Interannual changes of standing biomass in grazed and ungrazed steppes in the Atlas Mountains, southern Morocco

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Introduction

The study was conducted at the BIOTA Maroc test site Taoujgalt at the southern slope of the central High Atlas. In 2001, permanent monitoring plots were established in a sagebrush steppe.

The main objective of this work is to assess the effect of grazing on vegetation dynamics comparing biomass changes of the three dominant dwarf shrub species (Artemisia herba-alba, Artemisia mesatlantica and Teucrium mideltense) between grazed and ungrazed plots.

Fig. 1. Sagebrush steppe at the study site Taoujgalt.

Methods

First we established volume-biomass equations for the three species based on harvested individuals inside and outside of the exclosure (n = 20 each). As shrub densities change under grazing pressure, we calculated different equations for individuals from inside and outside. We applied a non linear regression model: $B = a \times V^b$, with $B$: biomass, $V$: volume, $(a, b)$: constants.

Second, the biomass of the permanent plots was estimated with a non-destructive method. We applied the volume-biomass functions to the monitoring data from 2004 to 2009 in order to calculate the standing biomass for each year.

Two different approaches were used for the exclosure plots, the first applied the exclosure biomass function and the second applied a transition biomass function calculated by adding transition values of a and b to the enclosure function. Finally, we compared the aboveground biomass for Artemisia herba-alba between the grazed and ungrazed plots.

Results

Annual biomass changes were significantly different in most cases except from 2004 to 2006. In most periods the mean biomass increase under exclosure conditions was higher. An exception was the period from 2006 to 2007 when both biomasses decreased.

Table 1: Permutation tests for differences between grazed and exclosed plots for Artemisia herba-alba

<table>
<thead>
<tr>
<th>Transitions</th>
<th>Method 1</th>
<th>Method 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008–2009</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>2007–2008</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>2006–2007</td>
<td>0.049</td>
<td>0.376</td>
</tr>
<tr>
<td>2004–2006</td>
<td>0.069</td>
<td>0.055</td>
</tr>
</tbody>
</table>

Conclusions

- Volume-biomass functions are sensitive to grazing pressure
- Mean annual biomass increase is higher under exclosure conditions
- Therefore, short time exclosure might accelerate the regeneration of degraded steppe ecosystems.