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Patterns and gradients in South Patagonian ombrotrophic peatland vegetation

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Summary

This thesis consists of three interrelated papers that address different aspects of the vegetation and the ecology of South Patagonian ombrotrophic peatlands. The floristic composition, as well as the major environmental gradients and vegetation properties such as diversity patterns were studied.

Paper 1: Gradients of continentality and moisture in South Patagonian ombrotrophic peatland vegetation

Numerical methods (Cluster Analysis and Detrended Correspondence Analysis) were carried out to explore 381 phytosociological relevés of South Patagonian ombrotrophic bog vegetation. This resulted in nine major vegetation types that were clearly separated in ordination space along two major gradients that were standing orthogonal on each other. First, along a gradient of increasing continentality hyperoceanic blanket bog vegetation dominated by cushion-forming vascular plants such as *Donatia fascicularis* and *Astelia pumila* were gradually replaced by communities of continental *Sphagnum*-dominated raised bogs. A transitional type was characterized by a small-scaled floristic mixture of both extremes. Second, samples were clearly separated along a water level gradient that could be found at both sides of the continentality gradient. In eastern *Sphagnum*-dominated bogs, the water level gradient reflected the hummock-hollow microtope zonation. In hyperoceanic blanket bogs, the separation of vegetation types along the water level gradient was attributed to different drainage conditions. The position within the roche moutonnées landscape strongly affected the edaphic moisture regime and consequently the floristic composition. Finally, similarities and dissimilarities of South Patagonian ombrotrophic peat bogs compared to their north hemispherical counterparts were discussed.

Paper 2: South Patagonian ombrotrophic bog vegetation reflects biogeochemical gradients at the landscape level

Ordination methods (Detrended Correspondence Analysis and Canonical Correspondence Analysis) were applied to find out the major environmental gradients affecting the floristic composition of South Patagonian ombrotrophic bog vegetation. For 82 phytosociological relevés biogeochemical peat characteristics were determined on the basis of volumetric mixed surface samples. Climatic constrains were interpolated by interpreting the available climatic data. Ordination revealed climatic variables as well as biogeochemical constraints

and the water level as major determinants of floristic composition. Among the climatic variables annual precipitation was most important. Within the biogeochemical variables, the total N content and the contents of plant available base cations explained a high proportion of the floristic variation.

Both, climatic and biogeochemical variables were highly correlated with the distance to the Pacific Ocean. Independent of this, the water level described a discrete gradient. It was concluded that the variation in vegetation along a longitudinal gradient crossing the southern Andes that was formerly mainly attributed to climatic constraints is also strongly affected by biogeochemical peat characteristics. According to the trophical status of the investigated peat bogs the variation in the input of sea-born cations depending on the distance to the ocean was supposed to be a key factor affecting the peat chemistry and consequently the floristic composition. Finally, the appropriateness of South Patagonian peatlands as reference systems for conservation and restoration ecology in particular in landscapes highly affected by human interferences was emphasized.

Paper 3: Patterns and gradients of diversity in South Patagonian ombrotrophic peat bogs

Along a transect crossing the southern Andes, α-, β- and γ-diversity measurements within ombrotrophic bog complexes were performed. α-diversity significantly decreased from hyperoceanic blanket bogs dominated by cushion-forming vascular plants via transitional cushion-*Sphagnum* mixed bogs to eastern *Sphagnum* bogs. This trend became evident within most functional groups. Dissimilarity (β-diversity) was highest in the transition zone. γ-diversity was lowest in *Sphagnum* bogs and similar in cushion bogs and *Sphagnum*-cushion mixed bogs. Found out by simple linear regressions, species richness was highly correlated to biogeochemical peat characteristics. To determine the best predictors of species richness a General Regression Model was performed. The model resulted in three environmental factors (total N, plant available Ca and water level) predicting species richness with an explained variance of 76 %. Within the three particular bog types different models were calculated. In continental *Sphagnum* bogs the water level and the content of plant available Mg were the best predictors, whereas in hyperoceanic cushion bogs the ash-content was the only remaining environmental variable. Species richness in *Sphagnum*-cushion mixed bogs was mainly affected by the water level and the total N content.

Dominance patterns of different functional groups along the major environmental gradients were explored by performing Generalized Additive Models. Response curves of the most dominant functional groups constituting South Patagonian peat bogs illustrated clear

preferences to specific environmental conditions such as mosses dominating at the low end of a nitrogen gradient, whereas cushion plants had their optimum at intermediate levels, and graminoids dominated at high nitrogen contents. Within the three particular bog types similar and contrary dominance patterns could be observed. The investigated relationships between environmental variables and diversity patterns were clearly scale-dependent and partly non-linear. The findings underpin the significance of the studied undisturbed peatlands in terms of testing ecological theory.