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Diet choice in grazing sheep: A new approach to investigate the relationships between preferences and intake-rate on a daily time scale

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Abstract

For the herbivore grazing heterogeneous vegetation, optimal foraging theory has been proposed to predict which food components would be included in the diet on the basis of their relative profitability. We investigated the relationships between preferences and intake-rate in four groups of six ewes grazing down during 10 days conterminal monocultures of *Lolium perenne* L. (L)–*Festuca arundinacea* L. (F) 0.50:0.50 by area, at a stocking rate of 92 ewes ha^{-1}. Both herbage species were initially offered at the same height (228 mm). The experimental design was repeated over 2 years, with two groups of ewes in each year.

Diet composition and time spent grazing each species were measured daily for all animals, using the *n*-alkane technique and automated photographs. The organic matter intake-rate ratio between L and F ($OMIR_L/OMIR_F$) was calculated from the proportion of L in the diet (x_L) and the proportion of grazing time spent on L (y_L) using the following equation: $OMIR_L/OMIR_F = (y_L(1 - x_L))/(x_L(1 - y_L))$. The digestible organic matter intake-rate ratio between L and F ($DOMIR_L/DOMIR_F$) was calculated from $OMIR_L/OMIR_F$ and OM digestibility of the grazed horizon in each species.

There was an initial marked preference for L, but the preference for L declined linearly until day 6 of the trial, after which there was no preference for either species. The decrease in preference for L was mediated via an increase in the time spent grazing F rather than a decrease in the time spent grazing L. Ratio of digestible OM intake-rate between L and F ($DOMIR_L/DOMI_F$) was higher than

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unity before day 5, and close to unity thereafter. The number of transitions between the two herbage species during feeding bouts increased linearly from the beginning of the depletion until day 5, at which time it was doubled, then it levelled off. This pattern probably reflected the level of difficulty for the animal in choosing between both species, the highest difficulty occurring when alternatives offered a similar DOMIR. These results are consistent with the optimal foraging paradigm, but further research is needed to support the direction of causality between DOMIR and preferences. We observed a marked interindividual variability in preferences, highlighting the importance of the number of animals under study.

Keywords: Foraging; Intake-rate; Preference; Selection; Optimal foraging

1. Introduction

Since grazing animals generally consume forages selectively, predictions of their nutrient intake and of the location and intensity of the impact on heterogeneous vegetations need an understanding of the animals' foraging decisions. The optimal foraging paradigm has been proposed as a general framework to predict which food components would be included in the diet based on estimates of their profitability (Stephens and Krebs, 1986). This study was conducted to investigate the relationships between preferences and energy intake-rate (IR) in sheep depleting conterminal monocultures of two herbage species offered initially at the same height. It is well known that preference for a plant species depends on its relative availability (Prache et al., 1997; Harvey and Orr, 2000; Carrère et al., 2001). If one assumes that the maximization of energy IR is a valid representation of the animal's behaviour, animal choices may be predicted from the relative energy IR between both species. When sward height is similar for both species at the beginning of the grazing down, sheep are assumed to spend most time feeding from the species allowing the highest IR. However, if grazing pressure is higher than the herbage growth of the preferred species, the height of this species will decline, and at some stage the animals are assumed to partly switch to the initially less-preferred species, as IR becomes equal on both species.

In most studies, energy IR maximization has been simplified into maximization of instantaneous dry matter IR. Some of these studies have shown that herbivores can discriminate among patches in response to differences in IR (Black and Kenney, 1984; Demment et al., 1993; Illius et al., 1999). However, the application of optimal foraging principles for prediction of diet composition has not met with success in a study by Prache et al. (2002) in sheep depleting conterminal monocultures of two herbage species offered initially at the same height. Nevertheless, IR was measured in this latter study at a short-term scale and with fasted animals. Furthermore, data were obtained on a small number of animals, which may be an issue considering the high interindividual variability in sheep diet choices (Prache et al., 1998).

To explore this matter further and address these issues, we investigated the relationships between preferences and IR in sheep depleting conterminal monocultures of two herbage species by using a new approach enabling (i) measurements to be taken for