Using critical loads to assess risks to broad habitats and designated areas from air pollution

Broad habitats : Jane Hall
Designated areas: Bill Bealey
National critical loads work aims to answer these questions:

Where is the problem?
  Which habitats are at risk and where are they?

How big is the problem?
  How much of the habitat is at risk?
  How much does deposition need to be reduced?

How good are the data?
  What are the uncertainties in the data/methods?

... and to inform policy making at the UK & European scales
Critical Loads

• The highest deposition load that will not cause chemical changes leading to long-term harmful effects on ecosystem structure and function

• Policy tool: **effects-based approach** for developing pollutant abatement strategies to reduce emissions (sulphur, nitrogen, heavy metals)

• Approach adopted in UK (Defra, EA) & Europe (UNECE, EU)

• Research funded in UK by Defra, EA
## Critical loads by habitat: acidity & nutrient N, acidity only, nutrient N only

<table>
<thead>
<tr>
<th>UK BAP Broad Habitat</th>
<th>EUNIS class (EUropean Nature Information System)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Broadleaved/mixed &amp; yew woodland</td>
<td>G1 Broadleaved woodland (managed)</td>
</tr>
<tr>
<td></td>
<td>G4 Broadleaved &amp; coniferous woodland including Atlantic oaks (unmanaged mixed woodland)</td>
</tr>
<tr>
<td>2. Coniferous woodland</td>
<td>G3 Coniferous woodland (managed)</td>
</tr>
<tr>
<td>7. Calcareous grassland</td>
<td>E1.26 Semi-dry calcareous grassland</td>
</tr>
<tr>
<td>8. Acid grassland</td>
<td>E1.7 Dry acid &amp; neutral closed grassland</td>
</tr>
<tr>
<td></td>
<td>E3.5 Moist or wet oligotrophic grassland</td>
</tr>
<tr>
<td>10. Dwarf shrub heath</td>
<td>F4.11 Northern wet heaths</td>
</tr>
<tr>
<td></td>
<td>F4.2 Dry heaths</td>
</tr>
<tr>
<td>12. Bogs</td>
<td>D1 Raised &amp; blanket bogs</td>
</tr>
<tr>
<td>15. Montane</td>
<td>E4.2 Moss &amp; lichen dominated summits</td>
</tr>
<tr>
<td>13. Standing open water</td>
<td>C1 Surface standing waters</td>
</tr>
<tr>
<td>14. Rivers &amp; streams</td>
<td>C2 Surface running waters</td>
</tr>
<tr>
<td>19. Supralittoral sediment</td>
<td>B1.3 Shifting coastal dunes</td>
</tr>
<tr>
<td></td>
<td>B1.4 Coastal stable dune grassland</td>
</tr>
</tbody>
</table>
Mapping the Montane broad habitat: represented by *Racomitrium* heath

% land cover (LCM2000) montane + inland bare ground

Final habitat map: Montane areas (*Racomitrium* heath).
Acidity critical loads for dwarf shrub heath

CLmaxS

CLminN

CLmaxN

keq H⁺ ha⁻¹ year⁻¹

- <= 0.2
- 0.2 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- > 2.0
Nutrient nitrogen critical loads

Dwarf shrub heath

Montane

Bog

kg N ha\(^{-1}\) year\(^{-1}\)
- Black: <= 2.8
- Red: 2.8 – 7
- Yellow: 7 - 14
- Green: 14-28
- Blue: > 28
Providing UK data for European policy: CLRTAP

UK National Focal Centre (CEH Bangor)
SUBMIT NATIONAL DATA

Coordination Centre (NL)
EUROPEAN MAPS/DATA

Integrated Assessment Modellers
SCENARIO MODELLING

Modelling & Mapping Programme
ESTABLISH METHODS
ASSESS & APPROVE RESULTS

Working Group on Effects
COORDINATE PROGRAMMES
REPORT TO EB

CLRTAP Executive Body
PROTOCOLS
IMPLEMENTATION
COMPLIANCE

EMEP Steering Body

Working Group on Strategies & Review

Other groups

Implementation Committee
Where & how big is the problem for acidity?

Exceedance acidity critical loads* by acid deposition
(a) 1996-98  (b) 2004-06  (c) 2020

* 5th percentiles based on CL for terrestrial habitats only (ie, excludes FAB site data)
Where & how big is the problem for nutrient nitrogen?

Exceedance nutrient nitrogen critical loads* by nitrogen deposition
(a) 1996-98  (b) 2004-06  (c) 2020

* 5th percentile critical loads for all terrestrial habitats
# Quantifying UK habitats at risk

<table>
<thead>
<tr>
<th>Broad Habitat</th>
<th>Percentage habitat exceeded by deposition data for:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Acid grassland</td>
<td>90.2 83.1 68.0</td>
<td>68.7 61.9 40.4</td>
</tr>
<tr>
<td>Calcareous grassland</td>
<td>0 0.0 0</td>
<td>78.6 61.4 19.6</td>
</tr>
<tr>
<td>Dwarf shrub heath</td>
<td>66.9 46.5 22.4</td>
<td>36.3 34.2 20.7</td>
</tr>
<tr>
<td>Bog</td>
<td>85.1 67.1 41.8</td>
<td>45.8 44.7 40.1</td>
</tr>
<tr>
<td>Montane</td>
<td>94.7 96.8 76.5</td>
<td>92.1 98.0 91.5</td>
</tr>
<tr>
<td>Managed Conifer</td>
<td>78.7 68.2 50.9</td>
<td>94.4 93.3 87.4</td>
</tr>
<tr>
<td>Managed Broadleaf</td>
<td>76.1 66.9 48.6</td>
<td>98.2 98.2 96.7</td>
</tr>
<tr>
<td>Unmanaged wood (ground flora)</td>
<td>70.1 56.4 35.9</td>
<td>96.3 96.5 94.7</td>
</tr>
<tr>
<td>Atlantic oak (epiphytic lichens)</td>
<td></td>
<td>97.2 97.7 87.3</td>
</tr>
<tr>
<td>Supralittoral sediment</td>
<td>N/A N/A N/A</td>
<td>38.5 16.8 3.9</td>
</tr>
<tr>
<td>Freshwaters*</td>
<td>29.1 21.9 14.3</td>
<td>N/A N/A N/A</td>
</tr>
<tr>
<td>All habitats</td>
<td>70.8 58.3 39.8</td>
<td>64.2 60.7 47.8</td>
</tr>
</tbody>
</table>

* Percentage of the catchment areas of 1752 sites sampled across the UK
Percentage habitats exceeded by country

**ACIDITY**
UK:
- 1996-98: 71%
- 2004-06: 58%
- 2020: 40%

**NUTRIENT NITROGEN**
UK:
- 1996-98: 64%
- 2004-06: 61%
- 2020: 48%
Defra Air Quality Strategy: providing underpinning evidence

AQS: setting air quality objectives & policy options to improve air quality and reduce risks to human health & the environment from air pollution.
Informing UK policy: Environment Agency

EA have used critical loads & exceedances for:
- Impacts of emissions from power plants
- Electricity Supply Industry: permits to emit sulphur

EA have funded research on:
- Uncertainties in critical loads data & models for application in a regulatory framework
- Developing site-specific methods for assessing risks from industry emissions to designated areas
How good are the data?

Sources of uncertainty:
Data inputs & resolution
- National databases, field data, default values, expert judgement, measured, modelled, extrapolated

Methods:
- Applicability to all countries, regions?
- Applicable at national and site-specific scales?

Some conclusions:
- Uncertainties vary from one site/habitat to another – almost any input parameter could be important!
- Parameters most sensitive in CL calculations can differ for national or site-specific inputs
- Uncertainties in critical loads generally considerably less than the uncertainties in individual input parameters
- Using site-specific input data will reduce uncertainties
Presenting uncertainty to the policymaker:
probability of exceedance (acidity, managed conifers)

<table>
<thead>
<tr>
<th>Probability of Exceedance &gt; 0</th>
<th>Area (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5%</td>
<td>378</td>
</tr>
<tr>
<td>5 – 25%</td>
<td>249</td>
</tr>
<tr>
<td>25 – 75%</td>
<td>720</td>
</tr>
<tr>
<td>75 – 95%</td>
<td>1068</td>
</tr>
<tr>
<td>&gt; 95%</td>
<td>1194</td>
</tr>
</tbody>
</table>

Green – unlikely to be exceeded
Red – highly likely to be exceeded
Grey – potential risk of exceedance
33% has >95% probability of exceedance
10% has < 5% probability of exceedance
Informing UK policy: Conservation Agencies

Common Standards Monitoring – First Six Year Report
- Monitoring the condition of designated site features
- Identifying human activities & other factors causing adverse effects

“The impacts of air pollution, and the identification of air pollution as an adverse activity affecting condition, are considered to be substantially under-reported in this assessment.”

JNCC funded research on:
- Development of site-relevant critical loads
- Assessing the risks of air pollution impacts on designated sites
- Bioindicator & biomonitoring methods for assessing the risks of N deposition to designated sites

Over to Bill……