Prescribed burning, domestic grazing and mowing to maintain European dry heaths at the southern edge of their distribution

Davide Ascoli
Giampiero Lombardi, Giorgio Vacchiano
Giovanni Bovio, Michele Lonati
Introduction

Heathlands: habitat of interest 4030 Nature 2000
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Heathlands: habitat of interest

4030 Nature 2000
Introduction

Heathlands: an endangered habitat

1800 1951

1978

Newton & Cordingley 2008

Haaland 2003
Introduction

Heathlands loss at the Southern edge

- Conversion to plantations - agriculture
- Habitat fragmentation
- < Calluna competitiveness
- > Tree encroachment
Introduction

Heathlands loss at the Nature Reserve of Vauda

- Area: 2635 ha
- Altitude: 240 ÷ 480 m
- Av. Temperature: 12.3°C
- Rainfall: 1200 mm/yr
Introduction

Heathlands loss at the Nature Reserve Vauda

Ascoli & Bovio (2010) iForest 3
Introduction

Heathlands at the Nature Reserve Vauda

Ascoli & Bovio (2010) iForest 3
Prescribed burning
Season: winter (Oct-Mar)
Intensity: 500-1000 kW m$^{-1}$

Prescribed browsing
Season: spring (Apr-Jun)
Intensity: 20 LU ha$^{-1}$ day$^{-1}$
## Experiment design

**Treatments x 4 replicates x 7 years**

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1)</td>
<td>Frequent fire <em>(FF)</em></td>
<td>+</td>
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<tr>
<td>2)</td>
<td>Yearly broswig <em>(B)</em></td>
<td>+</td>
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<tr>
<td>3)</td>
<td>Prescribed burn 1time <em>(F1)</em></td>
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<tr>
<td>4)</td>
<td>Prescribed burn 1time <em>(FB)</em> + Yearly broswig</td>
<td>+</td>
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</table>
Experiment design

Research questions: Burning and Browsing treatments...

1) ...can limit tree encroachment in the short and long-term?

2) ...are going to favor some alien species?

3) ...are suitable to restore heathland characteristics species?

4) ...can be sustainably implemented at the landscape scale?
Results

Short-term tree control

Prescribed burning causes tree stem mortality, browsing controls root suckering.

- The *heath* is resilient to fire, it is not browsed, and recovers the habitat structure.

Ascoli et al. (2013) *Forest Ecology Management* 289
Results

Long term tree-control simulation

Fire behavior
Rothermel based – Fuel models
Rate of spread, Flame length, Fire intensity

Fire-grazing effects
Tree mortality models vs. fire intensity
Grazing affects growth < 1.5 m in heigth

Stand dynamics
Tree growth
Mortality rates
Regeneration

Vacchiano et al. 2014 Forest Science 60(2)
Ascoli et al. 2015 Int. J. Wildland Fire 24
Results

Field fire experiments to calibrate fuel models

Exp. 7 – M1.3
Results

Fire behavior simulation

<table>
<thead>
<tr>
<th>Rothermel Fuel Model</th>
<th>Fuel load</th>
<th>Ratio S/V</th>
<th>Fuelbed depth</th>
<th>Moisture extinction</th>
<th>Heat content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min</td>
<td>[Image]</td>
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<td>Max</td>
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Grass-Shrub – GS3

Scott & Burgan 2005

Ascoli et al. 2015 Int. J. Wildland Fire 24

Correspondence 1:1
Results

Fire behavior simulation

Rothermel Fuel Model

- Fuel load
- Ratio S/V
- Fuelbed depth
- Moisture extinction
- Heat content

Genetic Algorithm Optimization

- OK fitness

Scott & Burgan 2005

Ascoli et al. 2015 Int. J. Wildland Fire 24
Results

Post-fire mortality simulation

*Fireline intensity 500 kW m\(^{-1}\)*

Vacchiano et al. 2014 Forest Science 60(2)

![Graph showing post-fire mortality simulation with observed and FFE mortality data for Betula pendula](image)
Results

Long term tree-control simulation

<table>
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<tr>
<th>Density (n ha(^{-1}))</th>
<th>Diameter(^2) (cm(^2))</th>
<th>Basal area (m(^2) ha(^{-1}))</th>
</tr>
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<tr>
<td><strong>NM</strong></td>
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<td></td>
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<tr>
<td>F1</td>
<td></td>
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<tr>
<td>FB</td>
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Simulation time

Vacchiano et al. 2014 Forest Science 60(2)
Results

Long term simulation

No management

15yr-rotation prescribed fire

15yr rotation fire + yearly grazing

Vacchiano et al. 2014 Forest Science 60(2)
Results

Alien species encroachment

*Panicum acuminatum* Swartz

*North America

Lonati M. et al. 2009 Botanica Helvetica 119
Results

Heathland characteristics species

- FF
- FB
- F1
- B

Brobo et al. submitted
Management

Sustainable implementation at the landscape scale

Training ground for Fire fighters

Available pastures for nomadic shepherds

Burn + Grazing Management plan
Thanks for the attention