Appendix S1

Detailed description of the case study site, sampling methods and species´ responses to environmental gradients

Study site

The study site is located in north–eastern Germany at the eastern shore of the Lake Müritz (53° 29' N, 12° 44' E). The flat lowlands of the study site emerged as a result of drainage some 165 years ago; a drop of water level by about 1.50 m caused by canalisation and removing old water hold–ups along the river Elde (Deppe and Prill 1958). The northeastern part of the study area consists of a sandy hill. Different soil types can be distinguished within the study area: subhydric soils, peat soils, gleys, clayey and sandy cambisols.

The climate is characterised by a transition between the oceanic influences of Western Europe and the continental Eastern European climate. Mean annual precipitation from 1930–2002 was 583 mm and mean annual temperature was 8.2°C. Melting ice and strong westerly winds have formed sandy barrier beaches, with older ones covered by dry grassland encroached with *Juniperus communis* shrubs. The entire site comprised extensive reeds, grasslands and more or less open forests, providing a variety of different habitats on a gradient of dry to wet soil water conditions.

Since the 1880s there has been a continuous extensive grazing history with horses and cattle (Deppe 1980). In 1969 Fjell cattle were brought in after a 15 year–period of abandonment. The animals ranged year-round and freely over the area without human care until 1990. Around 1980, Gotland sheep and Shetland ponies were introduced (Martin 1997). Since 1990, cattle, ponies and sheep have grazed the total area of 3 km² with approximately 0.5 livestock units ha^{-1}, depending on site-preferences of the animals. Additionally, occasional mechanical management like mowing and shrub encroachment has been carried out.

Sampling design and measurement of grazing intensity

Forty-three sampling plots were set up along a 100m x 100m – grid that covered the entire site. They were arranged in similar numbers for combinations of soil moisture and topography (dry, mesic, wet / barrier beaches, plain, hillside, hilltop). The density of plots was increased where habitat combinations changed rapidly on a small scale (e.g. changes in elevation). Each plot consisted of 4 subplots; one subplot was located in an exclosure (1.50m x 1.50m in heavily grazed areas; 2m x 2m in less grazed areas) and an equally sized subplot adjacent to the exclosure where grazing was allowed. During the periods 2001 – 2002 and 2003 - 2004, both subplots at each plot were cut at the end of winter and in summer when biomass peaked. The biomass produced (as the difference between winter and summer biomass) in the grazed subplot was expressed as a percentage of the biomass produced in the exclosed subplot, and for the purpose of the analysis this was averaged across the three years of sampling. The percentage biomass removed was taken as a measure of grazing intensity.

Vegetation sampling

In 2004, plant species abundance was measured in 44 plots of 1m², each divided into 10cm x 10cm cells, and located adjacent to the subplots used to measure biomass removal. The abundance of each species was recorded as the number of cells covered by all individuals of the species, by aiming at a vertical projection of each individual plant on the ground.

Soil sampling

Soil samples were taken from each soil layer within 60cm depth, located in the fourth subplot besides the other subplots, at each of 43 plots. Soil density and texture were determined in the field according to Anon. (1994). From these data, soil water content was calculated using Saxton et al. (1986, http://hydrolab.arsusda.gov/soilwater/Index.htm). Laboratory analyses yielded extractable phosphorus (Olsen P, Olsen et al. 1954).

Trait measurements:

The following plant traits were measured for 53 vascular plant species that were recorded in more than ten percent of plots: canopy height, specific leaf area (SLA), seed mass, leaf nitrogen content (LNC), leaf carbon content (LCC). Trait measurements were conducted using standard methods (Cornelissen et al. 2003), and following protocols developed to fit analyses of species to community responses to changing environmental conditions (see Garnier et al. 2007 for details). LNC and LCC were highly correlated and expressed as leaf C:N ratio to avoid statistical problems associated with co-linearity. Seed mass was subjected to $\log_{10}$ transformation to deal with a range of over two orders of magnitude (*Juniperus communis* 13.3 mg, *Agrostis capillaris* 0.036 mg). We also assigned to each species its onset of flowering date and whether it is monocarpic or polycarpic (data taken from Rothmaler 1994).

Correlation among environmental gradients

Grazing intensity was moderately correlated to soil water content (r = +0.5) and uncorrelated to soil phosphorous (r = -0.003). Likewise, soil water content was uncorrelated to soil phosphorous (r = -0.01).

Species´ responses to environmental gradients

Species´ responses to the environmental gradients were analysed with canonical correspondence analysis (CCA, Fig. 1). The three environmental variables explained 14.9 % of the variation in species composition in the CCA of the field data. Soil water holding capacity was relatively unimportant as an explanatory factor, whilst phosphorus and grazing intensity were nearly orthogonal in their correlation with species abundances (Fig. 2). The biplot shows some clear species responses: one group (*Bromus hordeaceus, Cerastium arvense, Poa annua*) occurred on dry overnight sheep camps that were grazed and enriched with phosphorus. Another group of annuals and semi rosettes (e.g. *Capsella bursa-pastoris, Cerastium glomeratum, Senecio jacobaea*) occurred on pastures abandoned around 1991.

These sites were dry and the soil enriched with phosphorus from their former agricultural use. The majority of classic grassland species occurred at intermediate grazing intensities at the moister sites close to the lake where, due to high concentrations of calcium in the soil, phosphorus was poorly available. Species characteristic of higher grazing intensities within this range include *Potentilla anserina* and *Ranunculus repens* whilst *Anthoxanthum odoratum* and *Deschampsia cespitosa* occupied less disturbed area.

Fig. S1.1. Species responses to environmental gradients (species with less than 5 % fit not shown). Abbreviations: dist.int: grazing intensity; SOIL.P: available phosphorus in soils; SOIL.WHC: soil water content. Species names coded with the first four letters of the genus and species names.

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