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Flammability descriptors of fine dead fuels resulting from two mechanical treatments in shrubland: a comparative laboratory study

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Abstract. Mechanical treatments are traditionally used to modify the fuel complex in shrubland, but information about their actual effectiveness in reducing the risk of wildfire initiation is scarce. The effects of two mechanical fuel treatments (shrub clearing with crushing and manual removal) on flammability in a shrubland community in north-western Spain were compared. Three months after treatment, laboratory tests using a point-ignition source were conducted on the fine dead fuels to analyse the effect of type of treatment and fuel moisture content (FMC) under two conditions: (1) flaming; or (2) glowing + wind ignition source. Fuel load effect within each treatment was also studied. Time-to-ignition, flaming duration, number of burnt sides of the sample and fuel consumption ratio were assessed. Logistic models were developed to assess ignition and sustained combustion probabilities. Type of treatment and FMC significantly affected flammability under both experimental conditions tested. Slow smouldering was observed in fuels subjected to shrub clearing and removal, whereas crushing fuels were rapidly burnt with flaming phase combustion. In general, shrub clearing and removal appeared to be more effective in reducing wildfire hazard in these shrubland communities.

Additional keywords: fuel management, Galicia (north-western Spain), ignition, mixed heathland, shrub clearing, sustained combustion.

Introduction

Wildland fires are a major problem in forest ecosystems all over the world and many of them affect shrubland areas. In Galicia, north-western Spain, over 11 000 wildfires including small fires (<1 ha), burn an average of 35 000 ha of forest land every year. Most of them occur in shrubland communities, which represent more than 70% of total burned area (Ministerio de Medio Ambiente 2006). Shrubland is widespread in the region and covers many wildland–urban interface (WUI) areas; therefore, management authorities need to apply fuel treatments in order to reduce wildland fire hazard.

Climate change scenarios in the Mediterranean region are expected to be more severe in terms of wildfire occurrence, with increasing fire danger indexes, length of fire seasons and frequency and length of extreme weather predicted. Shrubland species, which are tolerant of water stress, are also expected to become more abundant. This may lead to more frequent and intense wildfires in the future (Ministerio de Medio Ambiente 2005).

Mechanical fuel treatments are traditionally used to modify the fuel complex in shrubland or understory vegetation, especially in WUI areas (Franklin 1988; Vélez 1990; Keeley 2002; Busse *et al*. 2005). In some cases, this type of fuel treatment is the only available method of reducing wildfire risk in sensitive areas, like WUI, where the use of other strategies, namely prescribed burning, may be problematic (Glitzenstein *et al*. 2006).

However, there is little information about the actual effectiveness of this type of treatment (Martinson and Omi 2003, 2008) in terms of wildfire hazard reduction. There are very few studies concerning mechanical fuel treatments in shrubland (Baeza *et al*. 2003) or understory vegetation (Busse *et al*. 2005; Collins *et al*. 2007), and the effect on forest fuels flammability was not assessed in these studies. Glitzenstein *et al*. (2006) studied fire behaviour in experimental burns after chipping understory vegetation, but they did not address the flammability of the resulting fine dead fuels.

Flammability is a broad term used to address different fire aspects involving ignition and combustion of forest fuels. According to Anderson (1970), flammability is divided into three different components: (1) ignitability; (2) sustainability; and (3) combustibility. Ignitability is related to the delay until ignition. Sustainability is described as the burning rate stability or how easily the fuel continues to burn with or without the heat source. Combustibility refers to the rate of burning after ignition and is related to fire rate of spread. Martin *et al*. (1994) suggested a fourth component, defined as consumability, to address fire intensity in terms of the amount of material consumed in the burning process.

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