Post fire rehabilitation in Southern Europe

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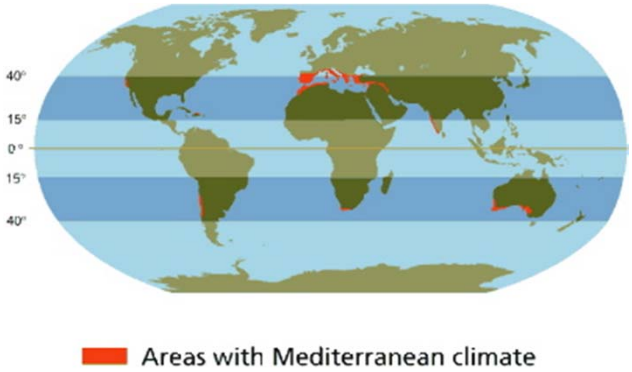
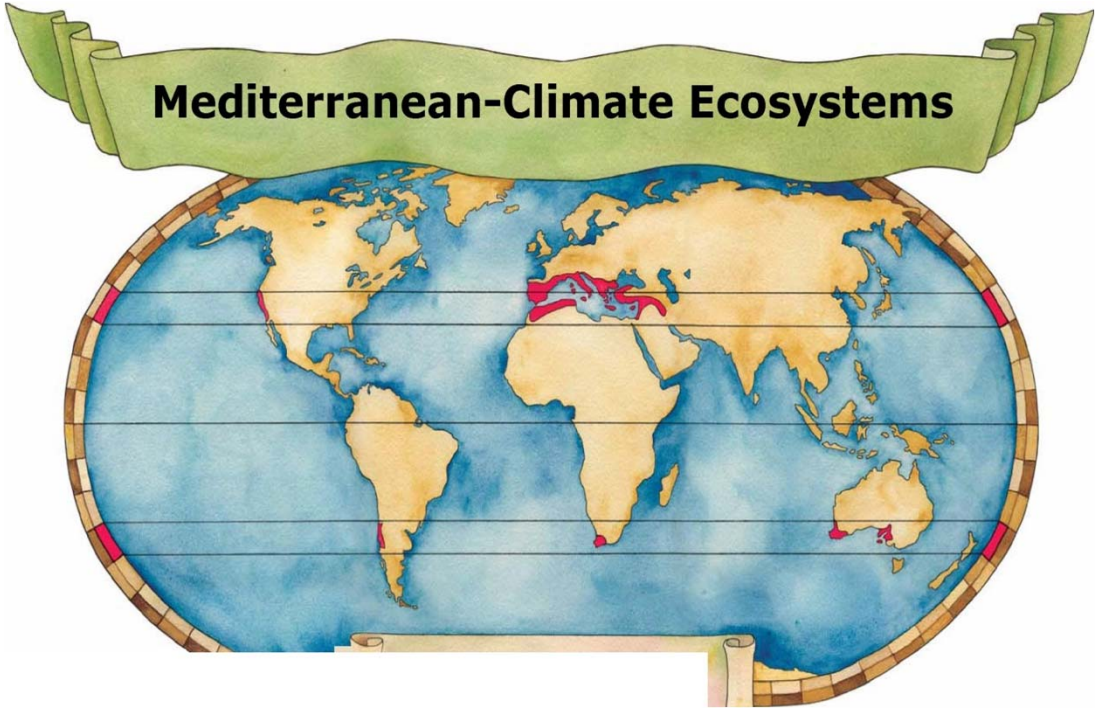
Introduction



- Mediterranean Basin
- California
- Central Chile
- South Africa
- Western Australia



Introduction-Fire history

- Fire incidents in the Mediterranean Basin are very common and a high frequency of fires has extended back into the past.

- Evidence of fire can be identified in the Iron Age, 2600 years B.C., when shepherds and farmers set fires in order to open the forest and the ground for improving pasture and cultivated land.

- In Mediterranean Basin, the first archaeological evidence of fire occurrence in the xerophytic landscapes goes back to the end of the Middle Stone Age.

Introduction

- Fire plays an important role in the Mediterranean Basin ecosystems.

Number of forest fires in five Mediterranean countries (1980-2010)

Portugal	Spain	France	Italy	Greece	TOTAL
565 831	471 760	152 431	304 861	48 110	**1 544 993**

Burnt area (hectares) in five Mediterranean countries (1980-2010)

Portugal	Spain	France	Italy	Greece	TOTAL
3 390 976	5 368 227	852 632	3 542 542	1 466 592	**14 620 968**

Introduction

- The biodiversity of Mediterranean Basin ecosystems is determined by the frequency and intensity of recurrent wildfires (i.e., fire regime).

- Frequent recurrent forest fires are usually common in the summer time introduce a high risk of direct damage to humans and structures in most of the highly populated Mediterranean countries, and especially in coastal regions.

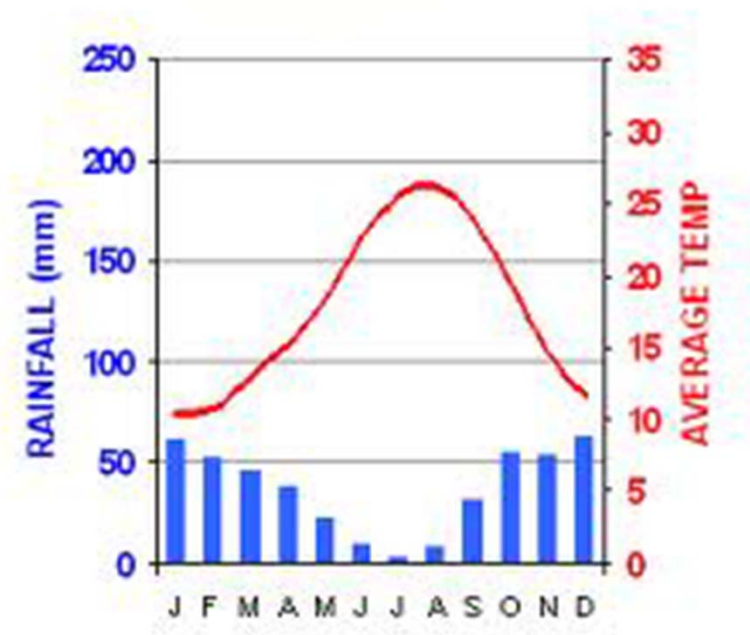
Fire regime

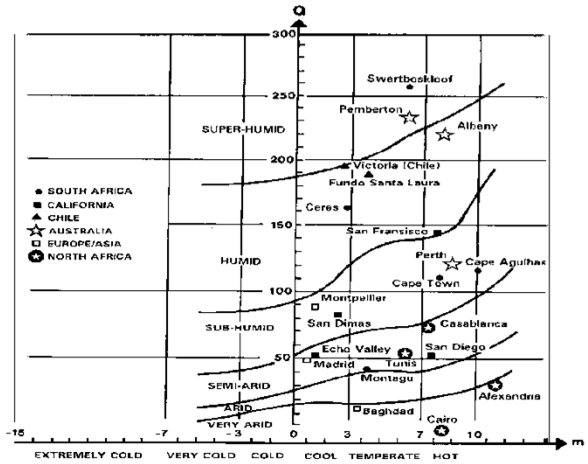
Forest fire cause statistic for four Mediterranean Basin countries during the period 1988-2004

Country	Causes - %		
	Human	Natural	Unknown
Croatia	75.3	0.8	23.9
Greece	55.5	3.0	41.5
Slovenia	45.9	8.3	45.8
Turkey	60.9	6.7	32.4
Average	**59.4**	**4.7**	**35.9**

Climate and Weather

- Warm and hot summers .
- Rainfall varies from place to place and is almost entirely confined to the winter months.





Coridothymus capitatus – thyme
Phlomis fruticosa – Jerusalem sage
Cistus spp. – rockroses
Sarcopoterium spinosum – thorny burnet
Euphorbia acanthothamnos – Greek spiny spurge

Type I: Phrygana (Garrigue)

- Communities in arid and degraded sites, mostly in the Eastern Mediterranean Region.
- Their vertical structure is restricted to one single layer, that of the dominant shrubs, which are seldom taller than 50 cm. At the mature stage, phrygana is a relatively closed community, leaving some open space between the individuals.
- The majority of the woody species are seasonal dimorphic, that is they change their leaves and type of branches twice a year, in order to face water stress.

Quercus coccifera – kermes oak
Pistacea lentiscus – lenisc
Arbutus unedo – strawberry tree
Myrtus communis – myrtle
Juniperus phoenicea – phoenician juniper
Juniperus oxycedrus – prickly juniper

Type II: Evergreen sclerophyllous shrublands

- Deep-rooted plants taller than 1m, such as *Quercus coccifera,* are the predominant species in these communities.
- Their leaves are thick, evergreen and sclerophyllous and larger than those of the phryganic species.
- They form very dense stands of one layer, leaving almost no space between individuals at the mature stage.

Pinus spp. – pine
Pinus halepensis – Aleppo pine (Spain, France, Italy, Greece, Turkey, Morocco, Algeria and Tunisia
Pinus pinea – stone pine
Pinus pinaster – maritime pine
Pinus nigra – Corsican pine
Pinus brutia – Turkish pine

Type III: Mediterranean pine forests

- They often form distinctive forests, particularly in the coastal regions which are less accessible to the activities of man.
- The trees can be up to 30 m tall, and generally have a rather poor understory stratum at the middle of their life span.
- The understorey stratum consists of either phryganic species or species of the evergreen sclerophyllous formations.

What to do after fire?

What to do after fire?

The questions:

- Is it always necessary to undertake rehabilitation actions after fire?
- Or better do nothing?
- If not always but perhaps sometimes yes: what are the criteria to decide where, how and when?

What to do after fire?

Those questions require:

- Fire impact analysis:
  - Prediction of burned ecosystems responses: post fire regeneration capacity
  - Estimation of post fire erosion and degradation risk

Understanding the critical factors for the fire impacts in the ecosystems to derive rehabilitation strategies.

POST-FIRE ECOSYSTEM REGENERATION IN THE MEDITERRANEAN BASIN

Phrygana species

- Therophytes and hemicryptophytes are the dominant life forms (in terms of species number) in the phrygana communities, with a noticeable advantage of therophytes.

- The relatively low diversity observed in phrygana communities might be the consequence of the absence or presence of grazing pressure on the community.

- High richness and diversity are the combined result of a long evolutionary history under constant stress by drought, fire, and grazing, in a warm-temperate climate, and the small-scale habitat heterogeneity.

Resprouting shrub species

- The most frequently burned areas with the shortest fire intervals present the highest species richness

- There is a clear negative effect of high disturbance frequency on resprouting capacity. This indication may help to predict changes in community structure under management (e.g. in fuel breaks and prescribed fires).

Non - resprouting shrub species

- The germination of many of these species is stimulated by the heat of the fire or, in some cases, by other fire products such as smoke or charred wood, and thus, the population size is often increased in post-fire conditions.

- These species are also highly flammable and more drought-resistant than resprouting species; not only they appear after fire, but they also colonize old fields and highly degraded ecosystems.

Mediterranean pine forests

- Post-fire regeneration relies on the canopy seed bank protected in the serotinous cones, although the degree of serotiny is highly variable among individuals and populations.

- The degree of serotiny is related to forest structure and fire history. The high variability in serotiny may explain the variability in post-fire regeneration found in some serotinous species.

Mediterranean pine forests

- The post-fire regeneration of these species is often very intense, although it can vary widely. This has been attributed to:

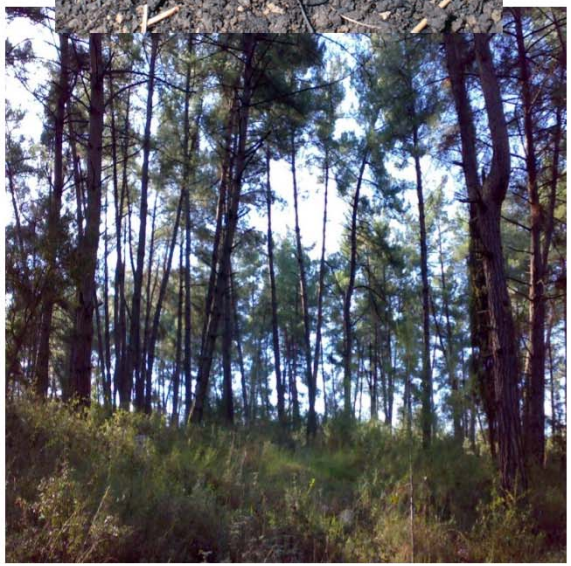
- the different fire characteristics, such as fire severity and fire size, to the different environmental and post-fire weather conditions, to land uses, to the variable post-dispersal seed predation and to the different degrees of serotiny in the pre-fire population.

- Despite the high post-fire resilience of Mediterranean pines, regeneration of these species may fail when time intervals between fires are shorter than the time required to accumulate a sufficient canopy seed bank.

Mediterranean pine forests

- The current increase in fire recurrence (i.e. reduction in fire-free intervals) in the Mediterranean Basin is reducing the capacity of these pines to regenerate after fire.

- Although serotinous pines have a relatively early first seed production, some of the areas they occupied a few decades ago have been repetitively burnt with fire intervals shorter than the time these pines need to produce a large enough seed bank to replace their population (15–20 years). Thus, many of the early pine woodlands are being replaced by shrublands.



Understanding the critical factors for the fire impacts in the ecosystems to derive rehabilitation strategies.

SOIL DEGRADATION AND EROSION RISK IS DEPENDENT ON PLANT COVER REGENERATION

Seeding

- A short term method to introduce relatively fast growing plants into a burned area so that a vegetative cover can be re-established as quickly as possible.
- Target areas are erodible soils that have been severely burned, or severely burned areas where all ground cover is lost

Mulching

- Mulching seeks to provide a suitable ground cover immediately after a fire is extinguished.
- The purposes of mulching are to reduce impact of raindrops, to hold topsoil in place, to disperse overland flow, and to provide space for reestablishment of vegetation.

Log Erosion Barriers

- Log erosion barriers (LEBs) are frequently installed to mitigate erosion from highly erodible soils on severely burned slopes.
- The purposes of LEBs are to provide mechanical barriers to runoff (thereby reducing the potential of rill erosion), while increasing infiltration potentia.

Conclusions

- The specific objectives of post fire rehabilitation treatments in Mediterranean ecosystems focus on soils and water-cycle conservation.
- Specific objectives vary depending on the degree of degradation, and climatic, biotic and socio-economic constraints.

Conclusions

- **Priorities:**
  - Soil and water conservation are the main priorities for reducing or preventing soil losses and for regulating water and nutrient fluxes.
  - Improving the resistance with respect to human and non-human disturbances: promotion of plants, animasl and microbial communities resilient to current and future disturbance regimes.
  - Increasing mature forest and shrublands formations depending on the environmental conditions of the site, in order to improve ecosystem and landscape quality and to increase carbon storage under scenarios of global warming and CO_2 build-up.
  - Promoting biodiversity and fostering the reintroduction of key species that have disappeared because of past land uses.

Conclusions

- **A landscape approach**

  - In many Mediterranean systems, and due to the large and long-standing human impacts, degradation processes are not local and large heterogeneous areas need to be restored. Rehabilitation treatments need to be viewed and approached at the landscape (and/or regional) scale.

  - Different combinations of the above-mentioned rehabilitation treatments may be required for different purposes, but also for different parts of the landscape.

Conclusions

- **Evaluation and Monitoring**

  -In order to improve our understanding of the success or failure of rehabilitation treatments, there is a need for long-term monitoring and evaluation of restoration actions in Mediterranean landscapes.

  - Evaluating rehabilitation success on the ecosystem and landscape scales can be performed using indicators, although widely accepted standard protocols are not yet available.

Conclusions

- **Extreme and unpredictable dry conditions**

  - Restoration techniques for Mediterranean conditions have greatly improved in recent decades, thanks to the inputs from disciplines such as community ecology and soil science.

  - However, we still lack well-tested and reliable techniques for restoring degraded ecosystems in arid or semi-arid regions, and thus further research is needed in this context.

Conclusions

- Moreover, nursery production needs to be diversified in order to provide high-quality seedlings for different purposes and conditions.

Conclusions

- **Economics**

  - The benefits of rehabilitation treatments are indirect and long-term, and thus they do not have a market value under prevailing economic systems.

  - For this reason, rehabilitation actions in the Mediterranean are strongly dependent on subsidies – mostly from the European Union – and changes in the existing subsidy policies could have strong impacts on our landscapes.

Thank you very much for your attention !!!

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