CHAPTER 13

Impact of atmospheric N on growth in heathlands

Herbert Diemont, Koen Kramer, Patrick Hommel and Werner Härdtle
Atmospheric N pollution may increase plant growth and subsequently cause a transition of dwarf shrub heath into grassland. However, although critical atmospheric N levels have already been defined, the evidence - if available - is still not unequivocal. Here, we assess the impact of precipitation and nutrients on direct and indirect growth of *Calluna* and some grasses over a wide range of climatic, edaphic and management conditions. The outcomes indicate that (1) the assessment of critical levels was timely, although effects have been delayed, and (2) effective management in terms of nitrogen removal restores heathland from grassland. However, it cannot be excluded ultimately that such management promotes grasses over the whole range of heathlands where N, NP and P limit growth.

**Introduction**

In the sixties of the last century nutrient balance studies were made to avoid risks of high nutrient losses in heathlands subject to burning. (Gimingham 1972). Regulations such as the Muir Burning Code were put in place to avoid nutrient depletion from burning, while risks of overgrazing was controlled by abolishing headage payments for sheep (Chapter 11). Nutrient balance studies received a new impetus in the 1980s when it became clear that enhanced levels of atmospheric N may change heathland into grassland (Heil and Diemont 1983). In the meantime, critical N loads have been identified. For the dry heath communities discussed here atmospheric N deposition should be below 10-20 kg.ha⁻¹ (Bobbink and Hettelingh 2011). Since the 1980s significant decreases of N inputs have been achieved, but they may be still above critical levels. Although critical loads have been defined, there is still uncertainty about the impact of N deposition. In particular, the effects on growth i.e. net above ground primary production (NPP; g.m⁻²a⁻¹) of dwarf shrubs such as *Calluna vulgaris* and grasses such as *Deschampsia flexuosa* and *Molinia caerulea* is not unequivocal (Falk et al. 2010). We postulate that these conflicting results emerge from growth differences depending on climatic and edaphic conditions (especially moisture availability and nutrient availability). For instance, in acid brown soils the system is - as we will see - N limited, whereas on poorer soils P may be the main factor limiting growth (Diemont 1994; Vitousek et al. 2010). It has also been noticed that N limited soils can become P limited in time as a result of enhanced atmospheric N (Härdtle et al. 2009). Further, it has also been suggested that P limited soils may become N limited in time if P levels increase (Chapman et al. 1989b). Transitions can be directly caused by growth changes which may change the competition between dwarf shrubs and grasses, but indirect growth effects, resulting from enhanced risks of frost, drought and heath beetle attacks, may also cause a transition. In the latter cases, direct effects of changes in competitive relations may or may not play a role. While the indirect effects cause an opening of the canopy of...