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Resilience of Mediterranean vegetation to fire: Issues under the global change scenarios

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Introduction

Mediterranean ecosystems are characterised by the oscillation in the prevailing meteorological conditions, with dry hot summers (lasting between two to three months on the French and Italian coasts in the northern Mediterranean Rim to more than five-six months on the Libyan and Egyptian coasts to the south) and mild wet winters. These ecosystems are also characterised by the occurrence of frequent wildfires. Fire has long ago being considered as a natural phenomenon, largely incorporated in mediterranean climate systems evolution, having shaped their diversity (Cowling et al. 1996) and function (Rundel 1981). Fire regime is critical in defining ecosystem responses, as for example, high fire frequency may prevent seeders from replenishing seed banks (Arianoutsou 2002), may deplete resprouters from their bud banks (Canadell and Lopez-Soria 1998, Arianoutsou 1999) and/or may favour the establishment of alien species (e.g. Vila et al. 2001). It is accepted that fire occurrence is determined by several different factors, among which human activities are also considered. However, fire characteristics are related to climatic factors (Chandler et al. 1983. Clark 1990 among others). Given the fact that there is strong evidence of warmer spring and summers and drier conditions prevailing over the Mediterranean Basin due to climate change (IPCC 2001), prediction of trends in the resilience of Mediterranean vegetation towards the altered fire regime become crucial.

Climate Change and the Mediterranean Basin Ecosystems

Sala et al. (2000) have provided a global assessment of different pressures on biodiversity; they showed that changes in land use were major drivers of biodiversity loss, followed by climate change. In this work, it was highlighted that Mediterranean ecosystems will experience large biodiversity loss because of their sensitivity to many drivers of change. Recently, Thomas et al. (2004) suggested that climate change may be the most important driver of biodiversity loss in the next 50 years. For the Mediterranean Basin air temperature is foreseen to increase between 2 and 4°C over the next century (Palutikof and Wigley 1996), while precipitation is predicted to decrease in autumn and increase in winter (Deque et al. 1998). These changes are expected to affect plant life (e.g. growth, litter production), species recruitment, community composition and biodiversity and overall, the regeneration processes afler fire (Lavorel et al. 1998).

Fires in the Mediterranean Basin

One of the major environmental concerns in the Southern European countries is the occurrence of summer forest fires. Currently, more than 60,000 fires burn throughout the Mediterranean Basin, consuming over an annual average of 600,000 hectares. Despite the fact that a lot of resources have been invested in fire prevention and suppression, the number of fires in recent decades has continued to increase markedly (JRC 2005). Much of the discussion (fire management and scientific) on changed forest fire regimes has been oriented towards the changes in land use history which has largely occurred afler the late 80's in most of the countries (e.g. Moreira et al. 2001. Arianoutsou 2001, Arianoutsou et al. 2002). Yet. neither the extent of recent changes nor the degree to which climate may be driving regional changes in wildfire regimes has been systematically documented. Piñol et al. (1998) studied a climatic series of 50 years from a Mediterranean locality in southern Spain and two relevant fire hazard indices. Both fire hazards increased over this period as a consequence of increasing mean daily maximum temperature and decreased minimum daily relative humidity. They concluded that an effect of climate warming on wildfire occurrence is supported by this relationship. Pausas (2004) analysed data from 350 meteorological stations in the eastern Iberian Peninsula covering a time period of 50 years (1950-2000) and fire records for the same area. He concluded that a clear pattern of increasing number of fires and size of area burned during the last century is observed. He suggested that this increase is partly related to changes in the observed climatic pattern. Similar results have been drawn from studies in the western United States (Westerling et al. 2006), particularly in areas where land-use histories have relatively little effect on fire risks and are strongly associated with increased spring and summer temperatures.

Resilience of the Mediterranean Ecosystems towards fire

The concept of resilience has received much attention in the Mediterranean ecosystems in the 80's (Westman 1978, Dell et al. 1986). Renewed interest has emerged on the concept because of two main reasons (Lavorel 1999): the accelerated loss of biodiversity and the potential loss of buffers to the impacts of disturbance and the projected effects on disturbance regimes that climate change might bring. Resilience is defined in the context of the amplitude of changes brought about by disturbance – in this case fire - and the dynamics of post-fire recovery. Resilience of Mediterranean ecosystems is estimated either through the monitoring of post-fire community dynamics or through the evaluation of values derived for several critical community components such as plant functional groups (e.g. Kazanis and Arianoutsou 2004). It is suggested that prediction of resilience, especially under altered fire regimes, can also be based on the use of plant functional groups in modelling efforts (Arianoutsou et al. submitted).

Furthermore, It is expected that climate change will not only affect fire regime in areas falling within the typical range of climatic conditions of Mediterranean climate (Lavorel et al. 1998), but will also induce fire events in areas characterized by more humid and cooler conditions. In Greece, there is strong evidence (Arianoutsou and Kazanis unpublished data) that this shifl has already started to occur. During the last decade serious fire events have occurred over mountainous regions covered by *Pinus* nigra (Taygetos Mt.. Pindos Mt. Range) and the endemic fir species of Abies cephalonica [Mainalo Mt., Kallidromo Mt.] all of which are found on altitudes higher than 1000m (the limit of Mediterranean ecosystems) and regularly receiving much higher annual precipitation. Mt Taygetos is the southern most distribution point for black pine and fir forests within Europe, hosting 21 narrow endemic plant species. If we consider that these systems have not evolved under the periodic influence of fire disturbance and therefore these ecosystems are not equipped with mechanisms to cope with fire – they are not resilient - then climate change is likely to have a considerable and adverse impact.

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