Land Use Policy 60 (2017) 12–15

Contents lists available at ScienceDirect

Land Use Policy

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

On the reactive nature of forest fire-related legislation in Portugal: A comment on Mourão and Martinho (2016)

Paulo M. Fernandes[a,*], Nuno Guiomar[b], Paulo Mateus[c], Tiago Oliveira[d,e]

[a] Centro de Investigação e de Tecnologias Agro-Ambientais e Biológicas, Universidade de Trás-os-Montes e Alto Douro, Quinta de Prados, Apartado 1013, 5000-801 Vila Real, Portugal
[b] ICAAM, Instituto de Ciências Agrárias e Ambientais Mediterrânicas, Universidade de Évora, Núcleo da Mitra, Apartado 94, 7006-554 Évora, Portugal
[c] Instituto da Conservação da Natureza e Florestas, I.P., Estrada Exterior da Circunvalação 11846, 4460-281 Senhora da Hora, Portugal
[d] The Navigator Company, Departamento de Proteção Florestal, Apartado 55, 2901-861 Setúbal, Portugal
[e] Centro de Estudos Florestais, Instituto Superior de Agronomia, Universidade de Lisboa, Tapada da Ajuda, 1349-017 Lisboa, Portugal

ARTICLE INFO

Article history:
Received 8 July 2016
Received in revised form
26 September 2016
Accepted 8 October 2016
Available online 20 October 2016

Keywords:
Fire management
Fire policy
Regulation

ABSTRACT

Portugal struggles with an abnormally high forest fire incidence in the context of southern Europe. In an earlier issue of the journal, Mourão and Martinho applied time-series analysis to official forest fire data (1980–2013) and legislation in Portugal and concluded that fire-related legislation is issued as a reaction to fire occurrence. In this viewpoint paper we show that Mourão and Martinho analysis is compromised because of poorly chosen fire variables that are inconsistent across time and do not depict fire damage. Identification of the pertinent legislation was subjective and incomplete, therefore biasing the results, and its relevance was equated to the volume of laws and regulations produced. Moreover, added production of legislation in the aftermath of catastrophic fires reflects a variety of responses, from ordinary adjustments to paradigm changes, including proactive elements therein. We ultimately argue that surges in fire legislation activity should not be simply interpreted or categorized as 'reactive' or 'proactive'.

1. Introduction

Wildfires are a major challenge to society and land use policies in the fire-prone Mediterranean Basin, especially in view of ongoing climate change and increasingly hazardous landscapes due to declining agricultural and forest management activities (Moreira et al., 2011). In this respect the analysis of temporal trends in fire activity is important because it can be used to assess the level of success of fire management and land use policies and to inform subsequent action.

In this journal, Mourão and Martinho (2016) have used time-series analysis of official wildfire statistics to examine whether Portuguese forest fire-related legislation is 'reactive' or 'preventive'. This comment on Mourão and Martinho's paper, hereafter MM, addresses three concerns, respectively (i) fire data and variables, (ii) the methodological approach to fire legislation, and (iii) the relevance of the hypothesis.

2. Fire data and metrics

2.1. Non-stationarity in fire data

MM collected official annual data for the 1980–2013 period on the total number of ignitions and mean ignition size, respectively 'number of forest fires' and 'burnt area per fire' (or 'average burnt area') in their terminology. A well-known feature of the official Portuguese fire database is that the ignition count threshold has changed over time (Pereira et al., 2011). The minimum fire size in the database changed from 0.1 ha to 0.01 ha in 1991, and from 0.01 ha down to the minimum measurable size in 2001 (Fig. 1). However, they seem unaware of this fact, hence their erroneous finding of 'an increasing trend in the number of forest fires from 1980 until 1995'. Inherently, their conclusion for a decreasing trend in mean ignition size is also an artifact of the different criteria used to record ignitions over the study period, which their identification of optimal breakpoints (1989–1990) for ignition mean size also reflects.

Usage of total area burned instead of ignition count and ignition mean size would have neutralized the spurious effects of data non-stationarity. Nonetheless, area burned from the official database is a limited descriptor, because of omissions and other

* Corresponding author.
E-mail addresses: pfern@utad.pt (P.M. Fernandes), nunogui@uevora.pt (N. Guiomar), paulo.mateus@icnf.pt (P. Mateus), tiago.oliveira@thenavigatorcompany.com (T. Oliveira).

http://dx.doi.org/10.1016/j.landusepol.2016.10.008
0264-8377/

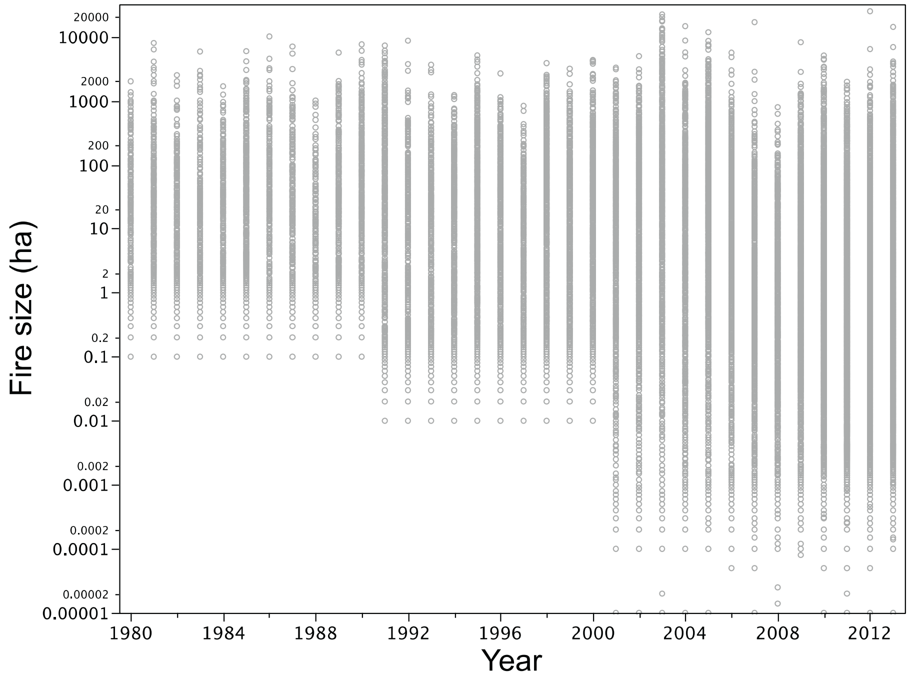

Fig. 1. Sizes of ignitions in Portugal (1980–2013) from the official database, excluding zero-area records. The log scale is used to highlight minimum sizes recorded.

problems identified by Pereira et al. (2011). Satellite-based burned area assessments are closer to the 'true' burned area value, are publically available,[1] and usually are the reference to study spatiotemporal fire patterns (e.g. Oliveira et al., 2012). Regardless of the variables used, homogenizing fire data over time is essential when analyzing time series (Turco et al., 2016), e.g. by imposing a minimum fire-size threshold.

2.2. Choice of fire activity metrics

Total number of ignitions and mean ignition size were the variables that MM used 'to test whether forest fire policies and legislation are reactive or preventive in relation to fire frequency, incidence and severity'. We first note that these variables are unrelated to fire frequency or fire severity, which are respectively defined as the number of times an area has burnt per unit of time, and the immediate ecological effects of fire (e.g. Agee, 1993). Secondly, fire size distribution is highly skewed and a minor proportion of the total number of events causes most of the damage, e.g. see Zea Bermudez et al. (2009) for Portugal. Inspection of the official database[2] reveals that 75.2% of all ignitions (1980–2013) were smaller than 1 ha and amounted to just 1.7% of the total area burned; and large fires (by definition ≥100 ha) comprised only 0.7% of the total number of ignitions, but accounted for 73.2% of the total surface burned. The identification of years with significant or abnormal fire activity is thus substantially constrained by assuming total number of ignitions and mean ignition size as fire damage proxies, as in MM.

Table 1 gives evidence of poor choice of fire activity metrics by MM. Number of ignitions and mean ignition size offer insignificant to modest explanation of the observed variation (as measured by the coefficient of determination R^2) in variables depicting the extent and gravity of fires, i.e. total area burned and area burned by large fires, computed from the official database. Additionally, and to overcome insufficiencies inherent to the fire database (Pereira et al., 2011), metrics of area burned were calculated from the Portuguese Landsat-based fire atlas, respectively total fire area and the number of extremely large (>2500 ha) burned patches (Fernandes et al., 2016); a 35-ha cut-off for fire size was used, the minimum detectable before 1984 (Oliveira et al., 2012). Again, both the number of ignitions and mean ignition size are shown to be weak surrogates for fire-activity level (Table 1).

Table 1
Coefficient of determination (R^2) and statistical significance of regressing variables of total and large fire area against number of ignitions and mean ignition size in Portugal (n = 34, 1980–2013).

Fire variable	Number of ignitions		Mean ignition size	
	R^2	P-value	R^2	P-value
Fire database				
Total fire area	0.24	0.003	0.09	0.078
Large fire area	0.17	0.015	0.13	0.036
Large fire area%	0.01	0.620	0.33	<0.001
Fire atlas				
Total (>35 ha) fire area	0.11	0.058	0.18	0.011
No. extremely large fire patches	0.14	0.031	0.12	0.042

Two additional major limitations of the indicators chosen by MM are apparent. The first is related to spatial autocorrelation in the distribution of ignitions, indicating spatial clustering (Fig. 2). In fact, 45.9% of ignitions are concentrated within just 10% of Portugal mainland. The second concern is the use of the mean as a metric of the central tendency of ignition size distribution in each year. The mean is inappropriate for data asymmetrically distributed (e.g. Killeen, 1985), because it is highly sensitive to outliers. This is corroborated by the comparison in Fig. 3 between the mean values used by MM and Tukey's location, a robust central-tendency metric (Huber, 1981), resulting in a mean square error of 66.6 and a correlation coefficient of 0.57.

3. Production of fire legislation often follows disruptive fire activity

A comprehensive legislative reform ensued the catastrophic fire seasons of 2003 and 2005 in Portugal (Mateus and Fernandes,

[1] http://www.icnf.pt/portal/florestas/dfci/inc/.
[2] Available at http://www.icnf.pt/portal/florestas/dfci/inc/.