

Response of subalpine grasslands communities to clear-cut and prescribed burnt to control shrub encroachment in Pyrenees

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Anthropogenic activities have modified vegetation in subalpine belts for long time, lowering treeline ecotone and influencing landscape mainly through grazing and fire. During the last decades the abandonment of traditional land use practices and global warming are contributing largely to the colonization of woody species in subalpine grasslands causing irreversible changes in ecosystem functioning. To prevent those changes a variety of management strategies are carried out to stop the expansion of the highly encroaching shrubs, which require the use of fire and/or clear-cutting, particularly for the conservation of grasslands in subhumid high productive ecosystems. However, it is still poorly understood how different management strategies affect the recovery of subalpine grasslands.

Using a field experiment we tested the impact of management treatments on soil properties and vegetation characteristics, including species richness, community structure, interspecies interaction, and complexity of network association. Vegetation was monitored during four years in eight stands (two stands per treatment) where the vegetation was removed by prescribed fire (Burnt treatment), or by mechanical removal (Clear-cut treatment). Two undisturbed *E. horridum* stands were used as a control (C-Erizón) and two grassland communities regularly grazed (C-Grass) were used as a control for subalpine grassland.

Soils nutrients declined in Burnt treatment 3 years after fire, but not differences between Clear-cut and C-Erizón were observed. Species richness and diversity were larger in C-Grass and lower in C-Erizón. Burnt and Clear-cut treatments increased species diversity and richness gradually after 4 year treatment. The proportion of legume forbs, grasses and non-legume forbs did not reach the levels of C-Grass after 4 years of Clear-cut or Burnt treatments. Shrubs and sub-shrubs increased faster after 4 years of burning than after 4 years of clearing, although they did not reach the level of the C-Erizón. Network connectivity and number of association was larger in well preserved grasslands (C-Grass) in comparison with any of the other treatments, mainly because of the abundance of negative plant-plant associations. On the contrary, the ratio of positive to negative associations was higher in C-Erizón and also, to a lesser extent in the Burnt treatment.

This study shows that grazing favors plant diversity and community complexity in subalpine grasslands, and that clearing is a better strategy than burning to recover grasslands after shrub encroachment because burning entails deeper soil degradation and a faster recovery of the pyrophyte shrub, *E. horridum*.