

STEPPE RESTORATION BY HAY TRANSFER

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Abstract. The steppe of La Crau is defined as a priority habitat by the EU (NATURA 2000 habitat FR9310064 & FR9301595). This habitat, rich in animal and plant species, has incurred a lot of damages and is today reduced to 11,500 hectares, of which 23 were destroyed during the construction of an underground pipeline in 2006. As reported in previous studies, steppe vegetation resilience is extremely low. An original experiment in restoration ecology was tested to find ways of accelerating steppe vegetation colonization on the buried pipelines. The aim of the study was to adapt and to test the technique of hay transfer. The first results obtained in 2007 showed an increase in species-richness by using hay transfer with the reintroduction of typical steppe species. Among these species, a lot of Poaceae were transferred. Some of them are locally rare, such as *Taeniatherum caput-medusae*.

Keywords: Semi-natural grassland formation, Natura 2000 habitat type: 6220 Pseudo-steppe with grasses and annuals of the *Thero-Brachypodietea*, fragmentation, destruction, pipeline construction, plant community restoration by traditional cultivation technique, seeding, new techniques for management.

Introduction

In the last centuries, a lot of European herbaceous ecosystems were damaged, fragmented, or disappeared as a result of industrialisation and agricultural intensification (Poschlod and Biewer, 2005). These changes are accompanied with an important reduction in botanical diversity (Edwards et al., 2007). With its geographical situation, its flat topography and a climate favourable to cultivation, the steppe of La Crau has not escaped these transformations.

Recent studies on fields abandoned for 25 years (Buisson et al. 2006) and on a pipeline built 30 years ago (Véla et al. 2004) have shown that vegetation resilience is low. Despite these findings, a new pipeline, part of a strategic planning, was built on this important habitat for biodiversity in 2006, destroying 23 ha of natural areas of the "Réserve Naturelle des Coussouls de Crau". In order to accelerate vegetation dynamics and restore steppe vegetation, we tested hay transfer just after this perturbation. This technique was thus tested in an Mediterranean herbaceous ecosystem for the first time to our knowledge..

Materials and methods

The study was carried out in the steppe of La Crau located in South-eastern France, between the Rhone delta and the Berre Lagoon on the former Durance delta formed during the Palaeolithic. This steppe is characterized by a vegetation tolerant of the dry

Mediterranean climate with a lot of wind and special soil conditions. The ground is cover at 50 % by stones and the substratum is an impermeable 5–40m thick conglomerate layer, made of a calcareous matrix, which prevents roots from accessing groundwater (Dureau & Bonnefon, 1998). Since the Neolithic, the vegetation of this fossil delta has been subjected to sheep grazing. Today, this steppe is reduced to 11,500 ha, broken up into fifteen pieces of land, the largest of which is 6,500 ha where our experiment was set up.

The experiment was set up in November 2006 on three replicate sites. Each replicate is composed of one area of steppe used as a control, and one area modified by the building of the pipeline.

On each site and on each area, four experimental units were set up. Each unit was composed of two plots: one exclosure and one grazed control plot, each measuring 1.5 m x 3 m. Each plot was divided in two 1.5 m x 1.5 m subplots: in one subplot hay transfer was tested and the other served as a control where no treatment was applied.

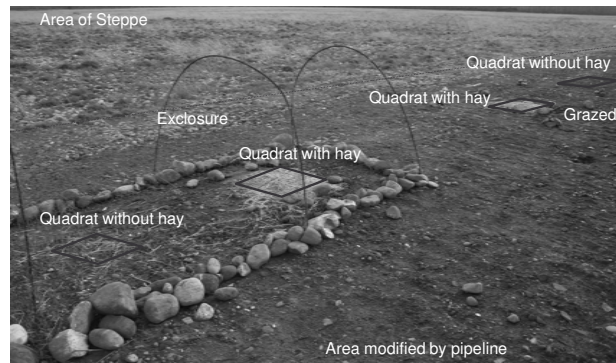


Figure 1 Experimental unit composed of two plots on an area modified by pipeline

In July 2006, hay was collected on the donor site: a patch of steppe ungrazed for four years. Hay was manually mowed, and then immediately collected by leave vacuum equipment. Hay was dispersed after the end of pipeline building, November, 23rd 2006. For each subplot where hay was applied, 112 g of hay was applied on a 40 cm x 40 cm quadrat located in the center of each subplot (17.92g/m²).

To find out the composition, richness, and species abundance of hay, three 112g samples were grown in a greenhouse. Floristic survey (family, genus, species) in greenhouse and in field were carried in spring 2007.

Results and discussion

Quadrats on steppe with hay and on steppe without hay have a species richness significantly higher than quadrats on the pipeline ($F=36.7$; $p<0.001$; fig. 2), but steppe with hay has a species richness significantly lower than steppe without hay. This latter

Conclusions

After one year, although hay transfer was conducted on small areas, the results are convincing, in particular for the introduction of some species, such as Poaceae, which are very important in a grazed herbaceous ecosystem. It would be interesting to extend this restoration ecology experiment to a larger scale, to initiate the return of the steppe vegetation over large areas.

Acknowledgments

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