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RELATIONSHIPS BETWEEN SPATIAL DISTRIBUTIONS OF HERBAGE MASS AND UTILIZATION IN A PASTURE PROGRESSIVELY GRAZED BY CATTLE

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Abstract

To obtain some information about the mechanisms behind the spatially heterogeneous grazing of a pasture by large herbivores, the relationships between the spatial distributions of herbage mass, herbage consumption and ingestive behavior were investigated on a bahiagrass (*Paspalum notatum* Flügge) pasture during a 6-day grazing period with cattle. The animals almost always consumed more herbage from locations with higher pre-grazing herbage masses, which was attributed to greater bite weights. It was suggested that the high spatial heterogeneity in the rate of defoliation was caused mainly by the spatial heterogeneity in both the bite weight and the number of visits when the mean pre-grazing herbage mass of the pasture was relatively high, and by the spatial heterogeneity in the bite weight when the mean pre-grazing herbage mass was relatively low.

Keywords: Spatial distribution, spatial heterogeneity, herbage mass, herbage consumption, ingestive behavior

Introduction

In the previous paper (Hirata and Ogura, 2001), we monitored the spatial distribution of the pre-grazing herbage mass, rate of defoliation and three ingestive behavior variables (i.e. number of visits, residence time and rate of biting) in a bahiagrass (*Paspalum notatum* Flügge) pasture under progressive grazing with cattle. It was shown that the rate of defoliation was the most heterogeneous variable, followed by the number of visits, residence time, pre-grazing herbage mass and rate of biting. The spatial heterogeneity in the rate of defoliation reflects the heterogeneity in ingestive behavior, which in turn reflects the heterogeneity in pasture characteristics (e.g. quantity and quality of herbage). Therefore, in this paper, we examined the relationships between the spatial distributions of the pasture and animal variables to obtain some information about the mechanisms behind the spatially heterogeneous grazing of a pasture by large herbivores.

Material and Methods

The analyses used the data obtained in the previous paper (Hirata and Ogura, 2001); the pre-grazing herbage mass, rate of defoliation, number of visits, residence time and rate of biting at the ninety-one 50×50 cm permanent locations in a bahiagrass pasture during a 6-day grazing period (Days 1-6) with cattle. The relationships between the spatial distributions of the pasture and animal variables were evaluated using correlation coefficients. As partly shown in the previous paper (Hirata and Ogura, 2001), all the 91 locations were not visited and grazed by the animals each day; the number of locations visited was 60, 65, 74, 78, 79 and 80 on Days 1, 2, 3, 4, 5 and

6, respectively. The calculation of the correlation coefficients used data from only these visited locations, when the residence time or the rate of biting was dealt with.

Results

On Days 1 and 2, there were high positive correlations between the rate of defoliation and the number of visits, indicating that herbage consumption was higher at locations which were visited more frequently (Fig. 1). This positive contribution of the number of visits to the rate of defoliation decreased with the progressive grazing, and the rate of defoliation was weakly correlated with the number of visits and/or the residence time on Days 4-6. The rate of defoliation was not correlated with the rate of biting throughout the grazing period.

There were positive correlations between the rate of defoliation and the pre-grazing herbage mass except for Day 4, indicating that herbage consumption was higher at locations with higher pre-grazing herbage masses (Fig. 2). This positive effect of the pre-grazing herbage mass on the rate of defoliation tended to become stronger with the progress of grazing. The number of visits and the rate of biting were often negatively correlated with the pre-grazing herbage mass, indicating that locations with higher pre-grazing herbage masses were less frequently visited and defoliated with lower biting rate. These negative effects of the pre-grazing herbage mass on the number of visits and the rate of biting tended to become weaker with the progressive grazing. The residence time was not correlated with the pre-grazing herbage mass throughout the grazing period.

Discussion

The animals almost always consumed more herbage from locations with higher pre-grazing herbage masses, and this trend became stronger with the progress of grazing (Fig. 2), i.e. with the decreasing mean pre-grazing herbage of the pasture (Hirata and Ogura, 2001). This result agrees with the previous finding (Hirata, 2000).

However, such a consistent positive effect of the pre-grazing herbage mass on the herbage consumption could not be explained with the three ingestive behavior variables. On Day 1, locations with higher pre-grazing herbage masses were less frequently visited (Fig. 2) and the less frequently visited locations had lower rates of defoliation (Fig. 1). These relationships tended to be maintained thereafter, though they became weaker. On Day 6, the pre-grazing herbage mass did not influence the three ingestive behavior variables (Fig. 2), and these variables hardly affected the rate of defoliation (Fig. 1).

The rate of defoliation in the current study is expressed as the product of the three ingestive behavior variables and bite weight. Many studies have reported that the bite weight of grazing animals increases with increasing herbage mass or height (e.g. Black and Kenney, 1984; Laca et al., 1992). Therefore, the higher rate of defoliation at locations with higher herbage masses throughout the grazing period (Fig. 2) may be attributed to greater bite weights at the locations, though the current study did not measure this variable. The positive correlations between the rate of defoliation and the pre-grazing herbage mass on Days 1 and 2 (Fig. 2) are taken as the result that the positive effect of the pre-grazing herbage mass on the rate of defoliation via the bite weight overwhelmed the negative effect via the number of visits (Figs. 1 and 2). Then, the increased correlations between the rate of defoliation and the pre-grazing herbage mass with the progressive grazing (Fig. 2) are taken as the result that the negative effect via the number of visits weakened (Figs. 1 and 2) whereas the positive effect via the bite weight was maintained.

The previous paper showed that the spatial distribution of the rate of defoliation was most heterogeneous (Hirata and Ogura, 2001). The present analyses suggest that this heterogeneity was caused mainly by the spatial heterogeneity in both the bite weight and the number of visits when the mean pre-grazing herbage mass of the pasture was relatively high, and by the spatial heterogeneity in the bite weight when the mean pre-grazing herbage mass was relatively low.

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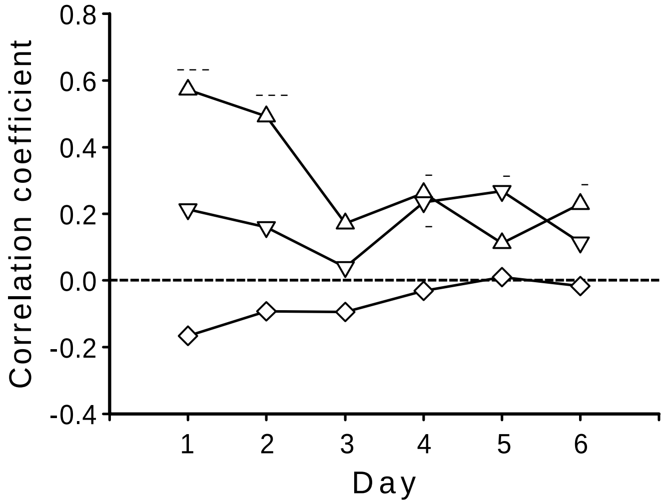

Figure 1 - Changes in the correlation coefficients of the number of visits (Δ), residence time (∇) and rate of biting (◊) with the rate of defoliation. * and *** indicate significance at P<0.05 and P<0.001, respectively. Refer to the text for the number of samples.

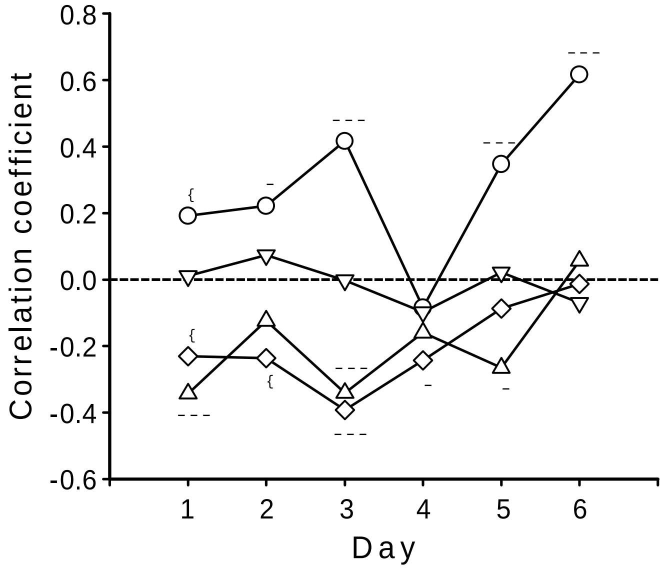

Figure 2 - Changes in the correlation coefficients of the rate of defoliation (Δ), number of visits (∇), residence time (◊) and rate of biting (○) with the pre-grazing herbage mass. +, * and *** indicate significance at P<0.1, P<0.05 and P<0.001, respectively. Refer to the text for the number of samples.