The Effects of Defoliation Management on Species Diversity in a Shortgrass-Type Grassland: a Preliminary Study

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Introduction

Secondary grasslands, which are one of the primary landscape element types\(^6\), have been maintained by mowing and pasturage under the traditional sustainable land use system in Japan\(^7\). However, in recent decades, most of the secondary grasslands have been discarded primarily due to the abandonment of the traditional management and socioeconomic changes. At present, secondary grasslands cover only 3% of the total area in Japan\(^8\). It has been suggested that grassland vegetation should be maintained in order to preserve biodiversity and to respect the principles of landscape conservation.

Burning, mowing, and grazing have been found to be effective management methods for preventing forest development and maintaining grassland vegetation. Among them, grazing is known to be an important factor in producing mosaic structures such as "stepped plant communities" and "garden-like plant communities" due to the grazing behavior of cattle\(^6\). The effects of cattle grazing on vegetation are widely recognized as an important factor in maintaining species diversity in grassland areas\(^9\). Nevertheless, there have been few studies focusing on the significance of grazing in relation to the species diversity of plant communities in Japan.

In the present study, the results of a preliminary survey of a shortgrass-type grassland under grazing management are compared with those of that under mowing management in order to clarify the characteristics of a grazing grassland and to evaluate cattle grazing as a method for conserving species diversity in grassland vegetation.

Materials and Methods

The study site was a secondary grassland at the foot of Mt. Sanbe, southwestern Japan, which had formerly been widely covered with short grasses maintained by cattle grazing\(^10\). Despite the nationwide decrease in grassland areas in recent years, there was still approximately 30 ha of pastureland, and 10 ha of mown grassland was being maintained for the recreational areas in 1996.

Three survey areas of shortgrass-type grasslands were selected in 1996 in relation to the management procedures, including a grazing area (extensive grazing at 1 head per ha), an infrequently mown area (mown 1–2 times a year), and a frequently mown area (mown 4–5 times a year). In both the grazing area and the infrequently mown area, there existed a mosaic vegetation pattern of tall patches and sur-

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rounding short turf, and the frequently mown area exhibited a monotonous short turf.

We surveyed five distinctive sites, namely, short turf (mean height of 10 cm) and tall patches (taller than 30 cm) in the grazing area, those sites in the infrequently mown area, and short turf in the frequently mown area (See Table 1). In the middle of June, 1996, a phytosociological survey based on Braun-Blanquet method\(^1\) was conducted at five plots (1 m × 1 m quadrat each) in each site. The Shannon function \((H')\), which measures species diversity of the community, was calculated from the coverage of each species for each plot. Additionally, detrended correspondence analysis (DCA)\(^3\) was employed to compare floristic composition among plots. DCA is an ordination method, being a variety of multivariate analyses.

### Results and Discussion

Both the grazing and infrequently mown areas were vegetation mosaics in which a number of tallgrass and shrub patches were scattered over the monotonous sod turf of the short-grass community dominated by Zoysia japonica Steud. or Arundinella hirta (Thunb.) C. Tanaka, while the frequently mown area was a monotonous sod turf similar in appearance to a short-grass community.

Table 1 shows the number of species and species diversity in each site. In the frequently mown area, the mean number of species per quadrat was 7.2, whereas in the infrequently mown and the grazing areas, there were 16.2 (13.6-18.8) and 17.7 (16.2-19.2) species per m\(^2\), respectively. The mean number of species in the frequently mown area was significantly less than those in the grazing area (\(p<0.05\)).

In the grazing area, the mean number of species tended to be higher in the ungrazed tall patches than in the grazed short turf. A large difference in floristic composition existed between the patches and the turf (See Fig. 1), and the total number of species was higher in the patches than in the turf. By contrast, in the infrequently mown area, the mean number of species tended to be higher in the short turf than in the tall patches. There was no difference in the total species number between the tall patches and the short turf site in the infrequently mown area.

The species diversity index \((H')\), based on the species composition and the dominance of each species, tended to be highest at the ungrazed tall patches in the grazing area, and lowest in the frequently mown area (Table 1). In the grazing area, a significant difference (\(p<0.05\)) in species diversity existed between the tall patches and the turf, whereas there was little difference in the infrequently mown area. Such species richness and diversity was associated with the difference in the species component and

<table>
<thead>
<tr>
<th>Site</th>
<th>Vegetation height</th>
<th>Number of species</th>
<th>Species diversity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
<td></td>
<td>Mean ((/m^2)^*)</td>
<td>Total ((/5m^2))</td>
</tr>
<tr>
<td>Grazing area</td>
<td>Short (10 cm)</td>
<td>16.2 (^a)</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>Tall (&gt;30 cm)</td>
<td>19.2 (^a)</td>
<td>49</td>
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<tr>
<td>Mowing areas</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Low mowing frequency</td>
<td>Short (10 cm)</td>
<td>18.8 (^a)</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>Tall (&gt;30 cm)</td>
<td>13.6 (^ab)</td>
<td>31</td>
</tr>
<tr>
<td>High mowing frequency</td>
<td>Short (10 cm)</td>
<td>7.2 (^b)</td>
<td>15</td>
</tr>
</tbody>
</table>

\(H'\) is a weighted mean value calculated based on the coverage (%) of each species.

* Values not followed by the same letter are significantly different (\(p<0.05\)) by Tukey's multiple range test.
vegetation structure between the grazing pasture and the mown grassland. Tall patches in the grazing area brought about by spiny scrubs, less palatable plants, and cattle dung were greatly different from those in the mown area in terms of both species composition and vegetation structure (Fig. 1).

The results show that grassland vegetation with some scattered tall patches, in which a highly diverse micro habitat mosaic contrasts with the surrounding area, is needed to maintain a high level of plant species diversity. From this point of view, relatively extensive grazing might be required. Vegetation management utilizing cattle grazing has some advantages compared with mowing such as sustainability, inexpensiveness, profitability, adaptation to steep slopes. In addition to these, an important advantage is that conservation practices can be employed by changing the grazing intensity.

In recreational places surrounding parking areas and rest houses, frequent cutting can be carried out in order to achieve a uniform short grass turf. However, in plant communities with a long history of grazing such as grasslands in the National Parks, vegetation management by extensive grazing can be advantageous in terms of maintaining high species diversity. More researches are needed to establish the agricultural potential of grasslands managed in ways consistent with these objectives.

References


*: In German.
**: In Japanese with English summary.
***: In Japanese.
****: In Japanese. Title translated by the present authors.