Mechanical facilitation by maritime pine against severe browsing on holm oak plantation in San Rossore forest

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Introduction

Protected area: Regional Park Migliarino, San Rosso, Massaciuccoli between 43°51′36″–43°35′25″ N and 10°14′26″–10°21′11″ E
Introduction

Fragmented geographic range of *Pinus pinaster*

Eastern side: disturbances due to higher stress factors in the species range limit (i.e. drought)

LOW RESISTANCE

Invasion by an alien insect *Matsucoccus feytaudi*

✓ Plant weakening
✓ Favor secondary diseases
✓ Tree and stands mortality
Required by law, forest logging started in winter 2010-2011 on *P. pinaster* stands 65 years old. Firstly, clear-cut on small surfaces, then on larger remaining areas.

*Quercus ilex* plantation 4x4 m in shelter (h 1.20 m)
High ungulates impact

Severe damages to forest natural regeneration

In 2007 ungulates density was 7 times higher than density compatible with forest regeneration dynamics (Vernina, 2007)
Aim of the study

MONITORING FOREST DYNAMICS

- *Quercus ilex* plantation - artificial regeneration
  432 oaks in 6 harvest units, 2 plots per unit
- *Pinus pinaster* natural regeneration
  216 sub-areas of 4 m² in 6 harvest units, 2 plots per unit

INTERACTION–COMPETITION or FACILITATION

Providing information and guidance for effective forest management leading to the enhancement of survival and establishment of holm oak seedlings for restoration
Results

**Q. ilex survival: 62.9%**

χ² test → two different groups of sampling areas: 41-60% vs 75-81%

- Establishment categories according to browsing effect:
  - **Dead**
    - Repeatedly browsed and re-sprouted from stump
    - $H=37.5\pm34.2$ cm
    - D 19.4-58.3%
  - **Repeatedly browsed at shelter height**
    - $H=131.0\pm6.5$ cm
    - BSH 8.3-50.0%
  - **Repeatedly browsed with ≥1 well-grown shoot**
    - $H=180.4\pm33.8$ cm
    - Alive and not browsed
  - **Repeatedly browsed**
    - $H=37.5\pm34.2$ cm
    - RS 5.6-44.4%

- High variability in occurrence of categories among sampling areas

- to look for a key variable to describe the occurrence of categories (among areas, 2 different groups distinguished according to GS%, < and >20%)
Results

- **Surrounding vegetation**

  - **Canopy cover** around oaks was positively related ($p<0.01$) to the presence of natural regeneration ($r=0.69$), but more to maritime pine regeneration ($r=0.84$)

  - **Holm oak survival** was positively related ($p<0.01$) to the height of surrounding vegetation canopy cover ($r=0.73$) and presence of pine ($r=0.68$) but NOT of other species

    - $P. \text{pinaster/ha} = 20583$ in areas where survival is higher than 75% (twice than in other areas, 10476 pp/ha)

  - **GS frequency** was positively related ($p<0.01$) to height of canopy cover ($r=0.89$) and of maritime pine ($r=0.79$)

Thus, focus on *Pinus pinaster* natural regeneration aspects which could affect FACILITATION
According to ANOVA, many pine characters affected holm oak re-sprouting and growth \( (p<0.01) \), highlighting clear differences among D, RS+BSH, GS

- **Pine presence**
  \( (\text{GS 9.2 plant/m}^2 \text{ vs 6.3 vs 3.7}) \)

- **Pine Height**
  \( (\text{GS 232 cm vs 140 vs 96}) \)

- **Pine crown development**
  \( (\text{GS MeanR 50 cm vs 40.8 vs 34.9; cover 73.9% vs 49.8 vs 41.9}) \)

- **Other indexes combining pine growth&crown and distance**

Other species did not facilitate holm oak resprouting
Conclusions

Current situation

☑ Natural regeneration of maritime pine was more effective than shelter to holm oak growth
☑ Maritime pine facilitation: plants can be a mechanical obstacle
☑ 82.9% of GS occurred where pine branches dominated the tree-shelter
☑ This is a recent occurrence (since about 2 years ago), thus, the maritime pine needs on average 6-7 years to be effective to protect shoots at 1.20 m height

Natural regeneration of *Pinus pinaster* facilitates *Quercus ilex* survival and growth under severe deer browsing pressure

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Conclusions

Future perspective

✓ Growing pines will facilitate more holm oak; thus RS and RSH → GS year after year
✓ But in a few years young maritime pines will be attacked by the *M. feytaudi*

✓ However, young maritime pines with mature cones resulted 1169 p/ha (range 0-2639), thus, it is likely that a further future generation of pines could facilitate new plantations

Maritime pine resilience → effective facilitation
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......lesson for the future
✓ Since holm oak is shade tolerant species, plantation should be:
  ✓ established 2-3 years after harvesting
  ✓ without shelter
  ✓ localized, according to pine natural regeneration density and growth
Thank you for your attention

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