Photo: Marc Sellarès

Incendies et pinèdes de montagne méditerranéennes: quels facteurs pilotent la dynamique après feu?

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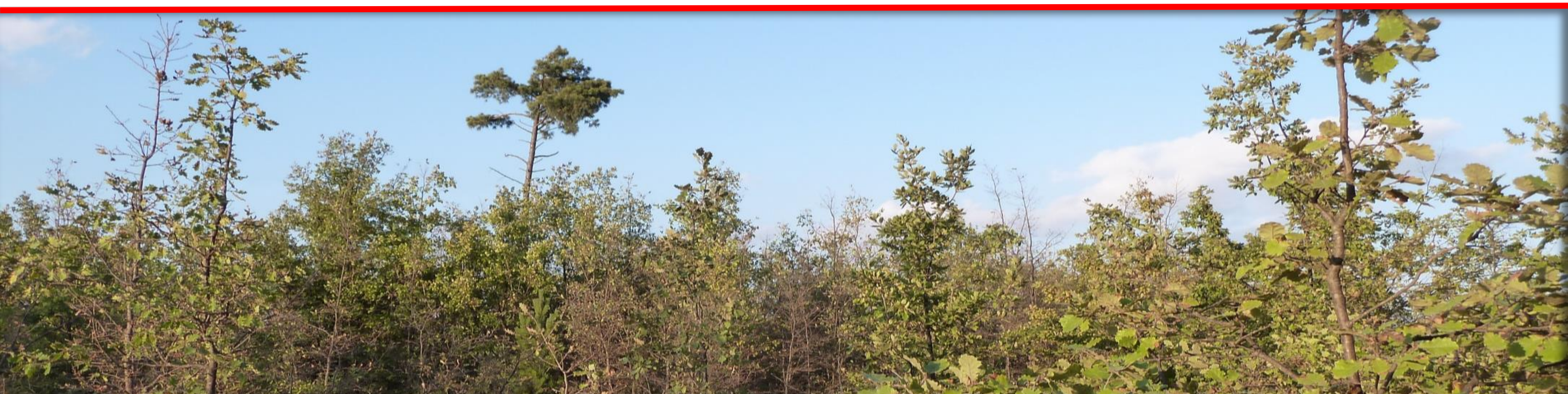


Mediterranean mosaic-like landscape

Photo: Capolatell

Market day in Solsona, beginning s. XX


Photo: AGS (CTFC)

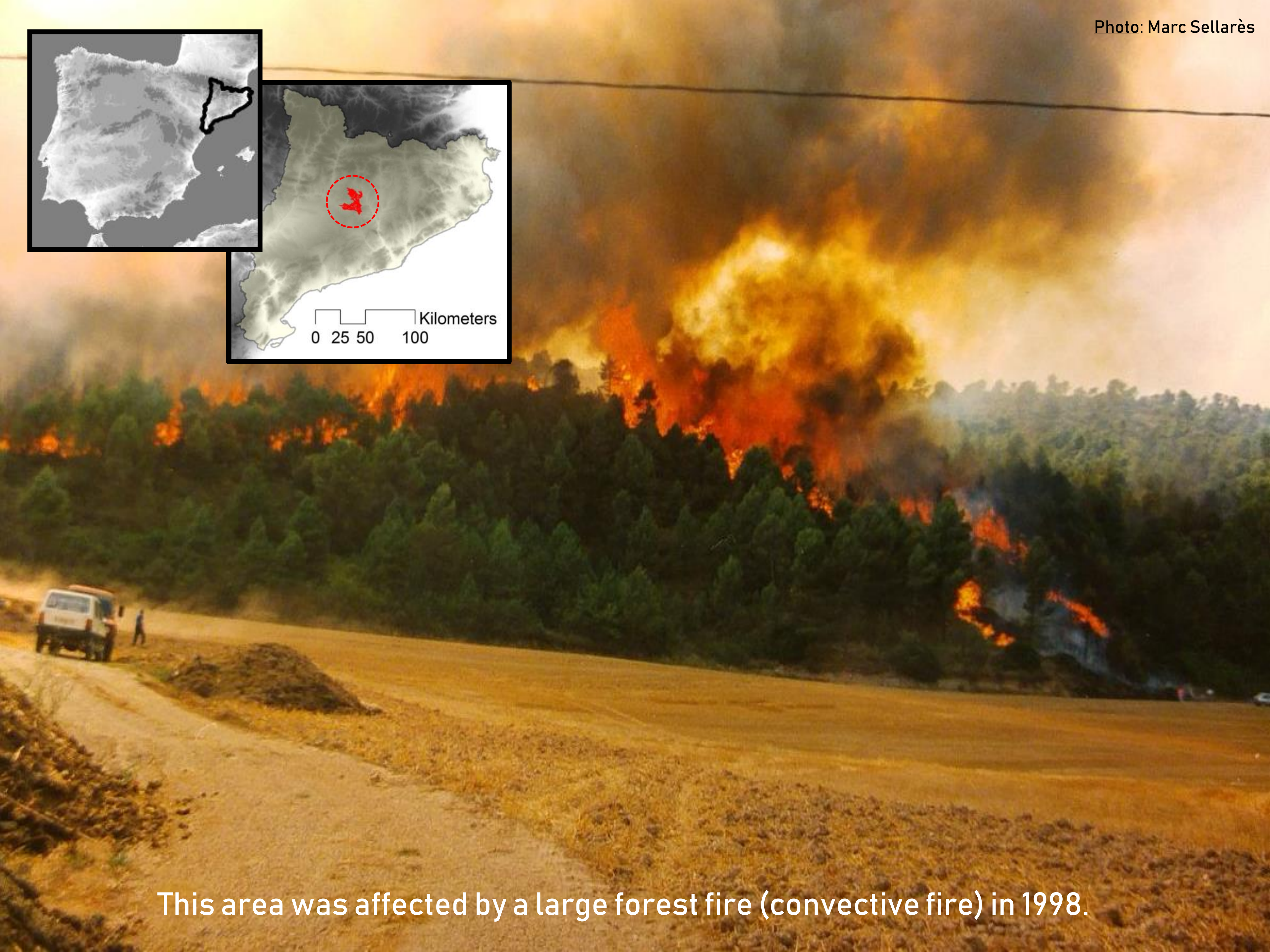


Photo: Marc Sellarès

This area was affected by a large forest fire (convective fire) in 1998.

Photo: Celsona


Photo: CTFC
Burned nearly 24,000 ha from which 18.000 ha of forests (~ 75% *P. nigra*)

- Study area ~ 4000 ha
- Tmean: 12°C, Pmean: 650 mm
- Elevation: 650 –800 masl

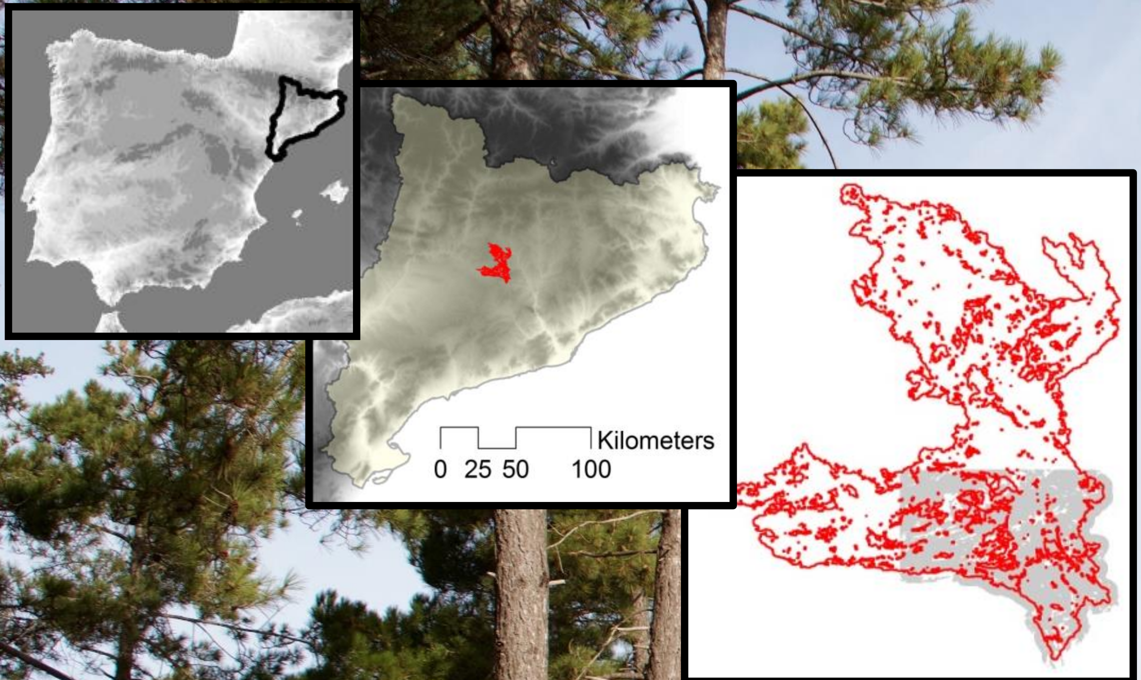
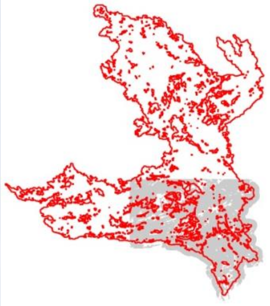


Photo: A. Ameztegui

15 years after the fire occurred...

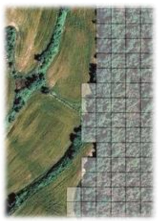


1) Assess post-fire regeneration typologies

2) Unravel the relative importance of factors driving the occurrence of post-fire regeneration typologies

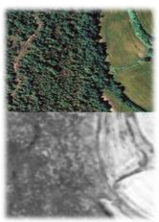
3) Understand the interactions between oak sprouts and pine regeneration

Photo: A. Ameztegui

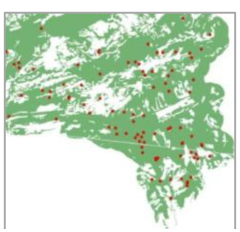


LiDAR data (LiDARCAT 0.5 p/m²)

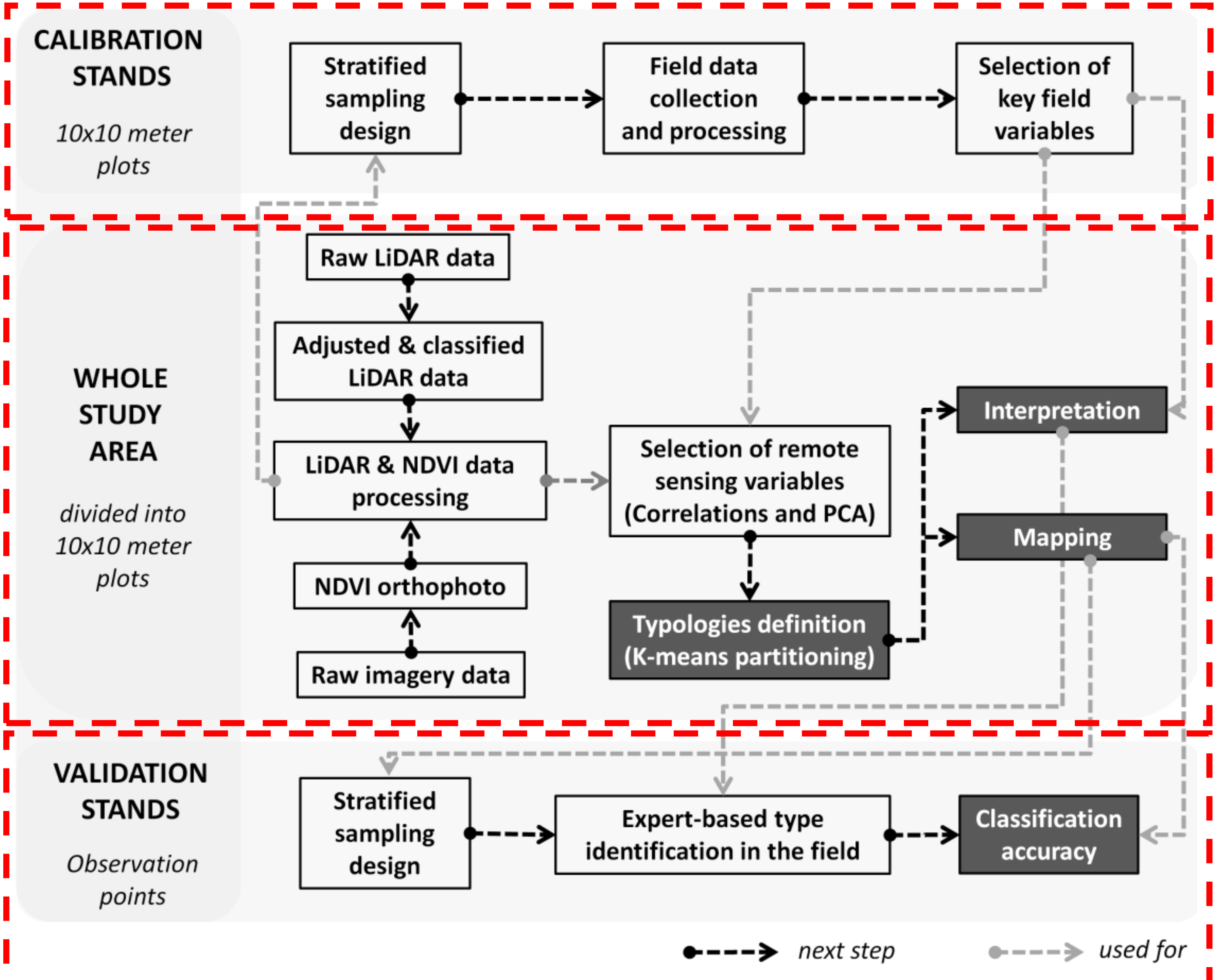
+



NDVI (OR-IR 25 cm)



Classification accuracy: 80%



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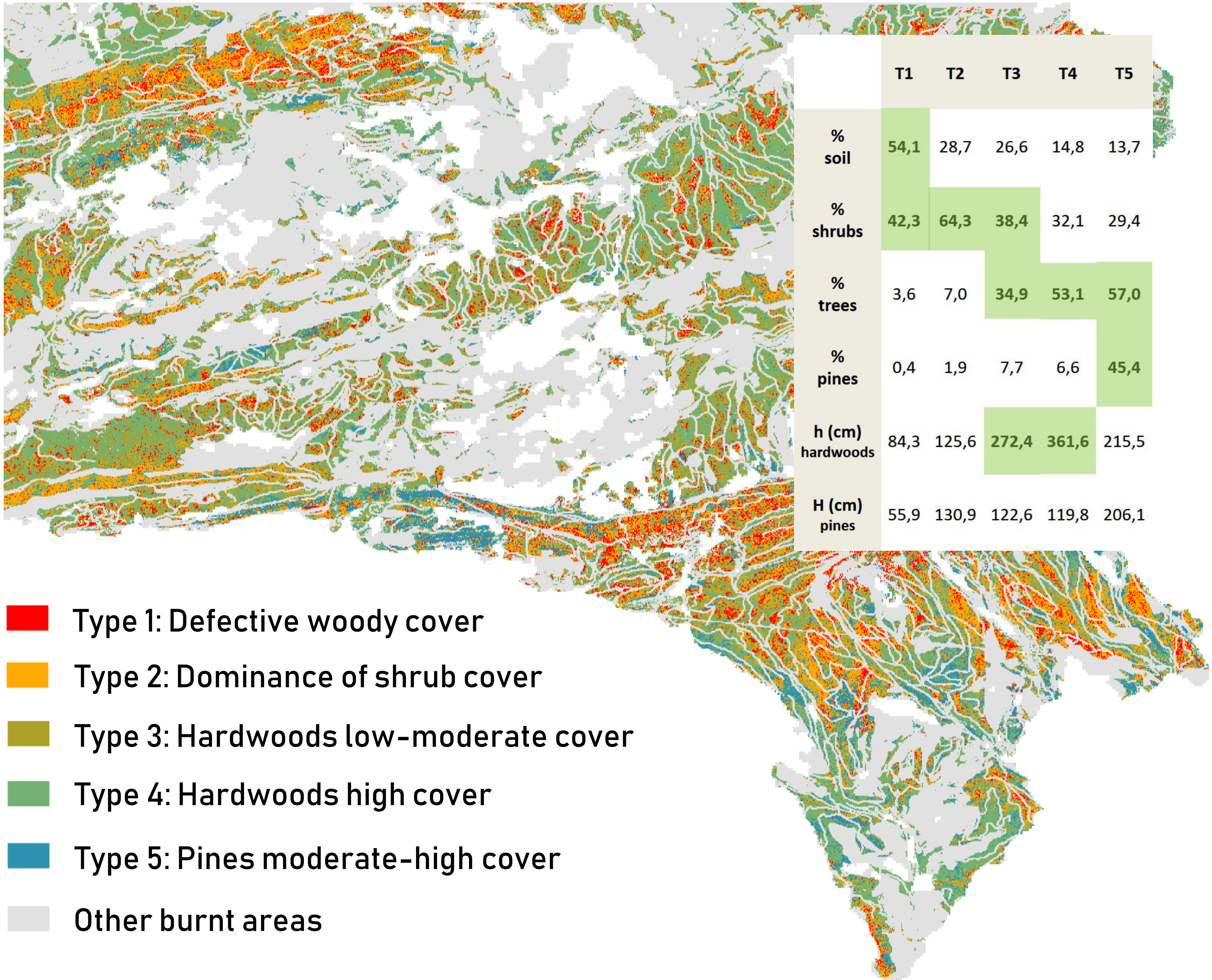
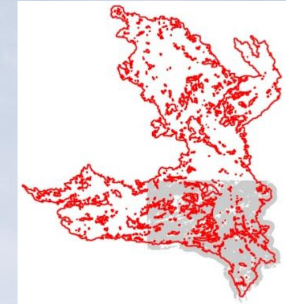


	T1	T2	T3	T4	T5
% soil	54,1	28,7	26,6	14,8	13,7
% shrubs	42,3	64,3	38,4	32,1	29,4
% trees	3,6	7,0	34,9	53,1	57,0
% pines	0,4	1,9	7,7	6,6	45,4
h (cm) hardwoods	84,3	125,6	272,4	361,6	215,5
H (cm) pines	55,9	130,9	122,6	119,8	206,1

Objectives



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3) Understand the interactions between oak sprouts and pine regeneration

Photo: A. Ameztegui

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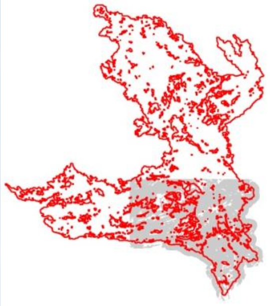

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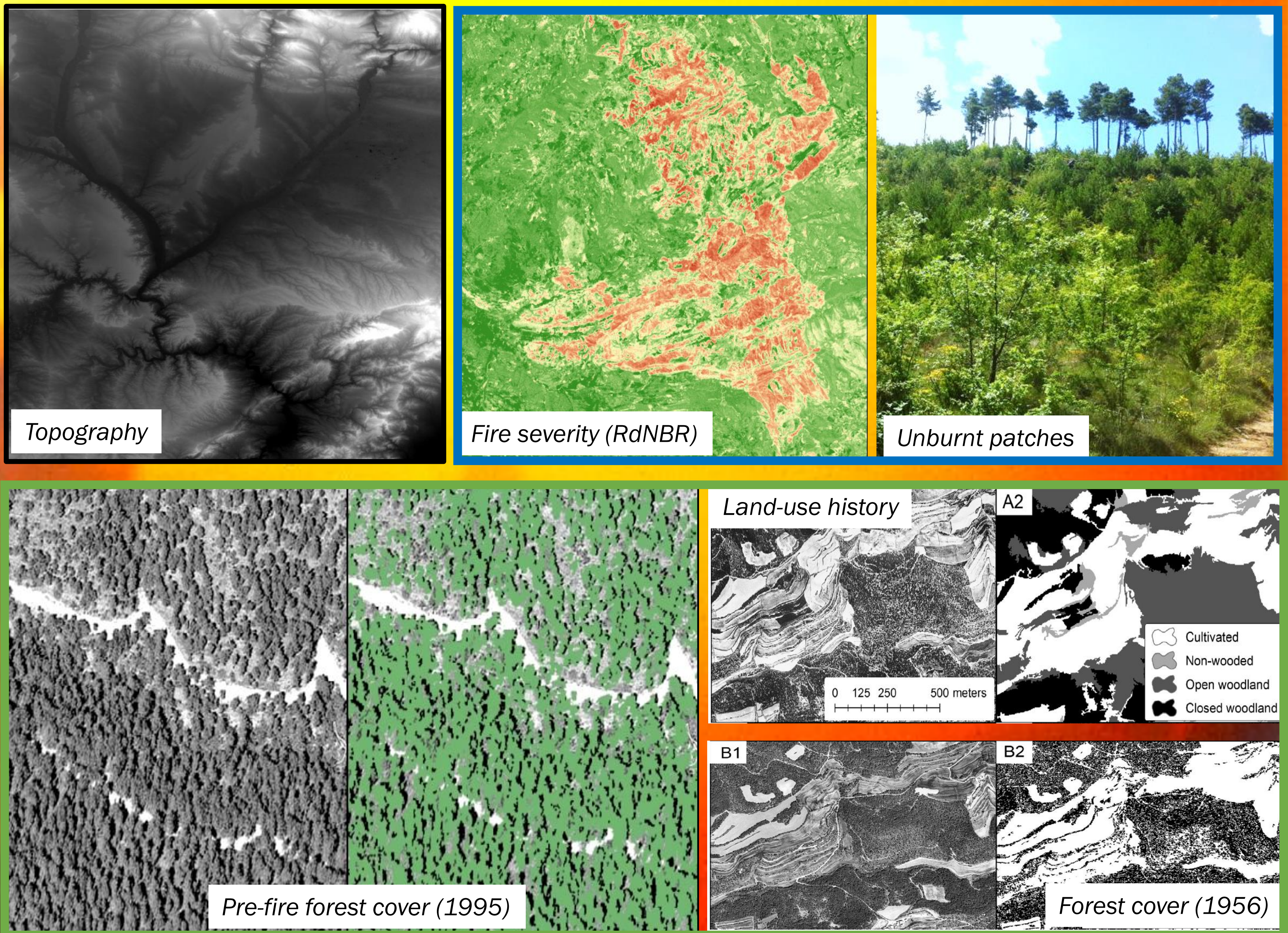
Topography
Fire severity (RdNBR)
Unburnt patches
Land-use history
A2
Cultivated
Non-wooded
Open woodland
Closed woodland
0 125 250 500 meters
B1
B2
Pre-fire forest cover (1995)
Forest cover (1956)

Regeneration trajectories ~ f (*topography, vegetation, fire*) ⇨ ***Importance of variables (Model Improvement Ratio)***

Regeneration types	T1	T2	T3	T4	T5
	Importance of variables (MIR)				
(a) Topography					
Elevation	1.00	0.93	0.66	1.00	0.63
Aspect	0.35	0.92	0.87	0.59	0.78
Slope	0.39	0.79	0.73	0.44	0.57
Curvature	0.23	0.36	-0.12	0.17	0.11
(b) Vegetation and land-use					
Forest cover in 1956	0.55	0.63	0.99	0.32	0.67
Forest cover in 1995	0.40	1.00	0.39	0.45	0.77
(c) Fire behaviour					
Severity (RdNBR)	0.51	0.18	1.00	0.41	0.99
Unburnt areas	0.15	0.93	0.30	0.29	1.00

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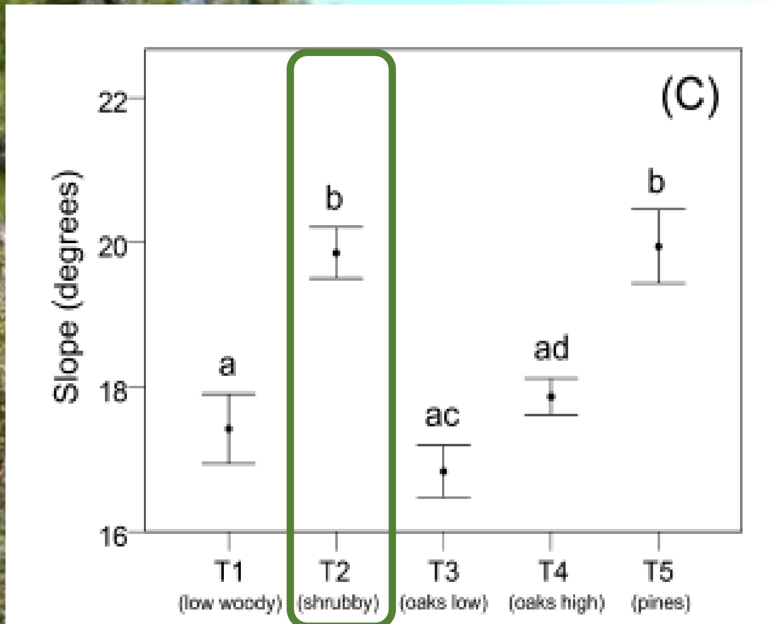
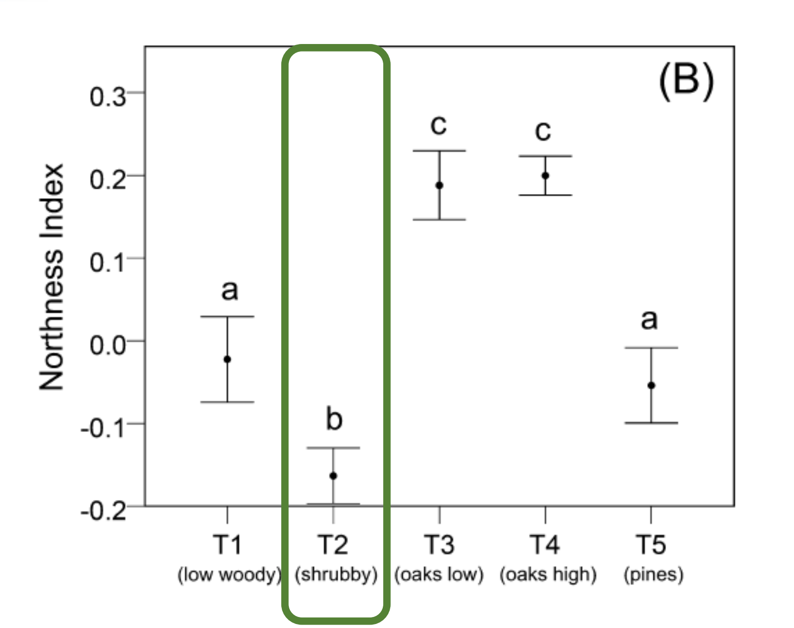
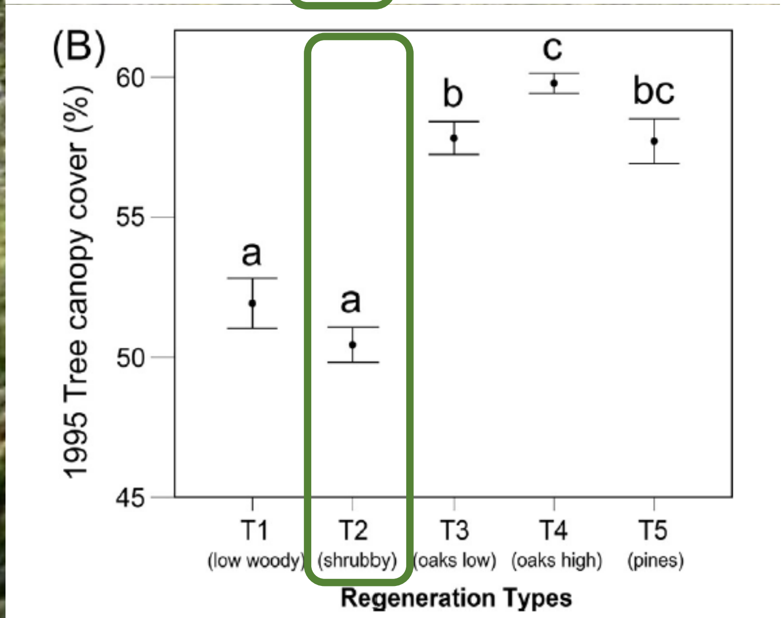
Type 2 – Dominance of shrub cover

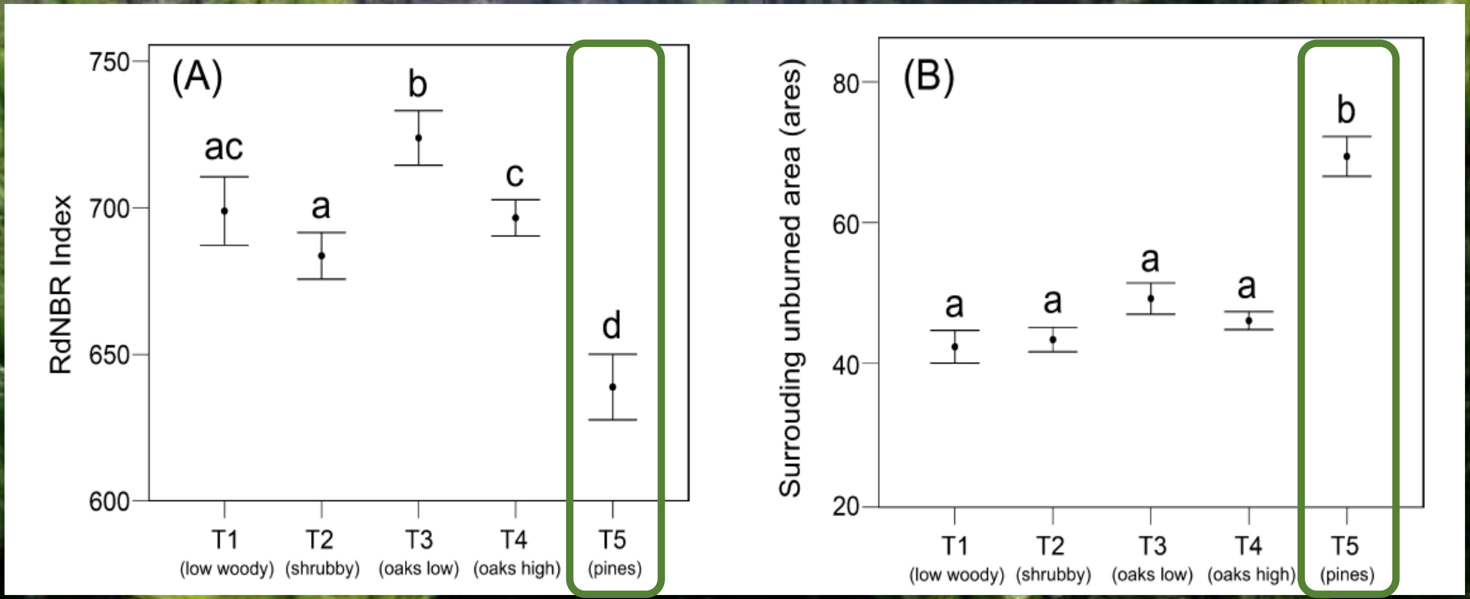






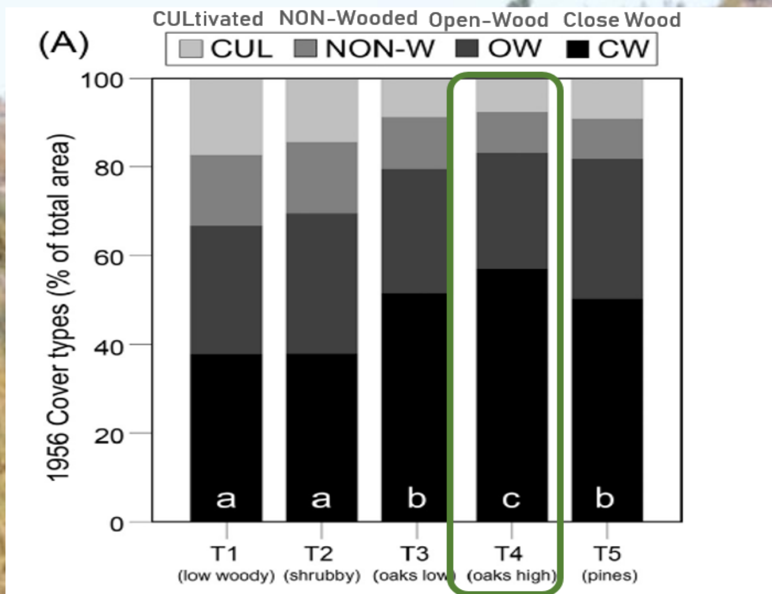
- ✓ *Steep slopes*
- ✓ *South facing areas*
- ✓ *Low tree vegetation cover before the fire*

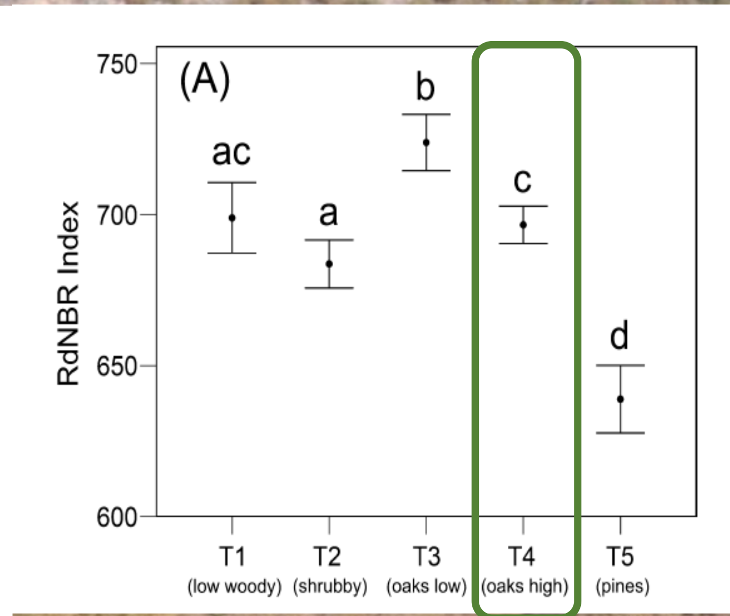
Type 5 – pines (moderate-high cover)

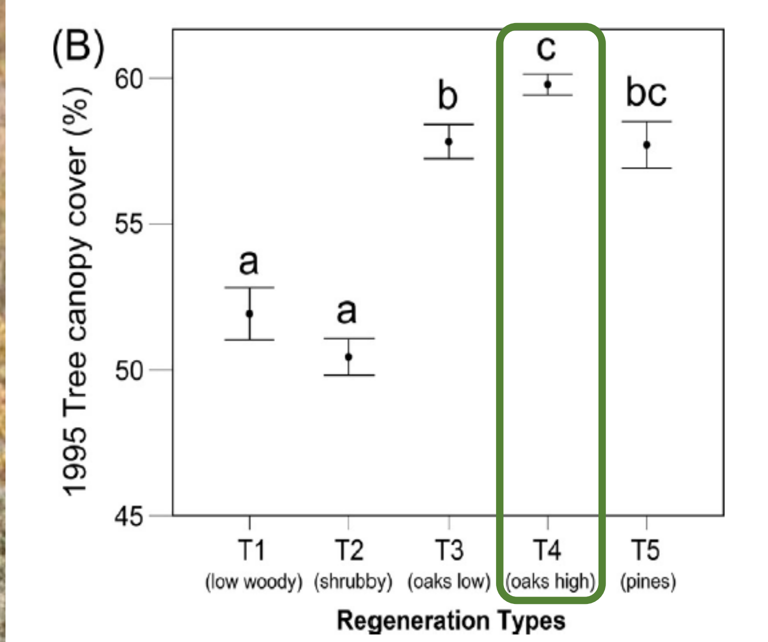


- ✓ *Close to un-burnt forest areas*
- ✓ *Low severity*

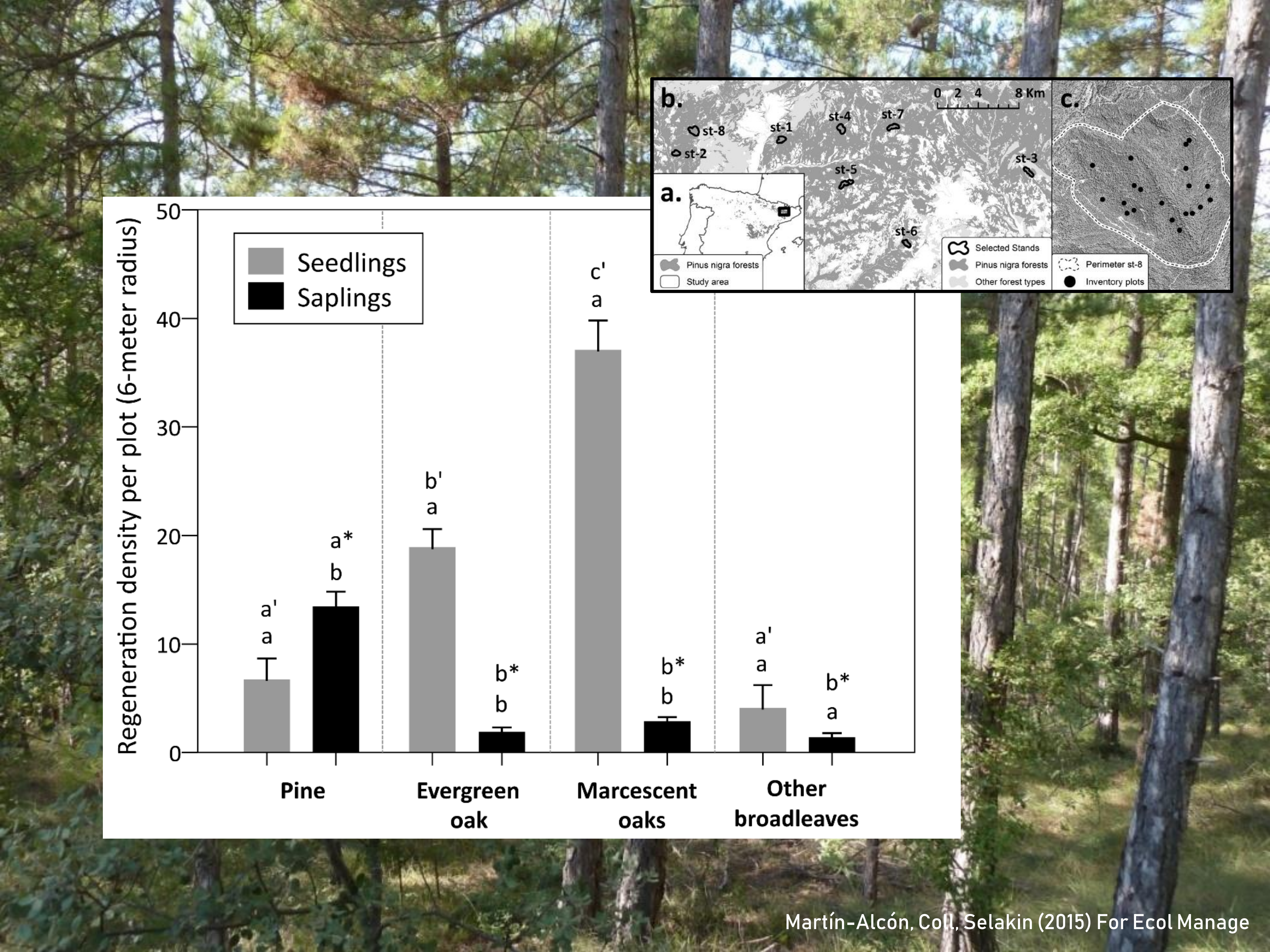
Type 4 - Hardwoods (high cover)



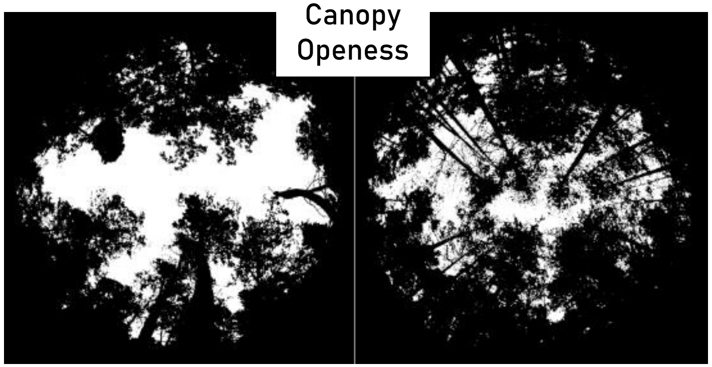


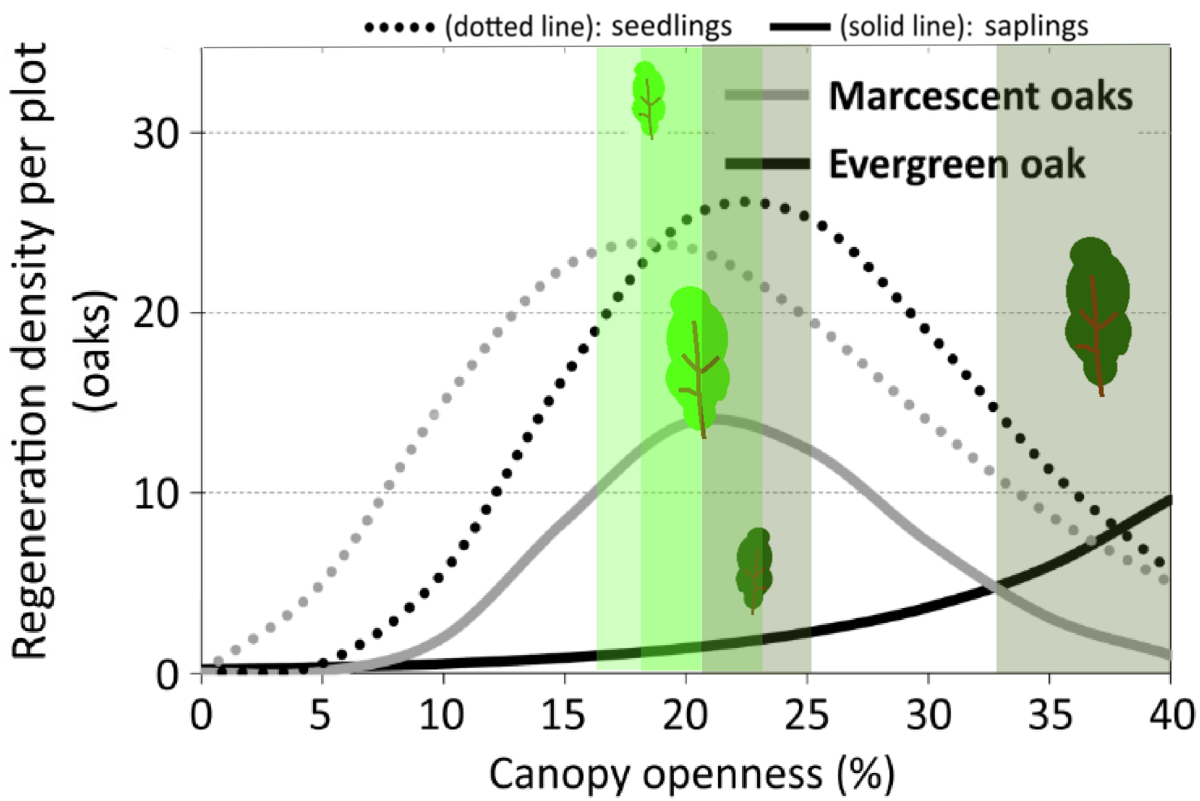


- ✓ *Intermediate severity*
- ✓ *High tree vegetation cover before the fire*
- ✓ *Close forests in the 50's*



Martín-Alcón, Coll, Selakin (2015) For Ecol Manage



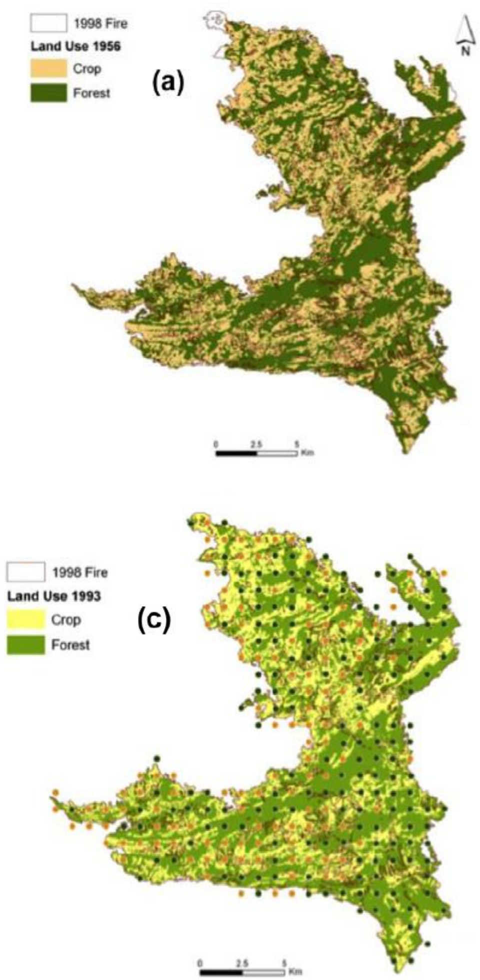


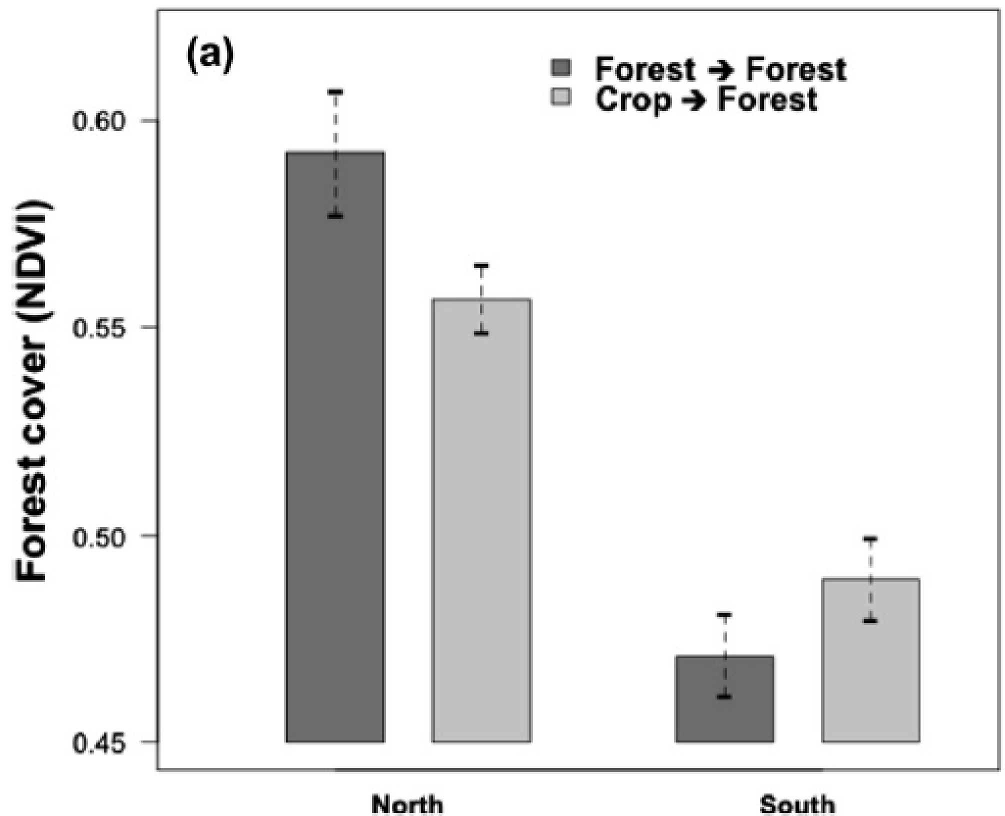
Martín-Alcón, Coll, Selakin (2015) For Ecol Manage

History matters: Previous land use changes determine post-fire vegetation recovery in forested Mediterranean landscapes

Carolina Puerta-Piñero [a,*,1], Josep M. Espelta [b], Belén Sánchez-Humanes [b], Anselm Rodrigo [b,c], Lluís Coll [a,b,1], Lluís Brotons [a,b,1]

[a] Forest Science Centre of Catalonia (CTFC), Crta. St. Llorenç de Morunys, km 2, Solsona E-25280, Spain
[b] CREAF, Cerdanyola del Vallès, 08193 Catalonia, Spain
[c] Unitat d'Ecologia. Facultat Biociències, Univ. Autònoma Barcelona, Cerdanyola del Vallès 08193, Spain

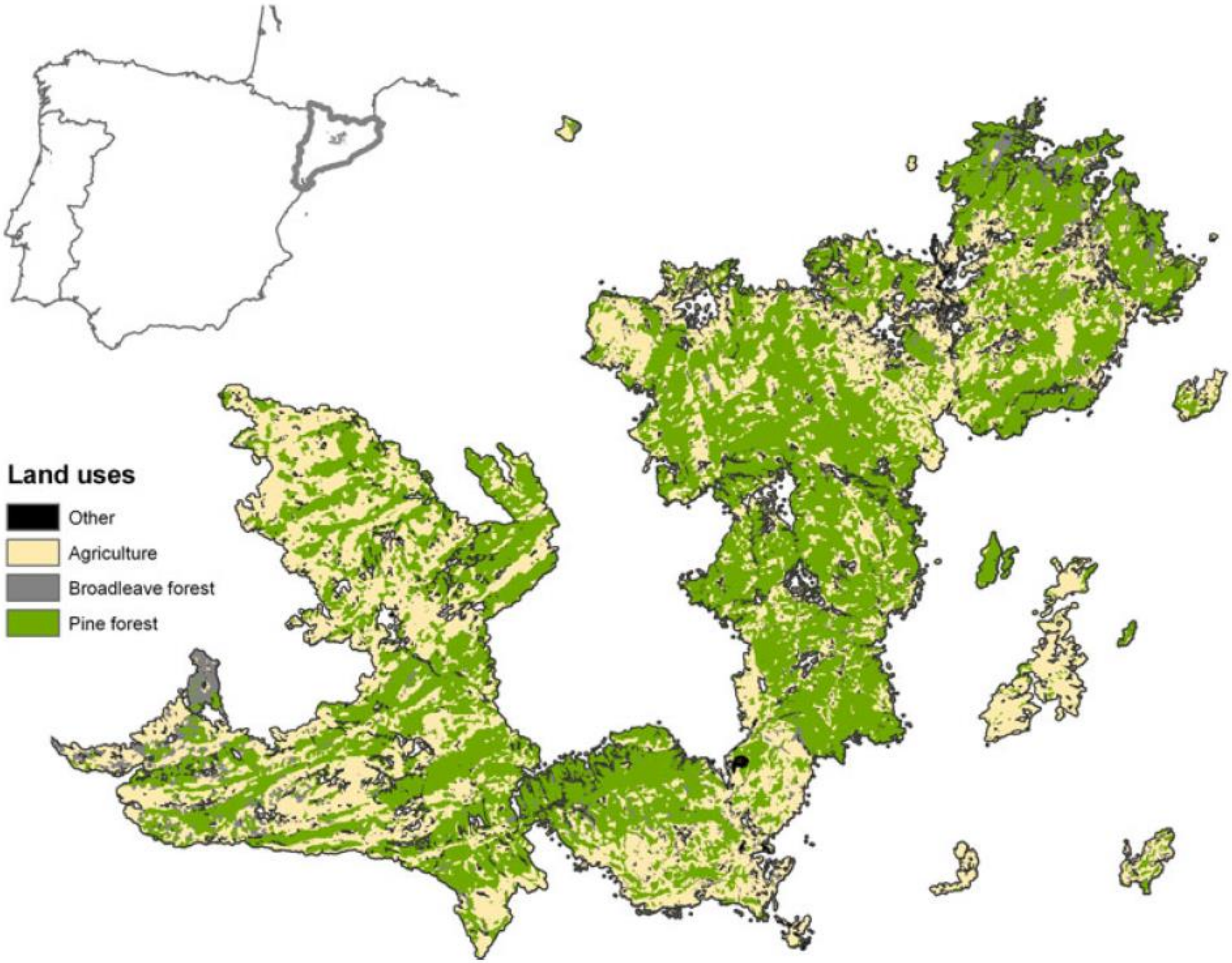




Puerta-Piñero *et al.* 2012 For Ecol Manage

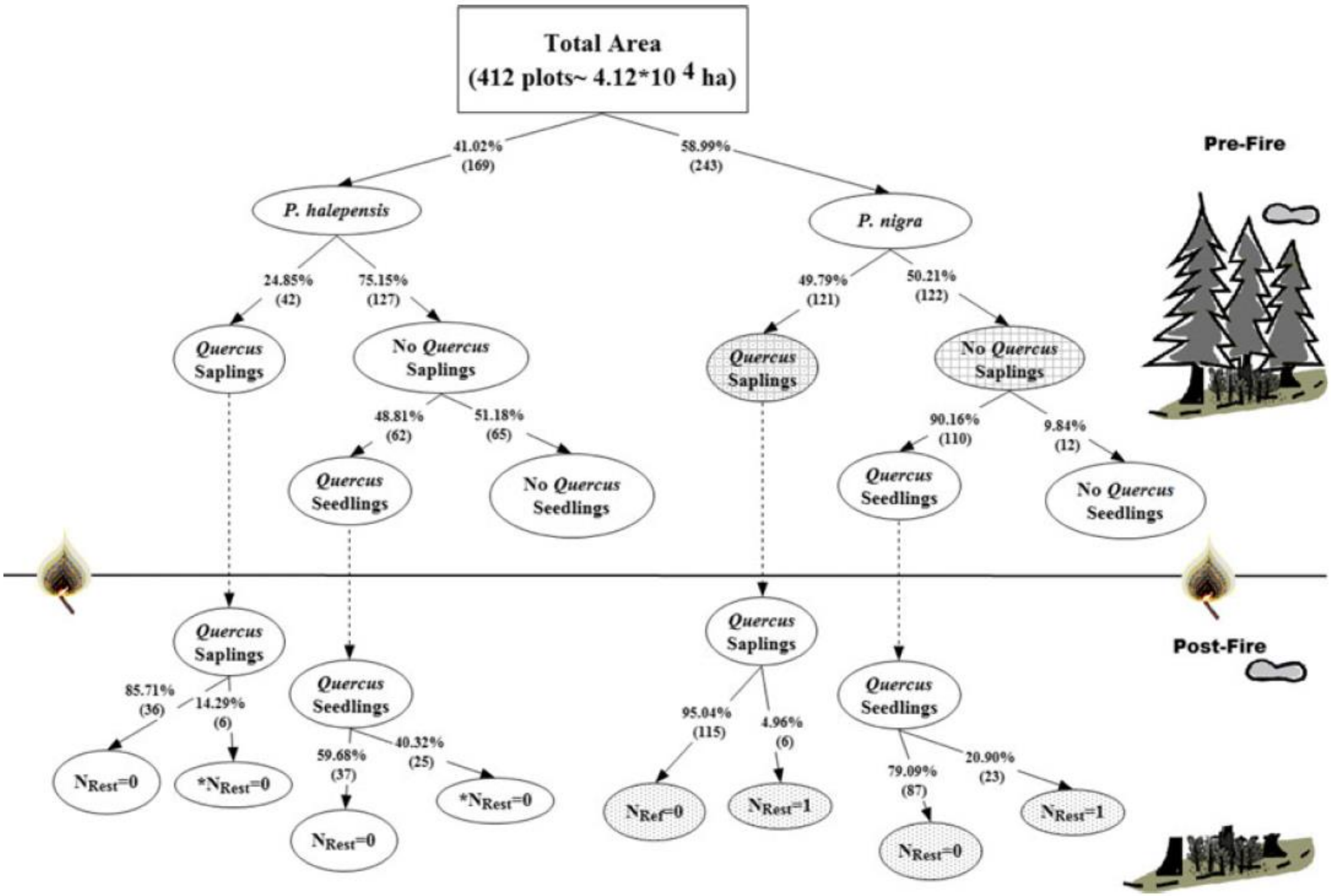
> 65.000 *ha*

National Forest Inventory plots (before/after fire)



Puerta-Piñero *et al.* 2012 Eur J For Res

Need restoration (N_{REST}=1) when sapling density < 127 tree/ha:
minimum of 1 sapling (2.5 < Ø < 7.5 cm) within 5-m radius sub-plot



. 412 plots
. 335 plots (81%) with young *Quercus* prior to the fire
. 60 plots (18%) "requiring" restoration actions

Objectives

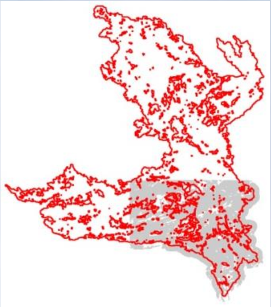


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Photo: A. Ameztegui

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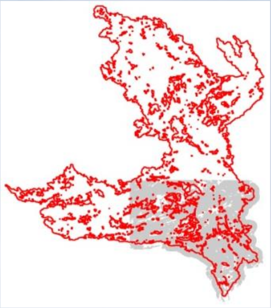

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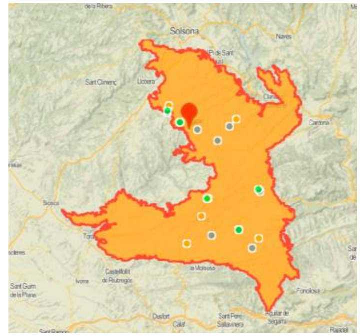
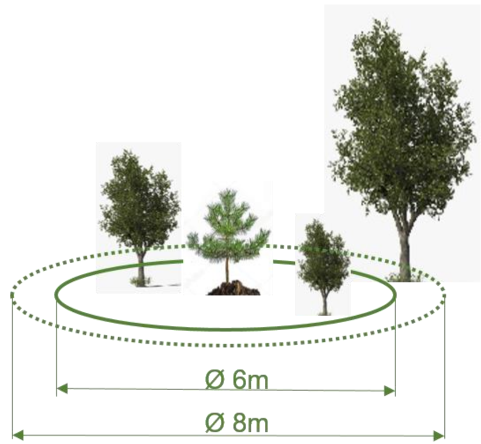


- 16 plots
- ≈200 target pines
- 1000 oaks



- Size, Annual growth
- Oak size (db, H)
- Distance pine-oak
- Water availability (SPEI)

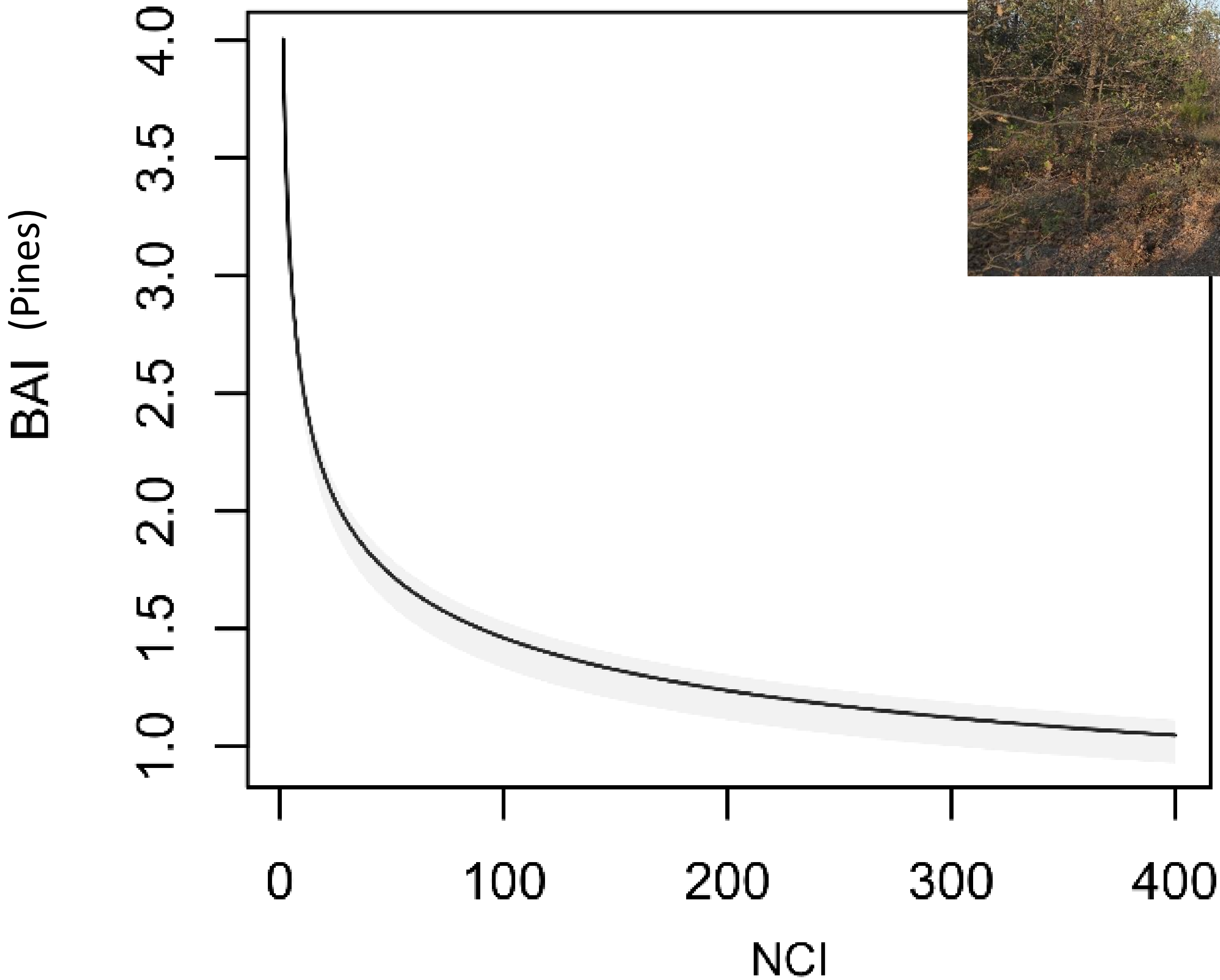
$$\mathrm{NCI} = \sum_{j=1}^{n} dbh_{ij}^{\alpha} \;/ dist_{ij}^{\beta}$$

j = 1,......,n neighboring trees

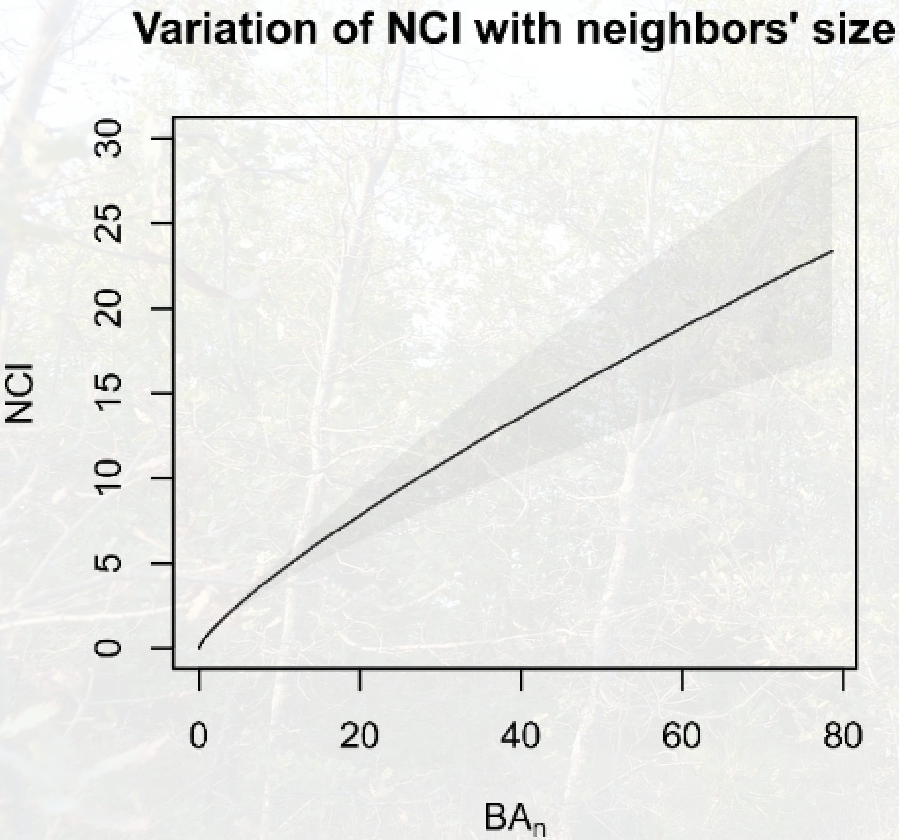
i = 1,......,s species on the growth of target tree z

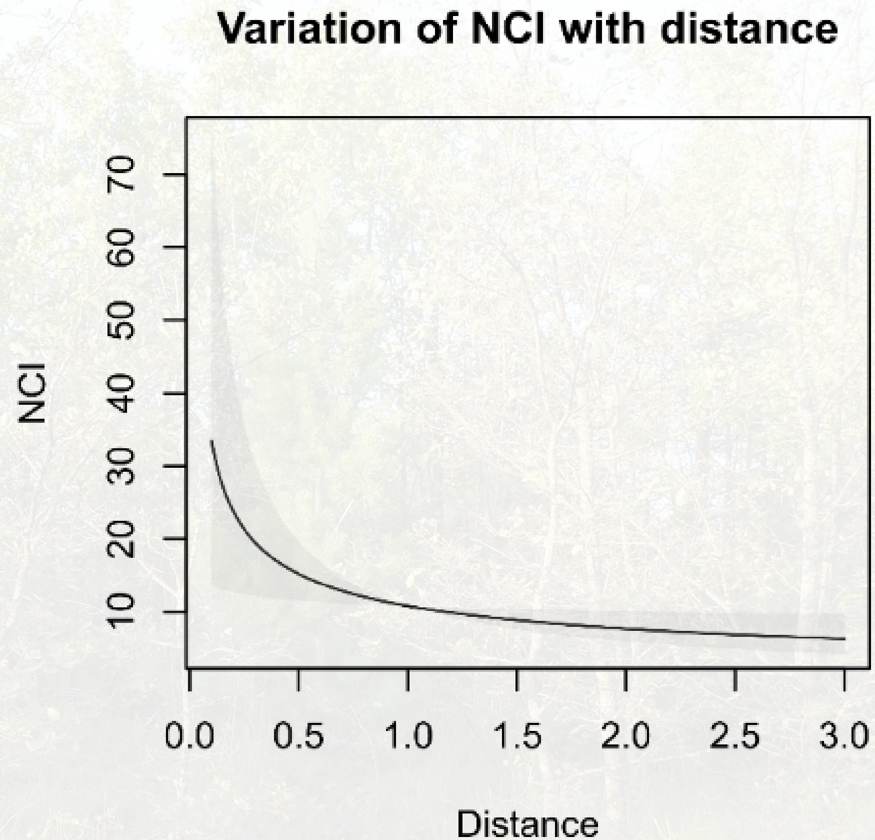
$$\log(BAI_b) = A + B\cdot\log(NCI) + C\cdot\log(BA_b)$$

For Ø = 2 cm



Sánchez-Pinillos et al (2018) For Ecol Manage





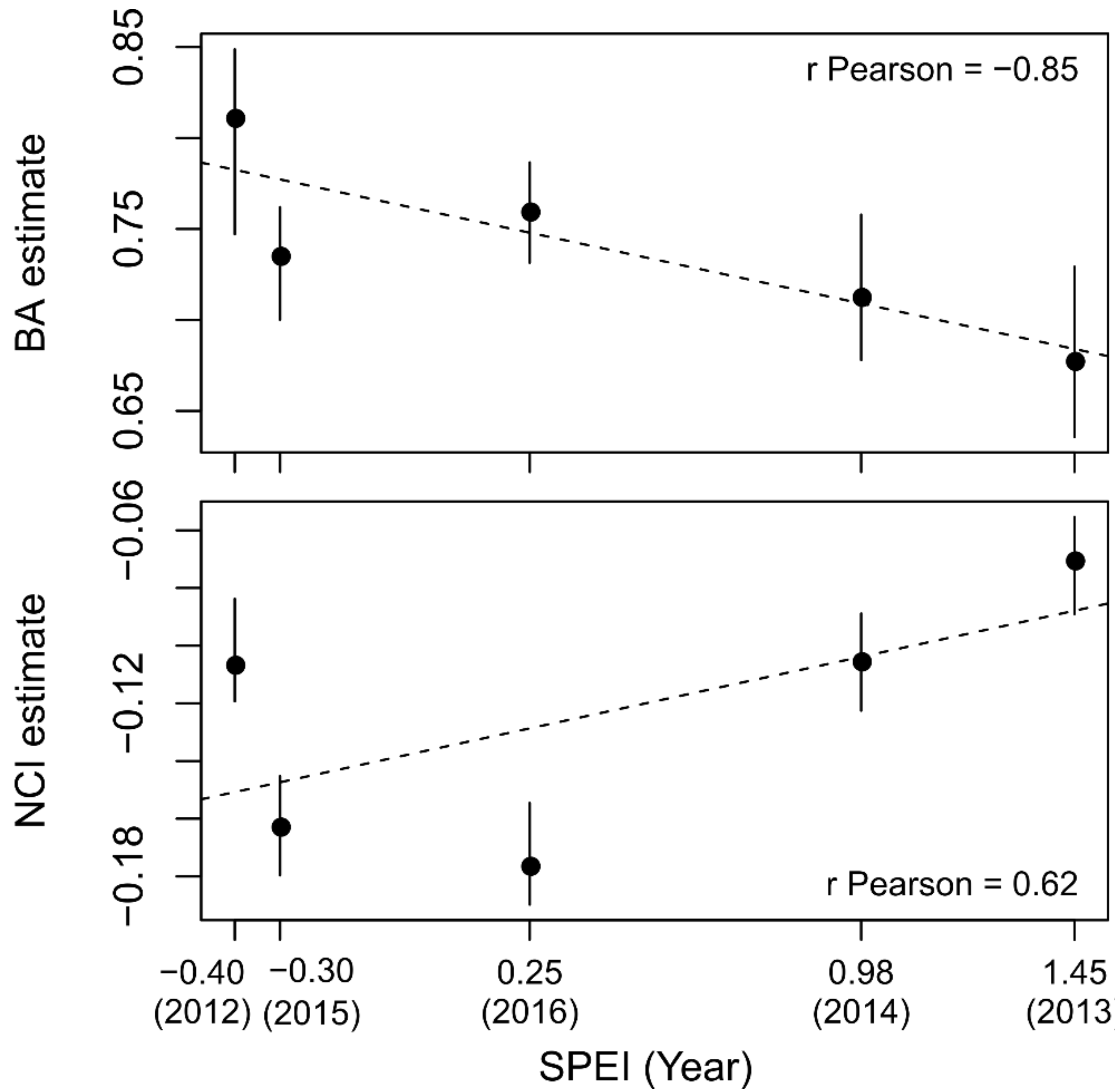
Higher competition by large neighbors

Higher competition by close neighbors

Sánchez-Pinillos et al (2018) For Ecol Manage

Positive effect of water availability

$$\log(BAI_b) = A + B\cdot\log(NCI) + C\cdot\log(BA_b)$$



Water availability mediated the effect of pine size and oak competition.

Standarized Precip-Evapo Index (SPEI) (growing season March – November)

In conclusion…

- *The combination of aerial LiDAR and multi-spectral imagery has proven very useful to generate regeneration types differentiated in terms of both structure and composition.*
- *The history of previous use determines in many cases the recovery capacity of Mediterranean forests to disturbances.*
- *Current levels of canopy closure (and shrub cover) allow the establishment of Quercus species in the understory of pinewoods but hampers the growth of established oaks. However, both saplings and seedlings show a high resprouting capacity after fire.*
- *We have not observed facilitative effects of resprouting oaks on post-fire pine sapling growth.*
- *The sensistivity of pines to neighbors varied depending on water availability during the growing size and plant size.*

Photo: Josep Rojas

Thanks to:

More information:

- Sánchez-Pinillos M., Ameztegui A., Kitzberger T., Coll L. (2018) *Relative size to resprouters determines post-fire recruitment of non-serotinous pines*. Forest Ecology and Management 429: 300-307.

- Martín-Alcón S., Coll L. (2016) *Unraveling the relative importance of factors driving post-fire regeneration trajectories in non-serotinous Pinus nigra forests*. Forest Ecology and Management 361: 13-22.

- Martín-Alcón S., Coll L., Salekin S. (2015) *Stand-level drivers of tree-species diversification in Mediterranean pine forests after abandonment of traditional practices*. Forest Ecology and Management 353: 107-117.

- Martín-Alcón S., Coll L., De Cáceres M., Cabré M., Just A., González-Olabarría J.R. (2015) *Combining aerial LiDAR and multi-spectral imagery to assess post-fire regeneration types in a Mediterranean forest*. Canadian Journal of Forest Reserach 45(7): 856-866.

- Puerta-Piñero, C., Brotons L., Coll L., González-Olabarría J.R. (2012) *Valuing acorn dispersal and resprouting capacity ecological functions to ensure Mediterranean forest resilience after fire*. European Journal of Forest Research 131: 835-844.

- Puerta-Piñero C., Espelta J., Sánchez-Humanes B., Rodrigo A., Coll L., Brotons L. (2012) History matters: previous land use changes determine post-fire vegetation recovery in forested Mediterranean landscapes. Forest Ecology and Management 279: 121-127.


Merci !
Photo: A. Ameztegui