

# Example of silvicultural simulation report with SIMANFOR (English)

Different thinning approaches in a *Pinus halepensis* x *Pinus pinaster* mixed  
stand

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## Inventoried stands description

The stands under study are mixed stands of *Pinus halepensis* and *Pinus pinaster*.

The most important stand variables are summarized in the following table:

ID	T (years)	N (trees/ha)	dg (cm)	G (m <sup>2</sup> /ha)	Ho (m)	V (m <sup>3</sup> /ha)	Wa (t/ha)	C (t/ha)
IFN2_11_217	18	578.05	22.19	22.35	8.03	66.28	75.4	50.39

where:

- $T$  is the average stand age (years)
  - $N$  is the stand density (trees/ha)
  - $dg$  is the quadratic mean diameter (cm)
  - $G$  is the stand basal area (m<sup>2</sup>/ha)
  - $Ho$  is the dominant height (m)
  - $V$  is the stand volume over bark (m<sup>3</sup>/ha)
  - $Wa$  is the stand aerial biomass (t/ha)
  - $C$  is the stand carbon stock including roots (t/ha)
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## Summary of thinning regimes

Four thinning regimes were simulated:

- **control**: Natural growth from the initial stand age to the simulation horizon, without any thinning intervention.
- **above**: Thinning from above with a low intensity (15% of basal area).
- **below**: Thinning from below with a low intensity (15% of basal area).
- **systematic**: Systematic thinning with a low intensity (15% of basal area).

The thinning regimes used in the simulations are summarized in the following table:

where:

- *Scenario*: Name of the thinning regime
- *Year*: Year of the simulation
- $T$ : Stand age after the action (year)
- *Action*: Type of action performed:

Scenario	Year	T	Action	Harvest type	Harvest criteria	Harvest severity	Future trees
above	0	18	Initialization	-	-	-	-
above	0	18	Thinning	Thinning from above	Basal area	15	-
above	40	58	Execution	-	-	-	-
below	0	18	Initialization	-	-	-	-
below	0	18	Thinning	Thinning from below	Basal area	15	-
below	40	58	Execution	-	-	-	-
control	0	18	Initialization	-	-	-	-
control	40	58	Execution	-	-	-	-
systematic	0	18	Initialization	-	-	-	-
systematic	0	18	Thinning	Systematic thinning	Basal area	15	-
systematic	40	58	Execution	-	-	-	-

- *Execution*: Stand growth without interventions (*notice that just the last execution was included in the table to save space*)
- *Thinning*: Thinning operation (see below for details)
- *Thinning type*: Type of thinning applied (systematic, from below, from above)
- *Thinning criteria*: Criteria used for selecting trees to be thinned (density, basal area, volume)
- *Thinning severity*: Severity of the thinning operation (from 0 to 100%)
- *Future trees*: Future trees or trees selected for the final cut (from 0 to 100%)

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## Simulation models and platform details

Simulations were carried out using the SIMANFOR platform (Bravo et al., 2005; available at [www.simanfor.es](http://www.simanfor.es)). Among the available models in the platform, the “*modelo de Masas mixtas de España*” was used. See more details in this [link](#).

### References:

Bravo, F., Ordóñez, C., Vázquez-Veloso, A., Michalakopoulos, S., 2025. SIMANFOR cloud Decision Support System: Structure, content, and applications. *Ecological Modelling* 499, 110912. <https://doi.org/10.1016/j.ecolmodel.2024.110912>

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## How to interpret simulations?

SIMANFOR is a platform that enables flexible silvicultural simulations tailored to the needs of each user. To achieve this, it incorporates empirical models (developed from real data) to estimate growth, mortality, volume, biomass, and the various types of information summarized here, all adapted to each species and its environmental conditions. However, these predictive models are subject to error, meaning that their outputs should be interpreted as a reference rather than an absolute truth. It is important to note that, as the simulation horizon increases, the potential errors also become larger, simply due to their cumulative effect.

Having said that, the specific values shown in the figures and tables should be interpreted with caution; nonetheless, the general trends and the comparisons between scenarios are more reliable and useful for understanding stand behaviour under different silvicultural interventions and for supporting informed decision-making.

In the SIMANFOR repository, you can find all the publications where this tool has been used. Have a look here: <https://github.com//simanfor/publicaciones>

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## Quantitative results at the end of the simulation

The most important average stand variables at the end of the simulation are summarized in the following table:

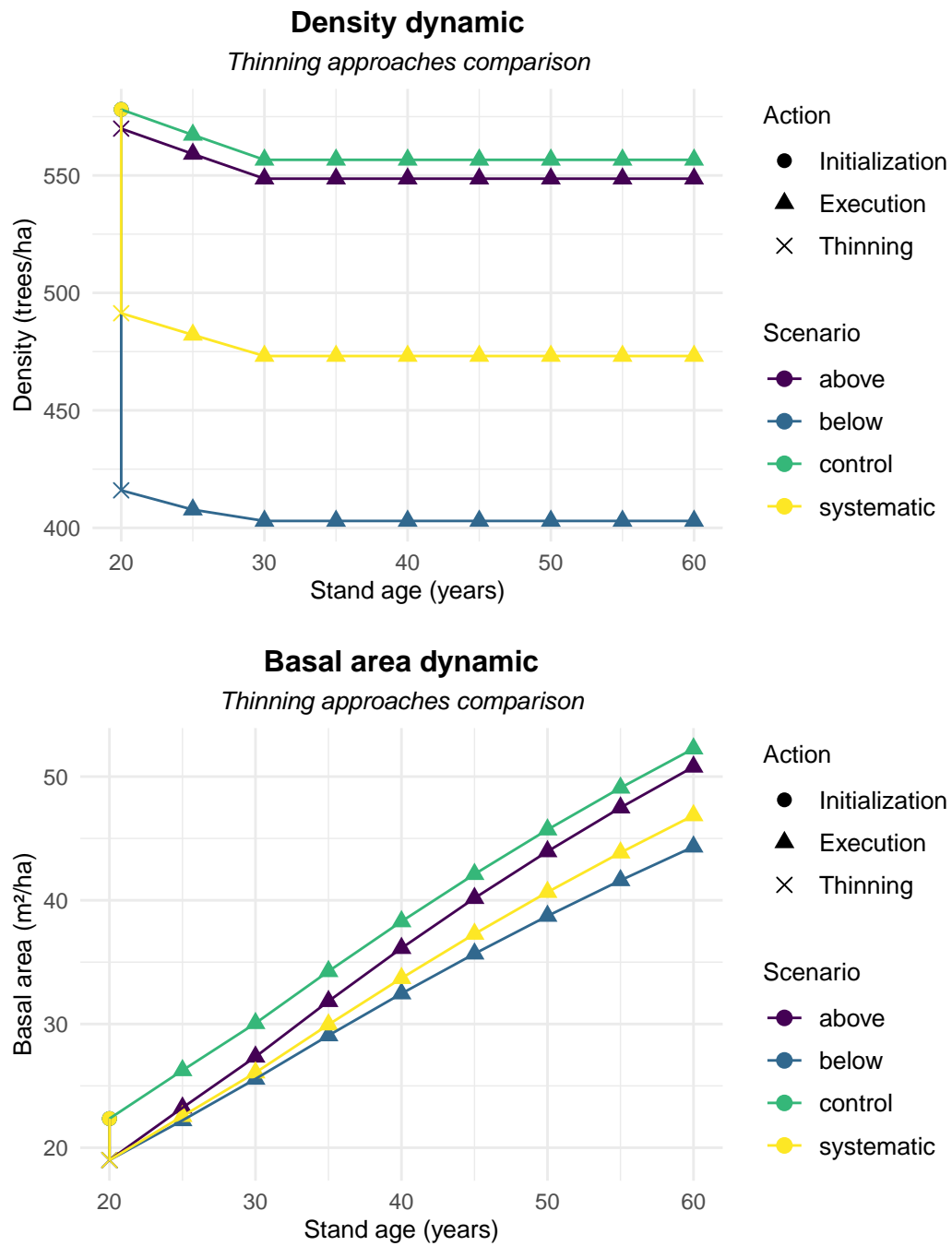
Scenario	N (trees/ha)	dg (cm)	G (m <sup>2</sup> /ha)	Ho (m)	V (m <sup>3</sup> /ha)	Wa (t/ha)	C (t/ha)
above	548.60	34.33	50.79	14.10	300.60	203.54	128.39
below	402.95	37.42	44.33	13.08	234.88	192.40	121.99
control	556.62	34.58	52.26	13.09	271.60	218.11	138.53
systematic	473.13	35.51	46.86	13.05	246.11	196.62	124.90

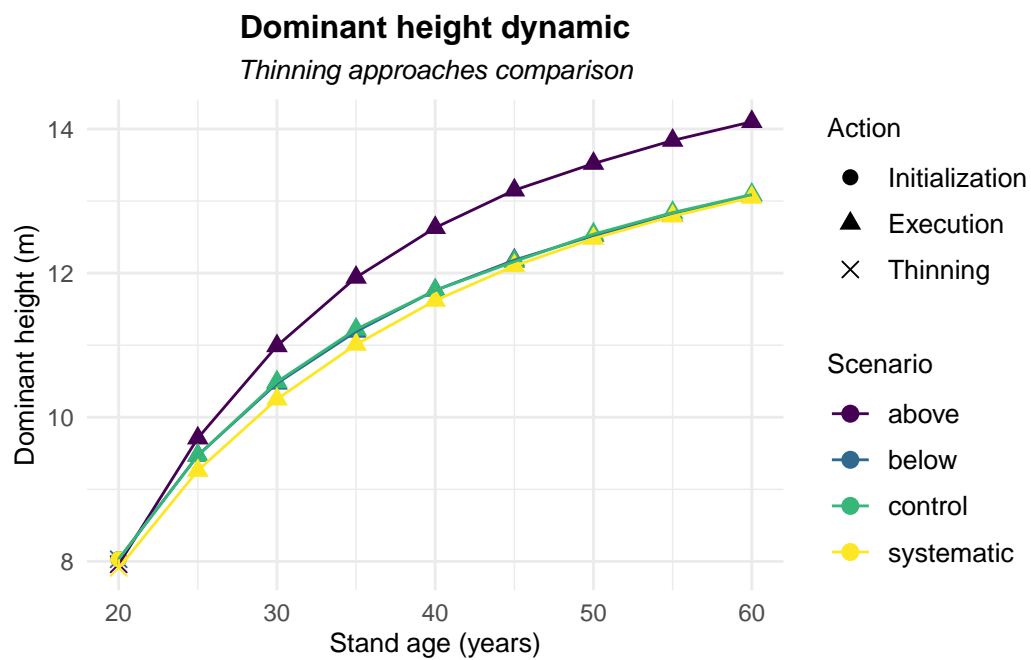
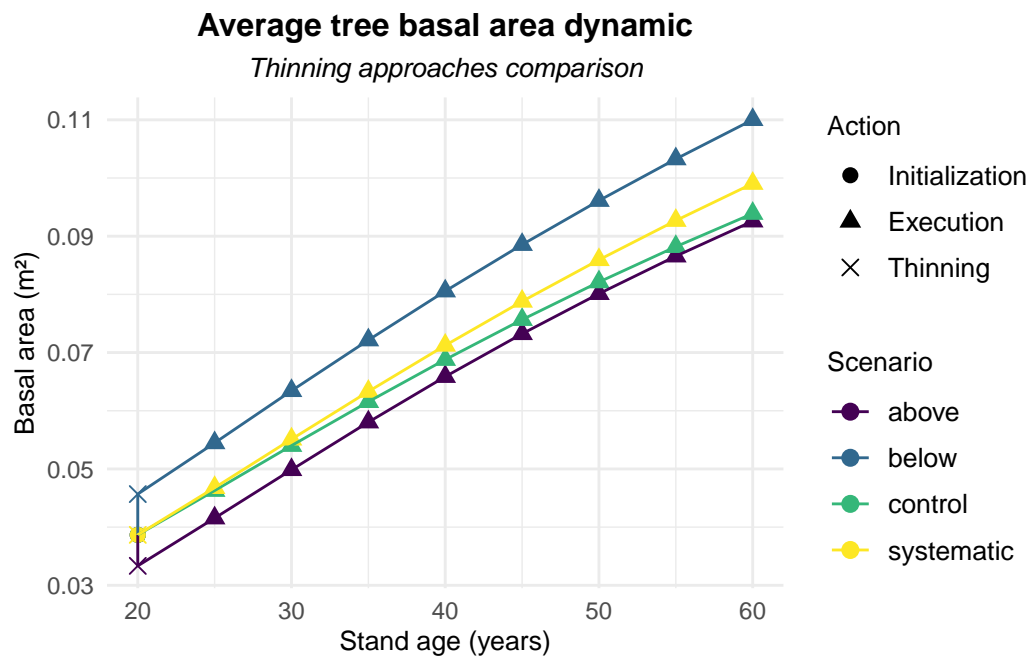
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## Graphical results

Based on the simulations performed, the following graphical results have been generated to compare the different silvicultural alternatives considered.

## Comparison of silvicultural alternatives: basic variables

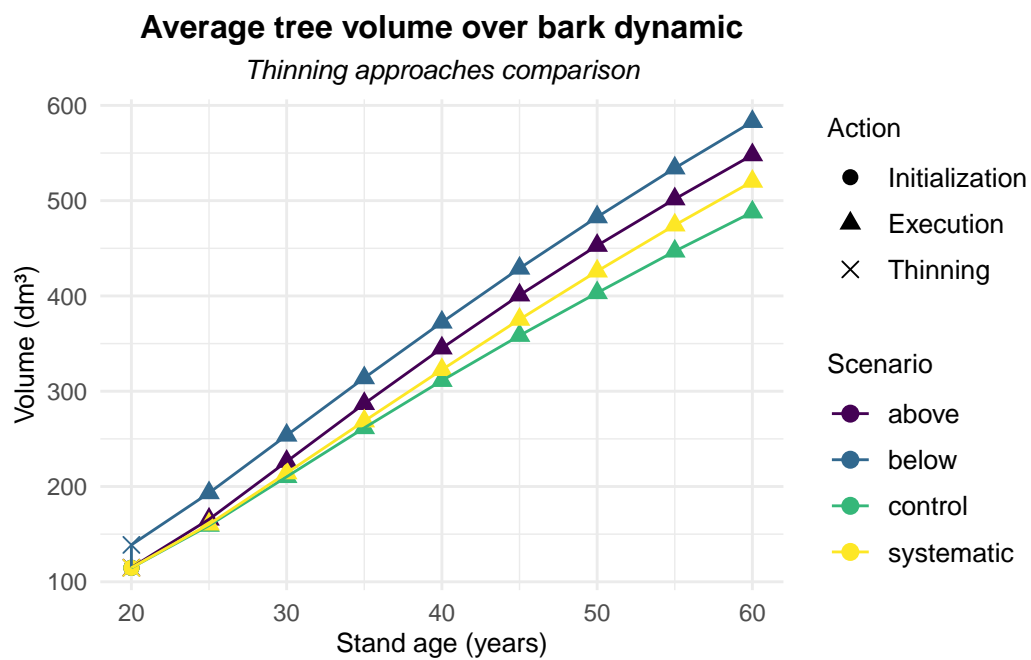
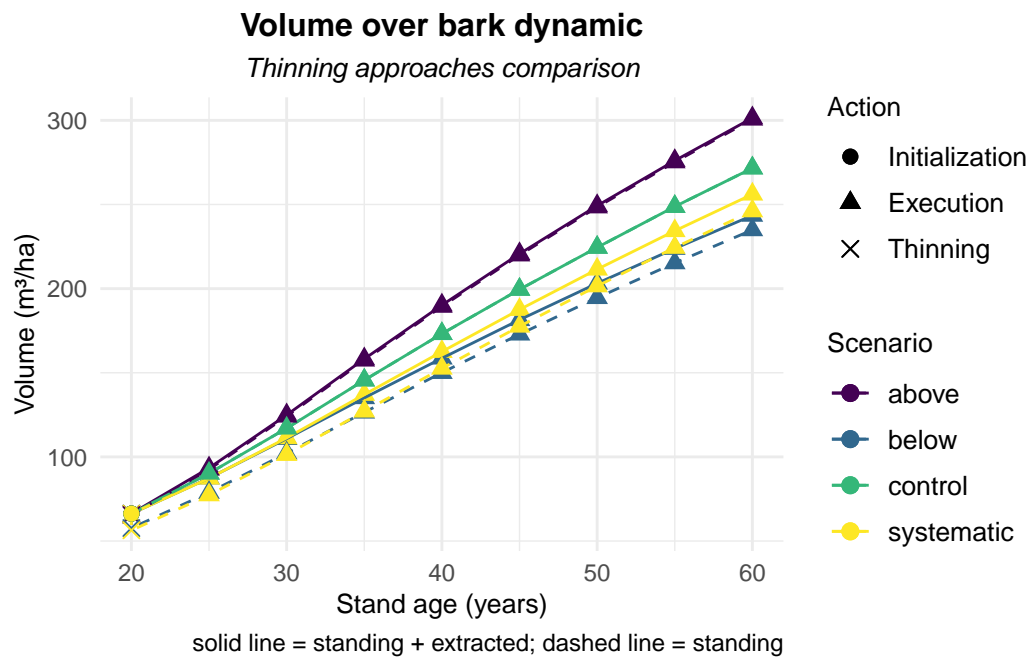




## Comparison of silvicultural alternatives: wood volume

*Note: Two lines are shown for each scenario. Solid lines represent cumulative values (standing trees + dead trees + trees removed by thinning), while dashed lines represent*

only the standing timber.



## Comparison of silvicultural alternatives: biomass and carbon

*Note: The biomass shown refers to the above-ground part (trunk, branches, and leaves), excluding roots, while the sequestered carbon refers to the whole tree.*

*Note: Two lines are shown for each scenario. Solid lines represent cumulative values (standing trees + dead trees + trees removed by thinning), while dashed lines represent only the standing timber.*

