Post-fire reforestation, natural regeneration and diversification plots network in Gredos (Central Spain)

Database was located in six sites along *Gredos* Mountains within province of Ávila (Central Spain). Total size of the sample was **1595 temporal plots and 63 permanent plots** distributed in the sites below:

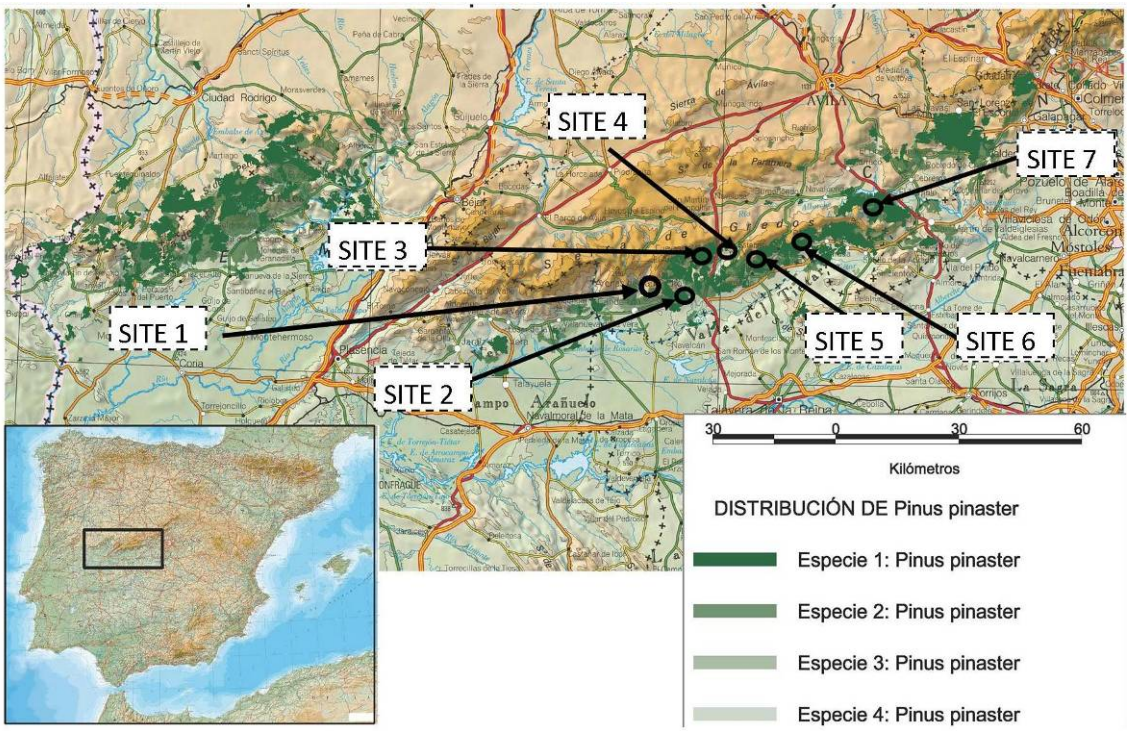

Figure 1. Localization map of sampling sites.

SITE 1: ***Proindiviso Arenas de San Pedro-Candeleda***

12 permanent plots were established (2013) in three reforestations with contrasting canopy cover. 4 types of seed-shelter were tested in 36 seeding points for each plot. This work was established in two other sites: *SITE 4 Villarejo del Valle* and *SITE 7 Valle Iruelas.*

SITE 2: ***Arenas de San Pedro***

35 temporal plots were established in 2009 after the wildfire distributed by reforestation works (in collaboration with "Silvopascicultura" Department, Polytechnic University of Madrid):

Image 1 Site1 Arenas de San Pedro: natural regeneration and shrub clearing, pre-commercial thinning and pruning.

- Natural regeneration and shrub clearing, pre-commercial thinning and pruning. Age 9. Years since fire: 10. 7 quadrate plots (10x10 meters).
- Natural regeneration and none forestry work. Age: 9. Years since fire: 10. 14 quadrate plots (10x10 meters).
- Hole digging reforestation by excavator machine and shrub clearing. Age: 9. Years since fire: 10. 14 quadrate plots (20x20 meters)

SITE 3: ***Mombeltrán y Cuevas del Valle***

1366 temporal plots were established in 2010-2011 after the wildfire distributed in regular network (100x100 meters):

- Natural regeneration. Age: 1. Years since fire: 2. 1366 plots by distances to six seedlings (in collaboration with "Restoration of nature" Section of Regional Govern in Ávila)

63 permanent plots were established in 2010-2011 after the wildfire distributed in regular network (400x400 meters) and was measured in three times: 2010 (all plots), 2011 (all plots) and 2013 (only 15 plots in Cuevas del Valle municipality)

- 2010 measure: Natural regeneration. Age: 1. Years since fire: 2. 63 plots by distances to six seedlings and stoked quadrant method (Matney and Hodges, 1991). They were established in collaboration with "Restoration of nature" Section of Regional Govern in Ávila).
- 2011 measure: Natural regeneration. Age: 2. Years since fire: 3. Soil Analysis in

Image 2 Regeneration Density measurement by stocked quadrant method

a selection of 35 plots. 63 plots by distances to six seedlings and stoked quadrant method (Matney and Hodges, 1991).

- 2013 measure: Natural regeneration. Age: 3. Years since fire: 4. 15 plots by distances to six seedlings and stoked quadrant method (Matney and Hodges, 1991). They were established in collaboration with "Second Section" of Territorial Service of Regional Govern in Ávila.

SITE 4: ***Villarejo del Valle***

Image 3 Site 3 Villarejo del Valle

18 temporal and quadrate plots (20x20 meters) were established in 2009 after the wildfire distributed in Hole digging reforestation by excavator machine (in collaboration with "Silvopascicultura" Department, Polytechnic University of Madrid). Age: 9. Years since fire: 14.

12 permanent plots were established (2013) in three reforestations with contrasting canopy cover, using the same method as *SITE 1*. 4 types of seed-shelter were tested in 36 *Castanea sativa* seeding points for each plot.

SITE 5: ***Pedro Bernardo***

48 temporal plots were established in 2009 after the wildfire distributed by reforestation works (in collaboration with "Silvopascicultura" Department, Polytechnic University of Madrid):

- Natural regeneration and shrub clearing. Age: 8. Years since fire: 9. 11 quadrate plots (10x10 meters).
- Clearing strips and ripping reforestation by bulldozer. Age: 7. Years since fire: 9. 5 quadrate plots (15x20 meters).
- Hole digging reforestation by excavator machine. Age: 7. Years since fire: 9. 12 quadrate plots (10x10 meters)
- Reforestation bulldozzer shrub clearing and 2nd sowing. Age: 6. Years since fire: 9. 5 quadrate plots (10x10 meters)
- Reforestation clearing shrub and replanting. Age

Image 4 Site 4 Pedro Bernardo: Natural regeneration and shrub clearing

7. Years since fire 9. 5 quadrate plots (15x20 meters)

- Manual hole digging reforestation. Age: 6. Years since fire: 9. 5 quadrate plots (20x20 meters)
- Hole digging reforestation by manual machine. Age: 6. Years since fire: 9. 5 quadrate plots (20x20 meters)

SITE 6: ***Casavieja***

21 temporal and quadrate plots (10x10 meters) were established in 2009 after the wildfire distributed in natural regeneration (in collaboration with "Silvopascicultura" Department, Polytechnic University of Madrid). Age: 3. Years since fire: 4.

Image 5. Site 5 Casavieja

SITE 7: ***Valle Iruelas***

21 temporal plots were established in 2009 after the wildfire distributed by reforestation works (in collaboration with "Silvopascicultura" Department, Polytechnic University of Madrid):

- Natural regeneration and shrub clearing. Age: 13. Years since fire: 14. 4 quadrate plots (10x10 meters).
- Clearing strips and ripping reforestation by bulldozzer, and shrub clearing. Age 10. Years since fire: 14. 13 quadrant plots (20x15 meters).
- Hole digging reforestation by excavator machine. Age: 10. Years since fire: 14. 13 quadrant plots (20x20 meters).

Image 6 Site 6 Valle Iruelas: Hole digging reforestation by excavator machine

12 permanent plots were established (2013) in three reforestations with contrasting canopy cover, using the same method as *SITE 1 and SITE 4*. 4 types of seed-shelter were tested in 36 seeding points for each plot.

Measurements

Density of shrub (leguminous, labiate, thorn, rockrose and fern), herb cover, rocky outcrops, slope, altitude, aspect, basal area before wildfire, age of regeneration, and years since wildfire, were continuous variables measured in every plot. Reforestation

method, forestry works (shrub clearing, pruning or pre-commercial thinning) and site, were factor variables measured in every plot. A complete analysis of soil (ITAGRA) was carried out in a selection of 35 permanent plots of Site 2. Slope, altitude and aspect, were obtained by GIS. Temporal plots in a regeneration age range since 1 to 13 years were measured.

Density of shrub was obtained by the Equation 1

$$Shrub\ density\ t = Hm_t \times fcc_t$$

Equation 1 Hm_i: average height (m) of the shrub formation type *i* in the plot area; fcc_i: cover (%) of the shrub formation type *i* in the plot area.

Pinus pinaster regeneration density (quadrate plot, six seedlings distances, and stocked quadrant method) and mean regeneration height were measured in every plot.

Image 7 Hole for soil analysis in permanent Plot, Site 2

In 36 permanent plots of *Castanea sativa* seeding with shelters, germination, mortality and growth were measured. The forest age, canopy cover, basal area and density were obtained for each plot. Also understory type and density, and litter depth were measured.

Performed and ongoing Studies

Ph.D. Thesis: "Restoration of *Pinus pinaster* forests in Central System (Spain): regeneration, reforestations and diversification"

Contacts with other groups running similar experimental sites are welcomed in order to collaborate in comparative studies.

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