Monitoring of Rehabilitation of Degraded Rangelands

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Introduction

The Algerian steppe covers an area of about 20 million ha, and is the barrier between the desert and the Mediterranean region. With more than 20 million sheep, overgrazing is an important issue resulting in continued degradation of the natural resources (Nedjraoui and Bedrani 2008). Trials of the rehabilitation of these ecosystems were undertaken in a participatory process with farmers complemented by some detailed monitoring of the responses in experimental plots (Hammouda 2009; Bouchareb 2012). This study reports on some results of the ecological monitoring and evaluation for a participatory project, in the steppe of South Algiers, conducted by a multidisciplinary team.

Methodology

The study was conducted at Hadj Mechri (33°51' to 34°07' N, 1°20' to 1°44' E). This arid rangeland receives on average rainfall of 350 mm/year, and has an average altitude of 1250 m. Vegetation was studied before, during, and after restoration, and is represented by mixed steppes landscape of *Stipa tenacissima* (type 1), *Lygeum spartum* (type 2), *Stipagrostis pungens* and *Artemisia herba-alba* (type 3).

The monitoring was performed by choosing 14 experimental plots with permanent transect lines. A point quadrat method (Daget and Poissonet, 1971) was used to determine seasonal floristic inventory (species richness and Shannon index), while biomass productivity was estimated by the indirect method of Daget and Godron (1995), and direct cuts (32 m^2 per plot), before and after restoration. Pastoral production was expressed as feed units (FU); *i.e.* the energy value provided by 1 kg of barley (averages quality) containing 86 % of dry matter, when ingested, produces 1.65 Kcal of energy (Meyer C 2013).

Among these 14 plots, 7 were very degraded and were treated by planting a mixture of *Atriplex halimus*, *Atriplex nummularia*, *Atriplex canescens*, and *Medicago arborea*. Three plots, characteristics of each grassland type (or facies), were selected as untreated controls, whereas the 4 others were treated as exclosures with no grazing. After signing an agreement with 3 farmers to place exclosures on their land and the introduction of forage plants, annual monitoring of the 14 plots proceeded over 3 years. The rehabilitated area was about 400 ha, but the area of plots selected to the monitoring was only ~50 ha.

Analysis of the plots was done seasonally monitoring both floristic and vegetation parameters, particularly noting the recovery and species diversity as criteria to identify the best restoration method.

Results

Species richness

The number of species was high in the *Stipa tenacissima* facies, and low in the *Stipagrostis pungens* facies (Fig. 1). Exclosure improved species richness in all facies when compared to control, demonstrating that exclosure remains a simple solution for rangeland development.

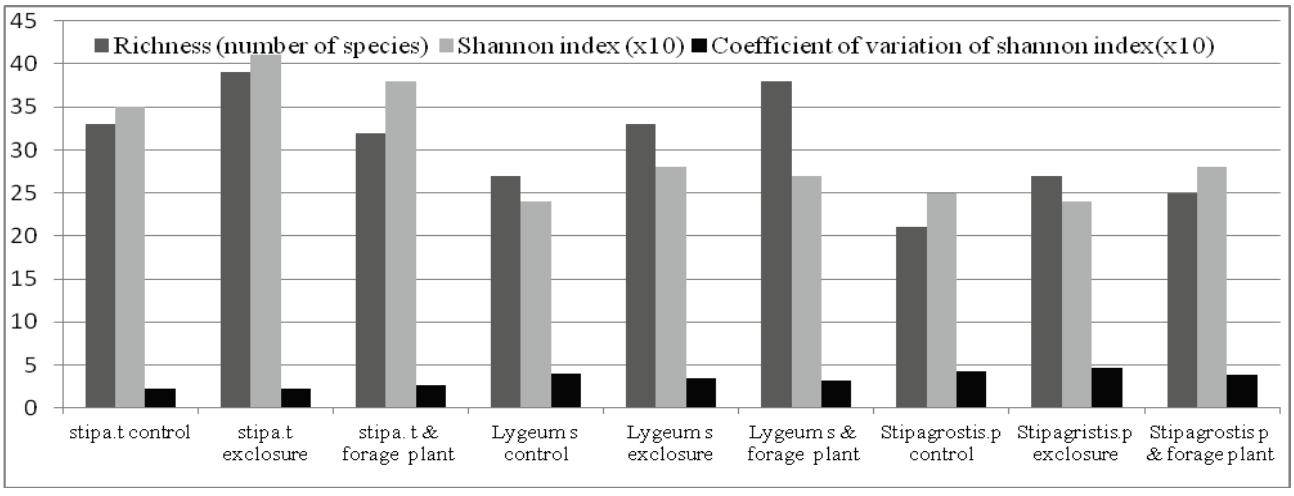

Figure 1. Values of richness, Shannon index, and coefficient of variation of Shannon index for control, exclosure and forage plant for 3 facies.

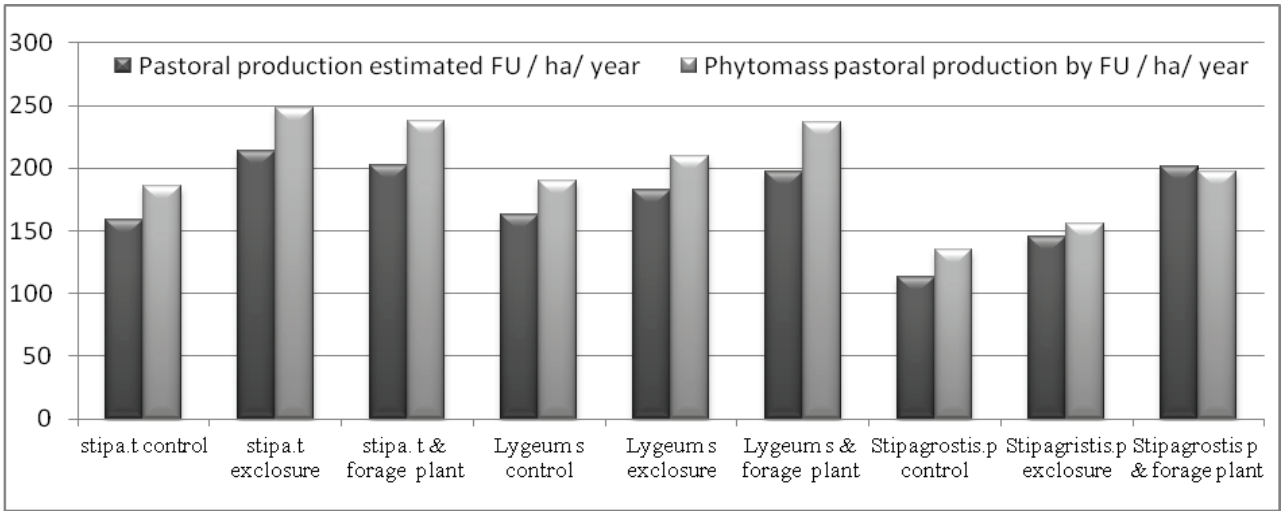

Figure 2. Values of pastoral production and phytomass pastoral production for control, exclosure and forage plant for 3 facies.

Shannon Index

Shannon index was highest in the *Stipa tenacissima* facies (Fig. 1). It was highest in the exclosure plots for *Stipa tenacissima and Lygeum spartum facies*, reflecting the impact of exclosure on potential to improved grassland condition. Since the coefficient of variation of Shannon index indicates the level of stability of each facies compared to the richness, the *Stipa tenacissima* facies were the most stable.

Grassland Production

Production estimated by the indirect method based on the floristic survey, and direct cuts of phytomass, showed an increase in dry matter due to forage planting and exclosure overcompared to the control. Steppes dominated by *Stipa tenacissima* show the best production in the exclosure plots, whereas *Lygeum spartum* and *Stipagrostis pungens* facies produced more feed units when oversown with forage plants. The species responses to various rehabilitations are important for select the best ways of restoration (Fig. 2).

Conclusion

The management of degraded steppe requires a broad knowledge of existing potentialities and perceptions of changes related to remedial actions chosen. The protected zones administrated by pastoralists gave excellent regeneration showing that exclosure was as effective as oversowing in increasing biodiversity and provisions of livestock feed resources. However there were some differences between facies with a trend for *Lygeum spartum* and *Stipagrostis pungens* to respond more to oversowing than *Stipa tenacissima*. Since the results reported in this study reflect change over only three years, continued monitoring is needed to confirm which strategy is most applicable to rehabilitate the different grassland types.

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