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Surveys

Understanding the heterogeneity of social preferences for fire prevention management

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ABSTRACT

The forest area burnt annually in the European Mediterranean region has more than doubled since the 1970s. In these forests, the main preventive action consists of forest compartmentalization by fuel break networks, which entail high costs and sometimes significant negative impacts. While many studies look at public preferences for fire suppression, this study analyses the heterogeneity of social preferences for fire prevention. The visual characteristics of fire prevention structures are very familiar to respondents, but their management is unfamiliar, which raises specific attention in terms of analysing preference heterogeneity. A random parameter logit model revealed large heterogeneity and preference for traditional heavy machinery, maintaining linear unshaded fuel breaks at a high density. A latent class model showed that this may be reflected by a third of the population preferring lighter machinery and shaded irregular fuel breaks; a quarter of the population not treating the budget constraint as limiting, another quarter only being worried about the area burnt and the remaining group being against everything. Finally, a discrete mixture model revealed extreme preference patterns for the density of fuel breaks. These results are important for designing fire prevention policies that are efficient and acceptable by the population.

1. Introduction

The ecosystem services provided by Mediterranean forests — such as protection against erosion or biodiversity conservation — are increasingly recognized (FAO, 2013). However, these services are under risk of degradation, with forest fires as the most important threat to Mediterranean forest ecosystems today (Ministry of Environment, 1998; Valbuena-Carabaña et al., 2010). Every year forest fires in the European Mediterranean region attract media attention and debate about forest management so as to minimize the environmental and social damages, in particular when villages and infrastructure are affected. The annual burnt area in the European Mediterranean region has more than doubled since the 1970s (Xanthopoulos et al., 2006). Farmland abandonment is regarded as one of the main drivers of this situation (Duguy et al., 2007; Loepfe et al., 2010; Pausas, 2004; Pausas et al., 2008; Vélez Muñoz, 2004) as the traditional rural mosaic that creates sufficient fuel fragmentation is becoming scarce. The build-up of large and continuous fuel beds facilitates fire spread (Loepfe et al., 2010; Pausas, 2004), and forest fires are expected to be aggravated by climate change and resultant longer dry summer periods (Mouillot et al., 2002; Morriondo et al., 2006; Pausas, 2004). The losses due to forest fires are not only related to ecosystems, but also to human lives and infrastructure, with a wide array of interrupted or diminished ecosystem services flowing to society (Barrio et al., 2007).

In the Mediterranean region, wildfire spread is mainly reduced through the forest compartmentalization by fuel break networks. These structures traditionally are linear strips where the trees are disposed of and the vegetation is removed down to the mineral soil with mechanical tools. The costs of creating and maintaining such networks are high and the negative impacts (landscape impact and soil erosion) can be locally significant. Therefore, some public agencies are testing new designs for these structures as well as alternative maintenance tools to lower both the negative impacts and the costs. Fire prevention plans are developed by public agencies and are mainly based on technical and budget criteria (De Castro et al., 2007). This may be the best strategy in so far that the differences in management are small, technical and not visible to the general public. However, fire prevention has large impacts on the visual perception of the landscape, and forest

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fires as an environmental problem attract much attention from the population (IESA/CSIC, 2007). Therefore, from a welfare economic point of view, public preferences for fire prevention should be taken into account when designing fire prevention strategies.

The influence of fire on the social value of forests was initially addressed in Vaux et al. (1984), where changes in recreational values were studied. Hesseln et al. (2004) and Starbuck et al. (2006) also pursed this research avenue. Somewhat related, other valuation studies focused on the estimation of citizens' WTP for protecting certain areas or reducing wildfire risk in the landscape as a whole (Loomis and González-Cabán, 1994, 1998; Riera and Mogas, 2004; Winter and Fried, 2001). In recent years, the focus has broadened to explore citizens' preferences for different strategies aimed at diminishing wildfire risk, such as mechanical fuel reduction, prescribed burning or biomass for energy (González-Cabán et al., 2004, 2007; Kaval et al., 2007; Loomis and González-Cabán, 2008; Loomis et al., 2004, 2005, 2009; Soliño, 2010; Soliño et al., 2010, 2012; Walker et al., 2007). Holmes et al. (2012) explore risk perception and assess the trade-offs between wildfire risk and damage in public fire prevention systems. Calkin et al. (2012) investigate the trade-offs fire managers are willing to make under competing strategic suppression objectives. The fire issue can also be explored in a broader context, assessing the trade-offs between fire prevention and many ecosystem services at the same time (Mavsar et al., 2013) as well as between fire and different climate-sensitive attributes (Riera et al., 2007).

Forest fires and fire prevention are complex issues, subject to a variety of perceptions and even different paradigms among the population (Absher et al., 2009; McCaffrey et al., 2012). In particular they are complex in the sense that while fire prevention is positive per se, it may have some impacts in the landscape that are unwanted; making the typical distinction of people who are environmentally concerned or not, less obvious. These kind of trade-offs are also of relevance in other environmental issues like green energy vs visual disamenities gained from wind turbines (Westerberg et al., 2013; Jensen et al., in press) or access reductions to preserve wildlife (Jacobsen et al., 2012). In this context, accounting and exploring for heterogeneity and understanding different distributional aspects provides knowledge of who will be affected by a policy change, which can be relevant to resource managers and to policy analysis.

Two complementary approaches may be distinguished to tackle the issue of preference heterogeneity. The first consists in assessing the observable component of heterogeneity by incorporating explanatory variables in the choice models (Choi and Fielding, 2013). Interactions of specific socioeconomic covariates with either site attributes or alternative-specific constants allow the capture of the observable component of heterogeneity (Choi and Fielding, 2013; Hynes et al., 2008). Socio-demographic characteristics are useful for interpretation (Hess et al., 2005), although assumptions are indeed required in the selection of the variables employed for these interaction terms; the variables must be relevant to the choice context being examined and they must have acceptable explanatory power (Boxall and Adamowicz, 2002). Attitudinal characteristics are increasingly being used as criteria for population segmentation or as explanatory variables for econometric models (Choi and Fielding, 2013; Lundhede et al., in press). Fire related valuation studies typically include socioeconomic covariates such as income, education or age (Loomis et al., 2009; Mavsar et al., 2013), but also attitudinal questions to gain insight on respondents' preferences. Fire related questions such as perceived fire danger, perceived fire frequency by the respondents (Kaval et al, 2007), witnessing fires or experiencing the negative consequences of forest fires have been proved to be significant in determining WTP for fire prevention or biomass reduction activities (Loomis and González-Cabán, 2008; Walker et al., 2007).

A complementary approach to the previous work consists in assessing the unobserved heterogeneity of preferences through the systematic component of utility. Random parameter logit models (RPL), latent class models (LC) and discrete mixture models (DM) are three ways of doing so (Birol et al., 2006; Campbell et al., 2014; Doherty et al., 2013; Morey et al., 2006; Provencher and Bishop, 2004; Train, 2009) and are applied in the current study. These modelling approaches may provide complementary views to understand the unobserved heterogeneity at different levels: average population, population classes and management attributes. This is of particular importance for fire prevention due to the characteristics hereof: both the measures and consequences are very concrete but while the consequences are very familiar to respondents, the measures are often not very familiar even if they have a high impact on the landscape, and consequently on people.

This study aims at assessing whether people are sensitive to changes in the current situation of forest fire prevention and whether heterogeneity exists among the population in their preferences for fuel break management issues. For that purpose, a choice experiment was conducted among citizens in the province of Málaga (Andalusia, Spain), to explore social preferences for three main fire-related attributes in fuel break management: the cleaning technique, the design of these structures, and the density of the grid. Respondents were asked to trade these against a payment in order to derive welfare economic estimates.

By using different modelling approaches (RPL, LC and DM) for the assessment of heterogeneity together with the consideration of socioeconomic and attitudinal variables, we are able to unveil different preference patterns both at the attribute and at the population level that are relevant in assessing social preferences for fire prevention management. This is, to our knowledge, not previously analysed in the fire related literature yet highly relevant due to the scarcity of these studies in the Mediterranean context. Furthermore, it adds to the literature on modelling heterogeneity in environmental valuation studies by applying recently developed models and compare what can be said by each. This is especially important for the application here which is concrete and familiar in output, yet unfamiliar in measures.

2. Forest Fires and Fire Prevention in the Mediterranean Region

Paleoecological studies suggest that fires are natural in the Mediterranean region (Pausas et al., 2008). Nevertheless, the increase in the number of fires and burnt area during the 20th century sometimes surpasses the capacity of these ecosystems to recover after the fire (Pausas et al., 2008). The social demand for environmental protection together with the consideration of forest ecosystems as a public good impelled the launching of permanent protection programmes against forest fires (Vélez Muñoz, 2004). The efforts evolved towards a policy centred in emergency suppression measures, based on very sophisticated equipment with high costs. As a result, fire suppression capacity in southern European countries has been improved since the 1990s, allowing for a reduction in the burnt area in relatively easy fire seasons. However, fire suppression policies have shown their limited ability to remove the risk of major disasters when not coupled with appropriate fuel management strategies (Xanthopoulos et al., 2006; Rigolot et al. 2009). The excessive focus on fire suppression instead of fire prevention resulted in reduced availability of financial resources for long term preventive actions (Montiel and San-Miguel, 2009), which are less spectacular and need continuous maintenance over time. It is expected that this trend will slowly change in light of the widely recognized role that prevention plays in fire protection (Tàbara et al., 2003), being maybe the most effective approach to face wildfires (FAO, 2013). Not only the researchers or land managers, but also the society, are progressively demanding a shift towards fire prevention management (Moyano-Estrada et al., 2006).

Fire prevention is a group of activities aimed at reducing or avoiding the probability that a fire starts and also at limiting its effects if it takes place (Vélez Muñoz, 2000). Fire prevention entails two complementary approaches: social and physical. The social dimension aims at diminishing the causes of anthropogenic fires (Martínez et al., 2009), while the physical fire prevention deals with the biomass for the purpose of modifying potential fire behaviour (Husari et al., 2006) by