Journal of Environmental Management 166 (2016) 211–216

Contents lists available at ScienceDirect

Journal of Environmental Management

journal homepage: www.elsevier.com/locate/jenvman

Research article

Shrub recovery after fuel reduction treatments in a gorse shrubland in northern Spain

Cristina Fernández*, José A. Vega

Centro de Investigación Forestal-Lourizán, Xunta de Galicia, P.O.Box. 127, 36080, Pontevedra, Spain

ARTICLE INFO

Article history:
Received 26 June 2015
Received in revised form
27 August 2015
Accepted 14 October 2015
Available online xxx

Keywords:
Prescribed burning
Mastication
Clearing
Resprouting
Gorse

ABSTRACT

Land managers need information about the environmental effects of fuel reduction techniques to select the most appropriate treatments in terms of conservation of ecosystem diversity and function. In this study, shrub cover recovery was monitored during the first four years after prescribed burning, clearing and mastication in a gorse shrubland dominated by *Ulex gallii* Planch. in northern Spain. Twelve experimental plots were installed just before treatments where plant cover was measured. All plant species present were identified, their frequency recorded and alpha diversity, richness and evenness determined. No differences between fuel treatments were observed for total shrub cover during the duration of the study. However, at the end of the study period, cover by *Ericaceae* shrubs and grasses was almost two times higher than the pre-treatment values, for all treatments. The treatments did not have different effects on gamma diversity or evenness during the four year interval, although higher species richness was measured in the burned plots than in the masticated or cleared ones throughout the study period. However, a redundancy analysis showed that the variation in species frequency during the study period was not related to the type of treatment applied. Fuel treatments significantly affected the shrubland under study in the short and medium term. The increase in Ericaceae shrubs and grasses cover may shift the long-term community composition. Long-term studies are required to establish whether the observed response lasts in time.

© 2015 Elsevier Ltd. All rights reserved.

1. Introduction

Fuel reduction treatments are increasingly being used throughout the world to reduce the risk of high-severity wildfires occurring (Vega et al., 2001; Davies et al., 2008; Schwilk et al., 2009; Fernandes et al., 2013). Prescribed burning is the most common fuel reduction technique because its application flexibility and low cost. Use of the technique also aims to ensure conservation of ecosystem structure and function through the emulation of historical disturbance regimes (Davies et al., 2008; Fernandes et al., 2013). However, prescribe fire application is limited by the adequate selection of suitable meteorological conditions, as well as other environmental effects, i.e. the increased risk of soil erosion (Vega et al., 2005; Fernández et al., 2008, 2012) or contamination by smoke (Haines et al., 2001). Mechanical methods are therefore increasingly used as alternatives for prescribed fire (Stephens et al., 2009; McIver et al., 2013), although there also some limitations to their application in areas with steep slopes or where stoniness is high.

The effects of prescribed fire and mechanical treatments on shrubland communities have been widely studied in recent years; however, little is still known about how mechanical treatments compare with prescribed burning, particularly in regard to the possible ecological effects. Changes in community composition have been reported (Pelton and Conran, 2002; Potts and Stephens, 2009; Gosper et al., 2010), as has the lack of any effects (Calvo et al., 2005; Fernández and Vega, 2014; Fernández et al., 2015). The findings are therefore inconclusive and depend on the characteristics of plant species (sprouters or obligate seeders) and how the treatments, i.e. heat effects or compaction by machinery (Fernández et al., 2013a,c). Moreover, as McIver et al. (2013) pointed out, little is known about the effects of fuel reduction methods carried out in different ecosystems under different conditions. Information about the ecological effects of different fuel treatment options is critical for guiding management decisions.

In northern Spain, fire prevention actions in shrubland areas is crucial as more than 35% of the wildland burned in Spain in the past decade was shrubland (MMA, 2010). *Ulex gallii* Planch. is a typical

* Corresponding author.
E-mail address: cffilgueira@gmail.com (C. Fernández).

http://dx.doi.org/10.1016/j.jenvman.2015.10.028
0301-4797/© 2015 Elsevier Ltd. All rights reserved.

Table 1
Results of mixed-model tests of fixed effects of fuel reduction treatments on vegetation variables. Treatment: Numerator degrees of freedom = 1; Denominator degrees of freedom = 2. Date: Numerator degrees of freedom = 1; Denominator degrees of freedom = 1064. Significant effects are indicated in bold type.

Variables	Fixed effect	F	P
Total vegetation cover	Treatment	0.2908	0.5897
	Date	78.431	< **0.0001**
	Treatment × Date	0.6676	0.7162
Ulex gallii cover	Treatment	0.0099	0.9980
	Date	17.648	< **0.0001**
	Treatment × Date	0.1346	0.9349
Ericaceae cover	Treatment	0.012	0.9129
	Date	68.7553	< **0.0001**
	Treatment × Date	0.1943	0.9074
Forbs cover	Treatment	0.0338	0.8542
	Date	5.6536	< **0.0001**
	Treatment × Date	0.1245	0.9397
Grass cover	Treatment	0.4414	0.5064
	Date	71.4791	< **0.0001**
	Treatment × Date	0.9203	0.6312
Alpha diversity	Treatment	2.8840	0.1307
	Date	24.2034	< **0.0001**
	Treatment × Date	2.5235	0.2832
Species richness	Treatment	8.7339	**0.0031**
	Date	11.0602	< **0.0001**
	Treatment × Date	9.2414	**0.0098**
Evenness	Treatment	0.650	0.4202
	Date	18.692	< **0.0001**
	Treatment × Date	0.659	0.7007

component of shurblands in Western Europe, and *Ericaceae* species are also common. In this type of shurbland, resprouting is the most common regenerative response after perturbation (Fernández et al., 2013b). Little differences between prescribed burning, clearing and mastication were found on the resprouting ability of *U. gallii* and Ericaceae species in the first months after treatment application (Fernández et al., 2013c). It would be of interest to establish whether that response has been maintained over time, thus shifting the shrubland community response in the mid term.

In the present research, we monitored the response of the vegetation during the first four years after application of prescribed burning clearing and mastication in a gorse shrubland, to assess whether these mechanical methods are suitable alternatives to prescribed burning, in terms of vegetation recovery and diversity and ecosystem management.

2. Material and methods

2.1. Study area

The study area is located in the Saja-Besaya Natural Park (43°13′14″N–4°12′57″W; 500 m a.s.l.) in the province of Santander (N of Spain). Mean slope is 40%. The shrubland is dominated by *U. gallii* Planch (Western gorse), with some *Ericaceae* (mainly *Erica ciliaris* Loefl. ex L. and *Erica cinerea* L.) also present. *U. gallii* is an evergreen shrub, up to 1 m tall, native from W Europe. It reproduces mainly by regrowth after disturbance (Fernández and Vega, 2014).

The mean annual rainfall is about 1400 mm and the mean annual temperature is 12.0 °C. The soils are Humic Cambisols (FAO, 1998). The site was affected in the past by frequent man-caused wildfires with high frequency (every 5–10 years) and low severity, which is common in shrubland areas in the region.

2.2. Experimental design

Twelve experimental plots (each 50 × 50 m) were installed on a hillslope in the study area. The experimental area had an area of 5 ha. Three different treatments were assigned at random: prescribed burning, clearing and mastication. Four replicates of each treatment were established. A priori power analysis determined that the number of replicates was adequate. Ten subplots (2 × 2 m) were also established within each plot. The experimental area was surrounded by electric fencing to prevent it from being grazed.

2.3. Treatments

The fuel treatments were implemented in spring 2010. In the

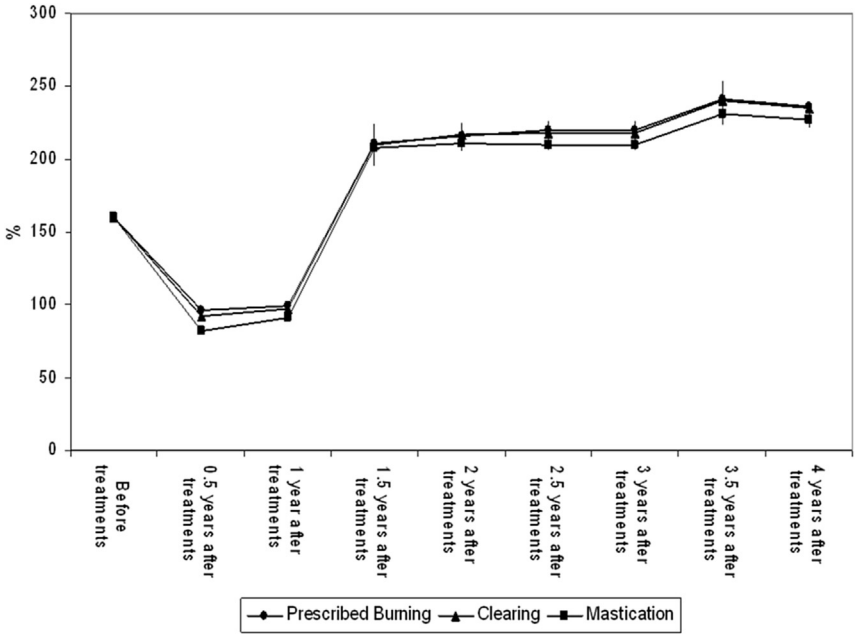

Fig. 1. Mean percentage of ground cover by vegetation during the first four years after application of fuel reduction treatments. Vertical bars are standard errors.

Download English Version:

https://daneshyari.com/en/article/7481377

Download Persian Version:

https://daneshyari.com/article/7481377

Daneshyari.com