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Short communication

Prioritizing fuel management in urban interfaces threatened by wildfires

Raffaele Lafortezza[a,*], Andrew J. Tanentzap[b], Mario Elia[a], Ranjeet John[c], Giovanni Sanesi[a], Jiquan Chen[c]

[a] Department of Agricultural and Environmental Sciences, University of Bari, Bari, Italy
[b] Department of Plant Sciences, University of Cambridge, Cambridge, UK
[c] CGCEO/Geography, Michigan State University, East Lansing, MI, USA

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ABSTRACT

Rapid growth of many cities in Europe in recent decades has resulted in the expansion of human settlements spreading into fire-prone landscapes. Wildfires are increasingly impinging upon human populations because of anthropogenic changes to the global fire cycle. Large investments are therefore required to prevent fires from spreading into urban areas to protect human life and reduce property damage. Naturally, prioritizing fuel management by identifying sites where the greatest number of people are exposed to wildfires is often a challenge for governments because of limited resources. Herein, we offer an approach to quantify management priorities and allocate interventions (i.e., fuel removals from forests) in interfaces between urban and wildland areas threatened by wildfires. For this purpose, an indicator for prioritizing management interventions was developed by integrating social, economic, and ecological factors. This indicator was applied to southern Italy as a case example, where fires have been increasing in both magnitude and frequency. Our results highlight the need to prioritize fuel removals in densely populated landscapes in terms of maximizing the number of people exposed to wildfire suppression per dollar spent on fuel removal. More broadly, we suggest that this approach form the basis for wildfire suppression in urban regions across the globe and be readily applied toward allocating any type of management intervention in landscape management.

1. Introduction

More than half of the world's population lives within densely populated urban areas (i.e., >770 people/km^2), which are rapidly encroaching upon their surrounding environments (United Nations, 2012). When urban areas are interspersed with forests, numerous threats to human well-being arise at the interfaces where anthropogenic development merges with wildland areas. Fire is perhaps one of the most potent dangers, since urban interfaces create environments where fires can easily move from forest fuels to human settlements (Bowman et al., 2009). Wildfires in urban interfaces have, in fact, become increasingly common globally over the last decade as humans have pushed ever further into their natural environments (Macie and Hermansen, 2002; Schoennagel et al., 2009). In May 2013, while this study was being drafted, a major fire event burned 11,000 ha in southern California, threatening 4000 homes (Ventura County Star, 2013).

Increasing efforts have been made in studying urban interfaces that are prone to wildfires from a spatial perspective (Lloret et al., 2002; Haight et al., 2004; Lampin-Maillet et al., 2010), with innovative approaches and views. For example, Haight et al. (2004) proposed the relative risk of severe wildfires on people and houses using the spatial knowledge of historical fire regimes and flammability of vegetation. Similarly, Lampin-Maillet et al. (2010) developed a method for mapping urban interfaces according to vegetation distribution and human presence. However, these approaches do not combine social, economic, and ecological factors in meaningful measures that can guide landscape-level management (i.e., prioritization). Meanwhile, San-Miguel-Ayanz et al. (2013) reviewed some of the most recent mega-fires (>500 ha) in Europe, including Portugal (2003, 2005), Spain (2006), and Greece (2007), and suggested that fuel management was one of the most cost-effective approaches for

* Corresponding author at: Department of Agricultural and Environmental Sciences, Università degli Studi di Bari "A. Moro", Via Amendola 165/A, 70126 Bari, Italy. Tel.: +390805443438.
E-mail address: raffaele.lafortezza@uniba.it (R. Lafortezza).

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preventing fires and reducing economic losses. Empirical studies on fuel management, such as decreasing the amount of fuel load per unit area, have indeed proven to be effective in reducing fire risk by up to 50% in urban interfaces (Stephens and Moghaddas, 2005; Schmidt et al., 2008; Safford et al., 2009). Other approaches for reducing fire risk in urban interfaces may also be effective, such as ignition prevention measures (e.g., elimination of ignition sources) as part of a broader wildfire management risk program (Cohen, 2000; Ryu et al., 2007; Gorte and Bracmort, 2012).

The consensus is that large investments are required to manage fuels or to prevent ignitions over entire landscapes while the necessary resources are always limited (Noss et al., 2006;

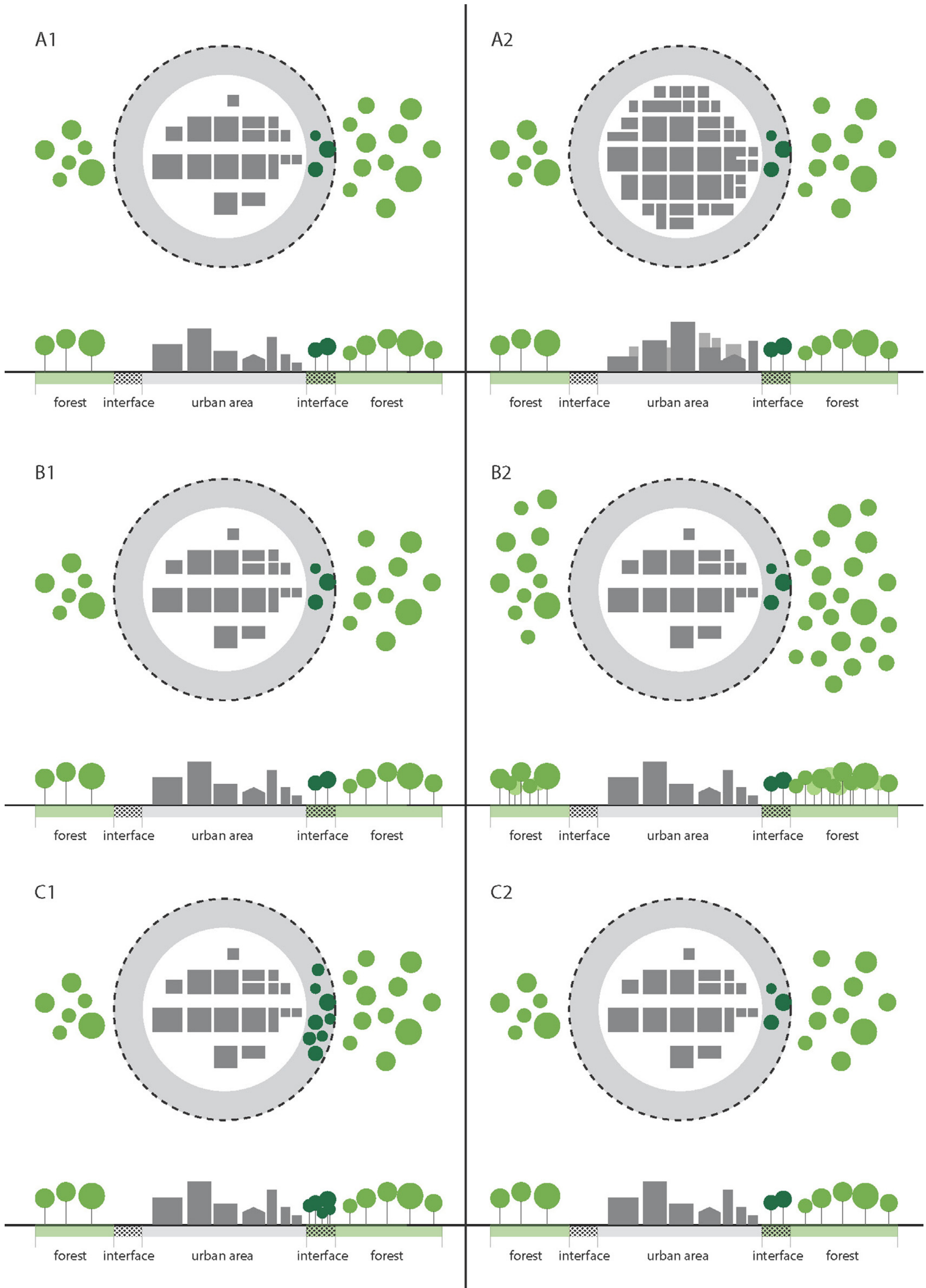

Fig. 1. Schematic examples of the management priority index (MPI) for the different combinations of people, cost, and landscape factors. For each pair of examples (e.g., A1 and A2), two of three factors were fixed as follows: (A) landscape and cost; (B) people and cost; (C) people and landscape. Based on the study approach, we expected: $MPI_{(A2)} > MPI_{(A1)}$; $MPI_{(B2)} > MPI_{(B1)}$; and $MPI_{(C2)} > MPI_{(C1)}$.