

Editorial

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## Fire ecology, Mediterranean forests and global change

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At the end of the twentieth century, fire ecology has enjoyed a new wave of (perhaps unexpected?) interest, for several reasons. Global environmental change, in particular the combined effects of atmospheric CO<sub>2</sub> increase, nitrogen deposition and climate change, has been recognised as a forcing of vegetation dynamics that perhaps at an early stage might affect fire regimes earlier than other processes — locally, this could be both an enhancement or a reduction of fire frequency. Simultaneously, a range of long standing management strategies are seen as affecting forest ecosystems in sometimes unexpected ways, e.g. in the sense of making fires more severe as a consequence of long fire suppression and the associated fuel increase, or due to changes in forest distribution as a result of agricultural abandonment.

All of these issues are in a particular focus in the notoriously fire-prone Mediterranean ecosystems worldwide, and they are well illustrated in the Mediterranean region of Europe. The international research programmes GCTE<sup>1</sup> and LUCC<sup>2</sup> consequently received a range of contributed papers about this subject during their joint International Open Science Conference, held in Barcelona (Spain) in March 1998. This special issue presents a selection of these contributions, addressing the problem of fire dynamics and environmental change from a range of different viewpoints.

Much of vegetation community response to fire occurs through the differential sensitivity of species to the impact of burning. Vilà et al. have studied the

tussock grass *Ampelodesmos mauritanica*, which occurs in shrublands, as an example for this through experiments combined with field and laboratory studies, showing that the end result of management depends on both, fire regime and grazing pressure. Critically, they point at the positive feedback that occurs from encroachment of the grass to increasing fire risk.

Giovannini et al. focus on land use change, which in the Mediterranean mostly means abandonment of marginal land from agriculture including the associated spontaneous or managed reforestation, and the impacts it has, through fire regime, on soil erodibility. From theoretical considerations, they show that increasing fuel load after abandonment likely enhances fire temperatures and thereby soil erodibility — despite the more developed root profile. Abandonment, therefore, does not necessarily stabilise soils in comparison with an intensively used agricultural landscape. De Luís et al. are also concerned with erosion and fire in shrublands. They note that, historically, climate trends have increasingly favoured both processes during recent decades. In an experimental study they show that the combination of both factors, i.e. higher rainfall intensity shortly after the fire, yields the strongest alteration of physical and chemical soil properties.

Romanya et al. carried out experimental studies of nitrogen mineralisation in connection with fire, in three different Mediterranean shrubland types. They found that most N mineralisation occurs during the months after the fire and not during the fire itself. Generally, N mineralisation in grasslands appeared to be determined by the temperature of the topsoil during the fire, while the key factor in shrublands seemed to be the amount of ash that was produced.

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<sup>1</sup> Global Change and Terrestrial Ecosystems, a core project of the International Geosphere Biosphere Programme, IGBP.

<sup>2</sup> Land Use and Cover Change, a joint project of the IGBP and the International Human Dimensions Programme, IHDP.

Advances in cartography and GIS permitted Vázquez and Moreno to perform an interesting quantitative assessment of fire frequency and extent for an area in central Spain, mostly covered with pine forest, during 20 years based on aerial photography. They find that the fire return period of this area is approximately 50 years, but it varies greatly at a local scale, depending on topographic and other conditions. They argue that an increase in fire frequency, if it occurs primarily in areas already burnt (rather than randomly), would have additional detrimental consequences not previously considered. Increasingly, the satellite archives become large and detailed enough, and cover sufficiently long time periods to allow fire mapping and management of larger forested areas. Díaz-Delgado and Pons concentrate on the detection of burnt forest areas in Catalonia during the period 1975–1995, using Landsat MSS data. On the basis of their processing, the number of fires not detected was still significant (23%), while the number of observed fires that did not actually occur was lower (8%). The scope of studying post-fire regeneration from these satellite data was shown to be limited.

Ultimately, the management of Mediterranean forests will have to rely on methods that allow us to predict future conditions. A suitable way to synthesise understanding of forest dynamics in such a way that prognostic studies become possible is the development of numerical simulation models. Mouillot et al. present such a model. As a tool of synthesis for the most critical quantitative features of plant species, they use the “vital attributes” approach, which allows to focus on regenerative traits as important features. Physiological responses are described using

a mechanistic carbon and water balance, which is also a prerequisite for fire behaviour simulation. The model is presented as a conceptual tool — it will be important to follow its validation against observations such as those presented by the other papers in this feature.

Overall, it is remarkable that the distinction between “descriptive” and “functional” studies no longer applies for any of the studies presented in this feature. It must also be noted that we are still a long way from successfully predicting all relevant aspects of fire dynamics in the Mediterranean or, for that matter, any other major ecosystem of the world. Work such as these studies needs to be followed up by similar investigations, equally characterised by an open mind towards modern methods such as numerical data analysis and GIS, as well as by advanced modelling techniques. If this happens, then maybe the pending questions for active management of fire-prone regions could be answered at a scale suitable for broad-scale decision making: we would know, for example, whether fire suppression — in the long term — needs to be re-oriented towards a stronger recognition of forest ecosystem processes. It is also likely that such work would greatly improve our capacity to assess likely impacts of global change on managed forests.

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