THE INTERNATIONAL MEDITERRANEAN ECOSYSTEMS CONFERENCE
PERTH, WESTERN AUSTRALIA, AUSTRALIA
SUNDAY 2 - WEDNESDAY 5 SEPTEMBER

2007

CONFERENCE PROCEEDINGS

D. Rokich, G. Wardell-Johnson, C. Yates, J. Stevens,
K. Dixon, R. McLellan & G. Moss (Eds).

Diversity and abundance of geophytes along post-fire chronosequences of *Pinus* halepensis forests in Greece

Dimitris Kazanis,[1,2] and Margarita **Arianoutsou**[1]

[1] Department of Ecology and Systematics. Faculty of Biology, University of Athens, Greece
[2] Contact should be made to D. Kazanis, email dkazanis@biol.uoa.gr

Keywords
geophytes, fire, biodiversity, CCA

Introduction

Although they are part of most terrestrial biomes around the world, geophytes present their maximum diversity in mediterranean-type ecosystems (Rundel 2004). It has been proposed that it is their subterranean storage organs, which provide them with a certain advantage against competition and the unpredictability of water availability that characterizes the Mediterranean climate (Pausas 1999). For Greece, in particular, many of the most important, in terms of rarity or/and endemism, plant taxa are geophytes (Kokkoris and Arianoutsou 2000). Therefore, geophytes could be regarded as a priority group for mediterranean climate ecosystems (MCEs) and understanding their response to disturbance should be of a key-importance (Ne'eman et al. 2004). There is a great deal of information on early post-fire regeneration and performance of geophytes from MCEs all over the world. Geophytes are generally regarded as obligate resprouters, with several species relying upon fire for anthesis and fruit production (Keeley 1993). Still, the long term post-fire pattern of this plant group has not been thoroughly examined, with the exception of the Californian chaparral, where it has been reported that geophytes, unlike most other post-fire herbaceous species, remain in the understorey as the woody canopy closes (Tyler and Borchert 2002). The aim of the present work is to study the long-term post-tire pattern of geophyte species richness and abundance in the most affected by fire forest ecosystems of Greece, those of *Pinus* halepensis.

Materials and Methods

Pinus halepensis (Aleppo pine) is the most important lowland forest species in several parts of continental Greece. The fire regime of these forests is characterized by high intensity fires with a fire interval of approximately 30 to 50 years (Kazanis 2005). Detailed long-term monitoring of plant community dynamics was performed along three post-fire chronosequences of Aleppo pine forests in Central Greece, each one corresponding to a different forest type in terms of understorey floristic composition and structure (Kazanis 2005). Forest stands of type A are characterized by dense, woody understorey, dominated by evergreen sclerophyllous shrubs, while the understorey of type C stands is sparsely covered by evergreen sclerophyllous and dwarf shrubs. Forests stands of type B present an intermediate situation. Furthermore, it could be argued that stands of type A, B and C form an altitudinal gradient, with type A being found at the mountainous zone and C near the coasts. Each chronosequence consisted of forests stands of different post-fire age, varying from 1 to >35 years. Within each stand, three 50m-long transects have been randomly established and all plant growing along them were recorded. Sampling campaigns were performed three times per year and for up to four consecutive years. Based on these records, geophyte richness and abundance have been evaluated for each stand per year of sampling. Data on geophyte species presence and abundance were analysed with the use of CANOCO™ 4.0 for Windows software. Direct gradient analysis was performed so as to evaluate the effect of several environmental variables.

Results

In total. 49 different geophvtic species have been recorded during field campaigns (16% of overall number of sampled taxa). Among the families with the higher number of geophytic taxa were those of Liliaceae (12 taxa), Orchidaceae (nine taxa) and Iridaceae (eight taxa), all belonging to the Monocotelydonous order. In terms of sub-terrain organ morphology, most of them were bulbous, followed by rhizomatous geophytes. Among the recorded geophytes, there were seven (seven) Greek endemic taxa.

For three species we were able to establish their inability to regenerate afler fire, i.e. *Scilla autumnalis*, *Muscari neglectum* (Liliaceae) and Romulea *bulbocodium* (Iridaceae). The species in question are all characterized by a bulb of small size, found near ground surface, and potentially destroyed by fire.

The patterns of geophyte species richness and abundance along the three post fire chronosequences are provided in Figures 1 and 2, respectively. It seems that both variables have their minimum values at stands characterized by high shrub cover, a phase of the post-fire pine stand dynamics that usually lasts between the 5th and 15th post-fire year (Kazanis 2005). The results of the performed canonical correspondence analysis (CCA) supported this negative relationship between geophytes and shrub cover. Furthermore. CCA revealed that stand type played a critical role in defining species composition, since there were several taxa present only in stands of the same type, indifferent to the post-fire age.

Discussion

According to our results, in most cases of burned Aleppo pine stands, no particular flush of flowering geophytes has been observed. Even mature forest stands of low or intermediate shrub cover hosted a significant number of them. Geophytes are generally regarded as a plant group characterized by high regeneration potential afler fire (Chapman and Crow 1981). Furthermore, they show particular longevity and persistence as vegetation develops (Tyler and Borchert 2002). As a consequence, the factors affecting the composition and abundance of the geophytic element in a given forest stand should be primarily related to the stand abiotic (annual precipitation, dry period duration) and biotic (vegetation and litter cover) characteristics and secondarily to post-fire age per se.

There are several studies in Mediterranean rangelands that support the negative relation of vegetation cover and geophyte abundance and discuss the positive effect of grazing (Ne'eman et al. 2004). From our data, it seems that a similar relation may also occur in forest ecosystems. Under the global pattern of land abandonment, the role of traditional forest land uses, such as resin harvesting and grazing, towards the maintenance of geophyte diversity across forested landscapes should be reconsidered.

References

Chapman R and Crow G. 1981. Application of Raunkiaer's life form system to plant species survival after tire. Bulletin of the Torrey Botanical Club 108:472-478.

Kazanis D. 2005. Post-fire succession of *Pinus* halepensis forests in Central Greece: vegetation dynamics patterns. PhD thesis. University of Athens, 350p. (In Greek with an English summary).

Keeley J. 1993. Smoke-induced flowering in the fire-lily *Cyrtanthus ventricosus*. South African Journal of Botany 59:638.

Kokkoris Y and Arianoutsou M. 2000. The endemic plants of the fire-prone environments of Greece: ecological profile and implications for conservation. In: Book of Abstracts of the 9th International Conference on the Mediterranean –type Ecosystems, Stellenbosch, South Africa.

Ne'eman G, Schwartz-Tzachor R and Perevolotsky A. 2004. The effect of cattle grazing on the Medterranean geophyte Anemone coronana – M Arianoutsou ano VP Papanastassis. eorors Proceedings of 10th MEDECOS Conference Rhooes Greece M llpress, Rotterdam (electron c eo tion)

Pausas JG. 1999. Mediterranean vegetation dynamics: modelling problems and functional types. Plant Ecology 140:27-39.

Rundei P. 2004. Mediterranean-climate ecosystems: defining their extent and community dominance. M Arianoutsou and VP Papanastassis. editors. Proceedings of 10th MEDECOS Conference, Rhodes, Greece. Millpress, Rotterdam (electronic edition).

Tyler C and Borchert M. 2002. Reproduction and growth of the chaparral geophyte, Zigadenus fremontii (Liliaceae), in relation to fire. Plant Ecology 165:11-20.

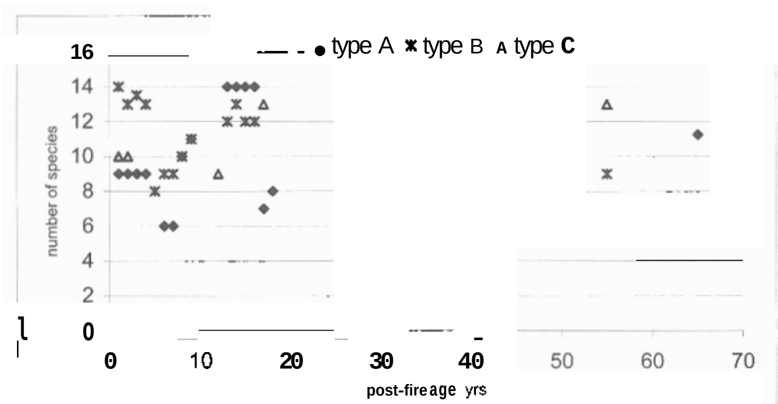

Figure 1. Geophyte species richness along three post-fire chronosequences of *Pinus* halepensis forests. A, B and C refer to the respective forest stand type chronosequence (see text for further information).

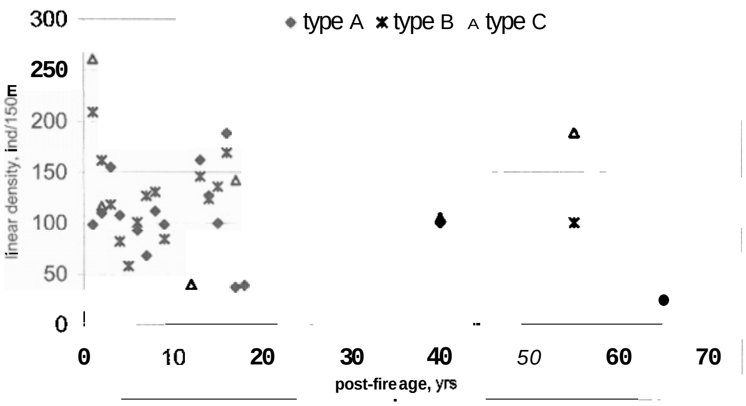

Figure 2. Geophyte abundance along three post-fire chronosequences of *Pinus* halepensis forests. A, B and C refer to the respective forest stand type chronosequence (see text for further information).