

## Effects of breed on foraging sites and diet in dairy cows on mountain pasture

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### Abstract

Biodiverse semi-natural pastures are threatened because of sub-optimal grazing. The influence of breed on choice of foraging vegetation type, diet and hence pasture management was investigated in dairy cows kept on mountain pastures. Five dairy cows each of the traditional Swedish Mountain cattle breed and the commercial Holstein breed were equipped with GPS receivers measuring animal position for 6 h daily grazing time during 6 days. Plant groups in the ingested herbage were recorded visually for 30 min per cow and day. The grazing area, mapped using infra-red aerial photography combined with field work, consisted of ten vegetation types dominated by bilberry forest (33%), mixed forest (28%) and grass and sedge fen (12%). Although grass-dominated pasture comprised only 0.3% of the area, the cows spent on average 27% of their time there. Swedish Mountain cows spent less time in grass-dominated pasture than Holsteins (24% vs. 31%) but more time in bilberry forest (21 vs. 13%). Swedish Mountain cattle also travelled longer distances during grazing (6.3 vs. 5.0 km). This limited study revealed a general selection of grass-dominated pasture, but indicated that using traditional breeds can result in better management of other vegetation types.

Keywords: cattle, grazing, vegetation, selection

### Introduction

The semi-natural grasslands of northern Europe are habitats with a wide diversity of valuable plant and animal species. They are under threat because of the cessation of grazing in modern farming. In this context, multifunctional agriculture using summer farming areas in the traditional way can play an important role. Historically, village livestock spent their summers on mountain pasture, which provided an important complement to the feed supply at home. Animal breed selection has often been suggested as a tool for obtaining specific grazing effects, as livestock bred in traditional nutrient-poor environments may differ from livestock selected in more fertile environments (Rook *et al.*, 2004). For mountain pastures, differences in vegetation and diet selection between low-yielding traditional and high-yielding modern dairy cows have previously been reported by Sæther *et al.* (2006). However, to our knowledge, breed comparison studies of cows with similar milk yield are sparse. The aim of this study was to determine the foraging behaviour and site selection of two contrasting dairy cow breeds grazing mountain pastures and to identify selected foraging areas, thus contributing to the improvement of grazing management strategies.

### Materials and methods

The experiment was conducted over six days in late summer 2009 on mountain pasture at a summer farm in central Sweden (62°21'22" N; 13°20'19" E; elevation 810 m a.s.l.). The

heterogeneous pasture consisted of ten vegetation types, which were mapped by area using infra-red aerial photographs combined with field work.

Cows were released onto the pasture in the morning and returned voluntarily after, on average, 6 h. On their return, the cows were kept indoors until the next morning and were fed water, grass hay and concentrate. For the experiment, five cows of the traditional Swedish Mountain cattle breed (mean body weight 370 kg) and five cows of the modern Holstein breed (mean body weight 550 kg) within the herd were used. On average across breeds, their daily milk yield was 12.4 kg. Manual observations of foraging and ingested plant groups (grasses, herbs, sedges/rushes, dwarf shrubs, bushes/trees, fungi) were performed by focal sampling during 30 min per cow and day. Animal positions were recorded with GPS receivers (GPS Plus 2, Vectronic Aerospace GmbH, Berlin, Germany). Data of animal position, behaviour and pasture were merged in ArcMap version 9.2 (ESRI, Redlands, USA).

Selection ratio for vegetation type was defined as:

$$\frac{\text{Time spent in the vegetation type as a proportion of total time on pasture}}{\text{Area of the vegetation type as a proportion of the total grazing area}}$$

Breed effects were analysed in an ANOVA with breed, individual and day as fixed factors in the GLM procedure (SAS Institute Inc. Release 9.2. Cary, USA). Data on time spent in the vegetation types and on plants ingested were arcsin-transformed before analysing. Selection ratios among the vegetation types were compared in Friedman's test, FREQ procedure, SAS.

## Results

Although the single patch of grass-dominated pasture only comprised 0.3% of the area, the cows of both breeds spent on average 27% of their time there, resulting in a much higher selection ratio for this vegetation type than the others ( $P < 0.002$ ). Mixed forest was also selected ( $P < 0.002$ ), but all other vegetation types had selection ratios below 1.0 and hence were avoided (Figure 1). The Swedish Mountain cows travelled longer distances than the Holstein cows (Table 1) and spent less time in the grass-dominated pasture (24% vs. 31%;  $P = 0.007$ ), but more time in bilberry forest (21 vs. 13%;  $P = 0.006$ ).

Table 1. Time spent on pasture, distance travelled, proportion of time spent foraging, and proportion of time spent foraging grasses, herbs, sedges/rushes, dwarf shrubs, bushes/trees and fungi per day by Swedish Mountain ( $n = 5$ ) and Holstein ( $n = 5$ ) cows on mountain pasture; SEM = standard error of the mean

| Parameter                    | Swedish Mountain | Holstein | SEM | <i>P</i> |
|------------------------------|------------------|----------|-----|----------|
| Pasture time, h              | 6.1              | 6.4      | 0.2 | 0.073    |
| Distance, km                 | 6.3              | 5.0      | 0.2 | <0.001   |
| Foraging, %                  | 78.9             | 85.2     | 3.3 | 0.161    |
| Grass, %                     | 79.3             | 84.5     | 4.9 | 0.516    |
| Herbs, %                     | 0.2              | 0.3      | 0.2 | 0.994    |
| Sedges/rushes, %             | 17.0             | 9.9      | 4.8 | 0.345    |
| Dwarf shrubs, % <sup>a</sup> | 2.3              | 4.0      | 1.2 | -        |
| Bushes/trees, % <sup>a</sup> | 0.4              | 1.3      | 0.3 | -        |
| Fungi, % <sup>a</sup>        | 0.8              | 0.0      | 0.2 | -        |

<sup>a</sup>Too low proportions for differences to be analysed.

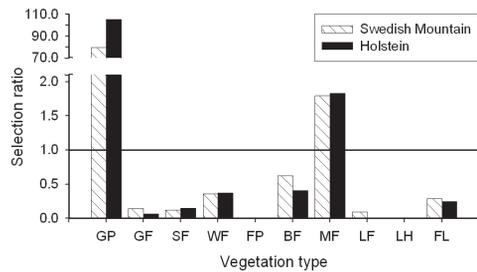


Figure 1. Selection ratio of five Swedish Mountain and five Holstein dairy cows for vegetation types on mountain pasture consisting of grass-dominated pasture (GP, 0.3%); grass and sedge fen (GF, 11.8%); wooded grass and sedge fen (SF, 7.7%); wet fen (WF, 4.4%); felling patch (FP, 3.0%); bilberry forest (BF, 33.1%); mixed forest (MF, 27.7%); lichen-rich Scots pine forest (LF, 4.8%); lichen heath (LH, 2.0%); and forest lake (FL, 5.3%)

## Discussion

The results from this limited study indicate that cows of a modern breed selected foraging areas with more digestible feeds, such as grass, to a higher extent than cows of a traditional breed, although no differences in proportion of grass ingested were found. The traditional breed travelled longer distances during grazing than the modern breed, which may be explained by more dispersed feed in the bilberry forest than in the grass-dominated pasture. The results are in agreement with previous studies (Sæther *et al.*, 2006; Dumont *et al.*, 2007). Contrary to Sæther *et al.* (2006), the differences in selection of vegetation type and diet observed here cannot be explained by differences in milk yield, but by a possible breed effect, caused for example by differences in body weight (Rook *et al.*, 2004). Cows of both breeds clearly selected to graze the patch of grass-dominated pasture. In general, the cows, after roaming around by themselves or in small groups, ended up together on the grass-dominated pasture, which was situated at a neighbouring summer farm. The pasture had historically been mowed and grazed, which had resulted in a dense grass-dominated flora with herbs and some sedges. The combination of high plant density and high nutrient content on the frequently managed patch is a probable explanation for its popularity and is in accordance with previous studies (Dumont *et al.*, 2007). The short distance to the home farm, 500 m, where no such grassland was available, could also have contributed to the selection of the patch. The cows to some extent also selected mixed forest for grazing. This vegetation type contained plenty of wavy hair-grass (*Deschampsia flexuosa*), which may explain this choice.

## Conclusions

This limited study revealed a general selection of grass-dominated areas in dairy cows on mountain pastures, but indicated that there is a better chance of also getting other vegetation types grazed when using a traditional breed, for instance Swedish Mountain cattle, rather than modern Holsteins.

## References

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