

Reconciling meat production and biodiversity conservation on marginal pastures

Zehnder T., Schneider M.K., Berard J., Kreuzer M., Lüscher A.

in

Casasús I. (ed.), Lombardi G. (ed.).
Mountain pastures and livestock farming facing uncertainty: environmental, technical and socio-economic challenges

Zaragoza : CIHEAM

Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 116

2016

pages 231-235

Article available on line / Article disponible en ligne à l'adresse :

<http://om.ciheam.org/article.php?IDPDF=00007451>

To cite this article / Pour citer cet article

Zehnder T., Schneider M.K., Berard J., Kreuzer M., Lüscher A. **Reconciling meat production and biodiversity conservation on marginal pastures.** In : Casasús I. (ed.), Lombardi G. (ed.). *Mountain pastures and livestock farming facing uncertainty: environmental, technical and socio-economic challenges*. Zaragoza : CIHEAM, 2016. p. 231-235 (Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 116)



<http://www.ciheam.org/>
<http://om.ciheam.org/>

Reconciling meat production and biodiversity conservation on marginal pastures

T. Zehnder^{1,2}, M.K. Schneider^{1,*}, J. Berard², M. Kreuzer² and A. Lüscher¹

¹Institute for Sustainability Sciences, Agroscope, Reckenholzstrasse 191, 8046 Zurich (Switzerland)

²Institute of Agricultural Sciences, ETH Zurich, Universitätsstrasse 2, 8092 Zurich (Switzerland)

*e-mail: manuel.schneider@agroscope.admin.ch

Abstract. Marginal alpine pastures provide society with valuable products, unique biodiversity and attractive landscape. These ecosystem services are under threat from ongoing transitions in mountain agriculture, leading to the abandonment of marginal areas and subsequent shrub encroachment. In Switzerland, the overall area used for mountain farming has dropped by 5% in the past 30 years, and by up to 20% in certain regions. Our main aim was to develop strategies for conservation of biodiversity and maintenance of productivity in shrub-encroached subalpine pastures by low-input grazing with robust breeds. In the first part of the project, we visited 19 sites across the Swiss Alps and investigated how shrub encroachment affects species richness. In the second part, a controlled field experiment was carried out at two sites. We studied how feeding behaviour of Dexter cattle and Engadine sheep affects vegetation as well as the performance of the animals. The botanical survey (Part 1) revealed that the identity of the dominant shrub species has a strong impact on species richness. For example, *Alnus viridis* (green alder), the most frequent successional species in the Alps, has a much stronger negative impact on species richness than *Pinus mugo* (creeping pine). The grazing experiment (Part 2) demonstrated that the understorey vegetation of *A. viridis* provides a largely underestimated forage resource for grazing animals. At low stocking density, no negative impact on animal growth performance was detected, even on pastures with substantial shrub cover. These results indicate that conservation targets can basically be reconciled with viable animal production using adapted robust breeds.

Keywords. Grazing – Species richness – Meat quality – Behaviour.

Conjuguer la production de viande et la conservation de biodiversité en zones marginales

Résumé. Les zones marginales en montagne fournissent à la société des produits à haute valeur, une biodiversité unique et un paysage attractive. Ces services écosystémiques sont menacés par les transformations qui touchent l'agriculture de montagne et qui conduisent à l'abandon des zones marginales et finalement à une augmentation de l'embroussaillage. En Suisse, la surface utilisée par l'agriculture de montagne a diminué de 5% au cours des 30 dernières années, et jusqu'à 20% dans certaines régions. L'objectif principal de notre étude était de développer des stratégies pour conserver la biodiversité et maintenir la productivité des pâturages embroussaillés par la pâture extensive avec des races rustiques. Dans la première partie du projet, nous avons visité 19 sites à travers les Alpes Suisses et étudié comment l'embroussaillage affecte la richesse spécifique. Dans la deuxième partie, un essai a été conduit en conditions contrôlées sur deux sites. Nous avons étudié comment la pâture de génisses de Dexter et des moutons Engadinois affecte la végétation ainsi que la performance des animaux. L'enquête botanique (Partie 1) a révélé que l'identité des espèces d'arbustes dominants a un fort impact sur la richesse spécifique. Par exemple, *Alnus viridis* (aulne vert), l'espèce de succession la plus fréquente dans les Alpes, a un impact négatif sur la richesse spécifique beaucoup plus marqué que *Pinus mugo* (pin de montagne). L'essai de pâture (Partie 2) a démontré que la végétation sous *A. viridis* fournit une ressource fourragère largement sous-estimée. Avec un faible nombre d'animaux par surface, aucun impact négatif sur la croissance n'a été mis en évidence, même sur les pâturages avec un couvert arbustif substantiel. Ces résultats indiquent que les objectifs de conservation peuvent essentiellement être conjugués avec une production animale durable en utilisant des races adaptées et rustiques.

Mots-clés. Pâture – Richesse spécifique – Qualité de viande – Comportement.

I – Introduction

Mountain pastures have been created and maintained over centuries by livestock grazing and human intervention. If utilisation declines or ceases, natural processes of succession change vegetation structure, habitat quality and the services provided by the ecosystem. These services include forage production for ruminants, the conservation of species-rich habitats, protection against natural hazards and the maintenance of an attractive landscape for recreation and tourism. Ongoing transitions in mountain agriculture have led to the abandonment of marginal areas in most mountain regions. In Switzerland, for example, the area covered by mountain farming has dropped by 5% in the past 30 years, and by up to 20% in certain regions (Bollmann *et al.*, 2014). This is still relatively limited but has raised public concerns and the political objective to keep marginal areas in the Swiss Alps open. The main aim of the project EG4BM (Extensive Grazing for Biodiversity and Meat production) was, therefore, to develop strategies for conservation of biodiversity and maintenance of productivity in shrub-encroached subalpine pastures by low-input grazing with robust breeds.

II – Materials and methods

In the first part of the project, we investigated how shrub encroachment and biodiversity are related. We selected 19 gradients from open grassland to closed shrubland across the subalpine zone of the Swiss Alps, stratified by parent material and aspect. We assessed the number of plant species in the understorey in 2 by 2 m² quadrats along each gradient at 0, 25, 50, 75 and 100% of shrub cover. We compared the relationship between shrub cover and species richness for the two dominant shrub species *Alnus viridis* (green alder) and *Pinus mugo* (creeping pine) using *t*-tests.



Fig. 1. Dexter cattle and Engadine sheep grazing on a marginal pasture encroached by *Alnus viridis*.

In the second part, we studied how feeding behaviour of Dexter cattle and Engadine sheep affects vegetation as well as the performance of the animals (Fig. 1). This was investigated in a controlled field experiment at two sites on both sides of the Albula pass in Eastern Switzerland (46° 34' N, 9° 50' E) at an elevation of 2000–2200 m a.s.l. Pasture productivity was measured using exclusion cages of 1.2 x 1.2 m² ground area at 20 positions in the pasture area. Forage quality is currently being analysed. The body weight gain of the grazing animals was assessed every second week and was analysed using linear mixed models. The analysis of the physico-chemical and nutritional quality of the meat is currently underway.

III – Results and discussion

1. Effect of shrub cover on species richness

Out of the 19 investigated sites, 11 were dominated by *A. viridis*, six by *P. mugo* and two by other species. This reflected the general distribution of shrub species in the Swiss Alps, with *A. viridis* being the most common shrub species followed by *P. mugo* (Brändli, 2010). The average number of species was inversely related to the cover of *A. viridis* (Fig. 2): at high cover of *A. viridis*, a very limited number of specialised species populated the understorey. In contrast, the average number of species in open grassland (0% shrub cover) was maintained up to 50% cover of *P. mugo*. At high shrub cover, vegetation was significantly species-poorer at sites dominated by *A. viridis* than at those dominated by *P. mugo*.

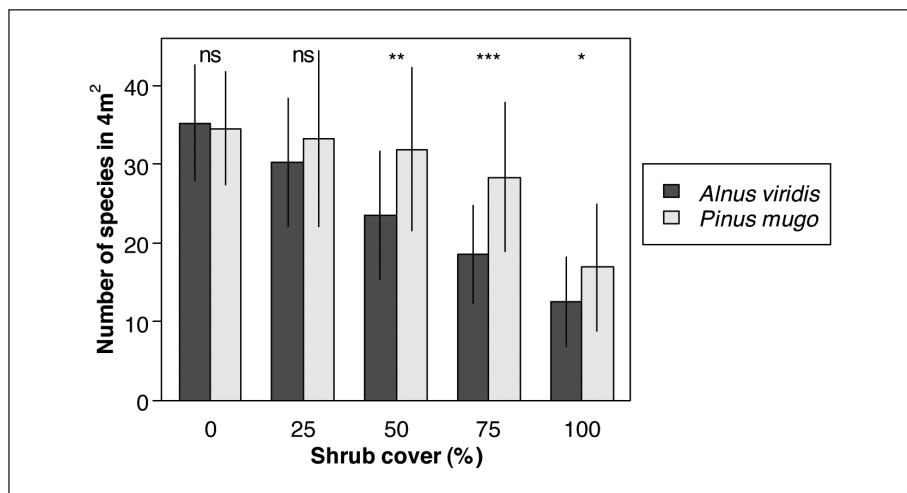


Fig. 2. Dependence of the average number of species in $2 \times 2 \text{ m}^2$ on the cover of *Alnus viridis* (dark bars) and *Pinus mugo* (light bars). Error bars show one standard deviation. Significance of *t*-tests between the two dominant shrub species are given as *** $P < 0.001$, ** $P < 0.01$, * $P < 0.05$ and ns non-significant.

Our results demonstrate that vegetation effects of shrubs depend on the dominant species. This corroborates an earlier investigation by Pornaro *et al.* (2013), in which sites were not repeated within shrub species and species-dependent effects could therefore not be derived. The evidence presented here suggests the need for different management targets for the two dominant shrub species in the Swiss Alps. Specifically, *A. viridis* should be kept at low cover levels as any increase is detrimental to the diversity of the local plant community. This is further supported by the fact that *A. viridis* increases N leaching and N_2O volatilization (Bühlmann *et al.*, 2014). In contrast, species richness is fairly stable at low to moderate cover of *P. mugo* and cover values of up to 50% are tolerable from a biodiversity point of view. Therefore, management of *P. mugo* in mountain pastures does not have to be as intensive as of *A. viridis*.

2. Pasture productivity and animal performance

Biomass production was, on average, 1.3 ± 0.6 t/ha for fertile and 1.1 ± 0.6 t/ha for nutrient-poor pastures (Zehnder *et al.*, 2016). The understorey vegetation of dense *A. viridis* shrubs provided with 1.5 ± 0.9 t/ha more biomass than fertile pastures. Variability in the productivity of understorey vegetation was considerable and 95% of the values ranged between 0.7 and 2.8 t/ha. In addition to the understorey vegetation, *A. viridis* provides biomass in the form of leaves in the range of 3.8 t/ha (Wiedmer and Senn-Irlet, 2006).

Shrub cover did not negatively affect animal performance with respect to body weight gain (Table 1). Weight gain was positive in all groups and there were no clear differences attributable to shrub cover. For Dexter cattle the lowest weight gains were observed in the group grazing pastures with a cover of *A. viridis* of around 80%. In contrast, the weight gain of Engadine lambs increased with the areal share covered by *A. viridis*. This may be due to a higher preference of this sheep breed for *A. viridis* leaves and understorey vegetation.

Table 1. Body weight gain (g/d) $\pm$ SE of Dexter cattle and Engadine lambs grazing areas with different degrees of *A. viridis* cover

Cover of <i>A. viridis</i>	Dexter cattle	Engadine lambs
None (0%)	186 $\pm$ 42	104 $\pm$ 14
Low (20%)	242 $\pm$ 42	92 $\pm$ 12
Medium (60%)	201 $\pm$ 40	132 $\pm$ 15
High (80%)	127 $\pm$ 39	131 $\pm$ 15

Vegetation composition and structure has been shown to be as important for animal grazing as is topography (Homburger *et al.*, 2015). Therefore, controlling grazing activities, for example, by rotational grazing or strategic placement of salt or water sources (Probo *et al.*, 2013), is a prerequisite for the management of sites with substantial *A. viridis* cover.

IV – Conclusions

Species richness along shrub cover gradients is affected by the dominant shrub species. *A. viridis* is an especially serious threat to biodiversity: the understorey vegetation contains substantially less species than the neighbouring open grassland. On the other hand, *A. viridis* and its understorey vegetation provide a substantial forage resource for animals grazing these sites. Body weight gain of the animals in our grazing experiment was equal, if not higher, on sites with *A. viridis* than on open pastures. These results demonstrate that conservation targets can be essentially reconciled with a viable animal productivity using adapted robust breeds.

Acknowledgements

Technical support by C. Hiltbrand, M. Schori and C. Wolf as well as linguistic corrections by K. Seipel are greatly acknowledged. This research was funded by the Mercator Foundation Switzerland under the umbrella of the World Food System Center at ETH Zurich.

References

- Brändli U.-B., 2010.** *Swiss forest inventory, results of 3rd assessment 2004-2006*. Swiss Federal Institute for Forest, Snow and Landscape Research, Birmendorf and Federal Office for the Environment, Berne.
- Bollmann R., Schneider M.K. and Flury C., 2014.** Minimalnutzungsverfahren zur Offenhaltung der Kulturlandschaft. *Agroscope Science*, 7.
- Bühlmann T.H., Hiltbrunner E. and Körner C., 2014.** *Alnus viridis* expansion contributes to excess reactive nitrogen release, reduces biodiversity and constrains forest succession in the Alps. *Alpine Botany*, 124, 187-191.
- Homburger H., Lüscher A., Scherer-Lorenzen M. and Schneider M.K., 2015.** Patterns of livestock activity on heterogeneous subalpine pastures reveal distinct responses to spatial autocorrelation, environment and management. *Movement Ecology*, 3, 1-15.
- Pornaro C., Schneider M.K. and Macolino S., 2013.** Plant species loss due to forest succession in Alpine pastures depends on site conditions and observation scale. *Biological Conservation*, 161, 213-222.
- Probo M., Massolo A., Lonati M., Bailey D.W., Gorlier A., Maurino L. and Lombardi G., 2013.** Use of mineral mix supplements to modify the grazing patterns by cattle for the restoration of sub-alpine and alpine shrub-encroached grasslands. *The Rangeland Journal*, 35, 85–93.
- Wiedmer E. and Senn-Irlet B., 2006.** Biomass and primary productivity of an *Alnus viridis* stand – a case study from the Schächental valley, Switzerland. *Botanica Helvetica*, 116, 55-64.
- Zehnder T., Schneider M.K., Berard J., Kreuzer M. and Lüscher A., 2016.** Valorizing forage resources and conserving ecosystem services in marginal pastures. *Grassland Science in Europe*, 21, in press.