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# Integrating Efficient Grassland Farming and Biodiversity

*Edited by*

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# Impact of different management systems and location parameters on floristic diversity of mountainous grassland

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## Abstract

Within the Man and Biosphere project 'Grassland in mountainous regions of Austria', which was initiated by the Austrian Academy of Science, comprehensive studies have been carried out in 8 representative grassland regions in Austria. More than 1700 botanical assessments have been carried out and were linked with important location properties and aspects of various management systems. The total number of vascular plants found on pastures and meadows reached a maximum of 115, depending on livestock intensity and land use type. It could be demonstrated that the Austrian grassland is not only characterized by high species diversity but also by a rich diversity of different plant communities.

The research findings clearly indicated the positive impact of low input farming systems on floristic diversity of grassland but failed to show any significant benefit to organic farming compared with other farming methods when compared at similar livestock intensities. Beside forage plants, a high number of red list species were found in meadows and pastures, depending mainly on land type and intensity of utilisation. Therefore, the different grassland types in Austria, which cover approximately 60% of the total agricultural used land, represent an indispensable part of the cultural landscape.

Keywords: species diversity, mountainous grassland, low-input farming, organic farming

## Introduction

Grasslands account for 60% of the total agricultural used area in Austria, 90% of which is permanent grassland and not ploughed for at least 20 to 25 years. Extensive managed grassland dominates the western and central production areas of "Hochalpen", "Voralpen" and "Alpenvorland". Ley farming areas are concentrated in the more favourable regions in the eastern and southern part of the country. Grassland not only provides forage for cattle and sheep production but also fulfils multifunctional tasks for society including the maintenance of biodiversity.

Agriculture has, in general, a large impact on the cultural landscape but also has significant influences on the conservation, development and diversity changes within this important ecosystem. Species and habitat diversity, as well as aspects of landscape, have been a focal point of the mid-term review according to the EU-ordinance 1257/99. Three main criteria and eight special indicators have been used to study different aspects of biodiversity. This paper presents some selected results of a current study, which was prepared and used in the Austrian mid-term review.

## Materials and Methods

Within the multi-disciplinary Man and Biosphere project 'Changing Agriculture and Landscape: Secondary grassland in the mountain regions of Austria', botanical studies have been carried out in eight representative grassland regions in Austria. More than 1700 comprehensive botanical assessments have been made and were linked with important location properties and different management systems. Beside the recording of  $\alpha$ -diversity based on the modified method of Braun-Blanquet (1951), additional investigations on  $\beta$ -diversity of

grassland were carried out. Apart from the official Austrian grassland classification, fifteen utilisation types were differentiated to specify the results and to consider the great variation of alpine and mountainous grassland (Poetsch and Blaschka, 2003).

## Results and Discussion

The species diversity of grassland is strongly depending on the type of land use, which again is characterised by different intensity levels. Figure 1, shows the abundance of vascular plant species, which were detected in diverse grassland types. The box plots include the median (horizontal line within the box), the quartiles (lower and upper bound of the box) and all values within the bar with the exception of outliers and extreme values.

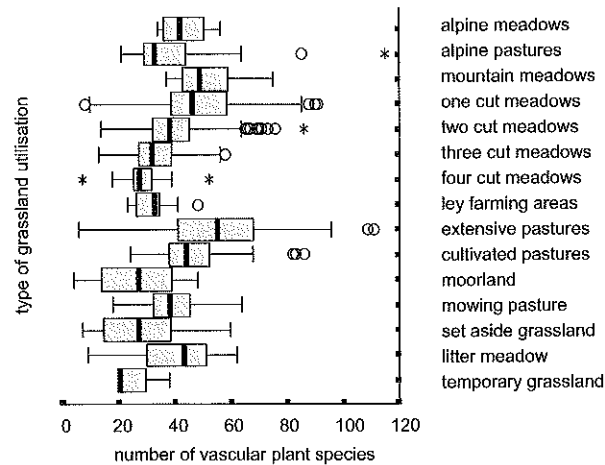


Figure 1. Species diversity of different grassland types in Austria

The highest number of vascular plant species was observed on extensive pastures ( $N = 115$ ) and mountain meadows, followed by one and two cut meadows. In more intensively used ley farming areas an average number of 32 species could be detected which was higher than the numbers observed by Bassler (2002). The grassland types with the lowest species number are the four cut meadows and temporary grassland areas. In total, 869 different vascular plant species could be observed in the eight project areas, thus strongly demonstrating the sustainability of the Austrian grassland management. Grassland and dairy farmers still consider the traditional and regional conditions and constraints for production and are still willing to use less productive, but species rich grassland types.

Forty percent of the Austrian grassland and ley farming areas are located at elevations of 600 m or less, 23% being found at altitude of 600 to 800 m and 34% are located at altitudes greater than 800 m. Approximately 40% of the grassland areas have a slope greater than 25%, with some being more than 50%, thus causes major problems in their management, especially in relation to harvesting, fertilising and resowing (Poetsch *et al.*, 2005). Figure 2, shows the relationship between species diversity and the altitude of grassland. There is a significant increase of plant species with rising altitude, which is caused mainly by the geographical distribution of the different grassland types. More extensive grassland types can be found at higher altitude being associated with lower livestock numbers and lower fertilising intensity, both of which strongly influence plant biodiversity.

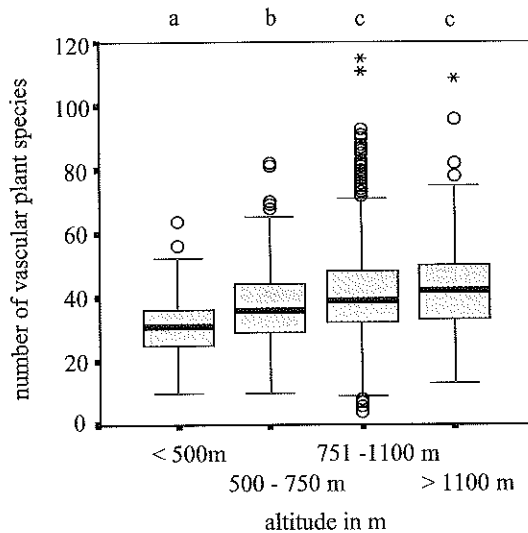


Figure 2. The relationship between floristic diversity and altitude

At higher altitudes there is an increase of organic farming, whereas conventional farming systems can be found in more favourable production areas in the lowlands. Over a range of grassland types it could be shown that a higher share of extensive and basically species rich grassland types exist on organic grassland and dairy farms (Poetsch, 2000). Nevertheless, in relation to species diversity, there was no significant difference between organic and conventional farming when compared at similar intensity level.

A non-linear relationship was observed between the species diversity and the management intensity. The highest number of plant species could be observed at a moderate intensity level ranging from 0.5 to 1.5 livestock units per ha grassland. The number of different plant species decreases with increased farming intensity, however a similar reduction was noticed at an intensity level lower than 0.5 livestock units per ha grassland.

Beside a high number of plant species, extensive grassland types also show a higher proportion of red list species, which are of great importance for aspects of nature conservation. Within this study 152 red list species could be observed, most of them were found on extensive pastures (up to 16 red list species), moor land, set aside grassland and litter meadows.

The Austrian environmental program for agriculture enhances diversification and discourages intensive and monoculture farming systems. For two selected regions, the diversity of land utilisation was illustrated by means of a GIS-analysis. A high utilisation diversity, which results in a diversified and well structured landscape, could be demonstrated. For different reasons, many Austrian grassland areas and regions are nowadays endangered by a migration of both farming and settlement. This development will not only lead to negative consequences for infrastructure, tourism and landscape but also for biodiversity. Therefore, the national and the European agrarian policy aim for sustainable and practicable solutions to avoid a dramatic change in this sensitive living space.

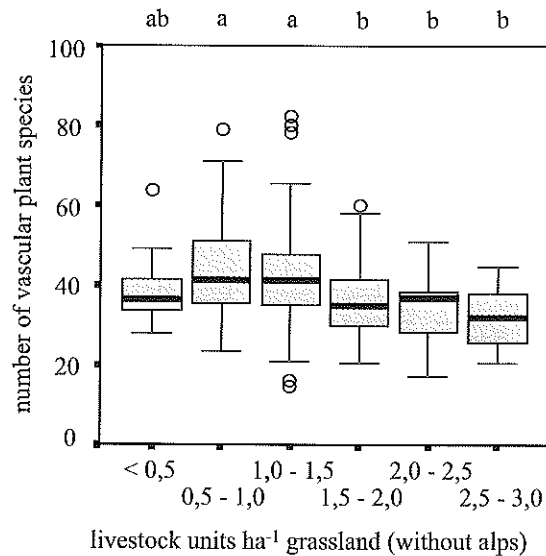


Figure 3. Relationship between floristic diversity and livestock intensity

### Conclusions

The results clearly indicate that high species diversity can be found on the different Austrian grassland types. The Austrian environmental programme for agriculture "ÖPUL", which is well accepted by farmers, contributes both to the maintenance of the farm structure and to the conservation of biodiversity. However, some special measures within that programme, aimed at nature conservation should be improved for the coming period to enhance their acceptance and efficiency. To advance the awareness of these relationships, farmers should be better informed about the association between farming, environment and nature protection issues. However, in spite of all efforts, a strong tendency for the abandonment of farming, especially in disadvantaged areas, can be noticed. Aiming at the sustainable preservation of cultural landscape and diversity of habitats, fauna and flora, there must be a strong improvement in the development of the rural space, including the productivity of grassland and dairy farming in alpine and mountainous regions. In the future, as well as payment for farm produce, agriculture will need to be rewarded for the care of the landscape, the care of which is seen as being in the common good of society.

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