

# Understanding the role of plant traits and their plasticity in N:P stoichiometry and competition

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For years Dutch nature conservancy organisations have been trying to manage their natural grasslands in such a way that plant species diversity is maintained or restored to its former high species richness. There are several factors that influence plant species diversity, e.g. nutrient availability, soil acidity, soil moisture and seed dispersion. Addressing all of these issues can be a particular challenge when nature reserves are surrounded by agricultural areas.

Management practices have often mainly focussed on reducing the amount of available nutrients without explicit consideration for the three major nutrients: nitrogen, phosphorus and potassium. Nutrient availability is often implicitly regarded as nitrogen availability because many studies have shown a relationship between increased nitrogen availability and decreased species richness (e.g. Stevens et al., 2004; Bobbink et al., 2010). Recent studies have shown that the type of nutrient availability is important for species diversity. The nitrogen:phosphorus ratio is a proxy for the type of nutrient limitation (Koerselman & Meuleman, 1996; Güsewell & Koerselman, 2002; Olde Venterink et al., 2003). It was found that species richness is highest at an intermediate N:P ratio and that endangered species occur more often under P-limited conditions (high N:P ratio; Wassen et al., 2005). Moreover, the effect of N:P ratio on species richness is independent from the total nutrient availability (Fujita et al., 2014). Fujita et al. (2014) found that both endangered and non-endangered plants that grow in P-limited conditions invest less in sexual reproduction; they produced fewer and smaller seeds.

In our study we investigate if plant species are specialised in different nutrient limitation types, i.e. if generalist and specialist species can be distinguished along the N:P axis. We are currently writing an article on this topic, together with Wim Ozinga. Preliminary results are promising. It is an interesting question, also for nature managers. If there are true specialists and generalists, we could infer the nutrient limitation type of a site by looking at the species composition. It would even be possible to indicate what changes in limitation type have to be achieved in order to create favourable conditions for the preservation or return of a target species. We therefore need to test if the N:P ratio inferred from a vegetation recording matches with a chemical N:P ratio measurement of that same site. To test this idea we need vegetation recordings and plant samples.

Last June and July we carried out fieldwork in seven different nature reserves. During the site selection process, we asked advice from Natuurmonumenten (our main stakeholder) as well as Staatsbosbeheer, Landschap Overijssel and several external advisors. We were looking for areas in which nutrients were likely to play a steering role in the species composition and for which the management history was well known. In addition, management had to have been constant over the past five years. The areas were chosen in consultation with stakeholders: they are specifically interested in these areas and potential management measures that influence N:P ratio.

The following sites were selected: 'de Wieden' (Photo 1), 'de Drentse Aa', 'Smalbroekken' (part of the 'Kampina' nature reserve, Photo 2), 'Brecklenkampse veld (Photo 3)', 'Stroothuizen', 'Punthuizen' and 'Lemselermaten'. We gathered plant samples and vegetation recordings from 43 plots. The plant material has been dried and will be chemically analysed for N and P. Measured N:P ratio can then be compared with an N:P ratio estimation that we infer from the species recordings. The latter estimation will be based on the outcomes of our current study on generalist and specialist species along the N:P axis.

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**Picture 1** | Normally you walk to your research site, but in nature reserve 'De Wieden' you have to take the boat. (Nature reserve 'De Wieden', province of Overijssel, Natuurmonumenten). Photo: Ineke Roeling



**Picture 2** | Fieldwork in 'Smalbroeken': Martin Wassen and Shuqiong Wang are harvesting plant material, while Jerry van Dijk is trying to identify a species. (Nature reserve 'Kampina', province of Brabant, Natuurmonumenten.) Photo: Ineke Roeling



**Picture 3** | Martin Wassen trying to find the corners of a permanent quadrat on a rainy day in nature reserve 'het Brecklenkampse veld' (province of Overijssel, Overijssels Landschap). Photo: Ineke Roeling

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