Post-fire recovery of black pine forests: the role of fire refugia and microsite

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DecisionES 2025
Porto Seguro
Jun 30th to Jul 4th BR
Symposium on Ecosystem Services, Forest Management and Decision Making

Context

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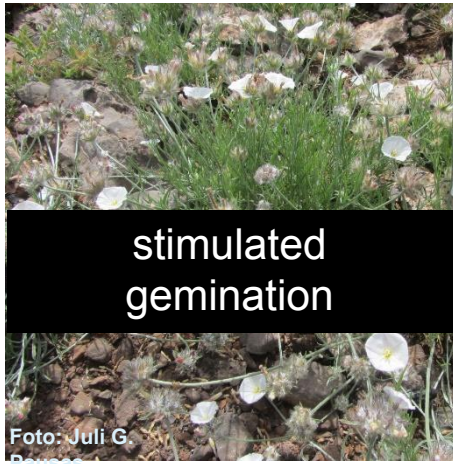
750 m
2
La Jonquera S

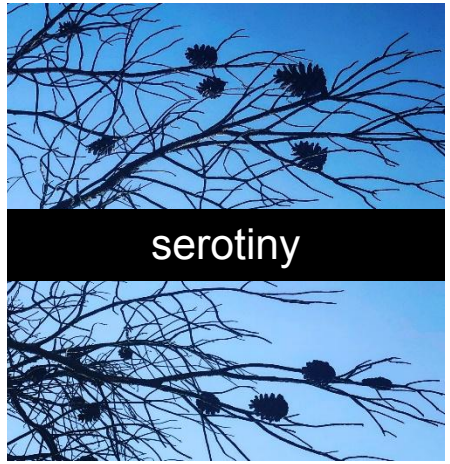
Fire-adaptive strategies

Convolvulus lanuginosus

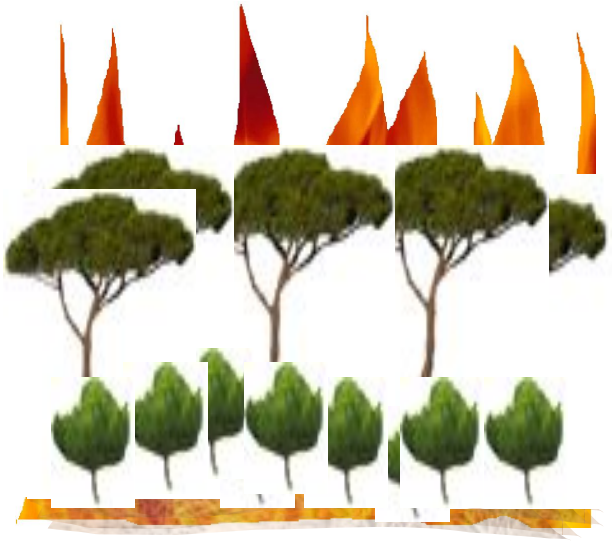


Ulex parviflorus

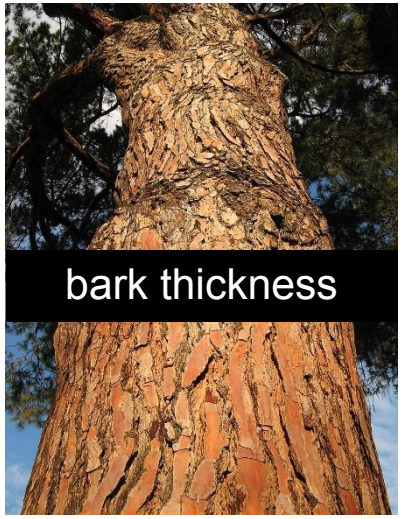
Pinus halepensis



Arbutus unedo



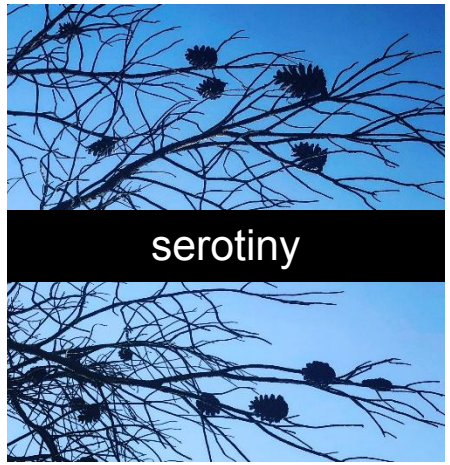
Pinus pinea

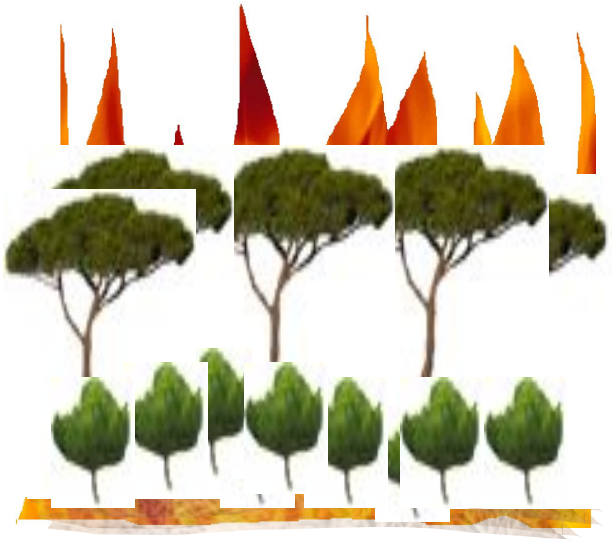


Pinus nigra

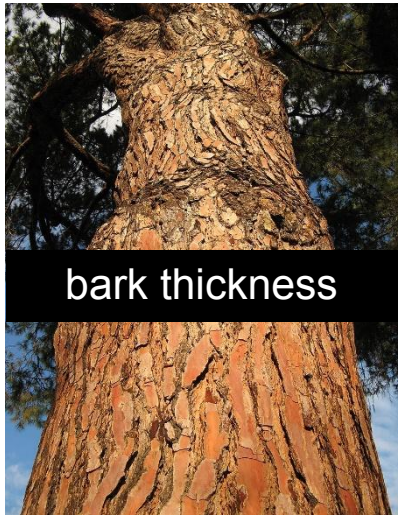
Fire-adaptive strategies in pine species

Pinus halepensis



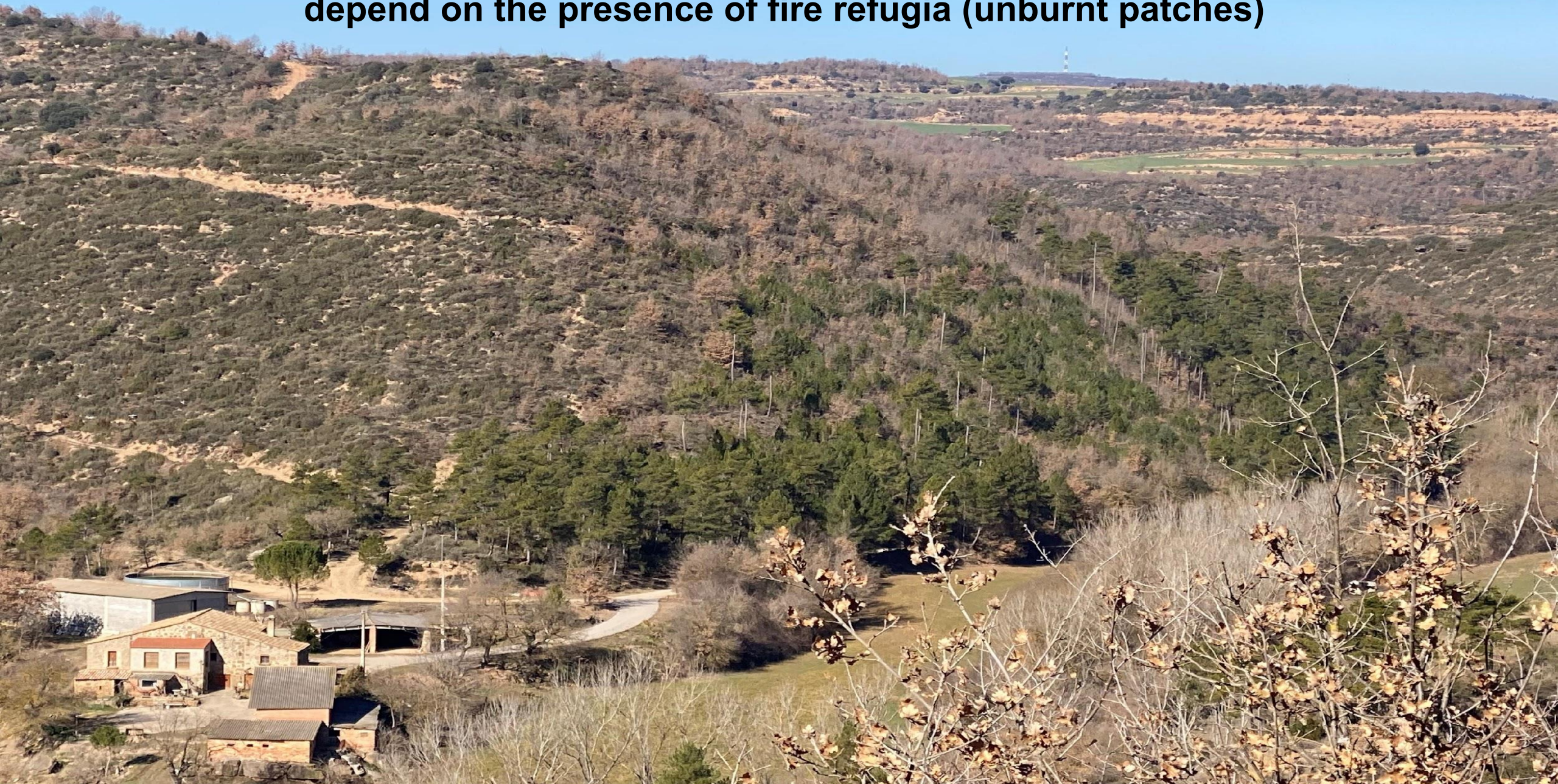


Pinus pinea



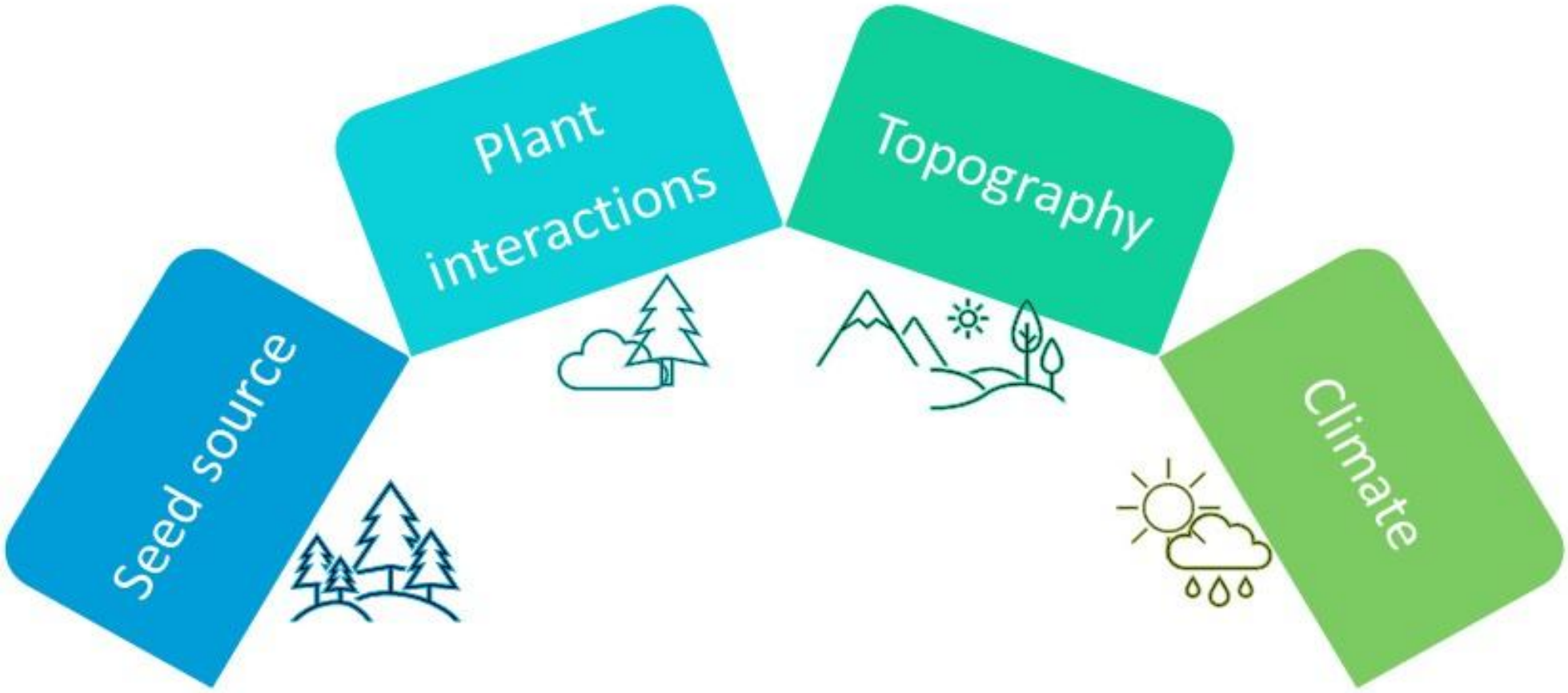
Pinus nigra

The persistence of non-serotinous pines in the landscape after high-intensity fires depend on the presence of fire refugia (unburnt patches)



Objectiv

- To provide further understanding on the biophysical factors affecting post-fire regeneration patterns of non-serotinous Mediterranean pine.



Methods

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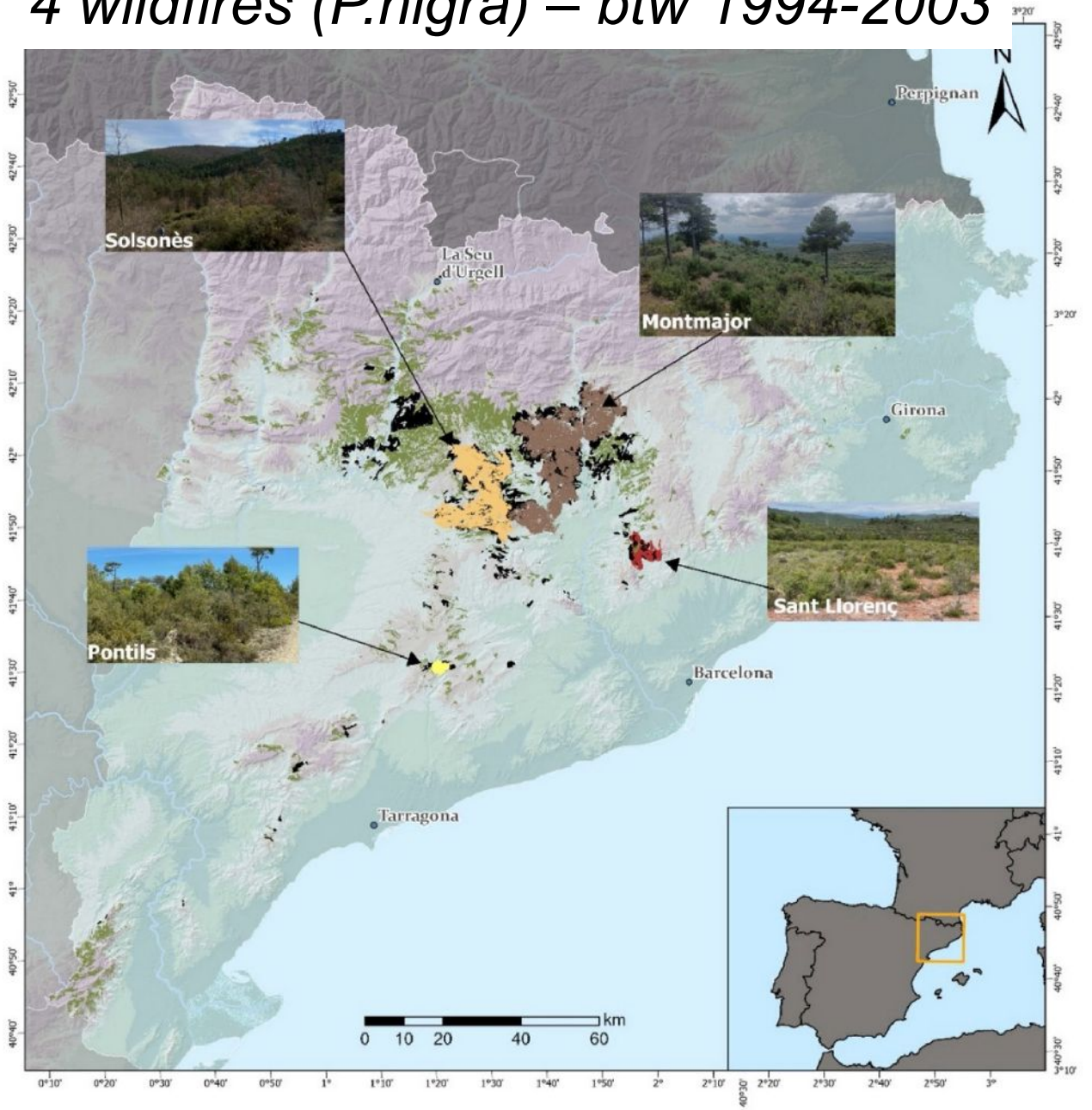
Pinus nigra subsp. *salzmannii*

4 wildfires (P.nigra) – btw 1994-2003



Step 1 - Fire refugia determination

esa ECOSPHERE

Landscape Ecol (2019) 34:771–792
https://doi.org/10.1007/s10980-019-00802-1

RESEARCH ARTICLE

Contributions of fire refugia to resilient ponderosa pine and dry mixed-conifer forest landscapes

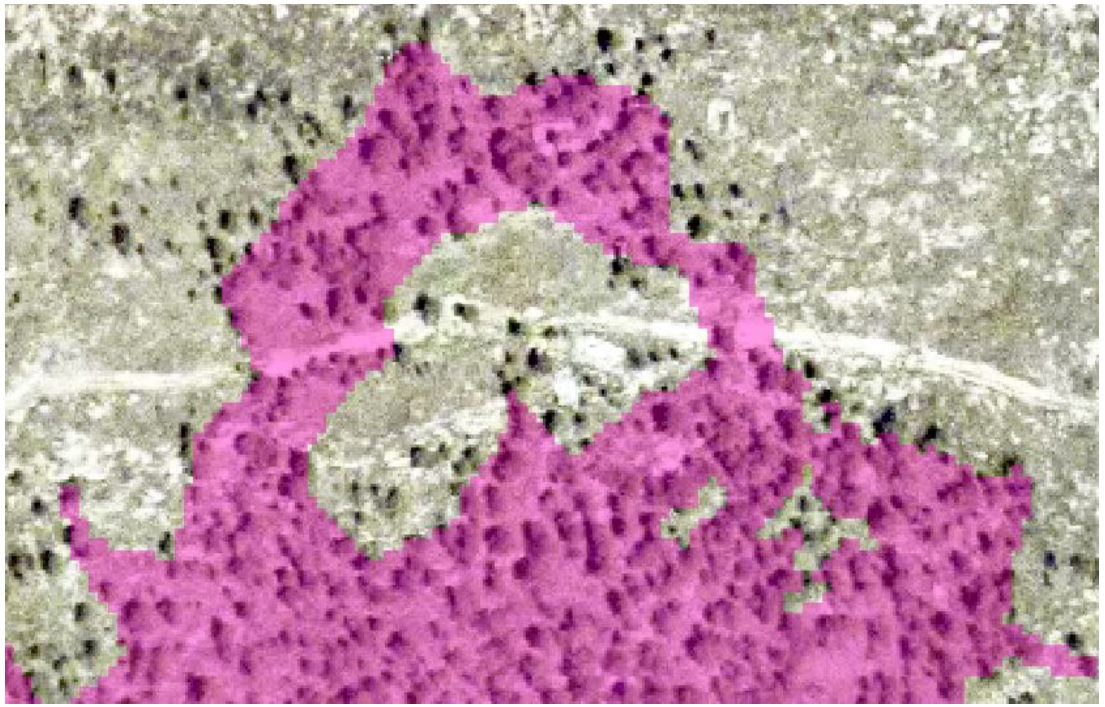
Jonathan D. Coop,[1,†] Timothy J. DeLory,[2] William M. Downing,[3] Sandra L. Haire,[4] Meg A. Krawchuk,[3] Carol Miller,[5] Marc-André Parisien,[6] and Ryan B. Walker[1]

Influence of fire refugia spatial pattern on post-fire forest recovery in Oregon's Blue Mountains

William M. Downing · Meg A. Krawchuk · Garrett W. Meigs · Sandra L. Haire · Jonathan D. Coop · Ryan B. Walker · Ellen Whitman · Geneva Chong · Carol Miller

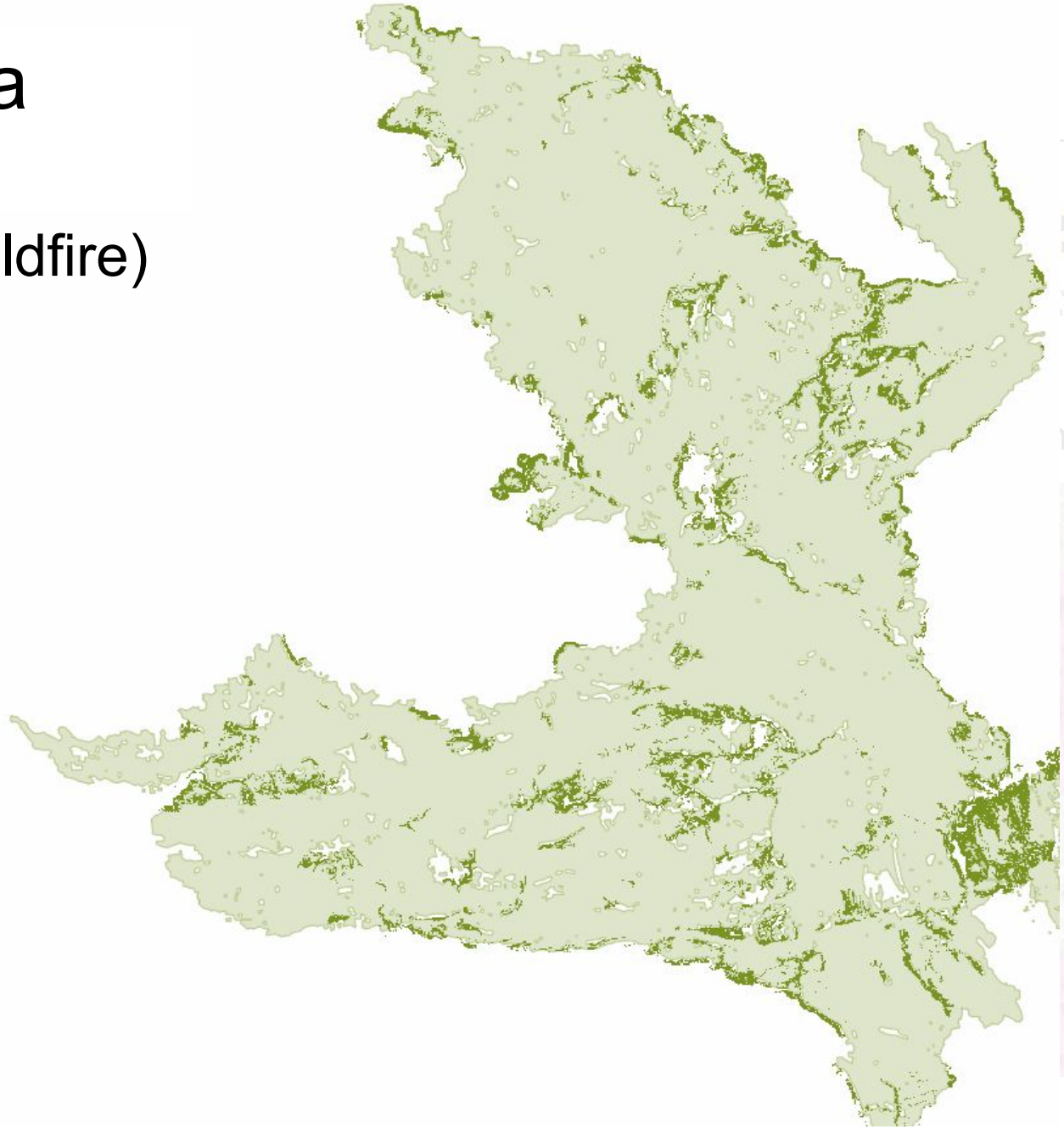
Identify post-fire surviving trees (ortophotos + ALS)

Group pixels within 20m and gaps < 50 m2



Fire refugia map

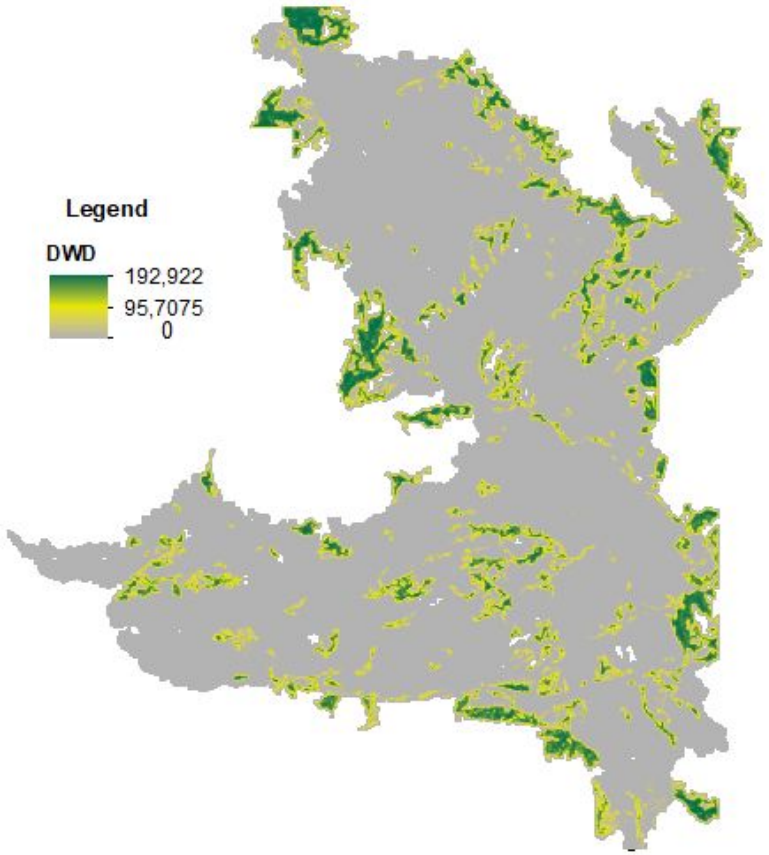
(Solsonés wildfire)

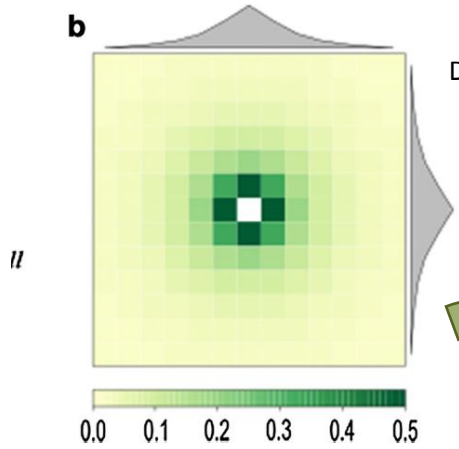


Step 2 – Potential seed availability

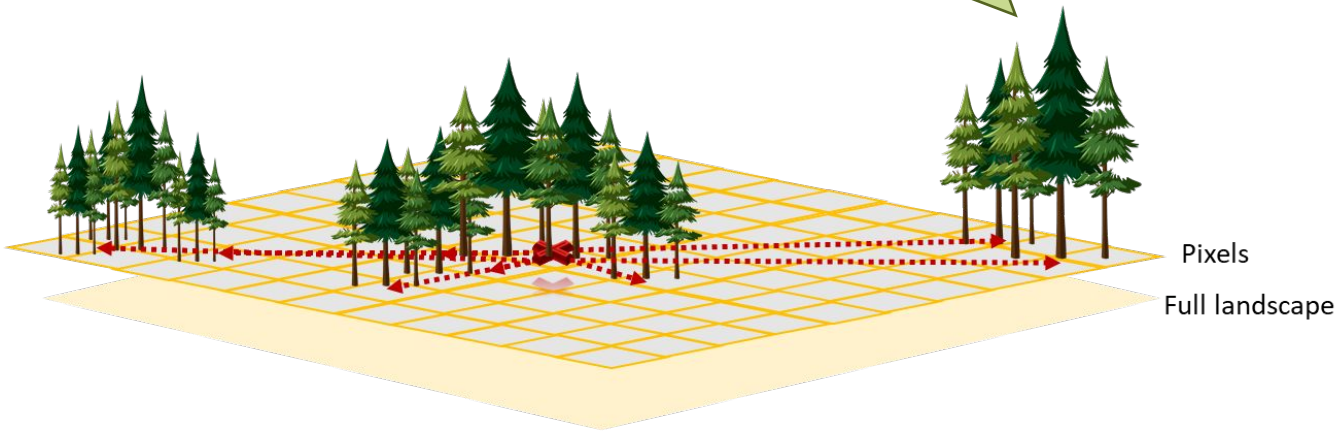
$$\mathrm{DWD} = \sum_{i=1}^{N} \frac{1}{(d_i + 1)}$$

Distance-weighted refugia density (DWD)





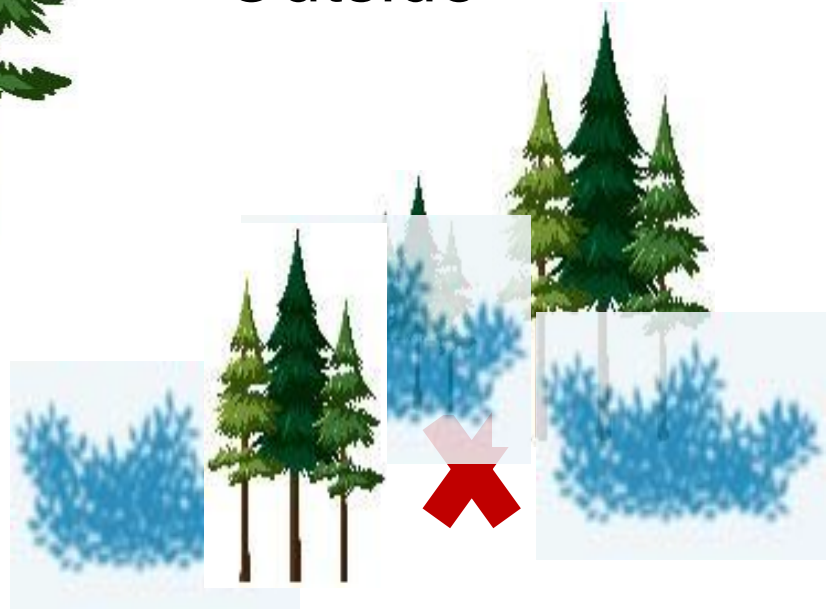
Downing et al 2019



Step 3 - Field work 272 plots (5-m radius)

Inside

Outside



- Climatic Data
  - Precipitation
- Topography
  - Slope
  - Aspect
  - Heat Load Index (proxy aridity)
- Plant communities
  - Species composition
  - Shrub cover (%)
  - *Rubus* cover (%)

Results

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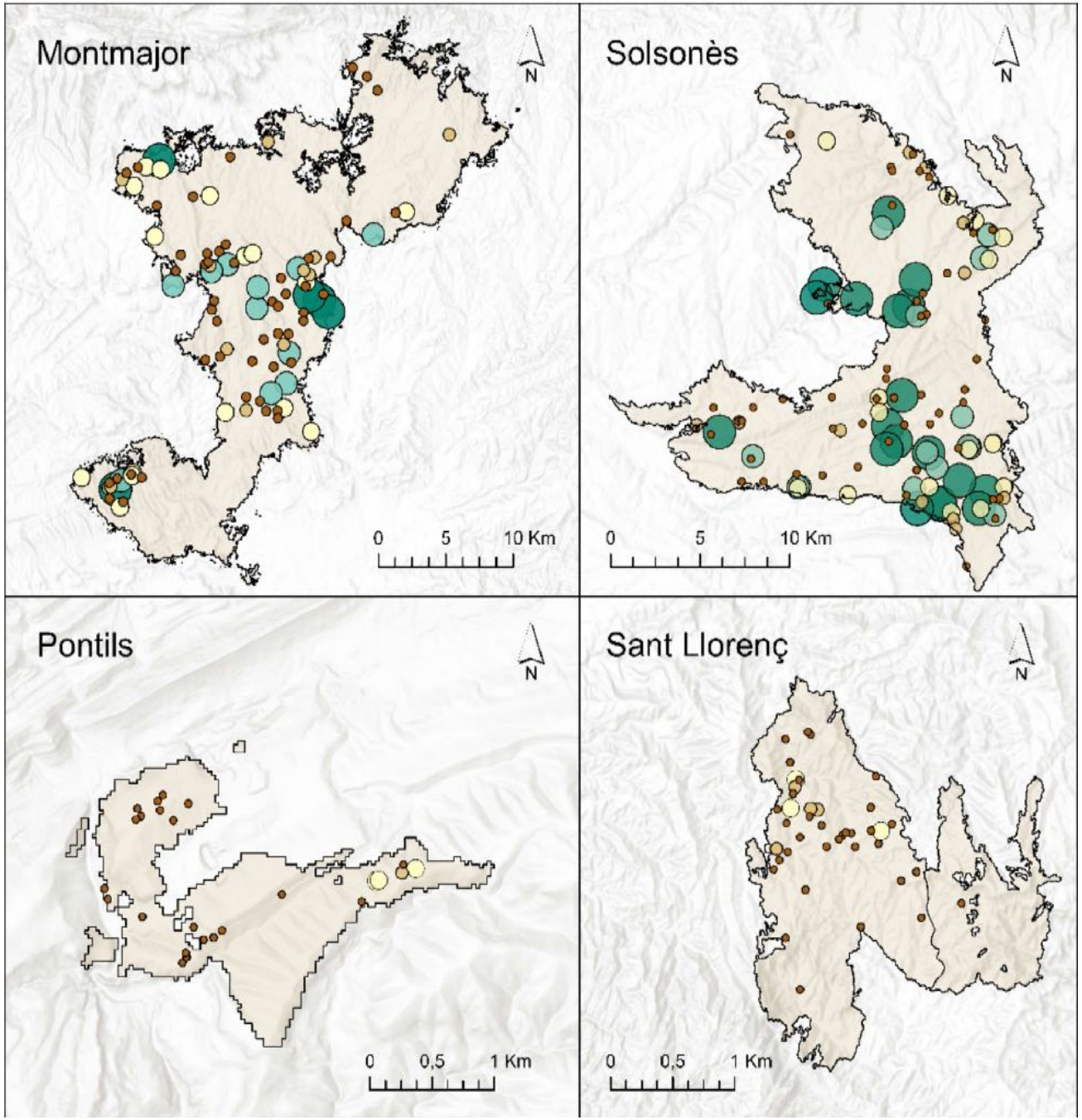
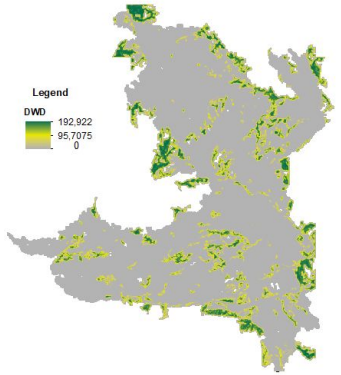
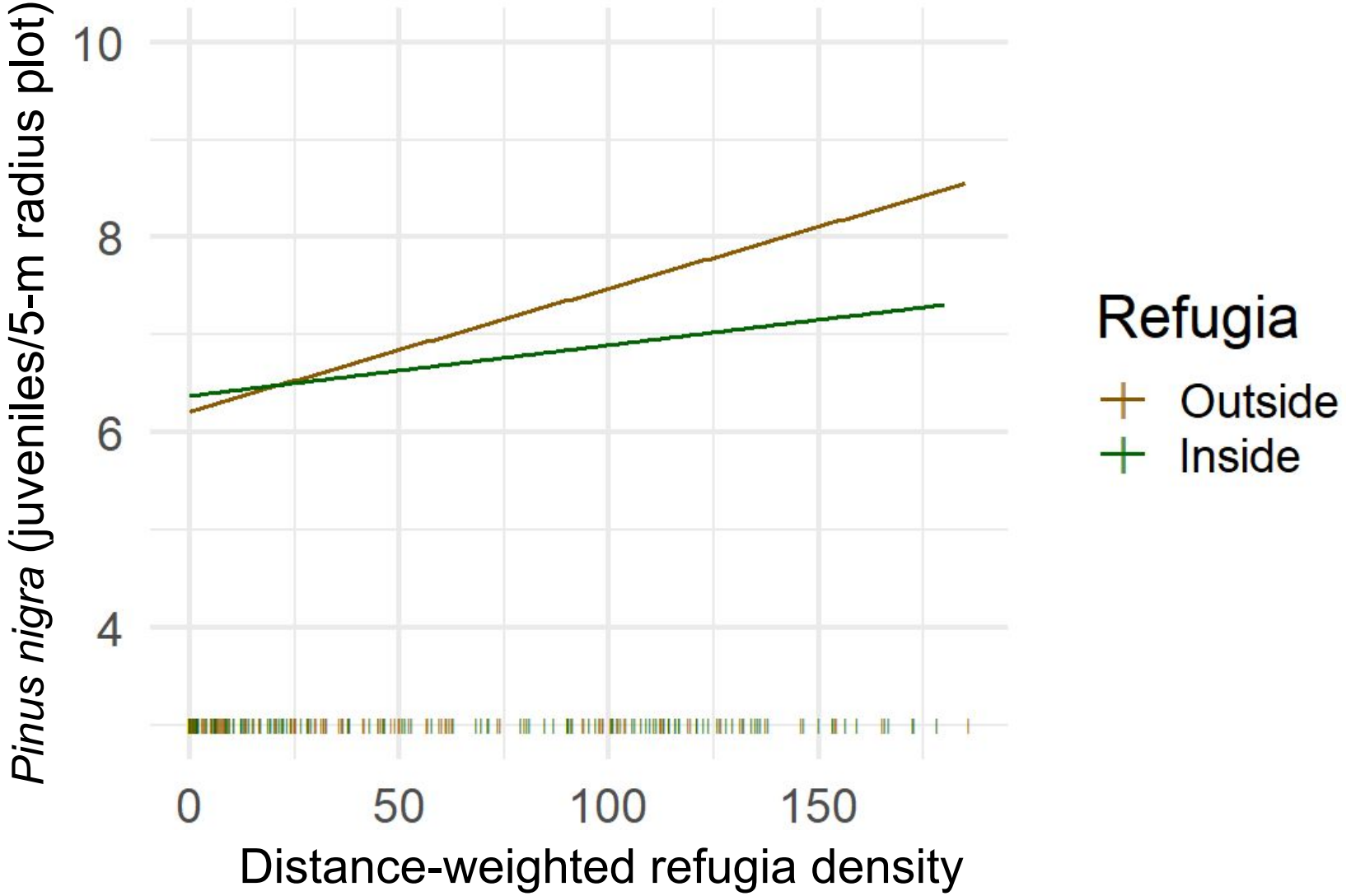


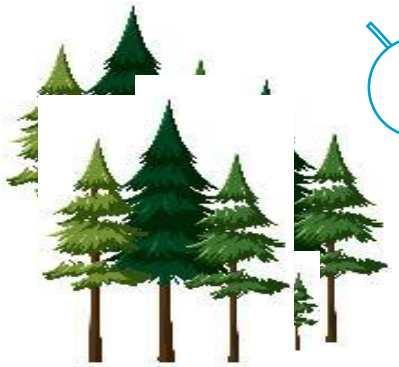
Observed abundance of *Pinus nigra* per hectare

0
1 - 250
251 - 890
891 - 3110
>3110

The DWD has a positive effect on post-fire P. nigra recovery, with a stronger effect outside refugia than inside.







Inside

Rubus spp.

Shrub Cover

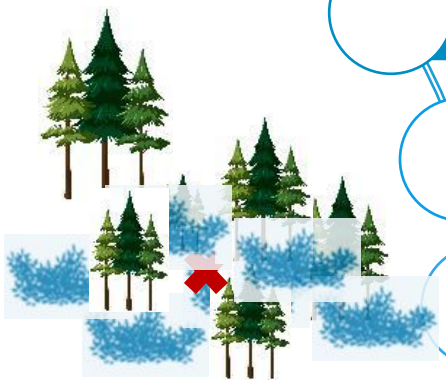
Precipitation

ΔAIC

-5.2 +

-5.8 −

-6.9 −



Outside

Rubus spp.

Shrub Cover

Heat Load Index

HLI : Shrub Cover

DWD

ΔAIC

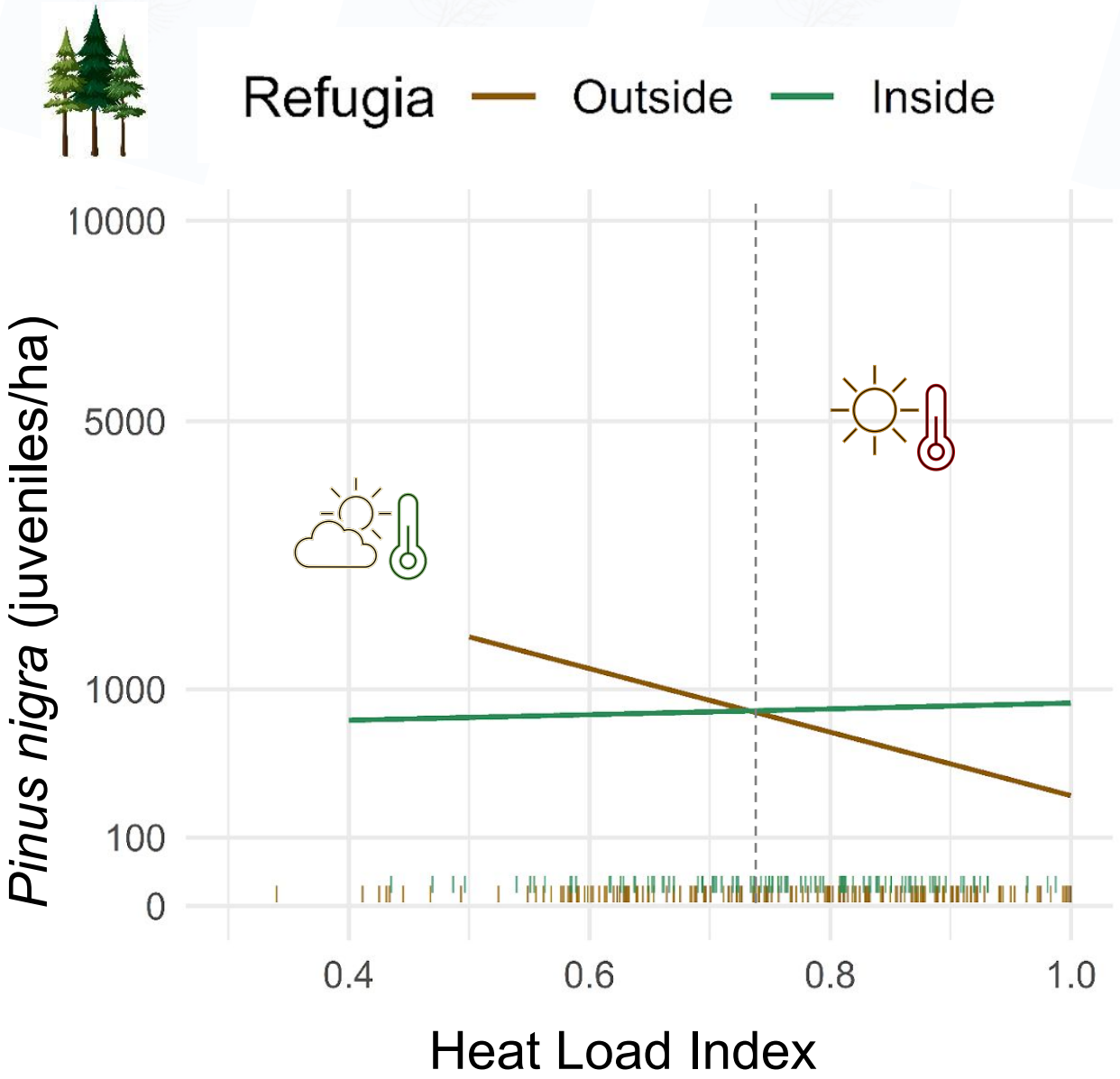
-7.2 +

-11 −

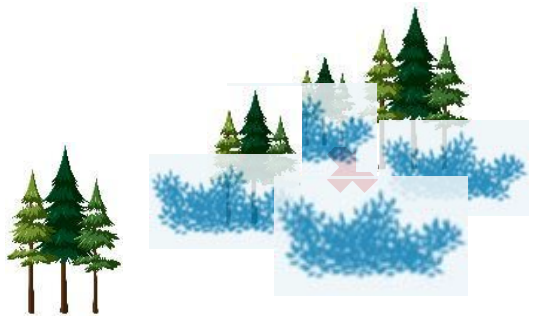
-7.3 −

-5 + −

-4.3 +

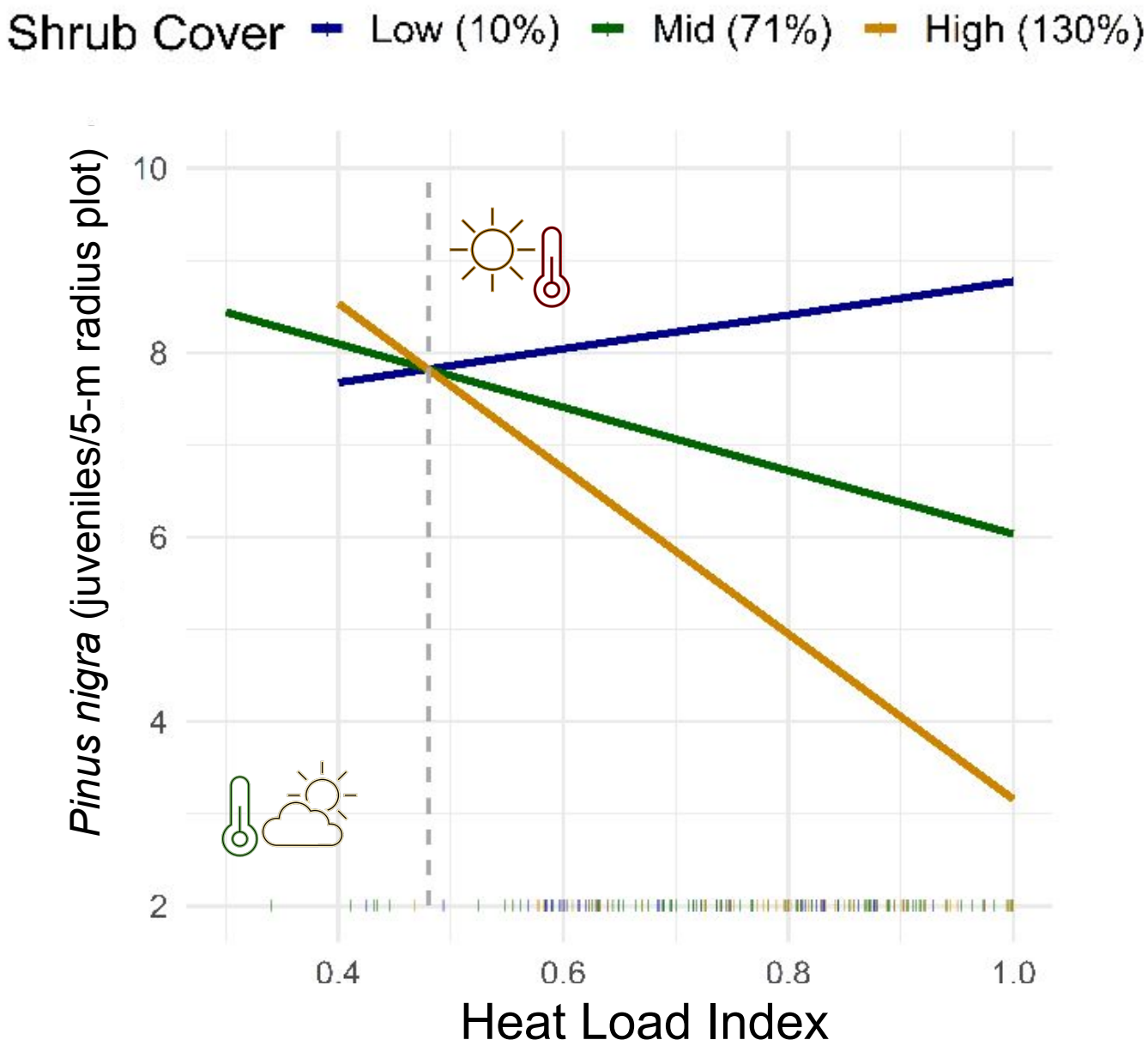


Aridity does not affect P. nigra recovery under canopy cover but outside the refugia



Outside

The (moderate) positive effect of shrub cover on pine regeneration turn to negative after a given aridity threshold



Generally, shrub cover had a negative effects on pine regeneration

…but not when only *Rubus* cover was considered

Conclusions

- Biophysical drives affecting *Pinus nigra* post-fire regeneration change the intensity of their effect depending on the presence or absence of fire refugia.
- Fire refugia are key for post-fire regeneration, as they create a sheltering effect against high aridity levels.
- Shrub cover interacts with heat load index, to provide shelter for *P. nigra* regeneration outside refugia.
- Some particular species (*Rubus ulmifolius*) showed particular facilitative effects (but don’t know why)

Muito obrigado!

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