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Silvopastoralism in the Alps: Native plant species selection under different grazing pressure

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ABSTRACT

To evaluate the suitability of wood pastures as a managing tool in subalpine regions it is essential to know more about the influence of grazing on the ground vegetation. This study assessed native plant species selection by cattle at different stocking rates, feeding habits and site preferences of cattle. Based on the results, conclusions concerning the value of silvopastoral systems in the Alps were drawn. A field study on six different wood pasture areas, grazed by cattle at different stocking rates, was accompanied by an experiment on three adjoining areas of 0.51 ha each, stocked with either three, six, or nine heifers. Plant species were recorded in plots of 20 cm × 20 cm before and after grazing, and the intensity of grazing on each species was assessed. At low stocking rates, grasses and tall species were most intensely grazed, while at higher stocking rates the intake of forbs and small species increased. Since no relationship was found between nutritional value and species preference, other factors such as accessibility of a plant seem to be important for the feeding preferences of cattle. The preference for grasses at low and medium stocking rates suggests that an increased growth of forbs might lead to an increase in plant species diversity.

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1. Introduction

Grazing in forests by cattle is probably the oldest known form of pasturing (Etienne, 1996) and has a long tradition throughout Europe. Its impact has shaped many forest ecosystems (Kuiters and Kirbyb, 1999). As forest grazing is the least intensive grazing system in Europe, it has lost much of its importance during the last century. However, especially farmers in mountain regions still depend on the additional forage in wood pastures to maintain their cattle herds. Thus 12% of the Swiss mountain forests are still grazed today, mainly by cattle (Brassel and Brändli, 1999). Mountain forests in the Alps traditionally yield several independent benefits at the same time, such as timber production, protection against natural hazards (e.g. avalanches and rockfall), recreation, and habitat for a diverse vegetation and wildlife. In consequence of those divergent interests, controversial discussions are going

on about the influence of grazing cattle on the regeneration of mountain forests in Switzerland as well as in neighbouring Alpine countries (Liss, 1989; Ten Klooster, 2000; Mayer et al., 2003), and there are attempts to reduce or even prohibit traditional forest grazing in the Swiss Alps (Delucchi, 1993).

The main interest in studies about wood pastures in alpine regions concentrates on the impact of cattle grazing on forest regeneration (e.g. Delucchi, 1993; Mayer et al., 2002). Although the ground vegetation is considered the most important component of silvopastoral systems (Gallandat et al., 1995), only a few studies (e.g. Putman, 1986; Rösch, 1992) focus on herbage selection by cattle in wood pastures. They are mainly concentrated on comparing species composition between grazed and ungrazed parts of the wood pasture. Although the knowledge about plant species selection by cattle is essential in order to qualify wood pastures (Rösch, 1992), little is known about the feeding behaviour of cattle in those biotopes. A better

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understanding of which factors influence plant species selection by cattle in heterogeneous areas might help to improve livestock systems and indicate how cattle can influence plant community change (Dumont, 1997). As wood pastures are not just used for agroforestry purposes but are also attractive for tourism (Gallandat et al., 1995) and support high biodiversity (Putman, 1996), both the intensity of browsing on young trees (Mayer et al., 2005) and the intensity of grazing on certain plant species in the ground vegetation should be considered as a basis for management decisions in wood pastures.

Our paper Mayer et al. (2003) concentrated on herbage selection on subalpine wood pastures. That study focussed primarily at digestibility and intake of herbage in order to determine the agricultural value of wood pastures. The present paper, however, deals with a much closer look at the feeding behaviour of cattle, presenting more detailed data not only from field studies but also from an experiment concerning different stocking rates. Feeding preferences of species, growth forms or site types under different grazing pressure are analysed to evaluate forest grazing as a management strategy. The study attempts to answer the following questions:

 (i) Which functional botanical groups are preferentially grazed by cattle in subalpine wood pastures?
 (ii) Which species are preferentially grazed and do cattle prefer species with a high nutritional value?
 (iii) Do cattle prefer species which are more easily accessible compared to others?
 (iv) How are cattle stocking rate and plant species selection related?
 (v) Which site types are preferentially grazed in subalpine wood pastures?
 (vi) Is forest grazing a valuable management strategy for subalpine forests concerning ground vegetation?

2. Material and methods

The study was conducted in two different regions using different approaches of investigation: at Region 1 (Dischma Valley) we chose the observational approach, while at Region 2 (Crapalv) an experimental approach was used.

2.1. Observational approach

2.1.1. Characteristics of the field study areas
This study was carried out in the Dischma Valley (46°46′ latitude N; 9°53′) near Davos in the Swiss Canton of Grisons. The soil in this area is a humus podzol (Krause and Peyer, 1986), derived from crystalline rocks (Bosshard, 1986). As Davos is a valley of the Central Alps but open to the northern part of the Alps, the climate has aspects of both continental and oceanic character. Compared to other Alpine regions, the annual precipitation is relatively low, reaching approximately 1050 mm per year including summer rain and winter snowfall (Günter, 1986). The growing season starts in May and ends in October. Thus, grazing is possible in this period only. During winter (November–April), avalanches are common natural hazards in the Dischma Valley (Brugger, 2003), creating and maintaining treeless vertical stripes through the forest belt.

The forest is mainly owned by farmers and has a selective logging history since settlement started in the 13th century (Laely, 1984). In 1873, the forest law of the canton Grisons was renewed and the utilisation of wood pastures by goats was banned. Since then, the wood pastures have been used mainly for grazing cattle.

The forests in the Dischma Valley are dominated by *Picea abies* L. Karst (Norway spruce) and *Larix decidua* Miller (European Larch); less frequently found tree species are *Pinus cembra* (Swiss Stone Pine) and *Sorbus aucuparia* (Rowan) (Bosshard, 1986). The ground vegetation represents a mosaic of different vegetation types. Further information on the study area and the grazing characteristics is given in a previous publication concerning the digestibility of the herbage on subalpine wood pastures (Mayer et al., 2003).

For our field study we chose six wood pasture areas traditionally stocked with cattle at different stocking rates. In the following, we call them "field study areas". The cattle stocking rate in summer 2000 ranged from 0.4 livestock units (LU; i.e., 600 kg body weight) per hectare (ha) to 2.8 LU ha^{-1}.

The field study areas are situated between 1560 and 2000 m a.s.l. and consist on average of 44% woodland, 31% open zone and 25% half-open zone (with shrubs and young trees). Field study area 1, the smallest of all field study areas, shows the highest cover with woodland (60%) belonging to the *Vaccinio-Piceion* (all of the following vegetation types are described in Landolt et al., 1986), but the spruce stand of field study area 1 is very open (approx. 100 trees ha^{-1}). The open part of the area comprises *Polygono-Trisetion* and, in the avalanche tracks, *Calamagrostietum villosae*. Field study area 2 is crossed by three avalanche tracks; thus open, half-open and wooded area alternate. Consequently, the vegetation represents a mosaic of different vegetation types including parts of *Nardion* for the open zones, *Rhododendron-Vaccinietum* and *Alnetum viridis* in the avalanche tracks and again *Vaccinio-Piceion* in the woodland. Spruce density is relatively high (approx. 350 trees ha^{-1}) in the upper parts and becomes more open (approx. 100 trees ha^{-1}) in the lower parts. Field study areas 3 and 4, which both are located at a south-facing slope, mainly consists of half-open zones with dense Norway spruce regeneration of an approximate height of 1–4 m, showing field study area 3 with the least number of species found (41). Again we find woodland belonging to *Vaccinio-Piceion* but also *Larici-Picetum* and open pastures of *Poion alpinae*. Field study areas 5 and 6 are close to the tree line; the forest contains approx. 200 spruces and larches (*L. decidua*) per hectare. Both field study areas include an avalanche track and open zones are characterized as *Nardion* and show a high number of species, especially field study area 5 with 72 different plant species (Table 1).

2.1.2. Vegetation sampling
On the field study areas, we selected plots of 20 cm × 20 cm which were systematically arranged on a grid of 50 m × 50 m in each field study area. The squares were marked with coloured nails inserted at each corner. To characterize the surrounding of the plot we assigned one of the following categories to each plot: forest, open forest, half-open zone, open zone.