Effects of social learning on foraging behaviour and live weight gain in first-season grazing calves

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1. Introduction

Keeping livestock on semi-natural grasslands touches on both animal production and nature conservation concerns. Pasture management at the beginning of the grazing period may be of importance for the results for the entire period. At turn-out, an accelerated onset of grazing diminishes animal live weight losses caused by environmental and feeding changes (Wright et al., 1986). At the same time, effective defoliation of pasture herbage early in the grazing period inhibits competitive plants from maturing to their reproductive phase, with accompanied decrease in nutrient contents and, hence, risks of refusals and, finally, over-growing (Hessle et al., 2008; Pontes et al., 2007; Donaghy et al., 2008). Pasture management at turn-out can be improved by instituting changes in either the pasture or the animals. On semi-natural grasslands a comprehensive goal is to maintain the biodiverse vegetation and the grazing pressure. Therefore, improvements must be focused on the animals and their foraging. Foraging behaviour in a herd can be altered genetically or environmentally (Rook et al., 2004). However, the potential of improving nature conservation results by using specific breeds is limited (Dumont et al., 2007; Hessle et al., 2008; Scimone et al., 2007; Wallis de Vries et al., 2007). Instead, animal behaviour can be environmentally

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ABSTRACT

When livestock are turned out to semi-natural grasslands, an effective onset of grazing is important both for animal productivity and for defoliation of the sward, which preserve the biodiversity of the vegetation. The aim of this study was to investigate whether foraging behaviour of naïve calves turned out to pasture was more intense, with a resulting diminished live weight loss, when experienced cattle accompanied them acting as social models. Twenty-six first-season grazing (FSG) dairy calves, allocated to groups with or without company of older, grazing-experienced steers, were turned out to semi-natural grasslands. Cattle behaviour was automatically recorded for 24 h during the first day on pasture and during 24 h after 1 month. Furthermore, the average live weight changes for the first day and for the first month on pasture were calculated. Calves turned out to pasture accompanied by grazing-experienced steers had similar grazing times (on average 42.7% of the day) to calves turned out to pasture in groups without older steers, but they had higher grazing activity during the first day on pasture (score 124 vs. 99, \(P = 0.005\)). Live weight changes were similar in calves kept with as in calves kept without company of grazing-experienced steers (\(-4.60\) kg for the first day and \(-0.30\) kg day\(^{-1}\) for the first month on pasture). In conclusion, the company of grazing-experienced conspecifics resulted in higher grazing activity in naïve calves, but their time spent grazing and live weight gains were unmodified. Hence, in this limited study we found no major positive effects on production of using grazing-experienced cattle as company to FSG calves on semi-natural grasslands.

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manipulated through learning. In maternal gregarious herbivores, evolutionary process has favoured a development where social learning plays an important role in the evolving foraging skills of the infants (Launchbaugh and Howery, 2005). The dam is the primary social model for the young, but other dominant conspecifics are also important for foraging learning (Thorhallsdottir et al., 1990; Howery et al., 1998). Furthermore, nearness of older herd members contributes to feelings of security in young calves (Green, 1992).

In some regions, such as the Nordic countries, dairy breeds compose the majority of the national cattle stock and therefore of possible grazers of semi-natural grasslands (Information Centre of the Ministry of Agriculture and Forestry, 2006; Official Statistics of Norway, 2007; Official Statistics of Sweden, 2007; Statistics Denmark, 2007). First-season grazing (FSG) dairy calves are turned out to pasture without company of their dams. With no experience of foraging in this novel environment, these naïve grazers may adopt a modest foraging behaviour, resulting in suboptimal pasture management and live weight gains.

Harris et al. (2007) have suggested that knowledge of social behaviour can be a tool for improving pasture management. Several experimental studies of the effects of social learning on foraging behaviour have been undertaken (i.e. Thorhallsdottir et al., 1987; Bailey et al., 2000; Ksiksi and Laca, 2000), but few studies have examined the phenomenon in applied pasture management.

The aim of this study was to evaluate the effects of turning out FSG dairy calves on semi-natural grasslands together with experienced conspecifics on calves’ behaviour and live weight changes during their first month of pasture.

2. Materials and methods

2.1. Study site

The experiment was conducted in the spring of 2005 on 18 ha of semi-natural grasslands at Götaåland Research Station, Skara, in south-western Sweden (longitude 13°21’E, latitude 58°42’N; elevation 150 m). Areas were mapped and their acreage estimated by a global positioning system (GPS) receiver with a precision of 1 m (Trimble Pro X1, Trimble®; Trimble Navigation Ltd., Sunnyvale, CA, USA). The grassland was divided into six enclosures (2.2–4.1 ha), all of which consisted of dry (10–26% of each paddock), mesic (55–71%) and wet (12–24%) areas. The pasture was mainly open, but included small areas of mixed deciduous trees. In general, the dominating plant species was mainly Deschampsia cespitosa (tufted hairgrass) but Festuca rubra (red fescue) was also prominently present. In dry areas, Festuca ovina (sheep’s fescue), Deschampsia flexuosa (waxy hairgrass), Nardus stricta (matgrass) and several herb species were abundant. Besides D. cespitosa and F. rubra, herbs were prevalent in mesic areas, while D. cespitosa and Cyperaceae (sedges/rushes) are dominant in wet areas. Water, salt and minerals were supplemented to the animals.

2.2. Animals

The study included 26 FSG steer calves, born in the summer of 2004, and six older grazing-experienced steers, born in the summer of 2003. All animals were of the dairy breed Swedish Red and had been purchased from commercial herds as weanlings at 2–3 months of age. During the pre-experimental indoor period, all animals were fed total mixed rations consisting of whole-crop barley silage, rolled barley and soybean meal ad libitum, with minerals and vitamins added in adequate amounts. During the previous grazing period (May–October 2004), the older steers had grazed semi-natural grasslands, which were similar to, but not the same as, the experimental ones. From weaning to the start of the experiment, average live weight gains were 0.71 and 0.73 kg day$^{-1}$ for calves and older steers, respectively. During the indoor period, the animals were trained to wear experimental equipment.

Two weeks before turn-out to pasture, calves and steers were randomly allocated to six groups of six animals each. In eating bouts (Sibly et al., 1990), the calves were accompanied by two of the grazing-experienced steers, while the calves in the remaining three groups were kept in the groups by themselves. When dividing the animals, similar stocking rates among the pasture enclosures were attained, resulting in 1.8 (standard deviation (S.D.) 0.4) animals ha$^{-1}$. At turn-out, the average age of the calves was 10.6 (S.D. 0.7) months corresponding to a live weight of 260 (S.D. 37) kg. The average age of the steers was 21.3 (S.D. 0.3) months of age, and animals had a 509 (S.D. 31) kg live weight. Animals were subjected to recommended prophylactic anti-helminthic treatments.

2.3. Behaviour recording

Behaviour recording in the calves and the grazing-experienced steers was performed for 24 h at turn-out to pasture (2–5 May) and after 1 month in the pasture (31 May–4 June; Table 1). Jaw movements, i.e. bites (prehensions) and chews (mastications), were recorded automatically using Institute for Grassland and Environmental Research (IGER) behaviour recorders (Rutter et al., 1997). Eating and ruminating jaw movements were distinguished by their appearances using the Graze software (Rutter, 2000). "Eating time" was defined as the time spent performing eating jaw movements and "grazing time" was defined as eating time plus pauses $<$ 7 min between eating bouts (Sibly et al., 1990). The proportion of grazing time consisting of eating time was calculated and defined as grazing efficiency. "Ruminating time" was defined as time spent ruminating jaw movements plus pauses $<$ 20 s between ruminating jaw movements. "Idling" was defined as time not spent grazing or ruminating.

Animal position was recorded every 15 s using collars equipped with GPS receivers, resulting in 5272 (S.D. 456) position fixes on average per animal on each recording day (GPS Plus 2; Vectronic Aerospace GmbH, Berlin, Germany). Head movements were measured by two orthogonally orientated accelerometer sensors on the collars, located at the animal's back of the neck, measuring the acceleration six to eight times per second. The differences between two measurements were automatically accumulated over 5 min and the average value stored (GPS Plus 2; Vectronic Aerospace GmbH, Berlin, Germany). Data for each 5-min interval were then automatically scaled to numerical values from 0 (no activity) to 255 (maximum activity) in the two directions, resulting in a final activity value on a score of 0–361, according to the Pythagorean theorem. The final value, previously found to correspond to observed activity levels (Coulombe et al., 2006; Gervasi et al., 2006), was defined as the activity score. The average activity score was calculated for 24 h as well as separately for the time animals spent grazing, ruminating and idling, respectively. Animal position data were downloaded to a computer and merged with pasture area data using the geographic information system (GIS) software ArcMap (ESRI, 2006) and travelling distances for each animal were calculated.

Behavioural recording was performed for one group of calves with and one group of calves without company of grazing-experienced steers each day for 3 consecutive days (Table 1). Each recording day, foraging behaviour, activity as well as travelling distance data were recorded from three calves in each of the two calf groups and from the two steers in the calf group including grazing-experienced steers. Because of technical failure, at turn-out only one or two jaw movement records were obtained from calves in each of the six groups (in total, seven calves) and from four steers in total. At the 1-month recordings, records for two or three calves in each group (in total, 16 calves) and for three steers in total were completed.

2.4. Live weight gain

Live weight was recorded for all 26 calves and all six grazing-experienced steers immediately before turn-out, the day after turn-out, and after 1 month on pasture. Average live weight changes were calculated for the first day in the pasture, reflecting changes in rumen digesta and thereby herbage intake on the last day, and for the first month on the pasture.
Table 1
Description of six paddocks of semi-natural grasslands used (A–F), treatments (company × calf groups kept with or without company of grazing-experienced steers; time × at turn-out and after 1 month of grazing), animals, pasture acreage and composition, recording dates and average sward heights (standard deviations in parentheses)

<table>
<thead>
<tr>
<th>Paddock</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatments Company</td>
<td>Without</td>
<td>With</td>
<td>Without</td>
<td>With</td>
<td>Without</td>
<td>With</td>
</tr>
<tr>
<td>Time</td>
<td>Both</td>
<td>Both</td>
<td>Both</td>
<td>Both</td>
<td>Both</td>
<td>Both</td>
</tr>
<tr>
<td>Animals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calves (n)</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Steers (n)</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Pasture</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acreage (ha)</td>
<td>2.2</td>
<td>2.5</td>
<td>2.7</td>
<td>4.1</td>
<td>3.0</td>
<td>3.6</td>
</tr>
<tr>
<td>Dry area (%)</td>
<td>17</td>
<td>21</td>
<td>10</td>
<td>13</td>
<td>26</td>
<td>22</td>
</tr>
<tr>
<td>Mesic area (%)</td>
<td>71</td>
<td>57</td>
<td>70</td>
<td>63</td>
<td>57</td>
<td>55</td>
</tr>
<tr>
<td>Wet area (%)</td>
<td>12</td>
<td>22</td>
<td>20</td>
<td>24</td>
<td>16</td>
<td>23</td>
</tr>
<tr>
<td>At turn-out</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recording date</td>
<td>2–3 May</td>
<td>2–3 May</td>
<td>3–4 May</td>
<td>3–4 May</td>
<td>4–5 May</td>
<td>4–5 May</td>
</tr>
<tr>
<td>Sward height (cm)</td>
<td>3.4 (0.9)</td>
<td>2.9 (1.0)</td>
<td>2.9 (1.5)</td>
<td>2.6 (0.8)</td>
<td>2.7 (0.5)</td>
<td>2.8 (0.7)</td>
</tr>
<tr>
<td>After 1 month</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recording date</td>
<td>31 May–1 June</td>
<td>31 May–1 June</td>
<td>2–3 June</td>
<td>2–3 June</td>
<td>4–5 June</td>
<td>4–5 June</td>
</tr>
<tr>
<td>Sward height (cm)</td>
<td>5.7 (1.1)</td>
<td>5.2 (2.1)</td>
<td>6.1 (2.0)</td>
<td>5.5 (1.8)</td>
<td>6.3 (1.5)</td>
<td>6.1 (1.5)</td>
</tr>
</tbody>
</table>

2.5. Herbage and weather

Sward height in each enclosure was measured at turn-out to the pasture and 1 month after turn-out. A route for sward height measurements was established by mapping out a path to be followed that passed through all parts of the enclosures. The path followed the shape of a W in each enclosure, as recommended by Frame (1993). Sward height measurements were performed with a rising plate meter (0.3 m × 0.3 m with a weight of 430 g), with 25–40 recordings in each enclosure.

To estimate chemical composition, 12–15 herbage samples were hand-plucked in 3 m diameter circles along the routes in each enclosure in imitation of foraging cattle. Samples were pooled to one sample for all enclosures per time (at turn-out and after 1 month). Herbage samples were analysed for concentrations of dry matter (DM), ash, crude protein (CP), neutral detergent fibre (NDF) and in vitro organic matter digestibility (Lindgren, 1979). The DM concentration was determined at 105 °C for 24 h, while ash concentration was determined at 550 °C for 5 h. The CP was determined in a Tecator Kjeltec Auto Sampler 1035 Analyzer (Tecator Inc., Höganäs, Sweden) and NDF was determined according to Goering and Van Soest (1970). Metabolizable energy (ME) concentration was calculated from in vitro organic matter digestibility (Lindgren, 1979).

Weather data were collected continuously every hour by an automatic station no further than 500 m from the enclosures.

2.6. Statistical analyses

Statistical analyses were performed for calves and steers separately. Data from individual animals were averaged over enclosure, resulting in three replicates per treatment combination. Data of behaviour, activity and distance travelled were observed to be approximately Poisson-distributed and, therefore, analysed using log-linked Poisson regression models in Proc Genmod (SAS, 2003). Data of live weight gains were observed to be approximately normally distributed and were therefore analysed using a general linear model in Proc GLM (SAS, 2003).

For calf data on live weight gain, the analysis included one fixed factor, company of grazing-experienced steers (with or without), using the model

$$y_{ijkl} = \alpha_i + \beta_j + \alpha\beta_{ij} + e_{ijkl}$$

where \(\alpha_i\) is the effect of company, \(\beta_j\) is the effect of time, \(\alpha\beta_{ij}\) is the interaction between company and time, and \(e_{ijkl}\) is the error term.

For data on behaviour, activity and distance travelled for grazing-experienced steers, the model included one fixed factor, namely time of recording (at turn-out or after 1 month), as follows

$$y_{ijkl} = \beta_i + e_{ijkl}$$

where \(\beta_i\) is the effect of time and \(e_{ijkl}\) is the error term.

For calf data on live weight gain, the analysis included one fixed factor, company of grazing-experienced steers (with or without), using the model

$$y_{ijkl} = \alpha_i + e_{ijkl}$$

where \(\alpha_i\) is the effect of company and \(e_{ijkl}\) is the error term.

The procedure t-test was used for sward heights (SAS, 2002). Differences among treatment means were denoted as significant at \(P < 0.05\) and as showing a tendency to significance at \(0.05 < P < 0.10\).

3. Results

3.1. Herbage and weather

The sward heights were similar among the enclosures during the experiment but were lower at turn-out than 1 month after turn-out (\(P < 0.001\); Table 1). Herbage DM content was 18% and 25% at turn-out and after a month, respectively. Herbage concentrations of CP, NDF and ME were 148 g, 604 g and 8.7 MJ kg\(^{-1}\) DM, respectively, at turn-out and 174 g, 513 g and 11.4 MJ kg\(^{-1}\) DM, respectively, 1 month later.

Average temperatures on the days of behaviour recordings were 9 °C at turn-out to pasture and 10 °C, 1 month later. Daily precipitation was <5 mm during all behaviour-recording days.

3.2. Behaviour

For the FSG calves, the effects of time (the initial day after turn-out vs. a day after 1 month) were generally more pronounced than effects of company of grazing-experienced steers (Table 2). Calves with or without the company of grazing-experienced steers spent similar proportions of
the days grazing and ruminating, but calves accompanied by steers tended to spend less proportion of the day idling (Table 2). Calves and grazing-experienced steers spent similar proportions of the day grazing and idling, but about 30% less proportions of the day ruminating, on the initial day after turn-out than they did 1 month later (Tables 2 and 3).

At turn-out, calves spent on average 1 h on the pasture before they started to graze, compared with only 2 min after 1 month (Table 2). Company of grazing-experienced steers accelerated the onset of grazing for the calves by 4 min, averaged over the two times. Calves with company of steers started their initial ruminating bout 154 min earlier than calves without company at turn-out ($P < 0.001$), but they started to ruminate 21 min later after 1 month ($P = 0.017$). Both calves and grazing-experienced steers had delayed onset of ruminating at turn-out compared with 1 month later (Tables 2 and 3).

For both calves and grazing-experienced steers, grazing efficiency was lower at turn-out than after 1 month (Tables 2 and 3) and for the calves, the lower grazing efficiency was accompanied by a lower number of chews (Table 2). Being in the company of grazing-experienced steers tended to result in more bites but fewer chews during calves’ grazing (Table 2).

During grazing bouts at turn-out, activity score, measuring head movements, was 25% higher for calves with company of grazing-experienced steers than for calves kept in groups by themselves ($P = 0.005$). However, after 1 month, activity score during grazing was similar between the two groups. The total activity of the calves was scored as 36% higher during the first day on pasture than after having grazed for 1 month, comprising 26% and 225% higher activity scores during ruminating and idling, respectively (Table 2). Also, grazing-experienced steers had a higher total activity score at turn-out compared with 1 month later, with activity during grazing and idling being 25% and 130% higher, respectively (Table 3).

Calves and grazing-experienced steers travelled 50% and 52% longer distances, respectively, during their first

### Table 2
First-season grazing calves on semi-natural grasslands with (three groups) or without (three groups) company of grazing-experienced steers, studied for 24 h at turn-out and after 1 month on pasture.

<table>
<thead>
<tr>
<th>Variables</th>
<th>At turn-out</th>
<th>After 1 month</th>
<th>SD</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Beavour (% of day)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grazing</td>
<td>45.7</td>
<td>34.5</td>
<td>42.7</td>
<td>38.8</td>
</tr>
<tr>
<td>Ruminating</td>
<td>22.2</td>
<td>16.2</td>
<td>28.5</td>
<td>27.5</td>
</tr>
<tr>
<td>Idling</td>
<td>32.2</td>
<td>40.3</td>
<td>28.7</td>
<td>33.7</td>
</tr>
<tr>
<td><strong>Time to first bout (min)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grazing</td>
<td>60</td>
<td>65</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Ruminating</td>
<td>434$^{b}$</td>
<td>588$^{a}$</td>
<td>155$^{c}$</td>
<td>134$^{d}$</td>
</tr>
<tr>
<td><strong>Grazing efficiency (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bites $\times$ 1000</td>
<td>28.2</td>
<td>23.8</td>
<td>32.6</td>
<td>26.3</td>
</tr>
<tr>
<td>Chews $\times$ 1000</td>
<td>9.1</td>
<td>11.3</td>
<td>10.1</td>
<td>12.2</td>
</tr>
<tr>
<td><strong>Activity (score)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>90</td>
<td>71</td>
<td>69</td>
</tr>
<tr>
<td>Grazing</td>
<td>124$^{a}$</td>
<td>99$^{b}$</td>
<td>129$^{a}$</td>
<td>131$^{d}$</td>
</tr>
<tr>
<td>Ruminating</td>
<td>31</td>
<td>29</td>
<td>20</td>
<td>21</td>
</tr>
<tr>
<td>Idling</td>
<td>120</td>
<td>102</td>
<td>32</td>
<td>37</td>
</tr>
<tr>
<td><strong>Distance (km)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>19.0</td>
<td>16.2</td>
<td>11.6</td>
<td>11.8</td>
</tr>
</tbody>
</table>

**Note:** Variables include behaviour (idling = not performing jaw movements), time to first expression of behaviour, grazing efficiency (eating time as proportion of grazing time), number of bites and chews, and activity (scored from acceleration measurements) averaged over 24 h (total) and during grazing, ruminating and idling, as well as distance travelled. S.D. is standard deviation pooled for the two combinations of company and time. Levels of significance for effect of company, time, or interaction of company and time ($C \times T$): ns = non-significant, $P > 0.10$; ic = incalculable. $A.K. Hessle / Applied Animal Behaviour Science 116 (2009) 150–155 153$
day in the pasture than during a day after 1 month of grazing (Tables 2 and 3). Calves with and calves without the company of grazing-experienced steers travelled similar distances (Table 2).

3.3. Live weight changes

Live weight changes in FSG calves, with or without company of grazing-experienced steers, were similar during the first day (average −4.60 kg) and the first month (average −0.30 kg day−1) on the pasture. Average live weight changes for grazing-experienced steers were −7.44 kg during the first day on the pasture and 0.14 kg day−1 over the first month.

4. Discussion

Both calves and grazing-experienced steers travelled longer distances and had higher activity, but lower grazing efficiency, at turn-out in comparison with 1 month later. The results indicate that the animals may initially have roamed to investigate their new environment, which agrees with earlier studies (Kisiksi and Laca, 2000; Rook et al., 2005). Such spatial learning aims to survey prospective foraging sites and results in higher feed intake (Rook et al., 2005). The usefulness of spatial learning is particularly pronounced in low-resource density areas with aggregated distribution of herbage, such as heterogeneous semi-natural grasslands (Kisiksi and Laca, 2000; Rook et al., 2005).

It should be noted that the initial lower grazing efficiency may be an effect not only of spatial learning but also of herbage supply. At turn-out, sward heights were lower than 1 month later, which may have resulted in less efficient grazing with smaller bites (Cazcarra and Petit, 1995) and hence, slower feed intake, which was indicated by the lower number of chews in the calves. However, our animals did not try to compensate for the lower grazing efficiency by increasing the number of bites or by spending more time grazing, which was the case in the Cazcarra and Petit (1995) study. Furthermore, at turn-out in our study the tender annual plant shoots were mixed with dead material from the previous growing season, resulting in low-nutritious herbage with high fibre content. The initial lower grazing efficiency and fewer chews may be explained by the animals’ tendency to continue their search for more preferred plots to graze instead of remaining at a possible grazing site (Dumont et al., 2002).

Spatial learning of new foraging areas may be enhanced by using experienced animals to act as social models. Ganskopp and Cruz (1999) found that grazing-experienced cattle turned out to heterogeneous pastures are focused on a smaller number of plant species than naïve grazers are and they also have higher bite rates. At turn-out in our study, calves accompanied by grazing-experienced steers had higher activity scores, indicating more head movements during grazing compared with calves kept in groups by themselves, which may be explained by the phenomenon of social learning. The increase in head movements agrees with the tendency in these calves to perform more bites, while the lower number of their chews may be explained by their numerous searching bites to be less comprehensive. However, after 1 month the grazing activity was similar in calves with and calves without company of grazing-experienced steers. Previous studies (Kisiksi and Laca, 2000) have shown that naïve grazers are quick to learn their foraging areas and they search feed better than expected by chance already within a few days.

Unrelated, experienced conspecifics as social models for inexperienced ruminants during foraging learning have been experimentally investigated with varying results. Kisiksi and Laca (2000) found that naïve calves were more efficient in finding preferred food locations in the presence of experienced steers as social models. By contrast, Bailey et al. (2000) failed to improve foraging ability in cattle by using experienced conspecifics. Lambs reared together with their dams or other ewes as social models performed a faster feed intake than orphan lambs (Thorhallsdottir et al., 1987, 1990).

In the present study, although there were effects of company on calves’ activity scores, their grazing time, grazing efficiency and live weight changes were unmodified. Whether calves had company of experienced steers or not, they lost 4.6 kg, corresponding to 1.8% of their live weight, during their first 24 h on pasture. Similar losses of rumen digesta in the two groups indicate that they had the same feed intakes, which is in agreement with Thorhallsdottir et al. (1987, 1990) who found lambs reared with their dams or other ewes as social models had similar feed intakes to orphan lambs. Also averaged over the complete first month on pasture, live weight changes were similar in calves kept together with grazing-experienced steers and in calves kept in groups by themselves. The results are in agreement with Thorhallsdottir et al. (1987) and Green (1992), who failed to find any positive effects of conspecific social models on live weight gains in young ruminants.

One might speculate if the live weight gains remained unmodified in calves with company of grazing-experienced steers, in spite of a higher grazing activity accompanied by a supposed higher energy intake, because of a more energy-expensive behaviour in these calves. However, Gervasi et al. (2006) investigated measurements of activity by the same sensors as in this study. Although activity scores were positively correlated to head movements, the scoring gave no information on body movements or animal energy expenditures (Gervasi et al., 2006). Instead, the authors suggested distance travelled to be a better indicator of energy-expensive behaviours and in the present study, no differences in distances travelled were found.

Besides social learning, the initial higher foraging activity in calves kept together with older steers may be explained by an increased feeling of security in these animals, which may be indicated by the shorter time span to first ruminating at turn-out of these calves. Young gregarious ruminants are aware of the anti-predator effect of proximity of older conspecifics (Green, 1992). Therefore, although no economical advantage from increased live weight gains may be obtained from using grazing-experienced steers as company to FSG calves, farmers may benefit by making the bunch calmer and easier to handle. Social interactions may, however, also interact
negatively with foraging behaviour as animals may stay in
a popular foraging plot with herd members for longer than
is optimal from a herbage intake aspect (Boissy and
Dumont, 2002). Furthermore, mixing younger and older
cattle immediately at turn-out to pasture may result in
more time spent on social behaviour such as aggression
and, hence, less time spent on grazing, accompanied by
decreased production (Philips and Rind, 2001).

5. Conclusions

The results of this limited study indicate that the
company of grazing-experienced cattle at turn-out to
pasture did not increase grazing time, grazing efficiency
or live weight gains in FSG calves. However, calves in the
company of experienced onspecifics were more active
during grazing compared with calves kept in groups by
themselves. To summarize, we found no major positive
effects on production of using grazing-experienced cattle
as company to FSG calves on semi-natural grasslands.

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References

locating feeding sites by cattle in an eight-arm radial maze. Appl.

Boissy, A., Dumont, B., 2002. Interactions between social and feeding
motivations on the grazing behaviour of herbivores: sheep more easily split
Sci. 79, 233–245.

Cazcarra, R.F., Petit, M., 1995. The influence of animal age and sward
height on the herbage intake and grazing behaviour of Charolais

Coulombe, M.-L., Massé, A., Côte, S.D., 2006. Quantification and accuracy
of activity data measured with VHF and GPS telemetry. Wildlife Soc.
Bull. 34, 81–92.

management on water-soluble carbohydrate energy reserves, dry
matter yields, and herbage quality of tall fescue. Agronomy J. 100,
122–127.

Dumont, B., Carrere, P., D’Hour, P., 2002. Foraging in patchy grasslands:
diet selection by sheep and cattle is affected by the abundance and

breed and grazing intensity on biodiversity and production in grazing

ESRI, 2006. ArcMap™ 9.2. ESRI®, Redlands, CA, USA.


Ganskopp, D., Cruz, R., 1999. Selective differences between naive and
experienced cattle foraging among eight grasses. Appl. Anim.
Behav. Sci. 62, 293–303.

Gervasi, V., Brunberg, S., Swenson, J.E., 2006. An individual-based method
to measure animal activity levels: a test on brown bears. Wildlife Soc.
Bull. 34, 1314–1319.

Goering, H.K., Van Soest, P.J., 1970. Forage fiber analysis (apparatus,
reagents, procedures and some applications). Agric. Handbk. No.

Green, W.C.H., 1992. Social influences on contact maintenance interac-
tions of bison mothers and calves: group size and nearest-neighbour
distance. Anim. Behav. 43, 775–785.

associations and dominance of individuals in small herds of cattle.
Rangeland Ecol. Manage. 60, 339–349.

Hessel, A., Rutter, M., Wallin, K., 2008. Effects of breed, season and pasture
moisture gradient on foraging behaviour in cattle on semi-natural

Howery, I.D., Provenza, F.D., Banner, R.E., Scott, C.B., 1998. Social and
environmental factors influence cattle distribution on rangeland.
Appl. Anim. Behav. Sci. 55, 231–244.

Information Centre of the Ministry of Agriculture and Forestry, 2006.


patterns of livestock as a consequence of foraging behavior. Range-

Lindgren, E., 1979. The nutritional value of roughages determined in
Swedish University of Agricultural Sciences, Uppsala, Sweden (in
Swedish).


including Food Statistics, p. 97.

Philips, C.J.C., Rind, M.I., 2001. The effects on production and behavior of
mixing uniparous and multiparous cows. J. Dairy Sci. 84, 2424–2429.

Seasonal productivity and nutritive value of temperate grasses found
in semi-natural pastures in Europe: responses to cutting frequency

Rook, A.J., Dumont, B., Isselstein, J., Osoro, K., Wallis de Vries, M.F., Parente,
G., Mills, J., 2004. Matching type of livestock to desired biodiversity

on spatial memory and learning by foraging sheep. Appl. Anim.
Behav. Sci. 95, 143–151.

Rutter, S.M., 2000. Graze: a program to analyze recordings of the jaw
movements of ruminants. Behav. Res. Methods Instrum. Comp. 32 (1),
86–92.

Behav. Sci. 54, 185–195.


breed and grazing intensity on grazing systems. 3. Effects on diversity

Anim. Behav. 39, 63–69.


learning in lambs with or without a mother: discrimination, novelty,

learn about novel foods while observing or participating with social

Wallis de Vries, M.F., Parkinson, A.E., Dulphy, J.P., Sayer, M., Diana, E.,
2007. Effects of livestock breed and grazing intensity on biodiversity
and production in grazing systems. 4. Effects on animal diversity.
Grass Forage Sci. 62, 185–197.

supply for ruminants: part 1, the effects of grassland type and
moisture gradient on water-soluble carbohydrate energy reserves.
Grass Forage Sci. 62, 185–197.