

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: Davies & Moss, 2002) hierarchical habitat classification scheme, developed for pan-European applications.

Habitat distribution maps are based on the CEH Land Cover Map 2000 (LCM2000: Fuller et al, 2002(a)(b)) 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. *It should be noted that the habitat distribution maps and areas used for UK critical loads (acidity, nitrogen) research (a) only include areas where data exist for the calculation or derivation of critical loads; (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 nitrogen critical loads.*

1.1.1 Acidity critical loads

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

An empirical approach is used to define acidity critical loads for UK soils; critical loads are assigned to each 1km grid square of the UK based on the amount of acid deposition that could be neutralised by the base cations produced by mineral weathering of the dominant soil type in the grid square. This approach is applied to mineral and organo-mineral soils (Hornung et al, 1995) but is inappropriate for peat soils because of the absence of inputs of alkalinity from mineral weathering (Smith et al, 1992; Gammack et al, 1995). 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 & Cresser, 1989); this pH reflects the buffering effects of organic acids upon 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 a specified critical chemical limit is not exceeded (Sverdrup et al, 1990; Sverdrup & De Vries, 1994). 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 in order to protect the long-term ecosystem function of the woodland habitats; this 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 exceedances (Section 2).

Acidity critical loads for freshwaters are calculated using the catchment-based First-Order Acidity Balance (FAB: Henriksen & 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 (ie, 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 Section 2).

1.1.2 Nutrient nitrogen critical loads

Empirical and mass balance methods also exist for calculating critical loads for eutrophication (ie, an excess of nitrogen as a nutrient). The empirical critical loads are based on experimental or field evidence of thresholds for changes in species composition, plant vitality 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 & Hettelingh, 2011; Hall et al, 2015).

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

1.2 Overview of UK deposition data

The sulphur, nitrogen 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 gases are interpolated to generate 5km maps of concentrations for the UK. Ion concentrations in precipitation (from the UK Eutrophying and Acidifying Pollutants (UKEAP) network) are combined with the Met Office annual precipitation map to generate maps of wet deposition. The wet deposition values include (a) direct deposition of cloud droplets to vegetation (known as "occult" deposition); (b) an 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 5km maps of total (wet + cloud + dry) deposition of sulphur (non-marine), oxidised nitrogen and reduced nitrogen; 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 2013-15 with the nitrogen and acid deposition mapped using the same class intervals and units; additionally for the nitrogen maps the legend also shows the values in kg nitrogen per hectare per year.

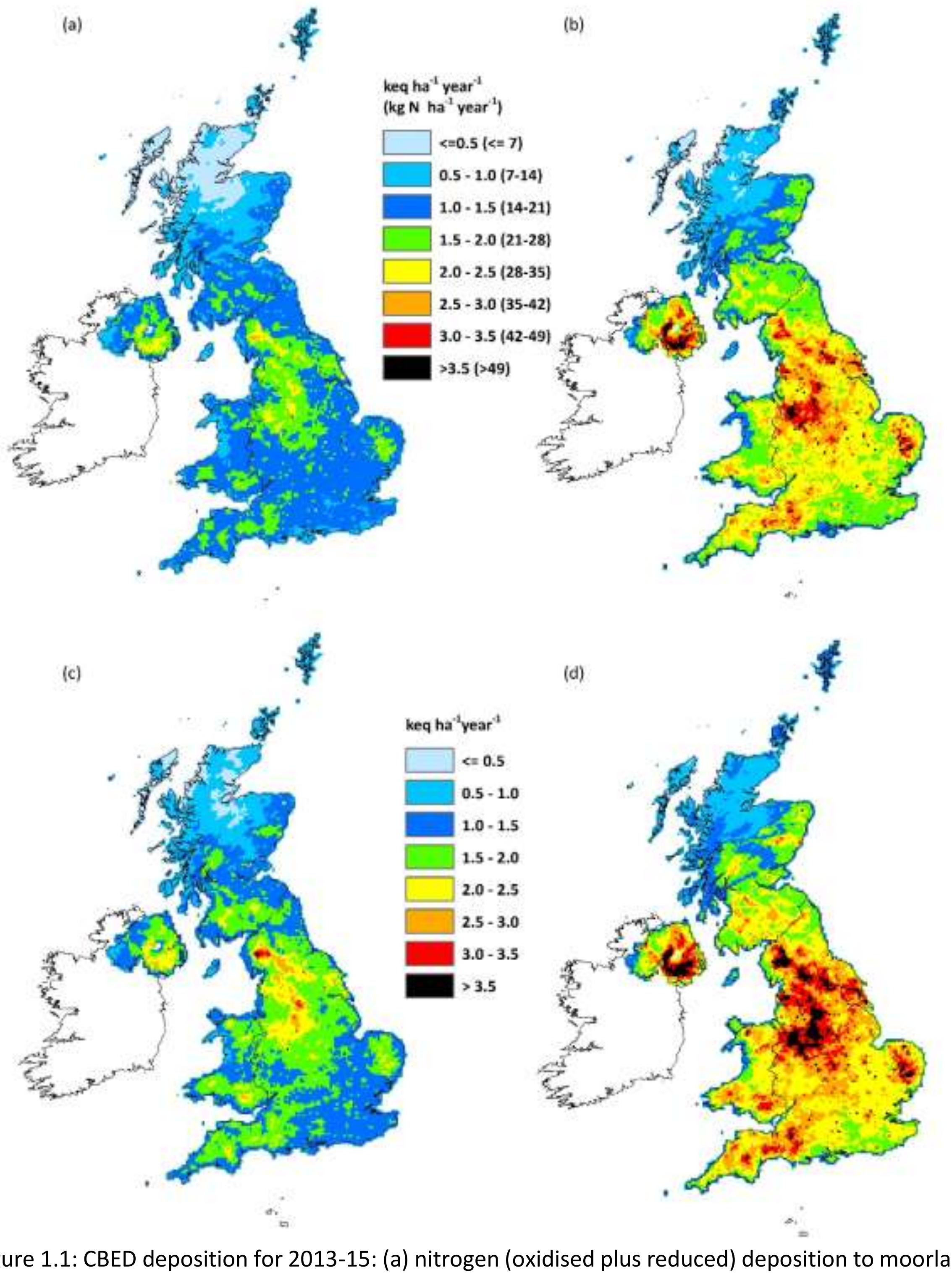

Figure 1.1: CBED deposition for 2013-15: (a) nitrogen (oxidised plus reduced) deposition to moorland; (b) nitrogen (oxidised plus reduced) deposition to woodland; (c) acid (sulphur + nitrogen) deposition to moorland; (d) acid (sulphur + nitrogen) deposition to woodland.

An error was discovered in the CBED deposition for 2012-14 used in the exceedance calculations published in the 2016 "Trends Report" (Hall & Smith, 2016); this has since been corrected and the updated exceedance results are included in this report.

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

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 nitrogen the calculation is simply total nitrogen deposition (derived from nitrogen oxides and ammonia) minus the critical load. For acidification, deposition of both sulphur and nitrogen compounds can contribute to the exceedance of critical loads. The Critical Load Function, developed under the UNECE CLRTAP (Posch *et al.*, 1999; Posch & Hettelingh, 1997; Posch *et al.*, 1995; Hettelingh *et al.*, 1995), defines combinations of sulphur and nitrogen 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 1.2a). The line intercepts the x-axis (representing nitrogen deposition) and y-axis (representing sulphur deposition) at chemically equivalent points, each representing the nitrogen or sulphur deposition equal to the critical load for acidity. Each point along the diagonal line represents the critical load in terms of some combination of sulphur and nitrogen deposition.

To allow for the long-term nitrogen removal processes by the soil and through harvesting of vegetation, the simple diagonal line is shifted along the nitrogen axis to increase the nitrogen values across the entire CLF (Figure 1.2b). More nitrogen can then be deposited before the acidity critical load is exceeded. There are no similar removal processes that need to be considered for sulphur.

The intercepts of the CLF on the sulphur and nitrogen axes (Figure 1.2c) define the following terms:

- The "maximum critical load of sulphur" (CLmaxS): the critical load for acidity expressed in terms of sulphur only, ie, when nitrogen deposition is zero.
- The "maximum critical load of nitrogen" (CLmaxN): the critical load for acidity expressed in terms of nitrogen only (when sulphur deposition is zero).
- The "minimum critical load of nitrogen" (CLminN): the long-term nitrogen removal processes in the soil (eg, nitrogen 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.

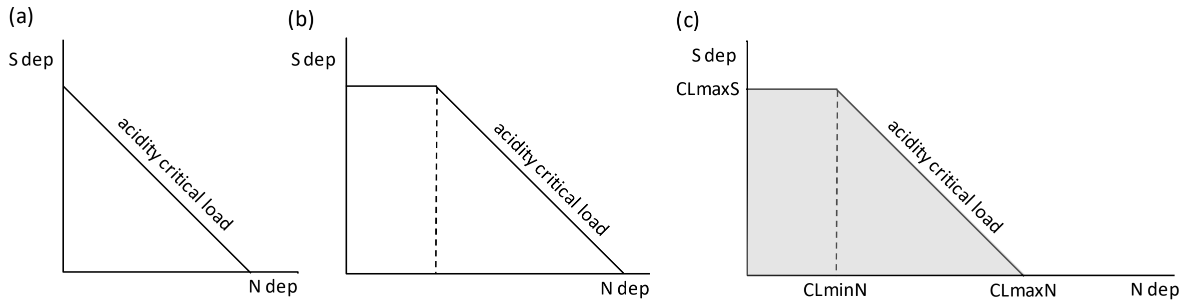

Figure 1.2: Development of the CLF: (a) acidity critical load defined by equal amounts of sulphur and nitrogen deposition; (b) shifting the acidity critical load diagonal line to allow for nitrogen removal processes; (c) the 3 nodes of the CLF: CLmaxS, CLminN, CLmaxN. The area shown in grey represents the combinations of sulphur and nitrogen deposition that are below the critical load (ie, critical load is not exceeded).

Exceedances are calculated by comparing the values of CLmaxS, CLminN and CLmaxN to the values of sulphur and nitrogen (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 1.3). The exceedance is defined by the sum of sulphur and nitrogen deposition as shown by the red arrows in Figure 1.3 (ie, not the length of the diagonal line); this is referred to as the "shortest distance" exceedance. Further details on the calculations are given in Hall et al (2015).

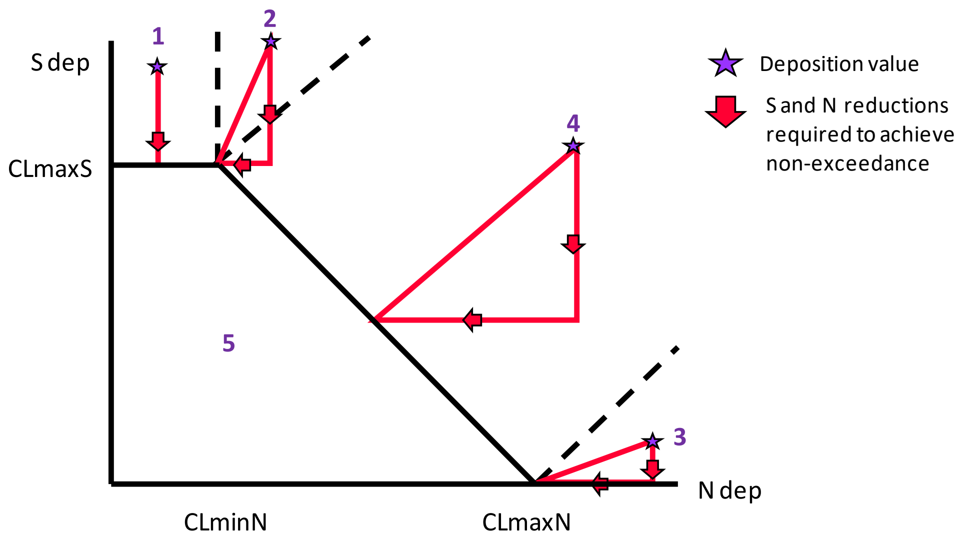

Figure 1.3: Example of S and N deposition reductions required depending on the region of the CLF. Deposition that falls in region 5 is below the critical load (ie, critical loads not exceeded).

1.3.1 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 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.

(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, it has its limitations, for example, when comparing exceedance results from one year to another (or one deposition scenario to another), there may very small (or no) changes in the percentage area of habitat exceeded. 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.

(iii) Accumulated Exceedance (AE)

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

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

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 keq $year^{-1}$ they tend to be very 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)

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.

1.3.2 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 1.4); 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:

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

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

The latest AAE maps for acidity and nutrient nitrogen (Figure 1.4) 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 nitrogen 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} $year^{-1}$).

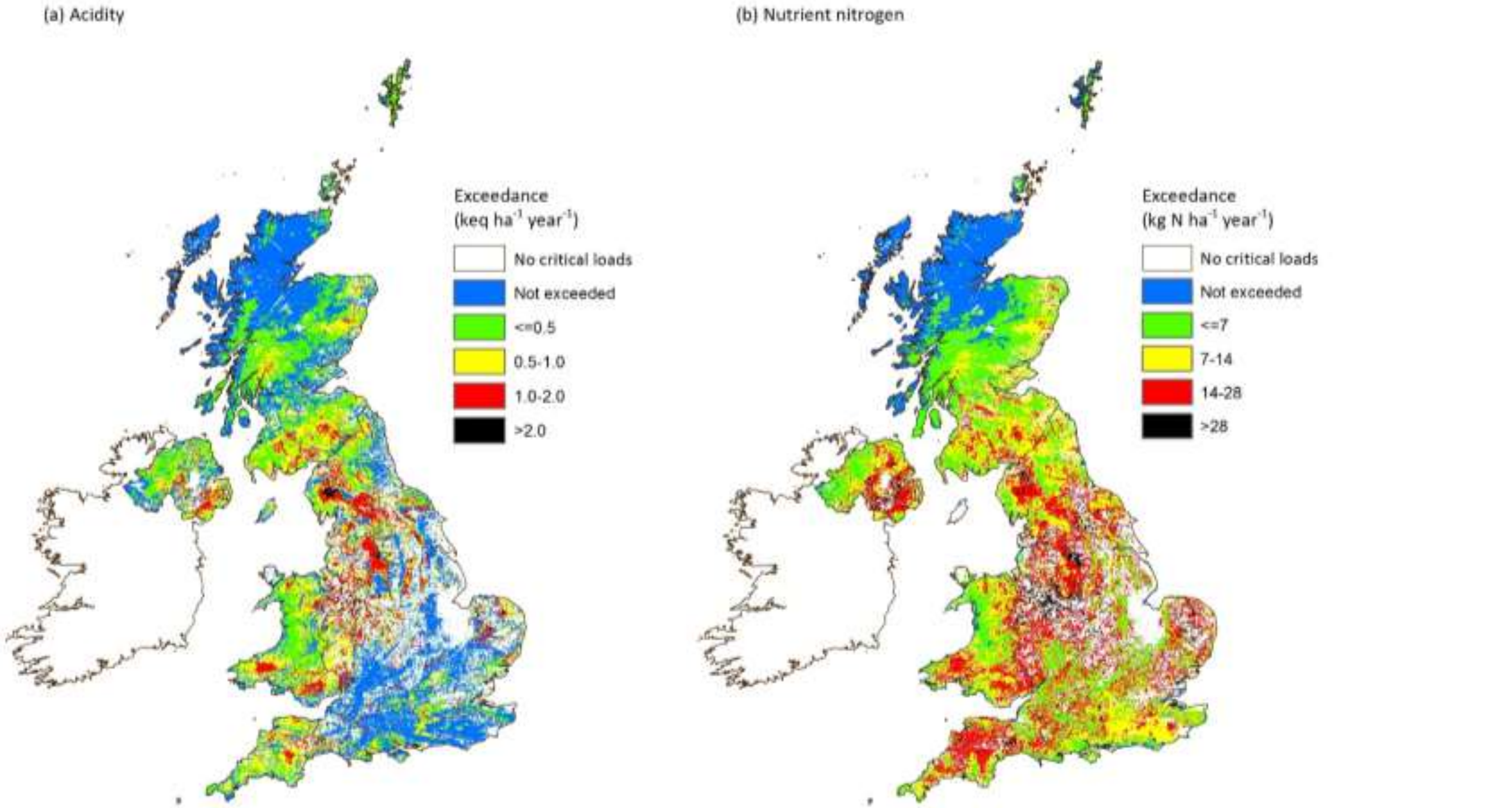

Figure 1.4: Average Accumulated Exceedance (AAE) of critical loads by CBED deposition for 2013-15. Although the legends for the two maps are given in different units the class intervals are equivalent (ie, 7 kg N ha^{-1} $year^{-1}$ is equivalent to 0.5 keq ha^{-1} $year^{-1}$).

2. Trends in critical loads exceedance by habitat and country

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

- JNCC: Biodiversity Indicator for assessing the pressures from air pollution
- http://jncc.defra.gov.uk/page-4233
- Defra: Environmental Statistics – Key Facts https://www.gov.uk/government/statistics/environment-statistics-key-facts
- Welsh Government: Sustainable Development Indicators for Wales http://wales.gov.uk/topics/statistics/headlines/sustaindev/120829/?lang=en
- Scottish Government: Key Scottish Environment Statistics http://www.scotland.gov.uk/Topics/Statistics/Browse/Environment/

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; 31% of the UK land area has habitats mapped for acidity critical loads, and 29% for nutrient nitrogen. *Note: throughout Part 1 of this report the 'percentage area exceeded' represents the percentage area of the habitats mapped as sensitive to acidification or eutrophication (ie, not % land area of the UK or countries).*

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

Country	Land area (km^2)#	Habitat areas mapped for acidity (km^2)	Area mapped for acidity as % of country	Habitat areas mapped for nutrient nitrogen (km^2)	Area mapped for nutrient nitrogen as % of country
England	132938	18635	14	19522	15
Wales	21225	7798	37	6837	32
Scotland	80239	48083	60	43200	54
NI	14130	3541	25	3467	25
UK	248532	78051	31	73027	29

The UK and its countries: facts and figures. Office for National Statistics: http://webarchive.nationalarchives.gov.uk/20160105160709/http://www.ons.gov.uk/ons/guide-method/geography/beginner-s-guide/administrative/the-countries-of-the-uk/index.html

2.1.1 Acidity results

The results for acidity (Table 2.2, Figure 2.1) show that the total area of habitats exceeding critical loads in the UK has declined from 72.6% in 1995-97 to 44.1% in 2013-15. 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; (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, 60% of Scotland has habitats mapped for acidity critical loads, and that means the actual areas exceeded are larger than in the other countries (eg, 15106 km^2 exceeded by 2013-15 deposition). Although only 14% of England has habitats mapped for acidity critical loads, 60.6% of their area is exceeded for 2013-15, equivalent to 11289 km^2. The magnitude of exceedance across the UK, expressed as AAE (Table 2.3, Figure 2.1), has more than halved from 0.78 keq ha^{-1} $year^{-1}$ in 1995-97 to 0.28 keq ha^{-1} $year^{-1}$ in 2013-15. The data show the largest reductions in the exceedances were in the late 1990s; changes since then have been smaller and fluctuated from one year to another, but continuing the general downward trend. Note that the acidity critical loads for calcareous grassland are not exceeded in any year (Table 2.3).

Table 2.2: Acid-sensitive habitat area and percentage area of habitats where acidity critical loads are exceeded, by country and deposition dataset year.

Year	Percentage acid-sensitive habitat area exceeded by country: [total area (km^2) acid-sensitive habitats by country]				
	England [18635]	Wales [7798]	Scotland [48083]	NI [3537]	UK [78051]
1995-1997	75.8	90.0	68.2	76.8	72.6
1998-2000	71.6	83.1	52.6	67.2	60.8
1999-2001	71.9	83.0	51.6	66.8	60.3
2001-2003	72.3	82.4	43.0	67.4	55.0
2002-2004	72.3	82.3	44.8	69.2	56.2
2003-2005	71.8	83.2	44.5	67.1	55.9
2004-2006	66.8	81.2	48.0	68.1	56.7
2005-2007	66.1	81.0	46.1	68.5	55.4
2006-2008	64.3	79.2	40.7	68.6	51.4
2007-2009	63.6	77.4	32.9	69.4	46.3
2008-2010	63.2	74.9	31.5	69.6	45.2
2009-2011	63.8	74.5	33.9	71.0	46.8
2010-2012	62.8	74.2	32.2	67.8	45.3
2011-2013	62.1	74.4	31.0	69.4	44.5
2012-2014	61.3	73.4	31.0	67.1	44.1
2013-2015	60.6	72.4	31.4	66.9	44.1
Reduction in % area exceeded 1995-2015	15.2	17.6	36.8	9.9	28.5

Table 2.3: Acidity Average Accumulated Exceedance (AAE in keq ha^{-1} $year^{-1}$) by country and deposition dataset year

Year	AAE (keq ha^{-1} $year^{-1}$) by country:				
	England	Wales	Scotland	NI	UK
1995-1997	1.33	1.36	0.47	0.80	0.78
1998-2000	1.00	0.84	0.28	0.46	0.51
1999-2001	0.98	0.82	0.27	0.46	0.50
2001-2003	1.04	0.82	0.23	0.51	0.50
2002-2004	0.94	0.79	0.24	0.46	0.48
2003-2005	0.93	0.84	0.24	0.42	0.47
2004-2006	0.77	0.74	0.24	0.42	0.43
2005-2007	0.74	0.73	0.21	0.45	0.40
2006-2008	0.68	0.61	0.17	0.44	0.35
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	0.6	0.47	0.14	0.46	0.3
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
Reduction in AAE 1995-2015	0.79	0.91	0.32	0.42	0.50

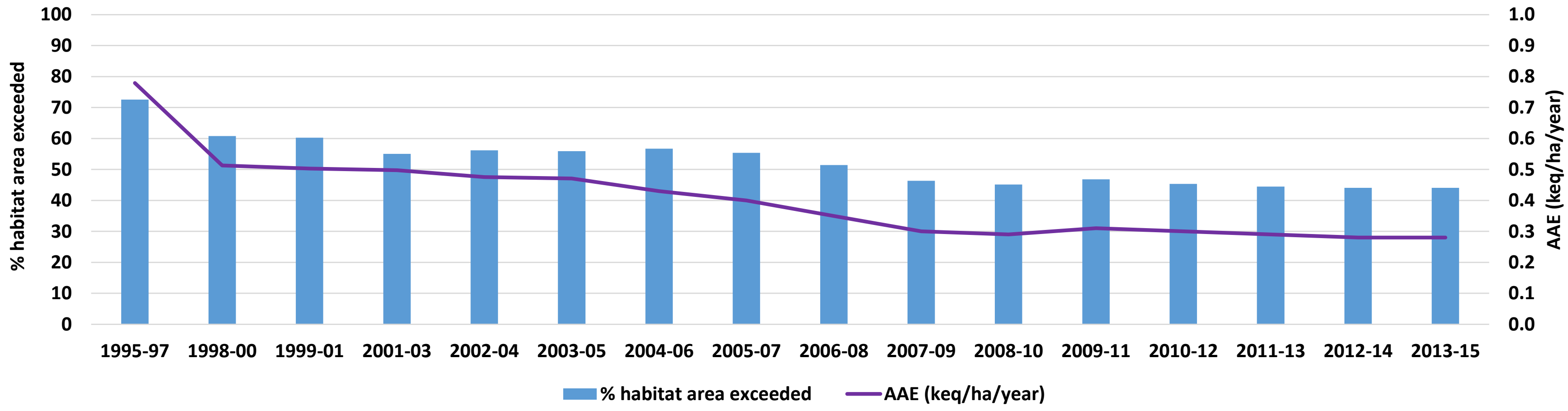

Figure 2.1: Acidity: Percentage area of acid-sensitive habitats with exceedance of acidity critical loads in the UK by year, and AAE in keq ha^{-1} $year^{-1}$.

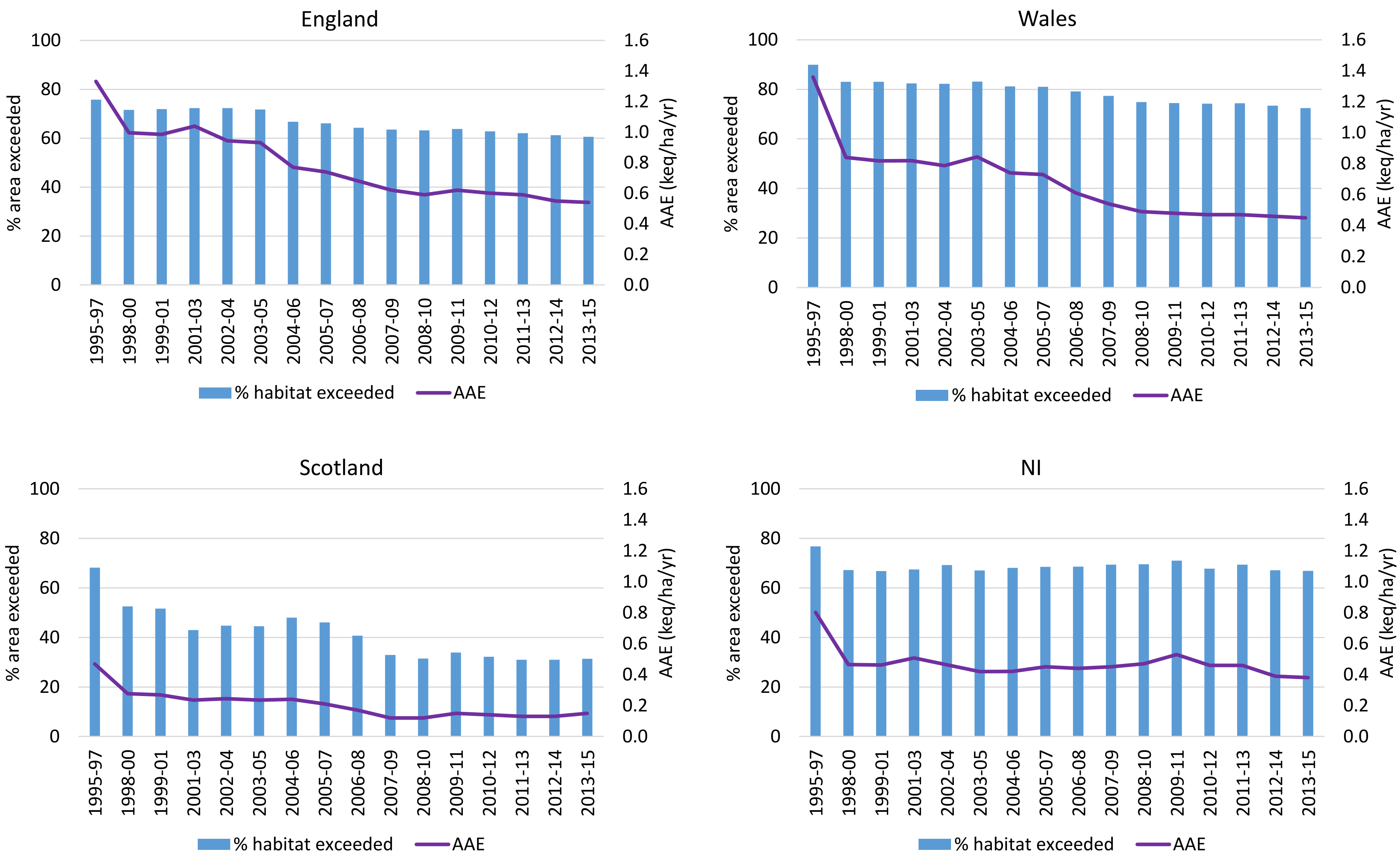

Figure 2.2: Acidity: Percentage area of acid-sensitive habitats with exceedance of acidity critical loads, by country and year, and AAE in keq ha^{-1} $year^{-1}$

2.1.2 Nutrient nitrogen results

The results for nutrient nitrogen (Table 2.4 and Figure 2.3) show a decline in the percentage area of habitats exceeded in the UK, from 75% in 1995-97 to 63.4% in 2013-15. The results for England and Wales remained 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 (18511 km^2 for 2013-15) is similar to the area exceeded in England (18703 km^2 in 2013-15). The results reflect the smaller reductions in nitrogen deposition over the last two decades compared to the reductions in sulphur deposition, which helped reduce the exceedances of acidity critical loads. However, the magnitude of the exceedance (expressed as AAE) across the UK has reduced by one-third, from 9.5 kg N ha^{-1} $year^{-1}$ in 1995-97 to 6.2 kg N ha^{-1} $year^{-1}$ in 2013-15 (Table 2.5, Figure 2.3). The AAE varies from one region to another with the lowest values in Scotland and the highest in England (Table 2.5, Figure 2.4).

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

Year	Percentage habitat area exceeded by country: [total area (km^2) nitrogen-sensitive habitats by country]				
	England [19522]	Wales [6837]	Scotland [43200]	NI [3467]	UK [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
2001-2003	97.8	93.5	47.7	85.4	67.1
2002-2004	97.6	93.3	50.2	86.3	68.6
2003-2005	97.5	94.1	50.6	83.8	68.8
2004-2006	96.7	93.2	52.9	84.8	69.9
2005-2007	96.5	93.6	53.6	86.4	70.4
2006-2008	96.1	92.9	49.0	86.8	67.5
2007-2009	96.4	91.7	41.8	88.7	63.3
2008-2010	96.5	89.7	40.7	89.7	62.6
2009-2011	97.0	89.8	44.5	91.4	65.0
2010-2012	96.5	89.6	41.4	88.5	62.9
2011-2013	96.0	90.3	40.7	89.9	62.5
2012-2014	95.9	89.4	40.9	86.4	62.3
2013-2015	95.8	88.5	42.8	87.4	63.4
Reduction in % area exceeded 1995-2015	2.5	9.5	16.6	5.2	11.6

Table 2.5: Nutrient nitrogen Average Accumulated Exceedance (AAE in kg N ha^{-1} $year^{-1}$) by country and deposition dataset year

Year	AAE (kg N ha^{-1} $year^{-1}$) by country:				
	England	Wales	Scotland	NI	UK
1995-1997	19.0	15.8	4.1	10.6	9.5
1998-2000	16.8	10.3	2.7	6.5	7.4
1999-2001	17.4	10.6	2.9	6.8	7.7
2001-2003	19.7	12.2	3.1	8.9	8.7
2002-2004	18.0	12.2	3.3	8.7	8.3
2003-2005	18.2	13.2	3.3	8.3	8.4
2004-2006	14.9	11.4	3.1	7.9	7.2
2005-2007	14.9	11.4	2.9	8.8	7.2
2006-2008	14.1	9.9	2.5	8.8	6.6
2007-2009	13.8	9.5	2.1	9.4	6.3
2008-2010	13.9	9.2	2.2	9.8	6.3
2009-2011	14.6	9.2	2.6	10.9	6.8
2010-2012	13.8	8.8	2.4	9.6	6.4
2011-2013	13.3	8.9	2.3	9.5	6.2
2012-2014	12.6	8.6	2.3	8.3	5.9
2013-2015	12.8	8.9	2.7	8.4	6.2
Reduction in AAE 1995-2015	6.2	6.9	1.4	2.2	3.3

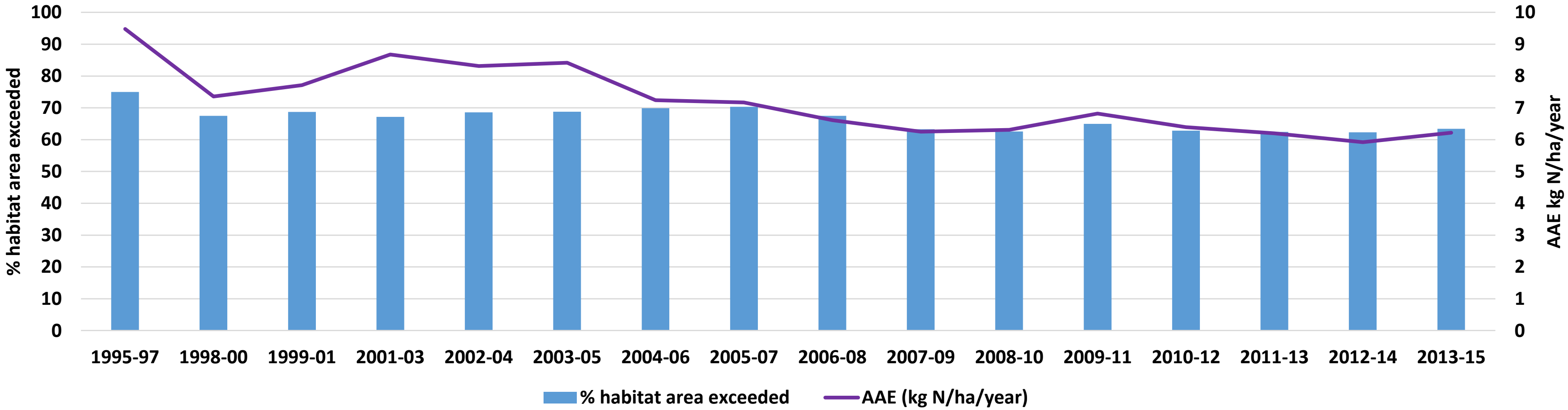

Figure 2.3: Nutrient nitrogen: Percentage area of nitrogen-sensitive habitats with exceedance of nitrogen critical loads in the UK by year, and AAE in kg N ha^{-1} $year^{-1}$.

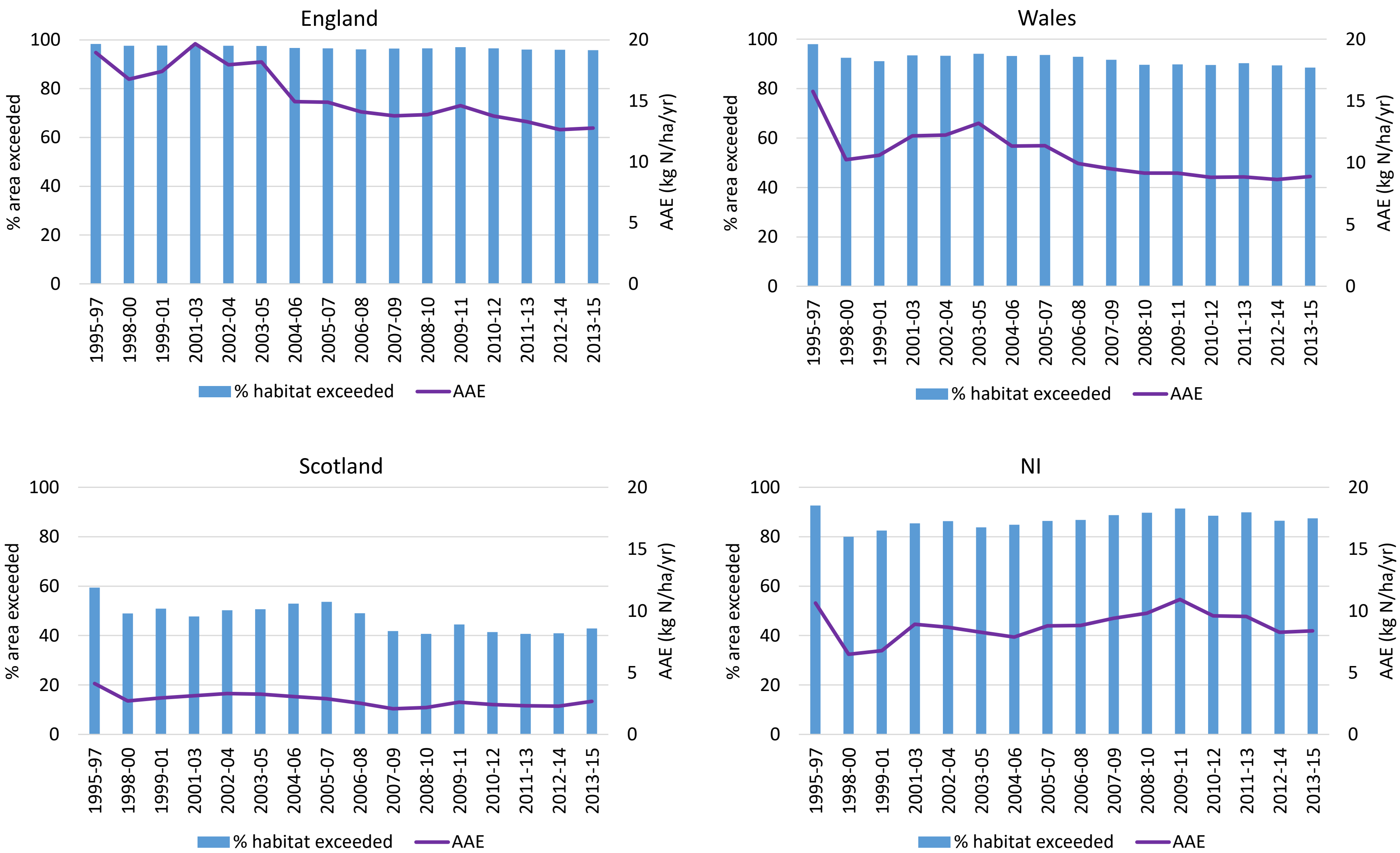

Figure 2.4: Nutrient nitrogen: Percentage area of nitrogen-sensitive habitats with exceedance of nitrogen critical loads, by country and year, and AAE in kg N ha^{-1} year^{-1}.

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 supplied to Defra and the devolved administrations.

2.2.1 Acidity results

As mentioned in Section 2.1 there is no exceedance of the acidity critical loads for calcareous grassland and this habitat is therefore 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 (42.2%) in the area exceeded, from 70.3% in 1995-97 to 28.1% in 2013-15. The largest reductions in AAE over the same timescale are for woodland 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 nitrogen in all years (Table 2.8, Figure 2.6): calcareous grasslands and woodlands (beech, oak, managed conifer and broadleaf and other unmanaged woodland). The largest reduction in the area exceeded is for dune grassland from 70.6% in 1995-97 to 26.9% in 2013-15, however, this habitat only occupies <1% of the total area of nitrogen-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 decreased from 22.7 kg N ha^{-1} $year^{-1}$ in 1995-97 to 12.3 kg N ha^{-1} $year^{-1}$ in 2013-15.

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.

Parameter	Acid-sensitive habitat areas in the UK 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)	15336	24705	5454	3054	8374	7452	4011	7857	78051
Data year									
1995-1997	92.0	70.3	88.0	95.8	79.4	75.8	69.5	29.9	72.6
1998-2000	84.9	49.5	78.8	91.3	69.9	68.4	57.2	24.2	60.8
1999-2001	84.7	47.9	76.1	93.4	70.2	69.1	58.2	23.9	60.3
2001-2003	79.5	40.7	61.6	82.5	66.5	69.6	58.5	21.9	55.0
2002-2004	80.3	42.3	60.1	89.4	68.4	70.8	60.1	21.3	56.2
2003-2005	80.4	41.5	59.3	92.9	68.2	70.1	59.1	21.7	55.9
2004-2006	82.5	45.1	71.7	96.3	64.2	61.5	48.3	21.7	56.7
2005-2007	81.9	41.5	76.4	94.4	63.6	60.5	46.7	21.3	55.4
2006-2008	78.9	35.4	73.3	85.6	60.5	57.2	43.4	20.6	51.4
2007-2009	73.9	28.5	63.7	71.4	57.1	55.9	42.1	19.0	46.3
2008-2010	72.2	28.1	57.9	70.1	55.6	55.6	42.0	18.5	45.2
2009-2011	74.8	30.6	54.9	71.6	58.0	57.0	43.3	18.9	46.8
2010-2012	73.0	29.3	54.4	65.3	56.7	55.0	41.5	19.0	45.3
2011-2013	73.4	28.5	50.1	62.3	56.2	53.5	40.5	18.8	44.5
2012-2014	72.6	27.8	55.5	62.7	54.9	51.6	38.5	18.6	44.1
2013-2015	73.0	28.1	52.4	65.0	55.8	51.0	37.9	18.2	44.1
Reduction in % area exceeded 1995-2015	19.0	42.2	35.6	30.8	23.6	24.8	31.6	11.7	28.5

Table 2.7: Acidity AAE (in keq ha^{-1} year^{-1}) by habitat for the UK 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	1.15	0.47	0.76	0.81	1.13	1.20	0.87	0.36	0.78
1998-2000	0.80	0.28	0.53	0.57	0.68	0.88	0.58	0.23	0.51
1999-2001	0.77	0.26	0.50	0.59	0.68	0.90	0.61	0.21	0.50
2001-2003	0.70	0.24	0.46	0.60	0.72	1.01	0.68	0.18	0.50
2002-2004	0.67	0.22	0.41	0.64	0.74	0.94	0.65	0.17	0.48
2003-2005	0.68	0.21	0.39	0.62	0.73	0.94	0.65	0.17	0.47
2004-2006	0.68	0.22	0.44	0.66	0.58	0.66	0.44	0.17	0.43
2005-2007	0.64	0.19	0.45	0.53	0.56	0.65	0.43	0.16	0.40
2006-2008	0.57	0.16	0.42	0.39	0.49	0.56	0.36	0.13	0.35
2007-2009	0.49	0.12	0.34	0.28	0.43	0.53	0.34	0.12	0.30
2008-2010	0.47	0.12	0.33	0.28	0.42	0.52	0.34	0.11	0.29
2009-2011	0.51	0.14	0.35	0.31	0.46	0.56	0.36	0.12	0.31
2010-2012	0.50	0.13	0.35	0.26	0.43	0.51	0.32	0.12	0.30
2011-2013	0.51	0.13	0.34	0.25	0.42	0.47	0.30	0.12	0.29
2012-2014	0.48	0.12	0.33	0.25	0.39	0.43	0.27	0.12	0.28
2013-2015	0.49	0.13	0.34	0.26	0.41	0.42	0.26	0.11	0.28
Reduction AAE 1995-2015	0.66	0.34	0.42	0.55	0.72	0.78	0.61	0.25	0.50

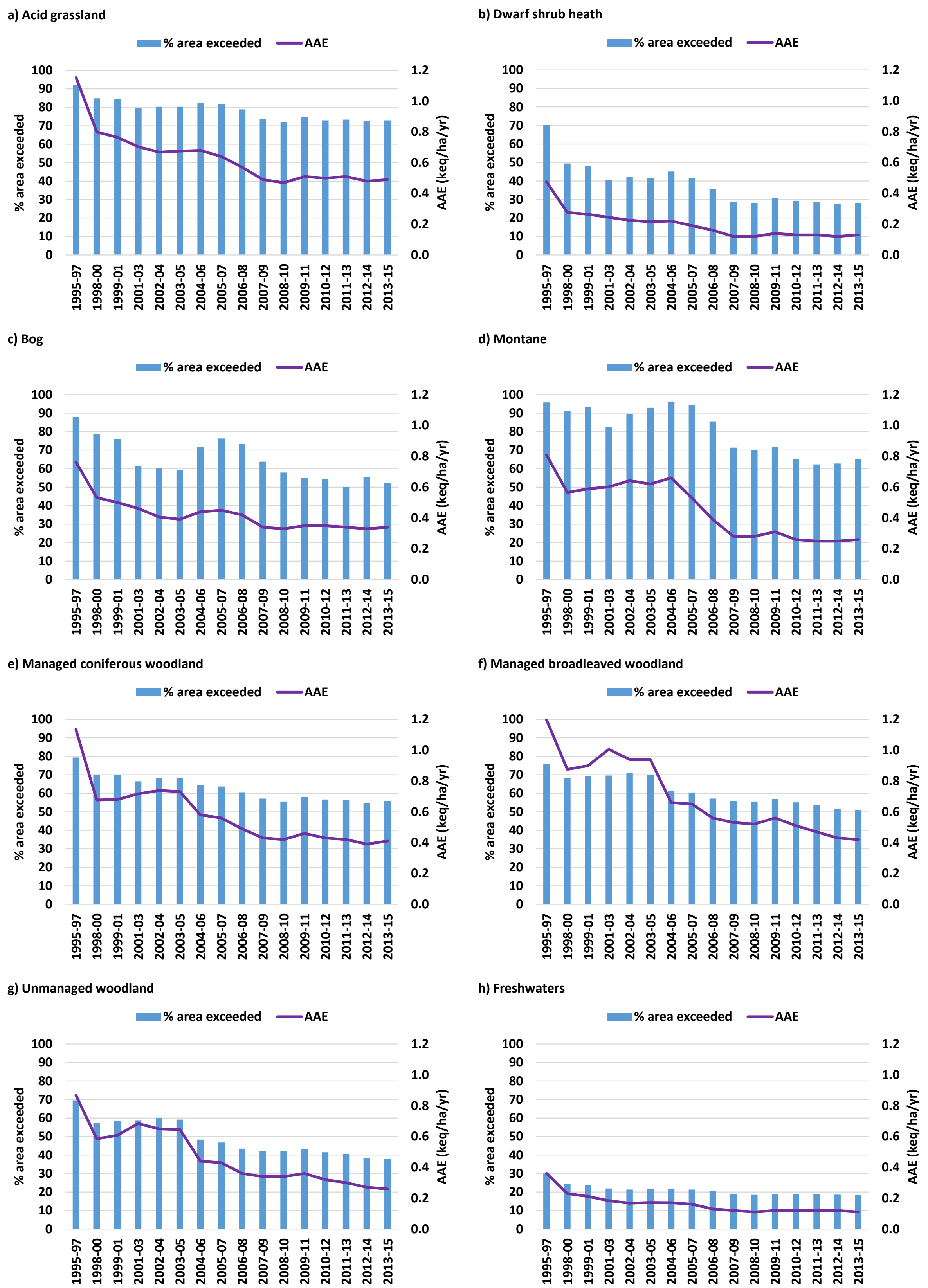

Figure 2.5: Acidity: Percentage area of habitats where acidity critical loads are exceeded and acidity AAE for the UK by deposition dataset year.

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.

Parameter	Nitrogen-sensitive habitat areas in the UK 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
Habitat area (km^2)	15235	3578	24826	5526	3129	8383	7482	719	1434	204	1761	323	427
Data year													
1995-1997	72.6	97.5	59.1	54.2	96.7	95.4	98.4	100.0	98.9	61.1	96.5	70.6	2.0
1998-2000	61.3	95.5	49.0	45.1	95.7	90.5	97.4	100.0	97.0	38.9	95.1	44.8	1.1
1999-2001	61.4	95.5	51.1	45.0	97.1	92.8	97.8	100.0	98.1	52.3	95.5	46.9	2.1
2001-2003	63.1	95.5	47.8	44.6	89.0	90.6	97.4	100.0	96.1	49.7	95.5	41.9	1.0
2002-2004	64.3	93.9	49.8	44.9	92.6	93.0	98.1	100.0	98.2	66.5	95.7	36.1	1.1
2003-2005	64.8	93.9	50.6	45.2	90.5	92.1	98.0	100.0	98.1	67.8	95.7	33.5	1.1
2004-2006	64.8	90.6	54.5	45.9	96.6	90.2	97.5	100.0	95.6	58.0	95.5	29.3	0.8
2005-2007	64.2	89.4	54.3	54.6	96.2	91.0	97.4	100.0	95.5	52.6	95.6	31.8	0.8
2006-2008	60.0	87.7	49.5	55.4	95.5	89.4	97.1	100.0	93.8	34.2	95.5	31.1	0.8
2007-2009	56.3	89.6	43.9	47.1	82.7	86.9	96.7	100.0	89.8	30.7	95.2	29.2	0.9
2008-2010	55.7	91.2	42.7	45.6	81.0	86.1	96.7	99.9	88.5	30.5	95.1	34.7	0.9
2009-2011	61.1	92.3	45.0	45.8	82.1	88.2	97.0	99.9	91.5	32.4	95.3	37.6	0.9
2010-2012	59.7	90.4	42.2	44.8	74.4	86.5	96.8	99.9	87.7	26.2	94.7	34.0	0.9
2011-2013	60.8	87.6	41.6	43.1	71.2	86.4	96.8	100.0	88.6	24.2	95.0	29.2	0.8
2012-2014	59.1	88.2	41.6	45.4	74.2	85.6	96.6	99.9	87.6	26.0	95.0	25.3	0.7
2013-2015	60.8	87.5	43.0	45.6	78.4	86.0	96.7	100.0	88.5	26.4	95.0	26.9	0.8
Reduction in % area exceeded 1995-2015	11.8	10.0	16.1	8.6	18.3	9.4	1.7	0.0	10.4	34.7	1.5	43.7	0.2

Table 2.9: Nutrient nitrogen: AAE (in kg N ha^{-1} $year^{-1}$) by habitat for the UK by deposition dataset year.

Year	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
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	0.04
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	0.05
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	0.06
2001-2003	4.5	8.9	3.6	4.4	5.7	14.4	25.8	22.9	18.8	3.2	25.2	1.5	0.03
2002-2004	4.2	6.9	3.4	3.8	6.1	14.7	24.5	22.1	19.1	4.0	23.8	0.9	1.7
2003-2005	4.4	6.9	3.4	3.8	6.1	14.8	24.8	22.6	19.4	3.7	24.1	0.9	1.7
2004-2006	4.4	5.7	3.4	3.9	6.4	12.2	19.3	15.8	15.5	2.6	18.7	0.8	0.03
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	0.04
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	0.04
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	0.04
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	0.05
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	0.06
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	0.05
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	0.03
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	0.01
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	0.01
Reduction in AAE 1995-2015	2.5	3.0	1.6	1.5	2.1	5.6	8.0	10.4	6.8	1.6	6.5	2.0	0.03

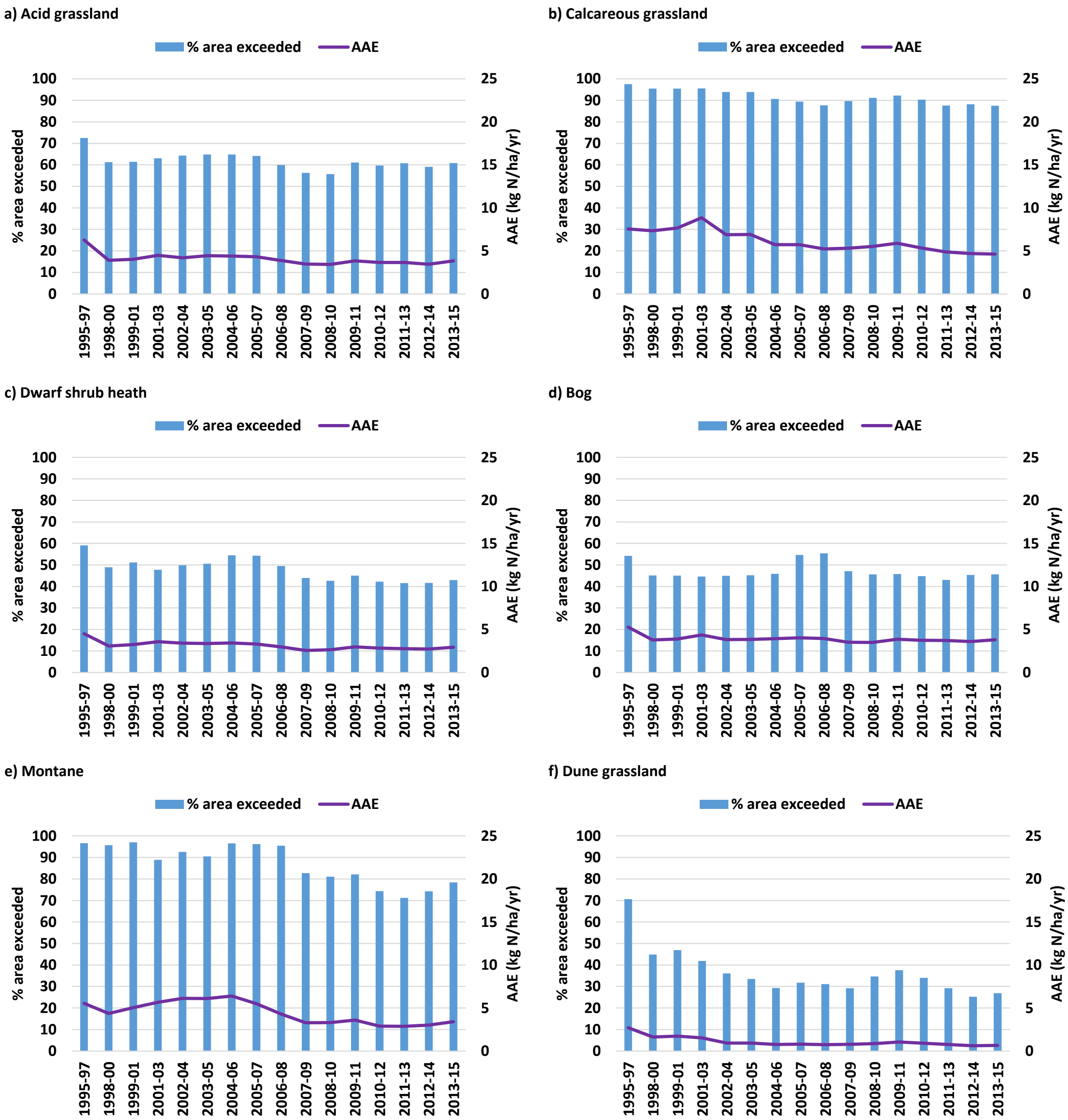

Figure 2.6: Nutrient nitrogen: Percentage area of habitats where nutrient nitrogen critical loads are exceeded and nutrient nitrogen AAE (in kg N ha^{-1} $year^{-1}$) in the UK by deposition dataset year.

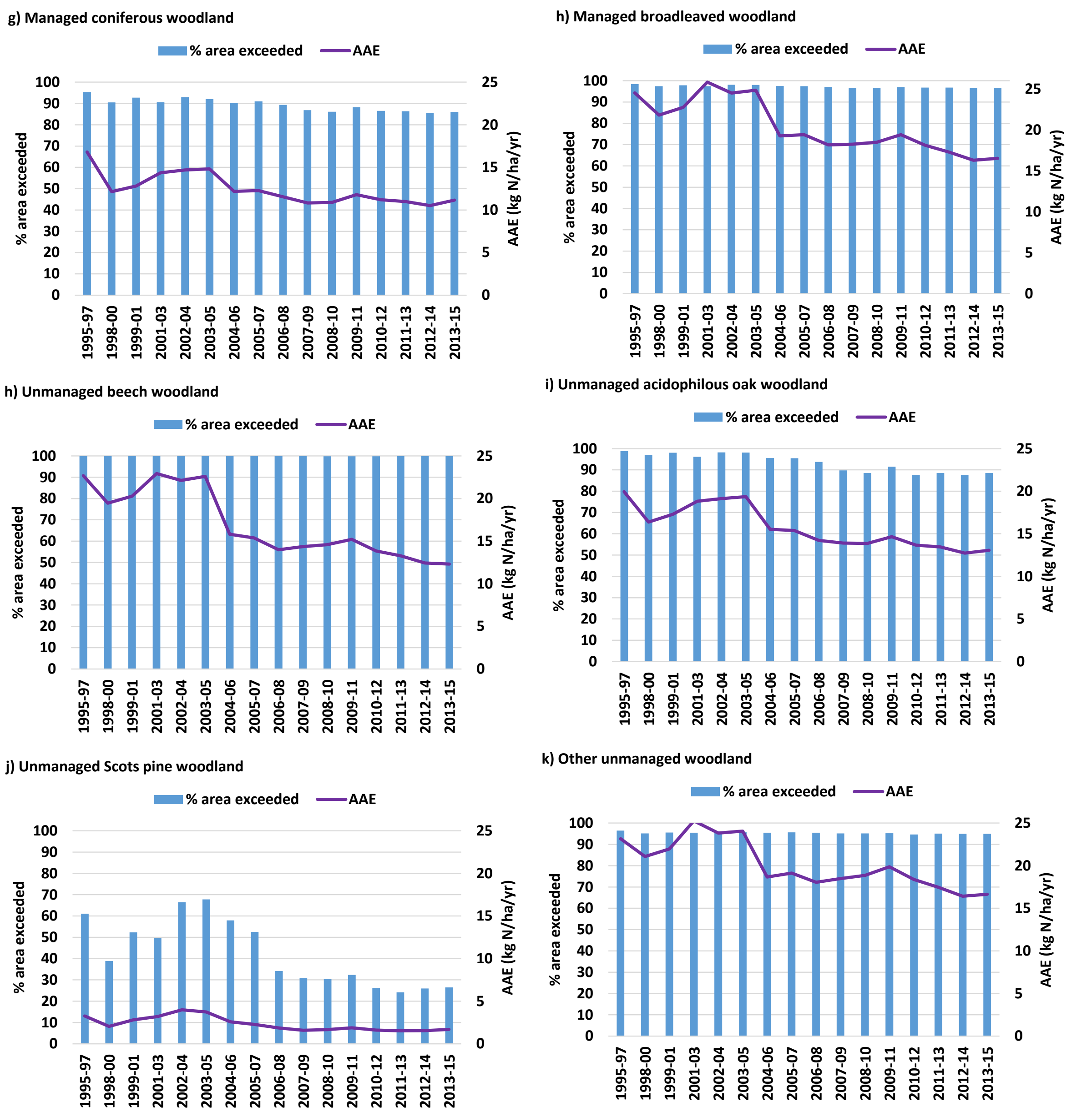

Figure 2.6 (continued): Nutrient nitrogen: Percentage area of habitats where nutrient nitrogen critical loads are exceeded and nutrient nitrogen AAE (in kg N ha^{-1} $year^{-1}$) in the UK by deposition dataset year.

Part 2: Site-relevant critical loads (SRCL) and their exceedances

3. Introduction

This part of the report focuses on the application of critical loads to designated sites, 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 nitrogen-sensitive habitats described in Part 1 of this report, and are applied to acid- and nitrogen-sensitive features within the designated sites. Exceedances of critical loads are also calculated in the same way as the habitats (Part 1) and also based on UK 5x5 km CBED deposition, however, some different metrics are used to describe the exceedance results for SRCL and are explained below.

3.1 Overview of site-relevant critical loads

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

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

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

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

To assign critical loads to the habitat features of designated sites it is necessary to link the different habitat classifications used. Acidity critical loads are mapped by broad habitat and empirical critical loads of nitrogen are based on the EUNIS (European Nature Information System; Davies & Moss, 2002) habitat classification. Look-up tables developed by Davies & Moss (2002) and published in the National Biodiversity Network (NBN) Habitats Dictionary (http://habitats.nbn.org.uk/) and available from the JNCC website (http://jncc.defra.gov.uk/page-1425) enable linkages to be made between:

- Annex I habitats and EUNIS classes

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

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

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

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

3.2 Overview of SRCL exceedance metrics

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

(a) Feature (within each site):

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

(b) Site:

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

(c) Country:

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

- Maximum exceeded area###
- Maximum AE calculated as the sum of the maximum AE for all sites
- Maximum AAE; calculated from the country maximum AE and total area of all sites (with SRCL) within a country.

Feature exceeded area: If the critical load is exceeded and the deposition values are constant across the whole site, the exceeded area equals the site area; if the deposition values vary across the site (e.g. as a result of the site crossing the boundaries between different 5x5km grid squares with different deposition values), then the exceeded area will be the sum of the 1x1 km portions of the site where the deposition exceeds the critical load.
Site maximum exceeded area: is set to the maximum exceeded area for any feature within a site.
Country maximum exceeded area: is calculated as the sum of the site maximum exceeded areas for all sites within a country.

The sections below summarise the key results by country, based on the CBED deposition (Section 1.2) for 1995-97 to 2013-15. Note that the summary statistics may present the "worst" case, as they are based on sites where at least one feature is exceeded; other features within a site may (a) have a smaller exceedance or (b) 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. For all site types (SACs, SPAs and SSSIs) the largest reductions in the percentage of sites with critical load exceedance between 1995-97 and 2013-15 are for Scotland (25-36% reduction), and the AAE has at least halved in all countries over this time period. These trends reflect the changing patterns of acid deposition over this time period. At the UK level the latest results (based on CBED deposition for 2013-15) show (i) for SACs, 76.2% of sites have exceedance of the acidity critical loads for one or more features (down 14.8% from 1995), and a maximum AAE of 0.65 keq ha^{-1} $year^{-1}$ (down by 0.86 keq ha^{-1} $year^{-1}$ from 1995-97); (ii) for SPAs, 70.3% of sites have exceedance of the acidity critical loads for one or more features (down 24% from 1995-97), and a maximum AAE of 0.44 keq ha^{-1} $year^{-1}$ (down by 0.67 keq ha^{-1} $year^{-1}$ from 1995-97); (iii) for SSSIs, 60.2% of sites have exceedance of the acidity critical loads for one or more features (down 17.4% from 1995-97), and a maximum AAE of 0.47 keq ha^{-1} $year^{-1}$ (down by 0.71 keq ha^{-1} $year^{-1}$ from 1995-97).

Maps of the maximum AAE per site (Figure 3.1) based on the latest CBED deposition (2013-15) 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} $year^{-1}$]

Parameter	**Country**						
	England	**Wales**	**Scotland**	**NI**	**Eng/Wales***	**Eng/Scot***	**UK**
Number of sites	231	85	236	54	7	3	616
Number of sites with SRCL for at least one feature	180	71	182	47	6	1	487
Exceedance by deposition data for:							
1995-1997	85.0 [2.36]	97.2 [1.87]	92.3 [0.66]	97.9 [1.32]	100.0	100.0	91.0 [1.51]
1998-2000	82.2 [1.80]	97.2 [1.29]	83.5 [0.42]	95.7 [0.76]	100.0	100.0	86.4 [1.10]
1999-2001	81.7 [1.83]	97.2 [1.31]	83.5 [0.44]	95.7 [0.78]	100.0	100.0	86.2 [1.12]
2001-2003	81.1 [1.89]	94.4 [1.31]	75.3 [0.41]	95.7 [0.87]	100.0	100.0	82.5 [1.13]
2002-2004	82.8 [1.77]	95.8 [1.27]	78.0 [0.43]	95.7 [0.77]	100.0	100.0	84.4 [1.09]
2003-2005	82.8 [1.75]	95.8 [1.33]	76.4 [0.42]	95.7 [0.71]	100.0	100.0	83.8 [1.08]
2004-2006	79.4 [1.50]	95.8 [1.08]	79.7 [0.42]	95.7 [0.70]	100.0	100.0	83.8 [0.95]
2005-2007	79.4 [1.45]	95.8 [1.05]	79.7 [0.38]	95.7 [0.73]	100.0	100.0	83.8 [0.91]
2006-2008	77.2 [1.35]	95.8 [0.90]	75.8 [0.31]	95.7 [0.71]	100.0	100.0	81.5 [0.82]
2007-2009	76.7 [1.21]	95.8 [0.82]	69.2 [0.22]	95.7 [0.72]	100.0	100.0	78.9 [0.71]
2008-2010	75.6 [1.16]	95.8 [0.77]	67.6 [0.22]	95.7 [0.75]	100.0	100.0	77.8 [0.68]
2009-2011	76.1 [1.20]	95.8 [0.75]	70.3 [0.23]	95.7 [0.79]	100.0	100.0	79.1 [0.71]
2010-2012	76.1 [1.17]	93.0 [0.75]	68.1 [0.21]	93.6 [0.72]	100.0	100.0	77.6 [0.68]
2011-2013	75.0 [1.18]	93.0 [0.75]	68.1 [0.19]	95.7 [0.72]	100.0	100.0	77.4 [0.67]
2012-2014	74.4 [1.15]	94.4 [0.73]	68.1 [0.19]	95.7 [0.66]	100.0	100.0	77.4 [0.66]
2013-2015	72.2 [1.13]	93.0 [0.67]	67.6 [0.19]	95.7 [0.63]	100.0	100.0	76.2 [0.65]
Reduction in % sites with exceedance 1995-2015 [Reduction in maximum AAE keq ha^{-1} $year^{-1}$ 1995-2015]	12.8 [1.23]	4.2 [1.20]	24.7 [0.47]	2.2 [0.69]	0.0	0.0	14.8 [0.86]

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

Table 3.2: Trends in acidity exceedances for SPAs; percentage of sites (with SRCL) with exceedance of SRCL for at least one feature, and maximum AAE of all sites/features: (a) % of sites with SRCL with exceedance of SRCL for at least one feature, (b)[maximum AAE keq ha^{-1} $year^{-1}$]

Parameter	Country						
	England	**Wales**	**Scotland**	**NI**	**Eng/Wales***	**Eng/Scot***	**UK**
Number of sites	78	17	145	14	3	0	257
Number of sites with SRCL for at least one feature	63	13	86	10	3	0	175
Exceedance by deposition data for:							
1995-1997	98.4 [1.73]	100.0 [1.85]	89.5 [0.45]	100.0 [1.09]	100.0	-	94.3 [1.11]
1998-2000	98.4 [1.41]	100.0 [1.14]	72.1 [0.24]	100.0 [0.43]	100.0	-	85.7 [0.81]
1999-2001	98.4 [1.39]	100.0 [1.21]	73.3 [0.24]	90.0 [0.41]	100.0	-	85.7 [0.80]
2001-2003	98.4 [1.38]	84.6 [1.24]	62.8 [0.23]	70.0 [0.55]	100.0	-	78.3 [0.80]
2002-2004	96.8 [1.24]	92.3 [1.25]	66.3 [0.23]	80.0 [0.32]	100.0	-	80.6 [0.73]
2003-2005	96.8 [1.21]	92.3 [1.32]	65.1 [0.19]	80.0 [0.26]	100.0	-	80.0 [0.70]
2004-2006	88.9 [1.08]	92.3 [1.01]	62.8 [0.19]	90.0 [0.27]	100.0	-	76.6 [0.63]
2005-2007	90.5 [1.04]	92.3 [0.98]	66.3 [0.19]	80.0 [0.25]	100.0	-	78.3 [0.61]
2006-2008	90.5 [0.99]	92.3 [0.77]	64.0 [0.16]	80.0 [0.25]	100.0	-	77.1 [0.55]
2007-2009	90.5 [0.91]	92.3 [0.66]	55.8 [0.10]	80.0 [0.23]	100.0	-	73.1 [0.48]
2008-2010	90.5 [0.87]	92.3 [0.62]	54.7 [0.09]	80.0 [0.25]	100.0	-	72.6 [0.47]
2009-2011	88.9 [0.90]	92.3 [0.59]	58.1 [0.11]	80.0 [0.32]	100.0	-	73.7 [0.48]
2010-2012	88.9 [0.89]	84.6 [0.59]	58.1 [0.09]	80.0 [0.27]	100.0	-	73.1 [0.47]
2011-2013	87.3 [0.86]	84.6 [0.59]	54.7 [0.08]	90.0 [0.28]	100.0	-	71.4 [0.45]
2012-2014	87.3 [0.86]	76.9 [0.58]	55.8 [0.08]	90.0 [0.21]	100.0	-	71.4 [0.45]
2013-2015	87.3 [0.84]	76.9 [0.52]	53.5 [0.09]	90.0 [0.20]	100.0	-	70.3 [0.44]
Reduction in % sites with exceedance 1995-2015 [Reduction in maximum AAE keq ha^{-1} $year^{-1}$ 1995-2015]	11.1 [0.89]	23.1 [1.33]	36.0 [0.36]	10.0 [0.89]	0.0	-	24.0 [0.67]

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

Table 3.3: Trends in acidity exceedances for SSSIs; 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}]

Parameter	**Country**						
	England	**Wales**	**Scotland**	**NI**	**Eng/Wales***	**Eng/Scot***	**UK**
Number of sites	4115	1018	1452	291	0	0	6876
Number of sites with SRCL for at least one feature	2924	676	905	178	0	0	4683
Exceedance by deposition data for:							
1995-1997	71.8 [1.66]	91.4 [1.63]	85.1 [0.60]	82.0 [1.18]	-	-	77.6 [1.18]
1998-2000	68.0 [1.24]	80.9 [1.11]	76.1 [0.37]	75.3 [0.65]	-	-	71.7 [0.84]
1999-2001	68.2 [1.24]	81.2 [1.09]	75.8 [0.36]	75.3 [0.66]	-	-	71.8 [0.83]
2001-2003	67.9 [1.27]	79.6 [1.07]	69.7 [0.32]	75.3 [0.77]	-	-	70.2 [0.82]
2002-2004	66.5 [1.16]	81.8 [1.04]	70.1 [0.33]	77.0 [0.65]	-	-	69.8 [0.78]
2003-2005	66.3 [1.15]	82.0 [1.10]	69.1 [0.32]	75.8 [0.59]	-	-	69.5 [0.77]
2004-2006	62.7 [0.99]	79.1 [0.95]	69.8 [0.33]	74.7 [0.58]	-	-	66.9 [0.69]
2005-2007	62.3 [0.95]	79.4 [0.93]	70.1 [0.31]	75.8 [0.60]	-	-	66.8 [0.66]
2006-2008	60.7 [0.88]	78.6 [0.80]	67.2 [0.25]	75.3 [0.59]	-	-	65.1 [0.59]
2007-2009	60.2 [0.79]	77.5 [0.72]	62.9 [0.17]	75.3 [0.59]	-	-	63.8 [0.51]
2008-2010	60.0 [0.76]	76.0 [0.67]	61.2 [0.16]	75.8 [0.61]	-	-	63.1 [0.49]
2009-2011	60.1 [0.79]	76.0 [0.65]	63.2 [0.19]	78.1 [0.65]	-	-	63.7 [0.51]
2010-2012	59.3 [0.77]	74.7 [0.65]	61.8 [0.17]	76.4 [0.60]	-	-	62.7 [0.50]
2011-2013	58.2 [0.77]	74.9 [0.66]	59.1 [0.16]	77.0 [0.60]	-	-	61.5 [0.49]
2012-2014	57.7 [0.74]	74.0 [0.65]	58.9 [0.16]	74.2 [0.55]	-	-	60.9 [0.48]
2013-2015	56.6 [0.73]	73.8 [0.61]	58.7 [0.17]	74.2 [0.52]			60.2 [0.47]
Reduction in % sites with exceedance 1995-2015 [Reduction in maximum AAE keq ha^{-1} year^{-1} 1995-2015]	15.2 [0.93]	17.6 [1.02]	26.4 [0.43]	7.8 [0.66]	-	-	17.4 [0.71]

* Some SACs and SPAs cross the England/Wales or England/Scotland border and have been assigned to these border areas; all SSSIs have been assigned to a single country only.

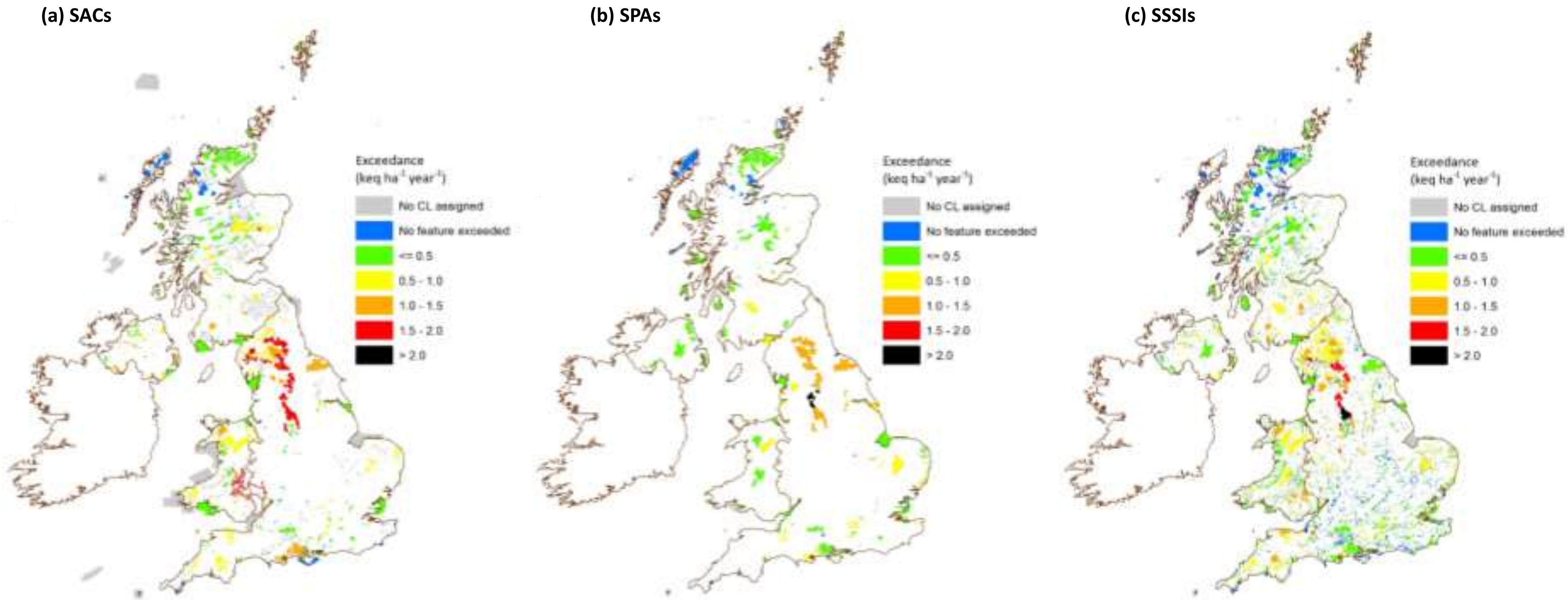

Figure 3.1: Average Accumulated Exceedance (AAE) of acidity critical loads by CBED deposition for 2013-15; maps show the maximum AAE for any feature within each site (other features may have lower or no exceedance).

3.2.2 Nutrient nitrogen results

The trends in nutrient nitrogen critical load exceedances from 1995-97 to 2013-15 are summarised in Tables 3.4-3.6. The reductions in the percentage of sites with exceedance of nutrient nitrogen critical loads for one or more features, and reductions in AAE, are smaller than the reductions seen for acidity, reflecting the smaller decreases in nitrogen deposition over time. Reductions vary by country for the different site types; the largest reductions in the percentage of sites with exceedance are greatest in Scotland for SACs (5.5% reduction) and SSSIs (9.8% reduction), and in Wales (21.4% reduction) for SPAs, though there are fewer SPAs in Wales compared to Scotland and England. The largest reductions in AAE (for all site types) between 1995-97 and 2013-15 are for Wales (38-43%) and Scotland (35-40%).

At the UK level the latest results (based on CBED deposition for 2013-15) show (i) for SACs, 90.9% of sites have exceedance of the nutrient nitrogen critical loads for one or more features (down 4.1% from 1995-97), and a maximum AAE of 9.2 kg N ha^{-1} $year^{-1}$ (down by 4.9 kg N ha^{-1} $year^{-1}$ from 1995-97); (ii) for SPAs, 73.3% of sites have exceedance of the nutrient nitrogen critical loads for one or more features (down 10.7% from 1995-97), and a maximum AAE of 8.7 kg N ha^{-1} $year^{-1}$ (down by 4.6 kg N ha^{-1} $year^{-1}$ from 1995-97); (iii) for SSSIs, 87.8% of sites have exceedance of the nutrient nitrogen critical loads for one or more features (down 7.1% from 1995-97), and a maximum AAE of 9.9 kg N ha^{-1} $year^{-1}$ (down by 5.0 kg N ha^{-1} $year^{-1}$ from 1995-97).

Maps of the maximum AAE per site (Figure 3.2) based on the latest CBED deposition (2013-15) show few sites with no exceedance of 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} $year^{-1}$]

Parameter	**Country**						
	England	**Wales**	**Scotland**	**NI**	**Eng/Wales***	**Eng/Scot***	**UK**
Number of sites	231	85	236	54	7	3	616
Number of sites with SRCL for at least one feature	197	79	201	50	7	2	536
Exceedance by deposition data for:							
1995-1997	98.5 [20.5]	98.7 [14.1]	89.6 [7.3]	98.0 [14.4]	100.0	50.0	95.0 [14.1]
1998-2000	97.0 [17.4]	96.2 [10.3]	85.1 [5.9]	96.0 [9.8]	100.0	50.0	92.2 [11.4]
1999-2001	97.0 [18.3]	96.2 [10.9]	85.6 [6.3]	96.0 [10.3]	100.0	50.0	92.4 [12.1]
2001-2003	98.0 [19.8]	94.9 [11.9]	84.6 [6.3]	98.0 [12.7]	100.0	50.0	92.4 [12.9]
2002-2004	97.5 [18.4]	93.7 [11.7]	85.6 [6.6]	98.0 [11.3]	100.0	50.0	92.4 [12.4]
2003-2005	97.5 [18.6]	96.2 [12.2]	85.6 [6.4]	98.0 [10.9]	100.0	50.0	92.7 [12.5]
2004-2006	95.9 [15.8]	94.9 [9.7]	84.6 [6.2]	98.0 [11.0]	100.0	50.0	91.6 [10.9]
2005-2007	94.9 [15.7]	94.9 [9.7]	86.1 [6.5]	98.0 [11.9]	100.0	50.0	91.8 [11.0]
2006-2008	94.4 [15.0]	93.7 [8.8]	86.6 [6.1]	98.0 [11.8]	100.0	50.0	91.6 [10.4]
2007-2009	94.9 [14.1]	93.7 [8.5]	83.1 [5.1]	98.0 [12.3]	100.0	50.0	90.5 [9.6]
2008-2010	95.4 [14.0]	93.7 [8.4]	82.6 [4.8]	98.0 [12.7]	100.0	50.0	90.5 [9.4]
2009-2011	95.9 [14.5]	93.7 [8.4]	84.1 [4.9]	98.0 [13.1]	100.0	50.0	91.2 [9.7]
2010-2012	95.4 [14.0]	93.7 [8.2]	83.1 [4.6]	98.0 [12.2]	100.0	50.0	90.7 [9.3]
2011-2013	93.9 [13.9]	93.7 [8.2]	82.6 [4.4]	98.0 [12.2]	100.0	50.0	89.9 [9.2]
2012-2014	94.4 [13.6]	93.7 [8.0]	83.1 [4.6]	98.0 [11.5]	100.0	50.0	90.3 [9.1]
2013-2015	94.9 [13.7]	93.7 [8.1]	84.1 [4.7]	98.0 [11.2]	100.0	50.0	90.9 [9.2]
Reduction in % sites with exceedance 1995-2015 [Reduction in maximum AAE kg N ha^{-1} $year^{-1}$ 1995-2015]	3.6 [6.8]	5.0 [6.0]	5.5 [2.6]	0.0 [3.2]	0.0	0.0	4.1 [4.9]

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

Table 3.5: Trends in nutrient nitrogen exceedances for SPAs; percentage of sites (with SRCL) with exceedance of SRCL for at least one feature, and maximum AAE of all sites/features: (a) % of sites with SRCL with exceedance of SRCL for at least one feature, (b)[maximum AAE kg N ha^{-1} $year^{-1}$]

Parameter	Country						
	England	**Wales**	**Scotland**	**NI**	**Eng/Wales ***	**Eng/Scot***	**UK**
Number of sites	78	17	145	14	3	0	257
Number of sites with SRCL for at least one feature	72	14	124	12	3	0	225
Exceedance by deposition data for:							
1995-1997	97.2 [18.7]	100.0 [18.5]	74.2 [6.5]	83.3 [14.9]	100.0	-	84.0 [13.3]
1998-2000	94.4 [17.4]	100.0 [13.4]	69.4 [4.9]	83.3 [8.9]	100.0	-	80.4 [11.2]
1999-2001	97.2 [17.8]	100.0 [14.4]	69.4 [5.2]	83.3 [9.1]	100.0	-	81.3 [11.7]
2001-2003	95.8 [18.7]	85.7 [15.9]	62.9 [5.2]	83.3 [13.6]	100.0	-	76.4 [12.4]
2002-2004	93.1 [17.1]	100.0 [16.2]	66.9 [5.2]	83.3 [11.1]	100.0	-	78.7 [11.6]
2003-2005	93.1 [17.2]	100.0 [17.0]	65.3 [4.9]	83.3 [10.7]	100.0	-	77.8 [11.5]
2004-2006	93.1 [14.3]	92.9 [13.7]	66.9 [4.8]	83.3 [10.1]	100.0	-	78.2 [10.0]
2005-2007	90.3 [14.2]	100.0 [13.7]	68.5 [5.2]	83.3 [11.1]	100.0	-	78.7 [10.1]
2006-2008	88.9 [13.6]	100.0 [12.4]	69.4 [4.9]	83.3 [11.1]	66.7	-	78.2 [9.7]
2007-2009	91.7 [13.3]	100.0 [11.9]	65.3 [4.0]	83.3 [11.6]	100.0	-	77.3 [9.1]
2008-2010	91.7 [13.4]	100.0 [11.6]	62.9 [3.8]	83.3 [12.0]	100.0	-	76.0 [9.1]
2009-2011	93.1 [13.8]	100.0 [11.3]	68.5 [4.0]	91.7 [13.3]	100.0	-	80.0 [9.4]
2010-2012	90.3 [13.3]	92.9 [11.2]	62.9 [3.7]	83.3 [12.2]	100.0	-	75.1 [9.0]
2011-2013	90.3 [12.9]	92.9 [11.3]	64.5 [3.4]	83.3 [11.8]	100.0	-	76.0 [8.7]
2012-2014	88.9 [12.8]	78.6 [11.2]	62.9 [3.5]	83.3 [10.4]	66.7	-	73.3 [8.6]
2013-2015	88.9 [12.9]	78.6 [11.1]	62.9 [3.7]	83.3 [10.5]	66.7		73.3 [8.7]
Reduction in % sites with exceedance 1995-2015 [Reduction in maximum AAE kg N ha^{-1} $year^{-1}$ 1995-2015]	8.3 [5.8]	21.4 [7.4]	11.3 [2.8]	0 [4.4]	33.3	-	10.7 [4.6]

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

Table 3.6: Trends in nutrient nitrogen exceedances for SSSIs; 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} $year^{-1}$]

Parameter	**Country**						
	England	**Wales**	**Scotland**	**NI**	**Eng/Wales***	**Eng/Scot***	**UK**
Number of sites	4115	1018	1452	291	0	0	6876
Number of sites with SRCL for at least one feature	2954	686	938	188	0	0	4766
Exceedance by deposition data for:							
1995-1997	95.2 [20.9]	100.0 [20.7]	90.1 [7.0]	94.1 [16.3]	-	-	94.9 [14.9]
1998-2000	94.2 [18.1]	98.8 [15.3]	85.0 [5.3]	86.2 [10.9]	-	-	92.7 [12.2]
1999-2001	94.8 [18.8]	98.8 [16.0]	85.9 [5.7]	87.8 [11.3]	-	-	93.3 [12.8]
2001-2003	96.4 [20.4]	97.4 [17.6]	82.9 [5.6]	87.8 [15.2]	-	-	93.6 [13.8]
2002-2004	92.6 [18.8]	98.8 [17.8]	84.3 [5.9]	88.8 [14.0]	-	-	91.7 [13.1]
2003-2005	93.2 [19.1]	98.8 [18.7]	83.6 [5.7]	88.8 [13.6]	-	-	91.9 [13.3]
2004-2006	89.4 [16.2]	98.7 [15.7]	83.2 [5.6]	88.3 [12.8]	-	-	89.4 [11.6]
2005-2007	89.9 [16.1]	99.0 [15.7]	84.6 [5.8]	89.4 [14.1]	-	-	90.2 [11.7]
2006-2008	88.6 [15.3]	98.8 [14.2]	83.7 [5.3]	92.0 [14.0]	-	-	89.2 [11.0]
2007-2009	89.5 [14.6]	98.5 [13.7]	81.2 [4.3]	93.1 [14.7]	-	-	89.3 [10.3]
2008-2010	89.9 [14.6]	98.4 [13.4]	80.3 [4.1]	93.1 [15.1]	-	-	89.4 [10.1]
2009-2011	90.0 [15.2]	98.5 [13.4]	81.1 [4.4]	93.1 [16.2]	-	-	89.8 [10.6]
2010-2012	89.1 [14.6]	98.0 [13.0]	80.1 [4.1]	92.6 [14.8]	-	-	88.8 [10.1]
2011-2013	87.7 [14.4]	98.1 [13.2]	80.2 [4.0]	93.1 [14.5]	-	-	87.9 [9.9]
2012-2014	87.8 [13.9]	98.0 [12.9]	79.7 [4.1]	92.6 [13.2]	-	-	87.9 [9.7]
2013-2015	87.5 [14.1]	98.1 [12.8]	80.3 [4.3]	92.6 [13.3]	-	-	87.8 [9.9]
Reduction in % sites with exceedance 1995-2015 [Reduction in maximum AAE kg N ha^{-1} $year^{-1}$ 1995-2015]	7.7 [6.8]	1.9 [7.9]	9.8 [2.7]	1.5 [3.0]	-	-	7.1 [5.0]

* Some SACs and SPAs cross the England/Wales or England/Scotland border and have been assigned to these border areas; all SSSIs have been assigned to a single country only.

(a) SACs (b) SPAs (c) SSSIs

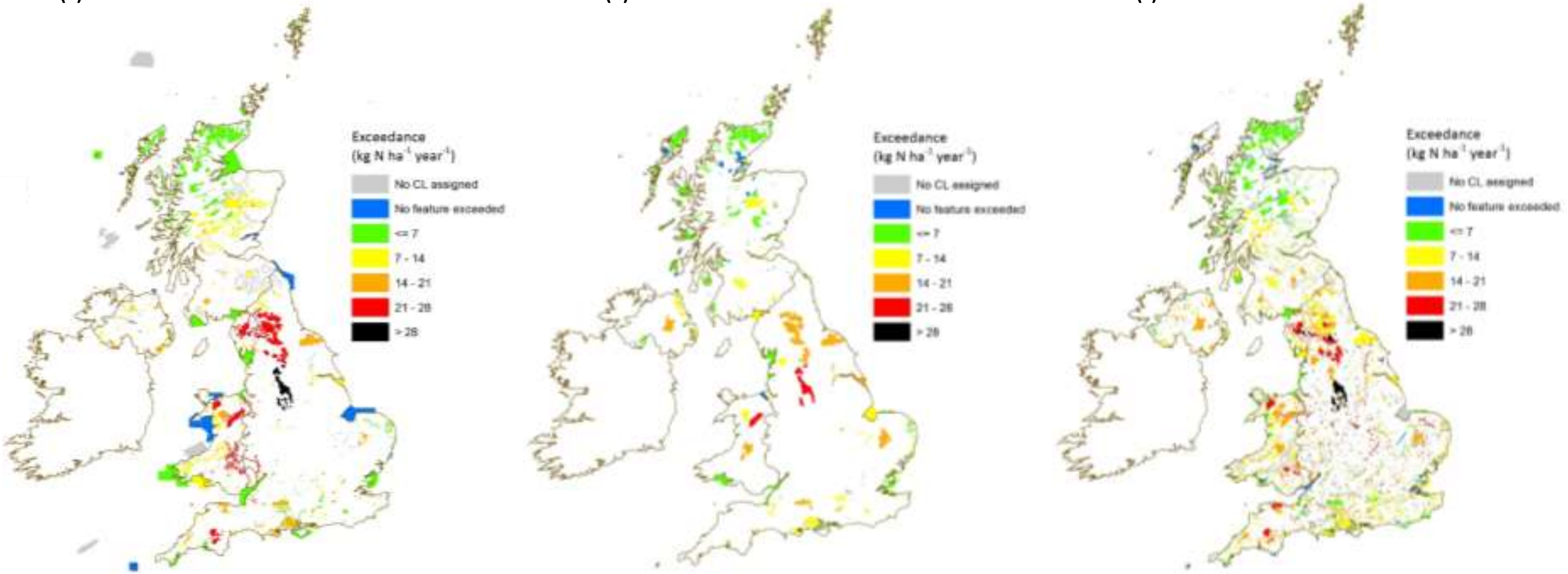

Figure 3.2: Average Accumulated Exceedance (AAE) of nutrient nitrogen critical loads by CBED deposition for 2013-15; maps show the maximum AAE for any feature within each site (other features may have lower or no exceedance).

Part 3: Critical levels and their exceedances

4. Introduction

This part of the report focuses on the trends in exceedance of the ammonia critical levels (i.e. gaseous concentration) set to protect (a) lichens and bryophytes; (b) higher plants. The trends only cover the period from 2009-11 to 2012-14 as these assessments were not carried out for earlier periods; they are based on 1x1 km rolling 3-year mean ammonia concentration data.

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, 2014). Critical levels are also defined for other pollutants: sulphur dioxide, nitrogen oxides and ozone, but these are not considered here; further information on these can be found in CLRTAP (2014).

The critical levels for ammonia were reviewed and updated at an international workshop held in 2006 (UNECE, 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 vegetation types (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 [µg m^{-3}]**	**Time period**
Lichens and bryophytes (including ecosystems where lichens and bryophytes are a key part of the ecosystem integrity)	1	Annual mean concentration
Higher plants (including heathland, semi-natural grassland and forest ground flora)	3*	Annual mean concentration

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

4.2 Concentrations of ammonia

The FRAME model (Singles et al, 1998) is used to provide 1x1 km resolution ammonia concentration data for the UK. This resolution data has been found to be better at spatially separating the source (agricultural) areas from the sink areas (natural ecosystems) (Hallsworth et al, 2010). Modelled ammonia concentrations are calibrated relative to annually averaged measurements from the National Ammonia Monitoring Network using the median bias to adjust the concentrations. Data from all stations in the monitoring network are used for the calibration, with the exception of one station very close to a point source emitter that was not representative of the surrounding area. The FRAME ammonia concentrations are updated annually using the new emissions data. For critical level exceedance calculations, rolling 3-year mean concentrations are used to reduce inter-year variability.

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 nitrogen-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 nitrogen 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.

4.3. Trends in ammonia critical levels exceedance

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

4.3.1 UK land area with exceedance of ammonia critical levels

Ammonia concentrations exceed the critical level of 1 µg m^{-3} across more than 60% of the UK land area (Table 4.2); this varies spatially with <20% of Scotland, and more than 80% of England and Northern Ireland with ammonia concentrations above 1 µg m^{-3}. The area of the UK with ammonia concentrations above 1 µg m^{-3} has fallen by 3.8% between 2009-11 and 2012-14 (Table 4.2).

The ammonia critical level of 3 µg m^{-3} is exceeded over a much smaller area of the UK, mostly <5%, with the exception of NI where 12-16% of the land area has received higher concentrations between 2009-11 and 2012-14 (Table 4.2). The main areas of the UK where this critical level is exceeded are parts of Northern Ireland and west/central England, with smaller areas across other regions of England (Figure 4.1).

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

Critical level (µg m^{-3})	**Concentration data years**	**% land area where ammonia concentrations exceed critical levels**				
		England	**Wales**	**Scotland**	**NI**	**UK**
1 µg m^{-3}	2009-11	88.9	58.9	19.7	85.6	63.9
	2010-12	88.5	59.0	19.8	86.0	63.7
	2011-13	86.9	57.6	19.4	86.7	62.7
	2013-14	84.0	55.1	17.0	85.5	60.1
Change in % land area exceeded 2009-2014		-4.9	-3.8	-2.7	-0.1	-3.8
3 µg m^{-3}	2009-11	5.3	0.9	0.1	13.4	3.7
	2010-12	5.5	0.9	0.2	14.7	3.9
	2011-13	5.2	0.7	0.2	15.6	3.8
	2013-14	3.6	0.4	0.1	12.4	2.7
Change in % land area exceeded 2009-2014		-1.7	-0.5	0.0	-1.0	-1.0

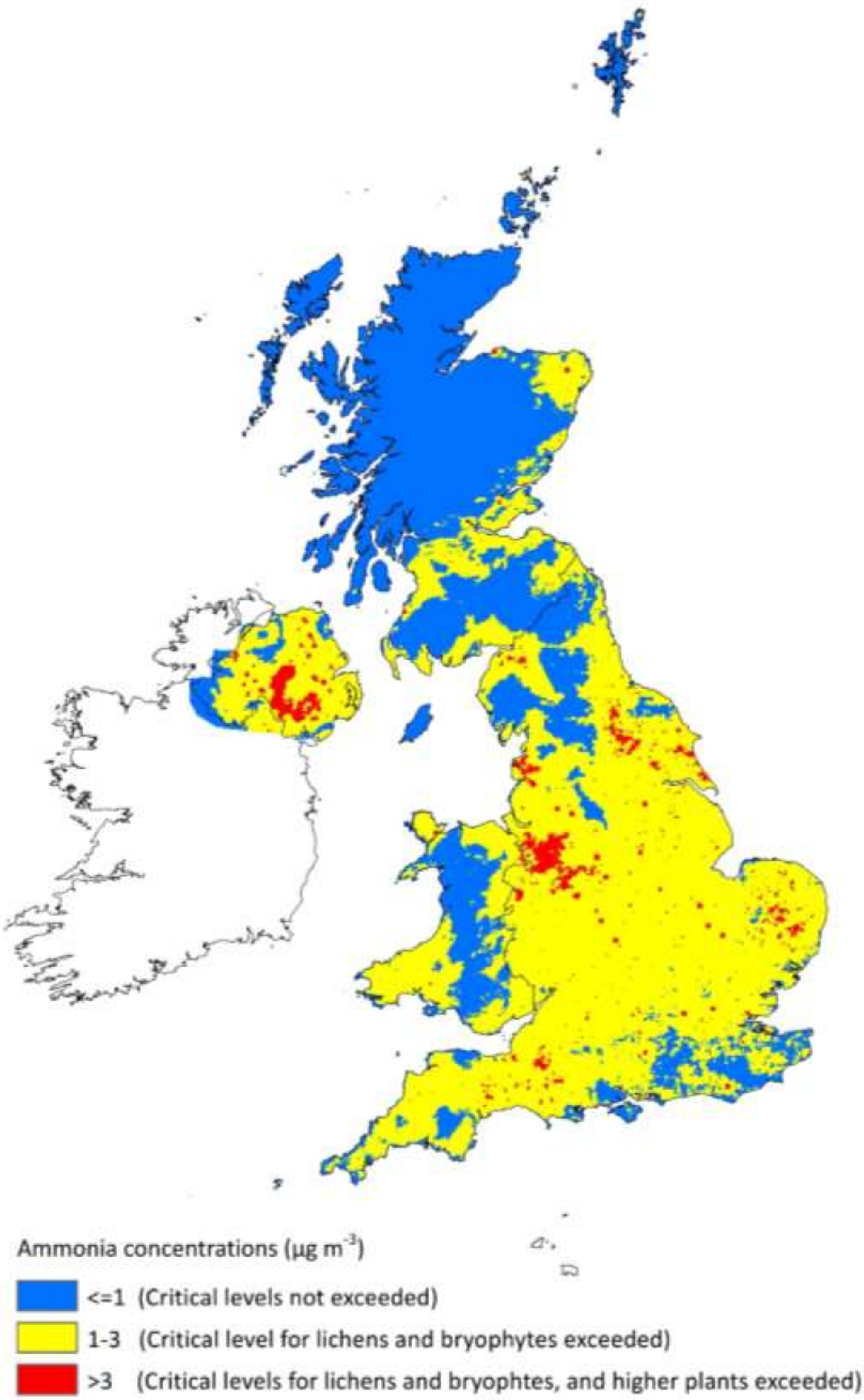

Figure 4.1: FRAME 1x1 km mean ammonia concentrations for 2012-14

4.3.2 Nitrogen-sensitive habitats with exceedance of ammonia critical levels

Approximately one quarter of the mapped area of nitrogen-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 (a) the variability in ammonia concentrations (see Figure 4.1), and (b) the distributions of the different nitrogen-sensitive habitats. Although 59% of the area of nitrogen-sensitive habitats are found in Scotland, as the ammonia concentrations are generally low in this part of the country (Figure 4.1), <3% of the habitat area coincides with ammonia concentrations above 1 μg m^{-3} and <1% with concentrations above 3 μg m^{-3} (Table 4.3). The highest exceedances are seen in England and Northern Ireland, with the ammonia concentrations above 1 μg m^{-3} for ~60% of their nitrogen-sensitive habitat areas and 1-4% above 3 μg m^{-3}. The percentage area of nitrogen-sensitive habitats in the UK with exceedance of the critical level of 1 μg m^{-3} has reduced by 2.8% between 2009-11 and 2012-14, however, in Northern Ireland the area exceeded increased by 1% over this time period.

Examining the results for individual habitats at the UK scale shows that exceedance of the critical level of 1 μg m^{-3} decreased by 20% between 2009-11 and 2012-14 for areas of unmanaged Beech woodland; however, this habitat only represents 1% of the total area of nitrogen-sensitive habitats mapped in the UK. Conversely, dwarf shrub heath represents 34% of the total area of nitrogen-sensitive habitats in the UK, and exceedance of the 1 μg m^{-}3 critical level across this habitat distribution only decreased by 1% over same time period.

Table 4.3: Percentages of the area of nitrogen sensitive habitats in the UK where ammonia concentrations exceed critical levels.

Parameter		**N-sensitive habitat areas (km^2) and % area where ammonia concentrations exceed critical levels**				
		England	**Wales**	**Scotland**	**NI**	**UK**
N-sensitive habitat area (km^2)		19522	6837	43200	3467	73027
Critical level (μg m^{-3})	**Concentration data years**					
	2009-11	65.3	28.9	3.59	59.6	25.1
	2010-12	64.4	29.5	3.62	60.9	25.0
	2011-13	62.1	28.8	3.56	63.9	24.4
	2012-14	57.0	26.6	2.89	60.6	22.3
Change in % habitat area exceeded 2009-2014		-8.3	-2.3	-0.7	+1.0	-2.8
3 μg m^{-3}	2009-11	1.62	0.04	0.01	3.12	0.59
	2010-12	1.68	0.06	0.03	3.58	0.64
	2011-13	1.64	0.07	0.04	3.95	0.66
	2012-14	1.13	0.03	0.03	3.17	0.48
Change in % habitat area exceeded 2009-2014		-0.49	-0.01	+0.02	+0.05	-0.11

Table 4.4: Habitat areas (km^2) and percentage area of nitrogen-sensitive habitats where the ammonia critical levels are exceeded in the UK, by concentration dataset year.

Parameter		**Habitat area (km^2) and percentage habitat area with exceedance of ammonia critical levels:**												
		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)		15235	3578	34826	5526	3129	8383	7482	719	1434	204	1761	323	427
Critical level (µg m^{-3})	**Concentration data years**													
1 µg m^{-3}	2009-2011	17.9	88.9	6.5	6.6	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	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	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	16.6	72.7	55.9	35.2	1.2	76.0	11.2	24.5
Change in % habitat area exceeded 2009-2014		-1.4	-8.5	-1.0	-0.8	0	-2.1	-8.6	-20.0	-8.7	-0.2	-6.0	-3.2	-7.1
3 µg m^{-3}	2009-2011	0.52	1.69	0.18	0.08	0	0.30	2.03	0.56	0.64	0	3.02	0.08	0.45
	2010-2012	0.58	1.77	0.21	0.10	0	0.37	2.12	0.51	0.66	0	3.22	0.11	0.38
	2011-2013	0.61	1.87	0.23	0.10	0	0.37	2.07	0.39	0.67	0	3.23	0.13	0.28
	2012-2014	0.51	1.36	0.17	0.06	0	0.27	1.37	0.30	0.47	0	2.23	0.11	0.23
Change in % habitat area exceeded 2009-2014		-0.01	-0.33	-0.01	-0.02	0	-0.03	-0.66	-0.26	-0.17	0	-0.79	-0.03	-0.22

4.3.3 Designated sites with exceedance of ammonia critical levels

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

SACs

Approximately 60% of SACs occur in areas of the UK where ammonia concentrations exceed 1 µg m^{-3} (Table 4.5); the lowest number of sites with exceedance is in Scotland where ammonia concentrations are mostly < 1 µg m^{-3}. The percentage of sites with exceedance of the 1 µg m^{-3} critical level has fallen by 4.6% between 2009-11 and 2012-14, but this varies spatially across the UK with no improvement seen in Northern Ireland over this time.

The percentage of SACs with ammonia concentrations above 3 µg m^{-3} is small (Table 4.5): <5% for Wales, Scotland and Northern Ireland; and <10% for England (in 2012-14). In Wales and Scotland there are small increases in the number of sites exceeding this critical level between 2009-11 and 2012-14, reflecting the changes seen in the ammonia concentrations over this time period.

Table 4.5: Percentage of SACs where ammonia concentrations exceed the critical levels anywhere across a site.

Critical level (µg m^{-3})	**Concentration data years**	**% SACs where ammonia concentrations exceed critical levels anywhere across a site [total number of sites]**				
		England [231]	**Wales [85]**	**Scotland [234]**	**NI [54]**	**UK [614*]**
1 µg m^{-3}	2009-11	94.4	72.9	20.9	85.2	62.7
	2010-12	93.5	75.3	19.7	87.0	62.4
	2011-13	90.0	72.9	20.1	87.0	60.9
	2012-14	86.6	70.6	17.5	85.2	58.1
Change in % SACs exceeded 2009 to 2014		-7.8	-2.3	-3.4	0.0	-4.6
3 µg m^{-3}	2009-11	10.0	0.0	0.9	3.7	4.9
	2010-12	10.0	1.2	1.3	3.7	5.1
	2011-13	13.4	4.7	1.7	5.6	7.5
	2012-14	9.5	2.4	1.3	3.7	5.4
Change in % SACs exceeded 2009 to 2014		-0.5	+2.4	+0.4	0.0	+0.5

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

SPAs

The results show a 6.3% increase in the number of sites in Wales exceeding the critical level of 1 µg m^{-3}, and decreases in England (-6.6%) and Scotland (-.4.4%) and no change in Northern Ireland (Table 4.6). Over 90% of SPAs in England and in Northern Ireland receive 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 4.2). In England, Scotland and Northern Ireland the percentage of SPAs with exceedance of the 3 µg m^{-3} has increased between 2009-11 and 2012-14, with the largest increase in Northern Ireland (7.7%).

Table 4.6: Percentage of SPAs with ammonia concentrations exceeding critical levels anywhere across a site.

Critical level ($\mu g\ m^{-3}$)	Concentration data years	% SPAs where ammonia concentrations exceed critical levels anywhere across a site [total number of sites]				
		England [76]	Wales [16]	Scotland [137]	NI [13]	UK [245*]
1 $\mu g\ m^{-3}$	2009-11	97.4	37.5	27.7	92.3	54.3
	2010-12	97.4	43.8	27.0	92.3	54.3
	2011-13	96.1	37.5	27.0	92.3	53.5
	2012-14	90.8	43.8	23.4	92.3	50.2
Change in SPAs exceeded 2009 to 2014		-6.6	+6.3	-4.4	0.0	-4.1
3 $\mu g\ m^{-3}$	2009-11	11.8	0.0	1.5	7.7	5.3
	2010-12	14.5	0.0	2.2	15.4	6.9
	2011-13	19.7	0.0	2.2	30.8	9.4
	2012-14	13.2	0.0	2.2	15.4	6.1
Change in SPAs exceeded 2009 to 2014		+1.3	0.0	+0.7	+7.7	+0.8

*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 $\mu g\ m^{-3}$ decreased by 5.2% between 2009-11 and 2012-14, to 67.8% (Table 4.6). Over 80% of the sites in England and Northern Ireland are in locations where this critical level is currently exceeded, as well as 59.7% of sites in Wales and 24.1% of sites in Scotland.

There are some small increases in the percentage of sites in Scotland and Northern Ireland with exceedance of the 3 $\mu g\ m^{-3}$ critical level, but overall the percentage of sites receiving ammonia concentrations above 3 $\mu g\ m^{-3}$ are small: from 0.4% of sites in Wales to 6.6% of sites in Northern Ireland.

Table 4.7: Percentage of SSSIs with ammonia concentrations exceeding critical levels anywhere across a site.

Critical level ($\mu g\ m^{-3}$)	Concentration data years	% SSSIs where ammonia concentrations exceed critical levels anywhere across a site [total number of sites]				
		England [4106]	Wales [1014]	Scotland [1430]	NI [289]	UK [6839]
1 $\mu g\ m^{-3}$	2009-11	89.6	66.5	27.9	83.4	73.0
	2010-12	89.1	66.3	27.9	84.4	72.7
	2011-13	87.5	63.8	27.9	85.5	71.4
	2012-14	84.0	59.7	24.1	83.0	67.8
Change in SSSIs exceeded 2009 to 2014		-5.7	-6.8	-3.8	-0.3	-5.2
3 $\mu g\ m^{-3}$	2009-11	4.8	1.0	0.4	6.2	3.4
	2010-12	5.0	0.9	0.5	7.6	3.6
	2011-13	5.4	0.7	0.7	8.0	3.9
	2012-14	3.7	0.4	0.5	6.6	2.7
Change in SSSIs exceeded 2009 to 2014		-1.1	-0.6	+0.1	+0.4	-0.7

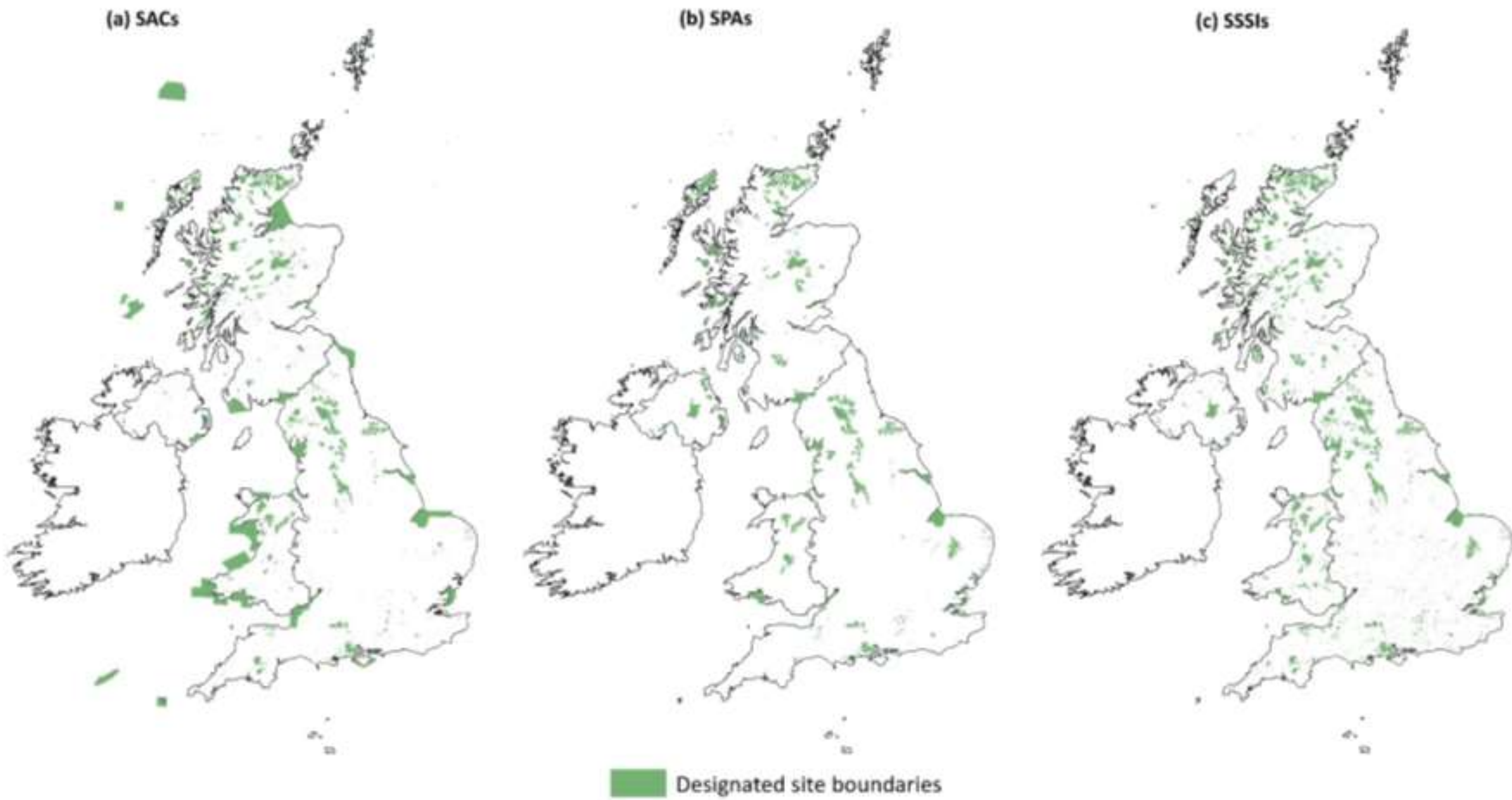

Figure 4.2: Distribution of SACs, SPAs and SSSIs in the UK

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