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Einfluss von Kulturtraditionen, Höhe und Landnutzung auf die Biodiversität von Grasland in den Schweizer Alpen

The cultural landscape of the Alps belongs to the most plant species rich areas in Europe. Below the timberline most meadows and pastures are man-made and replace cleared forests. In the Swiss Alps we distinguish three main cultural traditions. The Romanic culture developed after 1800 BC, and it is characterized by a self-sufficient alpine economy practicing mixed farming with permanent villages at the valley bottoms, transient summer settlements at higher altitudes, and (sub)alpine pastures. The Germanic culture developed after 600 AD, when Alemannic people from the North immigrated into the wetter northern and northeastern parts of the Alps and practiced mainly dairy farming. After 1200 AD the Walser, Alemannic people from the Valais, migrated eastwards and settled at relatively high altitudes. Apart from farming they lived on trade and maintenance of alpine passes. Current socio-economic changes are bringing about severe land use changes, mainly fertilization or abandonment, which may both negatively affect plant species richness.

My PhD thesis is part of a comprehensive project within the NRP 48 that investigates the influence of agricultural land use, altitude, and cultural traditions on biodiversity in the Swiss Alps. Biodiversity is considered at different levels, from the landscape to the gene. My thesis will contain three scientific papers, which particularly refer to plant species richness and diversity at the landscape and at the parcel level, genetic diversity of the grass species *Poa alpina* L., and differences in plant species composition.

In another part of the project, the level of biologic interactions as represented by leaf damages through herbivory, the performance of *P. alpina* L. in a common garden experiment, and the correlation of the different levels of biodiversity are investigated.

Paper 1: The relationship between plant species diversity of grasslands, cultural traditions, and land use in the Swiss Alps

In the species-rich cultural landscape of the Alps, the conservation of plant species diversity of grasslands depends on understanding effects of topography, land use, and, neglected in previous studies, cultural traditions. We studied plant species diversity in 216 grassland parcels at three altitudinal levels in 12 villages in the Swiss Alps. We found the likelihood of occurrence of different parcel types to depend on their land use history and altitude. In valleys of Romanic villages more different parcel types tended to occur than in those of Germanic and Walser villages, suggesting that cultural traditions still play a role in shaping landscape diversity. At the village level, higher man-made landscape diversity, i.e. a higher number of land use types per village, was associated with higher plant species richness. Of the 216 parcels, 29 formerly mown parcels now are grazed and 23 formerly mown and 10 formerly grazed parcels are abandoned, while no formerly grazed parcels now are mown. All these changes in land use reduced the workload of the farmers. Plant species richness per parcel increased from the valley bottom to intermediate altitudes and decreased again at the higher alp level. Plant species richness was lower in fertilized than in unfertilized parcels and in abandoned compared with used parcels. Grazing slightly reduced species richness compared with mowing among unfertilized parcels, while in fertilized parcels it had a positive influence. The highest species diversity was found in mown, unfertilized subalpine grasslands. Moderate grazing of former meadows can be a valuable alternative to abandonment. Among all parcels, higher species richness was associated with lower standing crop. We conclude that observed land use changes reduce plant species richness. Therefore, financial incentives appear indispensable to maintain a land use conserving high plant species diversity.

Paper 2: Influence of human land use on genetic diversity of *Poa alpina* L. in the Swiss Alps – a microsatellite study

The grass species *Poa alpina* L. is widespread in subalpine and alpine grasslands of the Alps. The plant is an indicator of nutrient rich and moist meadows and pastures, but it is also a pioneer species in alpine screes. It is one of the most important fodder grasses for cattle, and therefore *P. alpina* has been under an agricultural selection pressure for hundreds of years. *P. alpina* reproduces either sexually by seeds or asexually by pseudovivipary producing small plantlets instead of flowers. The species is a highly polyploid complex with common aneuploidy.

To investigate the effects of altitude, cultural traditions and land use on genetic diversity of *P. alpina* we collected plants from 12 villages in the Swiss Alps, from four villages of each of the cultural traditions. Eight individuals were sampled at three altitudinal levels, in parcels of land either used as meadows or pastures and either unfertilized or fertilized. Additionally, samples were collected from natural sites. Altogether we sampled 574 individual plants from 74 populations and screened them for alleles in five microsatellite loci. In total we found 209 different alleles, between 25 and 61 per locus. As measures for genetic diversity we calculated the mean number of alleles per plant and the allelic richness per population. There was no difference between populations from natural and agriculturally used sites. Among the used parcels, populations from pastures were more diverse than were those from meadows. We conclude that human land use has shaped genetic diversity of *P. alpina* in the Swiss Alps.

Paper 3: Influence of land use, altitude, and cultural traditions on plant species composition

For this paper we studied plant species composition of the same parcels of land as in paper 1. The still ongoing analyses so far showed that plant species composition was affected by the abiotic factors aspect, slope, pH, and altitude as well as by fertilization, traditional land use, abandonment and current land use. The proportion of species covering $\leq 5\%$ of the investigated area per parcel was higher in parcels with a higher slope, at higher altitudes, in unfertilized parcels, in parcels that had traditionally been used as pastures, in abandoned parcels, and in pastures than in meadows.

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