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Forest Fires and Climate Change

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1. Background

Catastrophic wildfires, i.e. fires involving high human and infrastructure losses, are becoming more frequent in different parts of the globe and particularly in Mediterranean bioclimatic regions, characterized by a coincidence of the dry and warm seasons. Besides large areas of burnt land, catastrophic fires cause a significant number of human victims (Table 1).

Table 1. Size of burnt area (in thousands of ha) and number of lost lives (in brackets) during catastrophic fires in different countries (EM-DAT 2009)

Country/region	2003	2005	2006	2007	2008	2009
Portugal	426 (21)	338 (17)				
Galicia, Spain			92 (4)			
Greece				270 (84)		
California, USA	320 (15)			200 (9)	325 (23)	
SE Australia						455 (173)

Infrastructures have also been strongly affected. For instance in Greece in 2007, over 2.100 buildings were destroyed, while in 2009 in Southeast Australia up to 35.000 buildings were ruined, causing the displacement of 7500 people. Economic damage due to wildfires in Portugal has been calculated at nearly 3 billion euros, the third costliest natural disaster in the decade over Mediterranean Europe (EM-DAT 2009).

Longer and warmer summers have resulted in a fourfold increase of major wildfires in the United States since 1986, and a six fold increase in the area of burnt forest, as compared to the period from 1970 to 1986. A similar increase has been noted in wildfires in Canada for the seven decades since 1920 (Running 2006).

Beyond direct effects on people and infrastructures, catastrophic fires impact soil, water, and biodiversity, and induce emissions of CO_2 and other Greenhouse Effect Gases (GEG) such as CO, CH_4 and N_2O. In Portugal, total emissions (CO_2 plus other GEG) due to forest wildfires between 1990 and 1999 varied (as converted to grams of CO_2 equivalents) between 1339×10^9 and 7149 Gg CO_2e (Silva 2003). These values indicate that total emissions caused by wildfires in Portugal amount to over 9% of the total emissions of the country, nullifying the carbon sink role of Portuguese forests as considered in the National Plan for Climate Change.

2. Explaining the trend

2.1. Better conditions for ignition

Poor forest management practices, leading to high accumulation of fuel vegetation on the ground or badly planned and compartmented landscapes, have long been seen as a primary cause of increasing wildfires, although global warming is becoming accepted as a major driver too (Westerling et al. 2006).

An explanation for the increasing severity and intensity of forest fires is an increase in the extension of the dry season and in extreme summer temperatures, thus creating the ideal conditions for the ignition of wildfires. These climatic trends have been reported in recent decades and are predicted to aggravate in Mediterranean bioclimatic regions, according to climate change scenarios (WMO 2003).

It is widely accepted that maximum temperature extremes have become more common in the past century as a possible consequence of global warming (Karl 1997, Houghton et al. 2001, IPPC 2001 and 2007). An analysis by the Portuguese Meteorological Authority, for example, showed that although several heat waves could be identified in records throughout the 20th century, overall heat wave frequency increased since the 1980s (Durão and Corte-Real 2006, IM 2004). Indeed, the Climate Change scenarios for Portugal predict a significant increase of the fire weather index, which measures the likelihood of wildfire occurrence (Pereira et al. 2002). This is particularly significant as over 2/3 of the variation in Portugal's annual burnt area can be explained by meteorological conditions alone (Pereira et al. 2006).

Also, increased rainfall concentration in the wet season may contribute for higher growth of plant biomass and fuel accumulation on the ground. Summarizing: there will likely be better conditions for ignition and propagation of fire in Mediterranean Bioclimatic regions. Indeed, the most dramatic seasons of catastrophic fires resulted from the sequence:

very wet season → very dry and warm season → heatwave + strong/variable winds

This was the case of Portugal in 2003, California in 2005, Greece in 2007, and Australia in 2009.

Although wildfires shaped most of Mediterranean ecosystems, which evolved with this ecological disturbance, the fire regimes (i.e. frequency and intensity of fire occurrence) have changed. The natural occurring 25-35 year cycle of fire in Mediterranean ecosystems was reduced (Pereira et al. 2006) and fires increased in intensity, becoming catastrophic fires and loosing their role of ecosystem renewal (e.g. release of nutrients and other resources) (Noss et al. 2006).

2.2. Socio-economic reasons (Mediterranean Basin)

Climate change drivers are increasing the likelihood of fire ignition (e.g. extreme temperatures) and propagation (e.g. plant biomass accumulation), but these are possibly interacting with socio-economic factors, exacerbating the potential occurrence of "catastrophic wildfires".

In the Mediterranean Basin, where natural fire ignitions (e.g. thunderstorms) are not common, ignitions are mainly related to human causes, and to the common use of fire for land management (e.g. for pasture renewal) in these regions. Traditionally, Mediterranean landscapes were characterized by a diversity of land uses: agricultural areas coexisted with orchards and crops. Shrubs were cut and used from livestock beds. These human landscapes were used and managed through millennia, and were characterized by discontinuities that inhibited fire propagation. Rural abandonment in

recent times, mainly due to socio-economic reasons, however, has led to lack of management, shrub encroachment, and homogenization of the landscape. Many rural areas of the Mediterranean Region have become potent fire-prone landscapes, with high levels of biomass accumulation during winter and spring, ready to explode in catastrophic wildfires during summer.

Some of these reasons may partially explain similar phenomena in other Mediterranean-type climate areas, such as coastal California and parts of southern Australia. In these regions, the situation is aggravated by expansion of semi-urban areas into forestry areas. Depending on local conditions of the woodland-urban interface, catastrophic fires usually lead to high death tolls and massive economic damage (Caballero 2004), as shown previously in Table 1.

3. Looking forward

Management of the land is crucial to maintain landscapes where fire has difficulties of ignition and propagation. Multiple use of the land, creating landscape discontinuity and fire propagation breaks, can contribute to mitigate catastrophic fires (Regato, 2008). There is a need to find innovative ways of using the land and increase the value of rural areas as an incentive to maintain people in the countryside. For example, the primary, often non-economic or strongly subsidised rural activities could be added to other activities related to social and environmental services (Pyne 2006), which often are not internalised into the economy.

Activities related to sustainable management of the land and wooded areas ought to be pursued, and those stakeholders engaged in such activities should be rewarded. Certification mechanisms as the Forest Stewardship Council (FSC), for example, contribute to this. FSC adds value to the forest as a market communication tool, rewarding those engaged in sustainable management of woodlands. Mediterranean woodlands provide important environmental services as well (e.g. biodiversity, soil conservation, water regulation, carbon storage). Proper mechanisms of evaluation and payment of such ecosystem services are needed to maintain sustainable use and management of the land and, ultimately, contribute to mitigate the catastrophic fire problem.

4. What is WWF doing?

WWF is involved in advocacy, communication and awareness actions related to climate change, and engaged with the corporate sector looking for capable ways of mitigating the ecological footprint and reducing carbon emissions of companies.

WWF is also involved in advocacy and looking for technical solutions related to the development and implementation of mechanisms for paying environmental services, which can secure the sustainable management of forests and landscapes, and create conservation opportunities properly rewarded by the market or politically recognized.

WWF has been actively leading FSC certification processes in many of the world regions. In Portugal, WWF conducted the process of the FSC National Initiative, and

stimulated the FSC certification through the Global Forest and Trade Network (GFTN Iberia). GFTN is a WWF tool for responsible market development of forest products.

WWF has also been involved both in Portugal and worldwide in ecological restoration, including that of burnt areas. In such cases, WWF looks for technical solutions which prevent fire ignition and propagation (e.g. adequate compartment of landscape).

All the above actions are related and aim to promote a sustainable use of the land, benefiting both people and conservation. Through that, we hope to contribute to mitigate the catastrophic fire problem, and to reduce one of the main impacts of Climate Change.

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- And promoting the reduction of pollution and wasteful consumption.

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