Where do we set the baselines? A long-term perspective on fire management of moorlands

Althea Davies
School of Biological & Environmental Sciences
University of Stirling
Burning in context

- History of moorland burning
- Rural economies & moorland dynamics
- Biodiversity
- Carbon budgets
Fire history I: natural vs. human

Is there a ‘normal’ or ‘natural’ fire regime for moorland habitats?
• Integral, adapted to fire or imposed?

Charcoal recording: standard – but methods vary
• Charcoal in peat profiles: recurrent element in history
• What scale? Spatial & temporal limitations in palaeoecology

• Fire: an agent in prehistoric moorland formation & dynamics
• Debate:
  – Natural, climatic or anthropogenic: management, industrial or domestic?
  – Driver or response?
  – E.g. c.8800-5700 cal BP in N Scotland & Western Isles: natural spread of acid, peat communities & climatic aridity?
  – People brought fire: West Affric

Appearance of charcoal with increased grazing indicators: management response to extensive heath- & peatland resource?

Sources: Davies 1999, Davies in Tipping 2003
Fire history II: management

Palaeoecology: varied purposes
• Grazing regime change: favouring *Calluna* or grass (e.g. Cheviots, Sutherland)
• But initial encouragement or post-formation maintenance of heather?
• Not consistently correlated

Written sources:
• Regulated burning since medieval period - at least
• References to ‘muirburn’: Act of Scottish Parliament in 1400
• Restated into the 17th century: no moor burning from March until September or harvest
• Aims: manage heather, grass, & protect trees
• Strip/patch burning known by late 19th century

• Contradicts assumption that systematic burning began in late 19-20th century

Fire history III: setting baselines

• Yallop et al. (2006) proposed 1970s baseline for moor burning in England

• Not applicable everywhere (e.g. Scotland: Hester & Sydes 1992)

• Long-term context: intensified over the last c.100-250 years, with further rise at some sites around 1900

• 20th century baselines: midpoint
• Potential to underestimate extent of regime change
• Sustainability: are targets set too high?

Source: Rhodes & Stevenson 1997
Rural economies & moorland dynamics

• Agricultural intensification impacts clearest

• Has the tendency to maintain lower sheep numbers on sporting estates had a cushioning effect and contributed to the better condition of heather on some grouse moors? (Bardgett et al. 1995)

• Details of relationship between changing upland regimes & burning patterns unclear: sheep, grouse, sporting estates
  - Lack of joint studies: high resolution palaeoecology tied to specific land management contexts/histories
Rural economies & moorland dynamics

- Cheviot dry heaths: moor-burning ceased as *Calluna* was replaced by impoverished grassland c.1750-1900

- Burning is one of the common factors, contributing to:
  - heather loss in 18-19\textsuperscript{th} centuries
  - heather expansion in 19-20\textsuperscript{th} centuries (North York Moors, North Pennines, Wales)
  - grass spread: loss of pre-18-20\textsuperscript{th} century balance (Exmoor, S Wales)

- Combined impacts: burning, grazing, air pollution, erosion, drainage, climate change (weather events)

Biodiversity

• We do not sufficiently know enough about the historical burning practices that have produced different vegetation communities. This can make it difficult to establish modern ‘good management practice’. (Holden et al. 2007)

• Mirroring ecological data bias & drivers: burning contributory
  Dry heaths, 11-13th centuries:
  Heather  Species-rich grassland

  Blanket & raised mires & dry heaths, late 18-20th centuries:
  Grasses (*Molinia, Nardus*)  Heather, *Sphagnum*, cotton-grass

  Blanket mires, 19 & 20th centuries:
  Heather  Grasses, sedges, *Sphagnum*

• Site-based decisions: are current patterns/trends recent or long-established?
• Heather: what is ‘natural’? Loss of balance: grass-heather
• Cumulative diversity impacts? Trends in sub-dominant taxa?

Carbon management: issues

• Carbon cycle: long equilibrium time so consequences of current actions will persist for centuries

• Threats: erosion, pollution, climatic warming
  – Eroding moors vulnerable: more charcoal in stratigraphy

• Emissions derive from old & recent C

• Key role of management: vegetation change impacts on productivity & decomposition

• Surprisingly little is known about the effects of anthropogenic activities
Carbon management: burning & grazing

- Moor House NNR data
- 10 year rotational burning: reduced C accumulation rates on blanket peat
  - How: direct loss from burnt layers, reduced/no peat accumulation or by changing vegetation composition?

- Low intensity sheep grazing: no significant effect over 30 years period

- Fires may cause a positive feedback: attract sheep & intensify C losses
  - direct biomass removal & indirect effects on NPP, decomposition, hydrology & compaction

Sources: Garnett et al. 2000, Worrall et al. 2007
Carbon management: climate threats

• Predictions vary: complex interactions
  – Indirect driver: mediated through changes in surface structure & developmental topography

• Greatest losses: warmer + drier conditions, especially summer droughts & severe fires

• Wetter/colder conditions: reduced NPP, enhanced CH$_4$ emission

• Continued review of burning practices required: climate-grazing-burning interactions

Where & how do we set the baselines?

• Long history of burning management
  – varied purposes ≠ single ‘tradition’
  – 20th century is a poor baseline for managing diversity or C stocks

• As a driver of moorlands burning cannot be divorced from other factors
  – Burning must be seen in context of unprecedented pressures on some upland environments (e.g. Pennines): added stress?

• Long-term & high resolution data lacking:
  – Range of moorland habitats
  – Are there moorland communities which were less/more adapted, less/more sensitive to fire?
  – What are cumulative management impacts on biodiversity, C stocks?

• Scope for more integration:
  – Processes & patterns in time & space
  – Ecology, history, palaeoecology, climatology, managers
Sources 1


Sources 2


