DRIVERS OF CHANGE in UPLAND and LOWLAND HEATHS

Intro: Potential threats to heathland communities.

Lucy Sheppard CEH
and
Sally Johnson SNH/JNCC

Heathlands are arguably a man made ecosystem …..
they do not represent climax vegetation.

Today their future and sustainability is now, more so than ever, in man's hands

Scotland's Heathland Heritage

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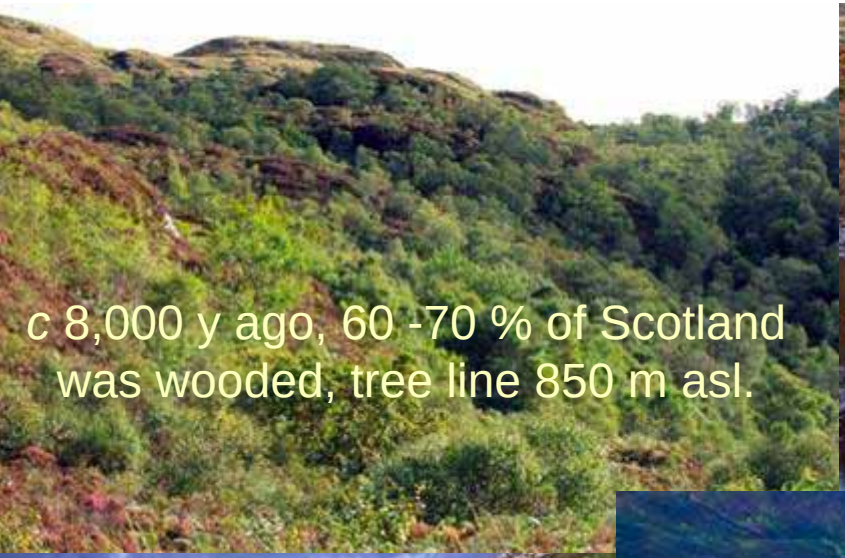

c 8,000 y ago, 60 -70 % of Scotland was wooded, tree line 850 m asl.

c 5,000 y ago, wetter climate

Large areas continue to be managed as open heathland for grazing and field sports such as managed 'grouse moors'.

Then man's activities – burning and grazing helped to create open moorlands.

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The moorland is an open landscape made up of a mosaic of habitats.

Scrub is an important part of the complex of habitats

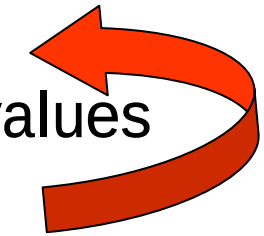
What do heathlands have in common?

- Occur on soils with inherently low levels of available nutrients.
- Characterised by biotic communities of ericaceous dwarf shrubs together with their associated flora and fauna.
- Represent a 'managed' ecosystem.
- Lowland heaths often found on dry sandy soils, organic (acid) component.

THREATS – Historical & Present day

- Need and ability to improve land and increase food and or timber production;
  - Drainage
  - Fertilisation

  - Demand for housing, roads and recreation
  - Decline in skilled affordable labour
  - Invasive species
  - Priorities, attitudes and values
  - Eutrophication
  - Climate change
  - Incentives



Climate change

0.6 ±0.2 ^{0}C global temperature rise for 20th century

1990's warmest decade

1998 warmest year

Glacial shrinkage, thawing permafrost and sea level rise…….

Effects on heathlands

Via changes in growing season, pests and pathogens and fire risk, heathlands on peats particularly at risk from increased temperature.

Increasing temperatures in Scotland will most likely accelerate biological activity: *via* effects on evaporation, water table depth, microbial respiration and C processing. Although, increased evapotranspiration may increase cloud cover…….feedbacks

Habitat and agricultural policies: Legislation

• **UK – Nature Conservation Act (Scotland) 2004, Countryside and Rights of Way Act 2000 (E&W). Wildlife and Countryside Act 1981** – protection of habitats and species through SSSIs

•**EU - Habitats Directive** – Aim is to protect and maintain threatened habitats (Annex 1 list - includes 4 types of heath) and species. Best examples of these are given greater protection in designated sites - Special Areas of Conservation (SAC)

• **International - UN Convention on Biodiversity 1992**: UK Biodiversity and Habitat Action Plans – Upland Heathlands and Lowland Heathlands Priority Habitats with Habitat Action Plans.

Habitat and agricultural policies: Incentives

Reform of the **Common Agricultural Policy** from production subsidy to stewardship support is resulting in biodiversity oriented new agri-environment schemes better aligned with habitat polices.

Agri-environment Schemes

- Scotland - Rural Stewardship Scheme
  → new **Land Management Contracts LMC**
- England - Environmental Sensitive Area payments & Countryside Stewardship Scheme (Eng)
  → new **Environmental Stewardship Scheme**
- Wales - **Tir Gofal**

Country Agency Incentive schemes for SSSIs

- Scotland – Natural Care (with become part of LMCs)
- England – Wildlife Enhancement Schemes

Habitat and agricultural policies: Incentives cont.

Other incentive schemes available include:

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EU funding

- LIFE Nature – funding for projects on Habitat Directive Natura sites (ie Special Areas of Conservation and Special Protection Areas)

BAP funding

- A range of funding schemes are available through the Country Biodiversity Groups and Local Authorities to support BAP related projects

Anthropogenic (man made) N Deposition

- Sources: Reduced N from agriculture
  Oxidised N from combustion *eg.* cars.

- 1987- 2001: 45% reduction in NO_2 emissions BUT no significant decline in NO_3^- concentrations or N deposition.
- Deposition of reduced N appears to be relatively static having declined from a peak in the early 90s.
- Legislation is effective against emissions BUT N deposition is influenced by many other factors and interactions .
- Forecast: elevated N deposition will continue for a while…..thus N will continue to accumulate or potentially leach from heathlands.

Effects of elevated N deposition and Current Issues

- Acidification/eutrophication: validation for Critical Loads (N loading causing no negative effects).
- Reduced vs oxidised, wet vs dry.
- *In situ* responses of soil and plants (lichens, mosses, ericoids, grasses).....what to monitor?
- Complexity of change with respect to trophic levels, food webs and heathland function.
- Timescales and recovery.
- Pollutant interactions with abiotic and biotic stresses.
- Can we counteract the effects of N enrichment *via* management?

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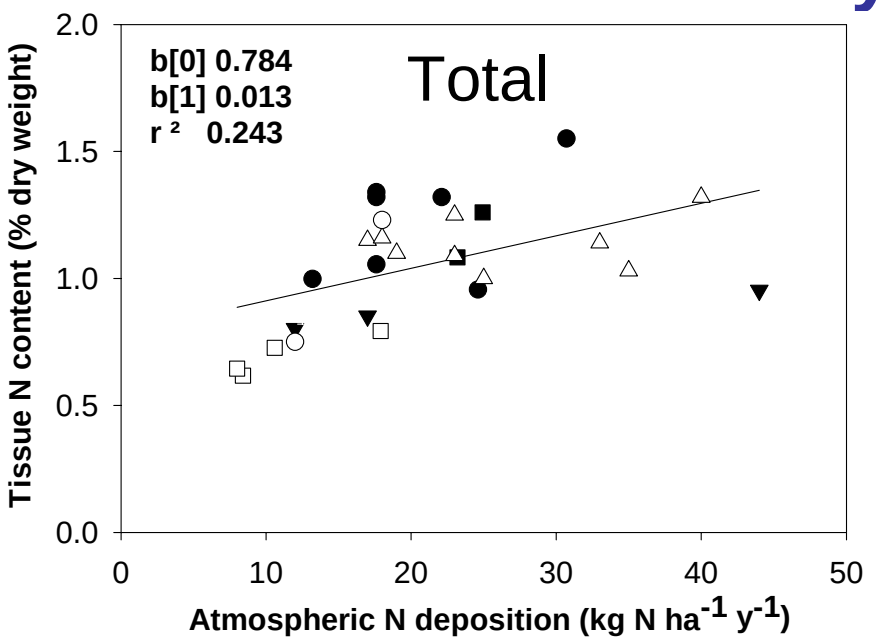
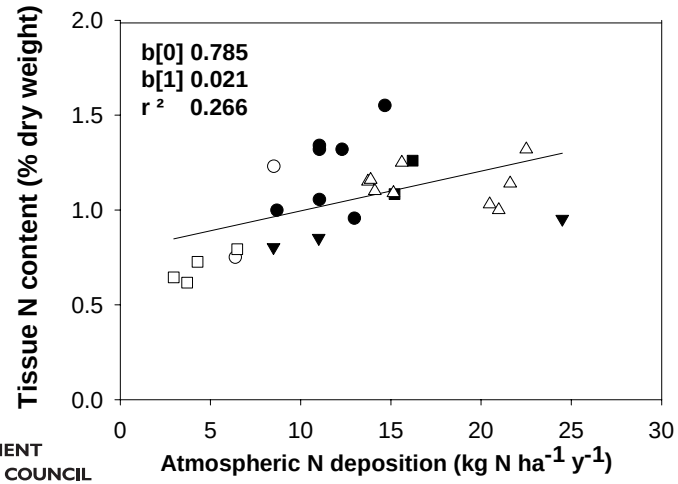
N deposition and tissue N in ectohydric mosses

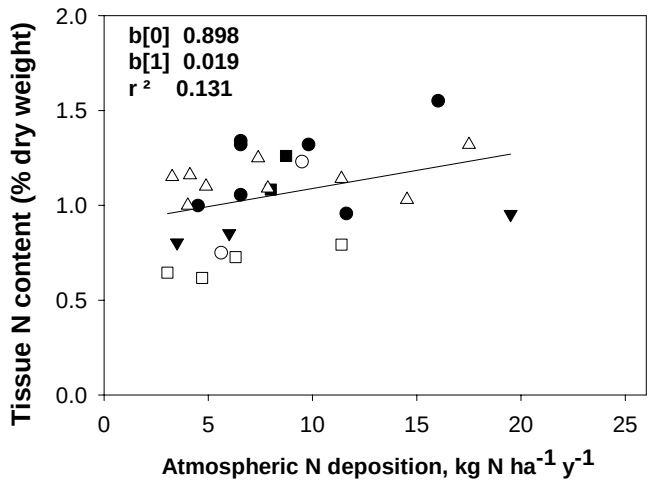


Source: Pitcairn *pers. comm.*

Reduced



Oxidised



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Whim Moss: Automated N manipulation system

Treatments coupled to: wind direction, wind speed and rainfall.

Wet treatments cover the **full** range of UK N deposition (**8 - 64 kg N $ha^{-1}y^{-1}$**) and dry gaseous NH_3 concentrations (**0.4 – 200 µg m^{-3}**).

11 treatments

4 x 12.5 m^2 plots

NH_3 3-14% y^{-1}

$NaNO_3$ or NH_4Cl

+/- K_2HPO_4

0.57- 4 ml

120 'rain' events y^{-1}

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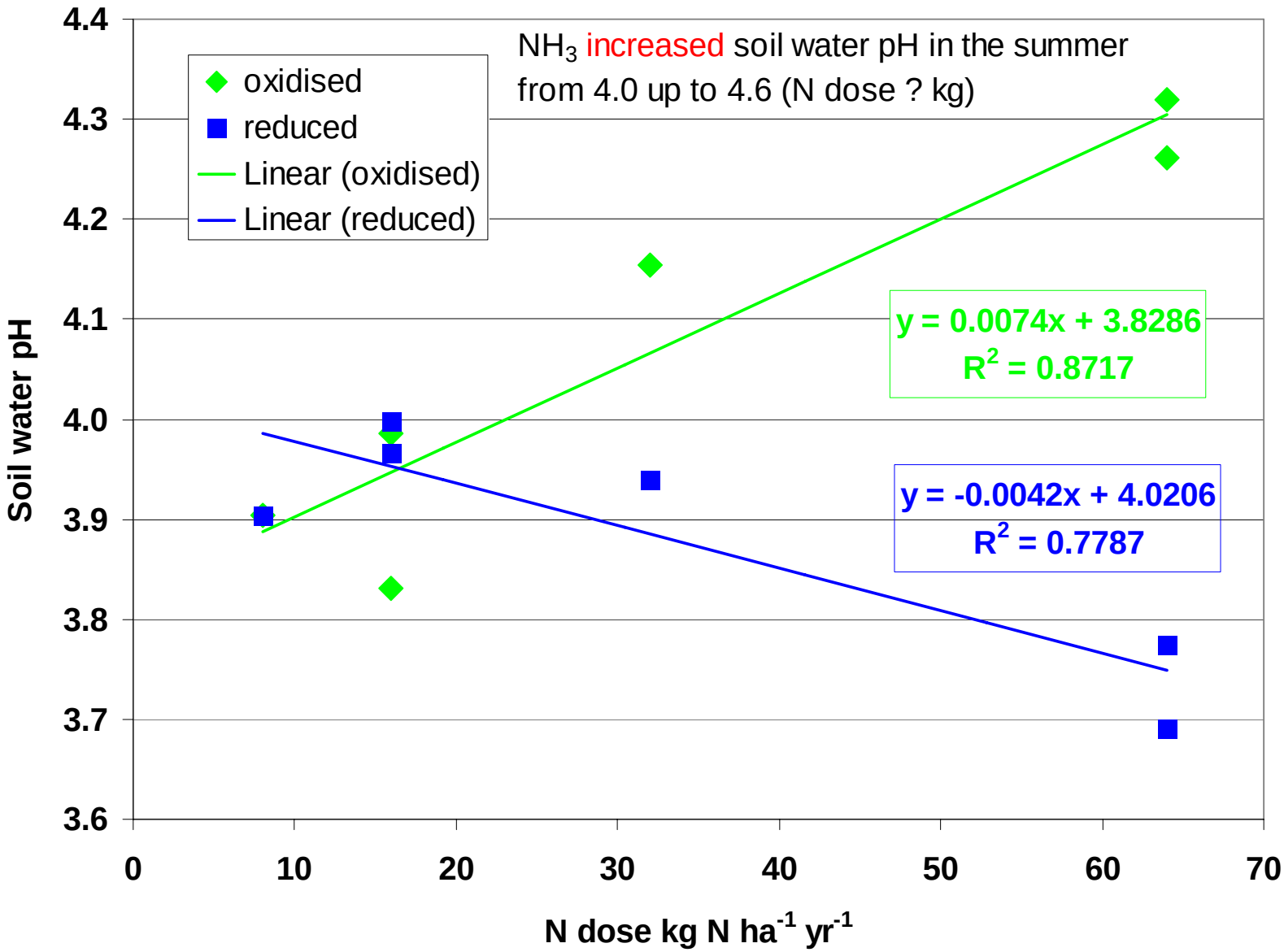
Relationship between soil water pH and N form and dose



None reversible visible damage has** only been observed along the **ammonia transect**, **where mean gaseous concentrations >16 µg m^{-3} . Higher concentrations accelerate damage development; often associated with acute membrane breakdown.

Cladonia portentosa

Winter desiccation

Botrytis

Spring frost/summer drought

Phytophora

Occurrence of similar symptoms on the wet plots for the same accumulated N dose has been minimal.

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DAMAGE TO *CALLUNA VULGARIS*