Creating “fire smart”
forests and landscapes
Introduction

Fire control in the Mediterranean Basin

From traditional land use mosaics

... to contemporary fire management policies
Introduction

More forest and less forest management: fuel accumulation
Fire control is limited by fuel and weather

Pinus pinaster forest

Direct attack

Fireline intensity (kW/m)

Fuel load (t/ha)

Fire danger: very high

Modelled after Fernandes et al. (2009)

Palheiro et al. (2006)

Direct attack

Fireline intensity (kW/m)

FWI

Fire danger rating

Mediterranean and boreal forests will adapt to climate change with more difficulty. Protection from wildfire will be important in these forest types, including large-scale fuel management, eventually through prescribed burning.

*In Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the IPCC*
“Fire smart” forests and landscapes

Fire Environment

Topography

Weather

Fuel

Fire regime

**“Fire smart” forests and landscapes**

**Goals**

- Fire suppression capacity is expanded:
  AREA BURNED is minimized
- Decreased fire severity:
  Increased RESISTANCE or RESILIENCE to FIRE

**Strategies**

- Fuel isolation (linear)
- Fuel modification (area-wide)
- Fuel type conversion
Objective criteria to manage forest stands against wildfire are available, but quantitative guidelines for prescription development are incipient.

Generalized lack of experimental studies.

Limited assessment of fuel management effectiveness from
- Fire regime analysis
- Fire modelling
- Wildfire case studies
- Evaluation by experts
Analysis of the fire regime: control by fuel or by weather?

Fire frequency analysis (Portugal, 1998-2008)

- The control of wildfire incidence by fuel age is weak to moderate.
- However, the fuel effect on burn probability is independent from weather conditions.
- Wildfires in younger fuels tend to be smaller and less variable in size.
Most fuel breaks were crossed or transposed by headfire, but still delayed fire growth.

Prescribed fire and/or grazing are recommended in the areas adjacent to the fuel breaks.

Fuel breaks parallel to fire spread were very effective at restraining lateral fire growth.

Reduce network density.
Impact of silvicultural treatments on the fire environment

Effect of thinning on fuel moisture

*Pinus pinaster*, NW Spain (Ruiz 2007)

- 3600 trees/ha, 36 m²/ha
- 1500 trees/ha, 22 m²/ha

Effect of thinning on wind speed
Impact of silvicultural treatments on fire behaviour: wildfire case studies

Effect of pruning

*Pinus radiata* & *P. pinaster*, Australia

**FIRE BEHAVIOUR CHARACTERISTICS OF THE LONGFORD FIRE**

17th November, 1962

by

A. G. McArthur
FOREST RESEARCH INSTITUTE

**FIGURE 4.**—Rate of spread in exotic pine plantations related to the forest fire danger index—

(A) In unpruned *P. radiata* plantations at Longford and Wandilo, S.A.,

(B) In pruned *P. pinaster* plantations at Gnangara, W.A.
Impact of silvicultural treatment on fire behaviour: modelling studies

Effect of thinning

*Pinus radiata*, Australia

Cruz et al. (2008) after Williams (1978)
Longevity of prescribed fire treatment

*Pinus pinaster*, NE Portugal

**Untreated and 13-yr. old treatment**
- Crown fire (passive to active)
- Intensity = 2000 – 11000 kW m⁻¹
- Mortality = 100%

**3- and 2-yr. old treatment**
- Surface fire
- Intensity = 200–1000 kW m⁻¹
- Mortality = 41-55%

Fire intensity decreased up to 10 years

(Fernandes 2009)
Resistance to fire and stand structure: insights from fire history

Mature, uneven-aged Mediterranean pine forests under a fire regime of low to moderate severity

Fule et al. (2008), SE Spain, *Pinus nigra*

Vega (2000), SW Spain, Sierra Bermeja, *Pinus pinaster*
Fire-resistant pine patches are open, vertically discontinuous, and coincide with frequent low-intensity fires. Their structure can be used as a silviculture model for fuel-breaks and other fuel-treated areas.
Fire hazard and stand structure: expert knowledge

González et al. (2007)

Fig. 2. Virtual reality stands and their observed priorities with respect to fire vulnerability. Lower priorities mean higher perceived vulnerability.
How do fires burn in different forest types? post-fire studies

Fire modification in forest types adjacent to *Pinus pinaster* stands

Fire intensity:
- Short-needled conifers < deciduous broadleaves < *P. pinaster*

Fire severity:
- (Short-needled conifers, evergreen broadleaves, deciduous broadleaves) < *P. pinaster*
- More abrupt decline in deciduous broadleaves
- Stand maturity decreases fire severity
How do fires burn in different forest types? modelling studies

*Quercus rotundifolia*, NE Portugal (Azevedo et al. 2008)

![Graph showing fireline intensity (kW/m)]
Resilience to fire and forest types

Quercus suber

Pinus canariensis
“Fire smart” landscapes and spatial patterns

Effects of random patterns: local mitigation but no effect on fire growth
• Current fire policies are unsustainable and often counterproductive, and are focused on fire pre-suppression and fire suppression.

• Towards Integrated Fire Management
  1. Prevention of ignitions
  2. Fire pre-supression and suppression
  3. Fuel management, including planned fire
  4. Management of unplanned fires
Conclusion

- Management of unplanned fires ("management fires")

Land management objectives

Threatened values and assets

Fire danger rating

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• “Fire-smart” landscapes are obtained by area-wide fuel modification and fuel conversion, rather than by fuel isolation. Spatial patterns are critical.

• Climate change will
  - Reduce the opportunities for type conversion into more mesic, less fire prone forests;
  - favour open dry forests, hence fire resistance.

• Research priority: experimentally improve the understanding of how silvicultural practices and fuel treatments change the fire environment, and how they impact on fire behaviour and severity.
Thank you