# Impact of atmospheric Nitrogen deposition on upland and alpine ecosystems

**Background**

- Ecosystems in the low-alpine zone are exposed to relatively high levels of nitrogen (N) deposition compared to surrounding lowland areas due to the high levels of rainfall (the rain contains the N).
- Nitrogen deposition has the potential to alter plant community composition and ecosystem function.
- Alpine areas are important biodiversity reservoirs.
- High levels of nitrogen (N) deposition and long-term heavy grazing pressures are thought to have caused severe degradation and loss of some alpine plant communities in the UK.

**Changes in vegetation caused by nitrogen deposition**

The following key impacts of N deposition on vegetation communities have been found from manipulative experimental studies combined with analysis of Scottish alpine vegetation data collected 1963–1987 compared to current vegetation at the same locations.

- Grass species cover increases with increasing N deposition while heather and related shrubs tend to decrease.
- Some northern and alpine plant species decline with increasing N deposition.
- Lowland generalist species tend to increase with N deposition resulting in increased homogeneity of vegetation.
- Lichen species richness declines with increasing N deposition; lichens were found to be one of the most sensitive groups of plants to increased N deposition.
- The moss mat covering the tops of many UK mountains is in poor condition (thin, fragmented or absent), probably due to combinations of N deposition and grazing. This moss mat provides a key habitat for insects which are the food source for many mountain birds, such as Dotterel.
- The impacts of nitrogen deposition on vegetation interact with management practices such as burning and grazing and the impacts of climate change, so the relationships can be complex.

**Changes in fungi**

- Fungi are an important component of nitrogen cycling in alpine habitats. Shifts in mycorrhizal fungal communities are observed when the plant populations they associate with are degraded.

**Changes in water and soil processes**

- Alpine heathlands, which occupy the headwaters of many rivers, have limited potential to retain deposited N and may rapidly become N saturated, leaking N into downstream communities and surface waters. This is most likely to be a problem in soils with low phosphorus content.
- High nitrogen deposition results in acidification of the soil and soil water.

**Long-term impacts and policy/legislation**

- Thresholds for effects observed in this study support the definition of a low 'critical load' for these sensitive alpine communities (<7.5 kg N $ha^{-1}$ $y^{-1}$) and suggest that the concentrations of N currently encountered across most of the UK have detrimental effects on the growth of sensitive species.
- Nitrogen emissions throughout Europe are slowly declining but the effects of elevated nitrogen loading (cumulative N deposition over time) will not disappear overnight. Recovery of mountain biodiversity and soil and water quality from eutrophication is likely to be a slow process, but one which can be influenced by targeted management techniques employed at a local level, as well as by stringent legislation to reduce emissions at source.

**On going research**

- Assessing the rate of recovery of alpine heaths following a decline in N deposition.
- Extending our resurvey and analysis of long term (40-50 years) vegetation change data to a wider range of Scottish habitats.
- Research investigating direct links between nitrogen deposition and alpine fungal communities is ongoing.

**Contact:** Dr Ruth Mitchell (ruth.mitchell@hutton.ac.uk)