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ASSESSING SOIL EROSION AFTER FIRE AND REHABILITATION TREATMENTS IN NW SPAIN: PERFORMANCE OF RUSLE AND REVISED MORGAN–MORGAN–FINNEY MODELS

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ABSTRACT

Although the Revised Universal Soil Loss Equation (RUSLE) and the revised Morgan–Morgan–Finney (MMF) are well-known models, not much information is available as regards their suitability in predicting post-fire soil erosion in forest soils. The lack of information is even more pronounced as regards post-fire rehabilitation treatments.

This study compared the soil erosion predicted by the RUSLE and the revised MMF model with the observed values of soil losses, for the first year following fire, in two burned areas in NW of Spain with different levels of fire severity. The applicability of both models to estimate soil losses after three rehabilitation treatments applied in a severely burned area was also tested.

The MMF model presented reasonable accuracy in the predictions while the RUSLE clearly overestimated the observed erosion rates. When the R and C factors obtained by the RUSLE formulation were multiplied by 0·7 and 0.865, respectively, the efficiency of the equation improved.

Both models showed their capability to be used as operational tools to help managers to determine action priorities in areas of high risk of degradation by erosion after fire. Copyright © 2010 John Wiley & Sons, Ltd.

KEY WORDS: soil erosion; RUSLE; MMF; wildfire; fire severity; rehabilitation treatments; Spain

INTRODUCTION

Post-fire erosion is a major concern to society because of the potential effects on soil and water resources. Increases in soil erosion rates are frequently observed following wildfire (e.g. Megahan and Molitor, 1975; Campbell *et al*., 1977; San Roque *et al*., 1985; Shakesby *et al*., 1993; Scott *et al*., 1998; Robichaud and Brown, 2000; Johansen *et al*., 2001; Martin and Moody, 2001; Meyer *et al*., 2001; Benavides-Solorio and MacDonald, 2005; Shakesby and Doerr, 2006). Fire severity, as a descriptor of the magnitude of the changes occurred in the soil, has been recognized as a decisive factor controlling those post-fire soil erosion rates (e.g. Benavides-Solorio and MacDonald, 2005; Vega *et al*., 2005).

Most of these studies have emphasized the reduction or elimination of vegetation cover and ground cover as the main factors explaining the increased soil losses. Soil cover increases infiltration, maintains high soil porosity, prevents soil sealing and increases surface roughness, reducing thus soil erosion (De Bano *et al*., 1998; Larsen *et al*., 2009). Fire can also alter the soil structure, by affecting bulk density and total porosity, thus reducing infiltration and promoting overland flow (e.g. De Bano *et al*., 1998; Neary *et al*., 2005). Fire-induced hydrophobicity (De Bano, 1981; De Bano *et al*., 1998; Robichaud, 2000; Huffman *et al*., 2001; Keizer *et al*., 2008a) may also contribute to increased soil losses. The effect of fire on soil water repellency depends primarily on the amount and type of litter

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