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Effect of continuous grazing on forage quality, quantity and animal performance

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Abstract

The effects of different grazing intensities of heifers on sward parameters such as sward structure, plant species diversity, herbage growth and forage quality as well as individual live-weight gains and live-weight gains per pasture area were studied in an upland area in the northern part of the Czech Republic over 4 years (1998–2001). The sward was maintained at a target height of 5 and 10 cm under intensive (IG) and extensive (EG) grazing, respectively. The total biomass production was higher under the IG than the EG treatment. In the Czech upland conditions, double peak curves of biomass growth during the grazing season were more typical than curves with one high spring peak. Species that responded positively to both treatments were the predominately short growing *Trifolium repens*, *Taraxacum* spp., *Veronica arvensis* and *Agrostis capillaris*. Tall species like *Senecio ovatus*, *Alopecurus pratensis*, *Elytrigia repens* and *Aegopodium podagraria* were associated with unmanaged plots. Total crude protein contents and forage digestibility were higher under IG. The content of crude fibre showed a reverse effect. Seasonal live-weight output per hectare under IG was approximately 1.5 times higher than EG treatment. However, if state subsidies are included, EG can be more profitable under the current Czech conditions than IG and satisfies both farmers and nature conservation objectives.

Keywords: Grassland; Pasture; Extensification; Sward structure; Plant species diversity

1. Introduction

Cattle systems are of major importance in the uplands and mountainous areas of the Czech Republic. In the early 1990s economic transformation led to a decrease in livestock numbers; the number of cattle decreased from 3.36 million in 1990 to 1.127 million in 2003 (Czech Statistical Office, 2004). Despite some reforestation of grasslands of low productivity, the total area of permanent grasslands increased from 833,000 to 961,000 ha during this period, because part of the arable land was reseeded with grasses in less favoured areas. Expected conversion of arable land into grassland and low EU quotas for ruminants will probably support further extensification of grassland utilization (Kvapilík and Střeleček, 2003). Extensification is beneficial on account of the reduction or even avoidance of mineral fertilization as well as changes in the timing and frequency of sward defoliation. In practice, however, it could be dangerous due to the risk of temporary or permanent abandonment of marginal areas (Pavlů et al., 2005). Unmanaged meadows and pastures are estimated to account for 30% of the total area of grasslands in the Czech Republic (Hrabě and Müller, 2004). Extensive grazing seems to offer the most suitable solution to the problem of increasing grassland area and the reduction in livestock numbers. Several studies have shown that changes in management intensity could affect sward structure, plant species diversity, productivity as well as the nutritive value of the forage (Hofmann et al., 2001; Barthram et al., 2002; Gaisler et al., 2004; Marriott et al., 2005; White et al., 2004). In general, there is a negative relationship between plant

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species diversity, forage quality and biomass production, causing in many cases conflicts between farmers and nature conservation (Mitchley, 2001; White et al., 2004).

Extensive grazing promotes selective patch grazing, which results in an uneven distribution of grazing pressure, both within and between plant communities and plant species (Tainton et al., 1996; Rook et al., 2004). Patchiness created by extensive grazing is particularly important for nature conservation if it creates a patchwork in sward structure (Bakker, 1998; Adler et al., 2001). In practice it is, therefore, desirable to find a type of management acceptable for both agricultural and nature conservation targets (Watkinson and Ormerod, 2001).

Although the impact of extensification on grassland production is well documented in studies from western Europe (e.g. Treweek et al., 1997; Fothergill et al., 2001; Marriott et al., 2002; Garcia et al., 2003), data from continental parts of Europe are missing. The main purpose of this 4-year study in the Czech uplands was to investigate how intensive and extensive grazing affect a wide range of sward parameters such as growth rate of herbage, forage yields, sward structure, plant species diversity and forage quality. A further aim of the study was to detect individual live-weight gains of heifers and live-weight gains per grazed area under different grazing intensities.

2. Materials and methods

The experiment was carried out from 1998 to 2001 in an experimental pasture in the Jizerské Mountains in the northern Czech Republic, at an altitude of 420 m. The average annual precipitation in the area was 803 mm and the mean annual temperature was 7.2 °C. The geological substratum is granite underlying low deep brown soil (cambisol): pH/KCl = 5.1, C_{ox} = 3.9%, available P content = 64 mg kg^{-1}, available K content = 95 mg kg^{-1} and available Mg content = 92 mg kg^{-1}. The experimental area was drained, ploughed and reseeded with a highly productive grass/clover mixture in the 1980s and was intensively managed by cutting and grazing. In the early 1990s mulching was applied once a year only (in August) and then the grassland was abandoned. There was no agricultural management in the 5 years before the start of the experiment in 1998. The dominant species in 1998 were common bent (*Agrostis capillaris*), meadow foxtail (*Alopecurus pratensis*), red fescue (*Festuca rubra*), ground-elder (*Aegopodium podagraria*) and hedge bedstraw (*Galium album*). No fertilizers were used during the experiment.

The pasture was continuously stocked with growing heifers (1998–1999 Czech Pied, 2000–2001 Holstein) of 150–220 kg initial live-weights. The treatments were: intensive grazing (IG), extensive grazing (EG) and unmanaged control (U). The experiment was arranged in two completely randomized blocks. The paddock area for each IG and EG plot was approximately 0.35 ha, whereas the control area was 0.12 ha only. IG paddocks were grazed by two separate herds consisting of four to five heifers, while EG paddocks were grazed by two separate herds of two to three animals only. With the exception of the first week of the grazing season, no supplementary feed was supplied. The stocking density in the different treatments was adapted to the target sward height of 5 cm (IG) or 10 cm (EG) and was maintained by varying the grazing area available for the treatment. To maintain the target sward height, an additional non-sampled area with the required sward height for both IG and EG treatments was added in the course of the grazing season. The grazing seasons lasted from the end of April to the end of October.

2.1. Sward sampling

Sward height was measured using the first contact method (modified point quadrat method) weekly. Measurements were derived from the first perpendicular contact of a long needle at 0.20 m intervals (Pavlů and Velich, 1997). Sward height was calculated as a mean of 100 records on 20 m linear transect across each paddock. Herbage under four exclosure cages (1 m × 1 m) was harvested every 3–5 weeks in each paddock. Stable height was 5 and 10 cm in IG and EG treatment, respectively. The exclosure cages were relocated after sampling. The sward height under the exclosure cages was adjusted to the target sward height for different treatments after moving. The 3-week period for sampling was used at the beginning of the grazing season, a 4- and 5-week period in late summer and autumn, respectively.

Relevés were made in permanent 1 m × 1 m plots using a continuous grid of nine 0.33 m × 0.33 m subplots in four replications in each paddock. The proportional cover of all vascular species was recorded. Plots were visually estimated before the start of grazing in May each year from 1998 to 2001. An initial estimation was conducted before the first experimental manipulation in order to provide baseline data for each plot. Nomenclature of plant species follows Kubát et al. (2002).

Four samples of herbage in each treatment were taken by hand plucking every week to simulate grazing and were subsequently dried for 48 h at 70 °C. After drying, the herbage samples for 2 weeks were mixed and analyzed for crude protein (CP), crude fibre (CF) and in vitro digestibility organic matter (IVDOM). CP and CF were determined by Wenden's method (AOAC, 1984). IVDOM was estimated as the percentage of digested forage if fed to a ruminant. The analysis of digestibility was estimated by Steingass and Menke (1986) method. The digestion involved incubating forage samples inoculated with rumen fluid for 24 h in Vitrogest equipment.

The live-weight of the heifers was identified by weighing at regular monthly intervals. Performance of the heifers was recorded until the end of September, when extensive grazing in the EG treatment was finished.