

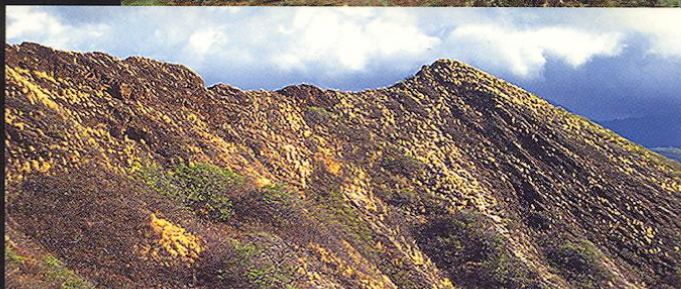
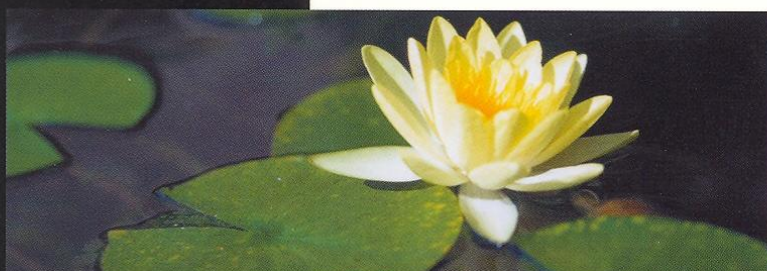
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THE ROLE OF FIRE IN THE MEDITERRANEAN FORESTS: PAST, PRESENT AND FUTURE PERSPECTIVES**Margarita Arianoutsou**

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Introduction

Fire is a major ecological factor in many biomes of the world (Rundel, 1981). In the Mediterranean ecosystems fire has acted as an integral part of their evolutionary history, by having shaped their adaptive traits (Naveh, 1975). Fire has probably played an important role in the selection of many extant Mediterranean plants: the protective bark of the widespread cork oak (*Quercus suber* L.) and its remarkable capacity to resprout after fire from aerial buds is difficult to be explained without the evolutionary intervention of fire. The specific regeneration behaviour of plants is closely related to their physiological traits and is strongly influenced by fire regime (fire season, intensity, interval), (Arianoutsou, 1998). More specifically, plants of these ecological systems can regenerate through resprouting from intact buds situated at the base of the root crown or from other root rhizomes, or from underground organs such as the lignotubers or the bulbs. Other plants can preserve their reproductive units either in hard cones (e.g. Pines) remaining on the plant, forming thus a canopy seed bank, or by forming hard-coated persistent soil seed banks (e.g. Cistaceae, Leguminosae). Both seed banks are not destroyed by fire and they become available after its passage.

Post-fire succession in the Mediterranean plant communities is an autosuccession that leads to the recovery of the pre-fire vegetation. This means that all species, which occurred in the site before fire, are present immediately after it, even in different numbers and relative cover. In this autosuccession, herbaceous plants are abundant in the early post-fire communities and within the herbaceous taxa, legumes are the dominant functional group. Pre-fire community structure is rapidly re-established. Woody plants dominate in the late post-fire communities, both in species numbers and in phytomass.

Fire frequency is an important parameter of fire regime. Very frequent fires may diminish plants that have either short life cycles, such as the rockroses or other long living plants, which require an adequate period before they can regenerate. Pines belong to the last category, as they require at least 6-8 years to produce cones and these cones require some period before they become mature. Although our knowledge on the factors that control species richness in post-fire Mediterranean environments is poor, available evidence indicated that species richness is more sensitive to fire severity and fire frequency than plant cover. The 'natural' window time between two consecutive fires is between 50 -60 years for the Mediterranean Basin.

Man and the Mediterranean Landscapes

Man early settled the Mediterranean Basin. Consequently, Mediterranean landscapes have long ago experienced the human impact. Indigenous agriculture and animal husbandry have been practiced here for more than 10000 years, in combination with deforestation practices and fire management. Plant community structure and diversity patterns have therefore being evolved under the influence of this interaction. These patterns were kept in a dynamic equilibrium at least until the Second World War. Since 1950 major changes have occurred to the economies, the livelihood and hence the landscapes of the Mediterranean countries (Arianoutsou, 2001).

Pinus halepensis forests of Greece: a study case

Pinus halepensis Mill. and *Pinus brutia* Ten. are two major forest species widely distributed around the Mediterranean, from sea level to relatively high altitudes and they alone account for about 25% of the forested area of the Mediterranean Basin. They are both highly flammable seeding species, growing on virtually all kind of substrates, landforms and topography. *Pinus halepensis* (Aleppo pine) and *Pinus brutia* (East Mediterranean pine) forests cover approximately 40% of the coniferous forests and approximately 9% of the total forested area in Greece. They develop at areas of low altitude at relatively dry Mediterranean conditions. Mediterranean forests of Greece host almost 10% of the plants, which are endemic in the fire-prone environments of the country.

Almost 1/5 of the fire events which occurred in Greece during the last 30 years have burst over Aleppo pine forests consuming ~ 400000 ha of them. *Pinus halepensis* ecosystems are resilient to fire provided that fire interval follows the 'norm'. This time window must not in any case be less than a minimum time required by Aleppo pine to accomplish its biological cycle, that is to establish new seedlings and reach reproductive maturity. This period is not less than ~25 years.

Traditional use of Aleppo pine forests was primarily related to resin collection and secondarily to wood collection and grazing. During the last 30 years Aleppo pine forests attract other human activities, e.g. recreation and housing constructions. This shift is clearly reflected to the number of fire events starting at the wildland - urban interface.

Pinus halepensis natural forests of Mountain Penteli in Attica is a typical example of such landscape changes and fire interactions, having experienced very frequent deliberate fires at quite short time intervals. Plant community structure and diversity are greatly affected. The short fire interval has stronger impact on the occurrence of the woody plant species than on the herbaceous. *Pinus* seedlings are no longer appearing and ruderal taxa become dominant. Therophytes become more abundant both in species richness and in cover. The relative representation of key-functional groups changes significantly. Evidence that at least 3 plant endemic taxa *Campanula drabifolia*, *Erysimum graecum*, both biennial hemicryptophytes and *Onobrychis ebenoides*, a perennial pubescent chamaephyte protected by the Presidential decree 67/1981, did not manage to survive.

Conclusions

There has been an increasing interest in many terrestrial biomes on issues relating biological diversity and ecosystem function. Mediterranean ecosystems of the World have been proposed as critical in this scientific effort in the sense that they provide important models for searching new paradigms relating biodiversity with ecosystem stability and resilience. Given the fact that these ecosystems are under the threat of severe and progressing landscape changes, the need of full understanding the processes underlying these links is essential and becomes crucial under the foreseen climate change scenario.

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