Combining biodiversity goals and multilayered stand structures with economic profitability

-in the case of boreal forests

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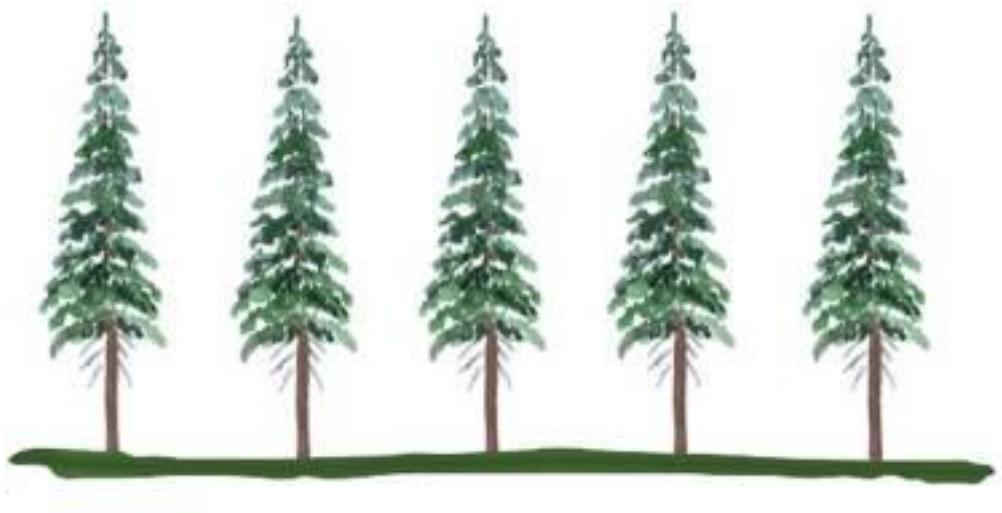
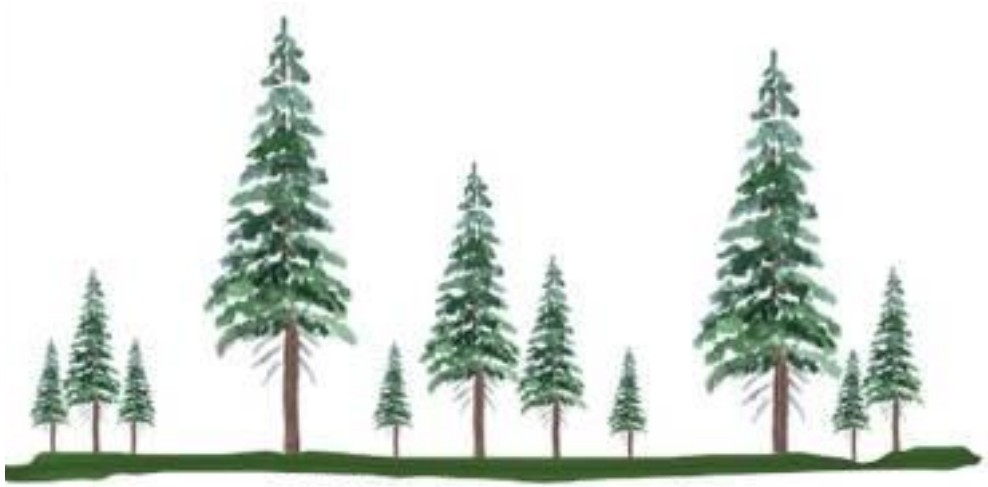
Two management strategies

– different economic advantages



- Large uniform treatment units
- Lower cost per harvested m^3
- Uncomplicated
- Easier to predict
- Easier to change plant material



- Higher income per harvested m^3
- Lower costs for regeneration and tending
- Tree level optimized selection
- Trees harvested gives a positive net return
- Better spread of risks
- More flexible to market price changes

Two management strategies

– biodiversity advantages?

More important than management strategy is:

- Thinning intensity
- Amount of large living trees
- Amount of large decaying trunks
- Amount of large deciduous trees

Favours species depending on continuity in:

- Shade or semi-shade conditions
- Tree spatial distribution

(Mycorrhiza, mosses, tree dependent lichens, bilberry)

How to compare profitability

- Optimization at **stand level**
- **Net present value** is most often the objective value
- Multilevel numerical optimization where common decision variables are:
  - **Timing of thinning**
  - **Timing of clear-felling**
  - **Thinning intensity**
  - **Target diameter**
  - **Discount rate**

Complex calculations depending on many assumptions, selected method and used models

- Growth models (stand structure)
- Initial state
- Ad hoc assumptions
- Sub models (regeneration, harvesting costs, roundwood price variation)

State of knowledge

- *Comparing profitability of uneven-sized forestry (USF) with rotation forestry (RF) in boreal forests*

General statement: An average Norway spruce stand, within the boreal coniferous zone, which is not too dense or too overstocked with large trees is likely more profitable to manage with USF.

The profitability for USF increases with:

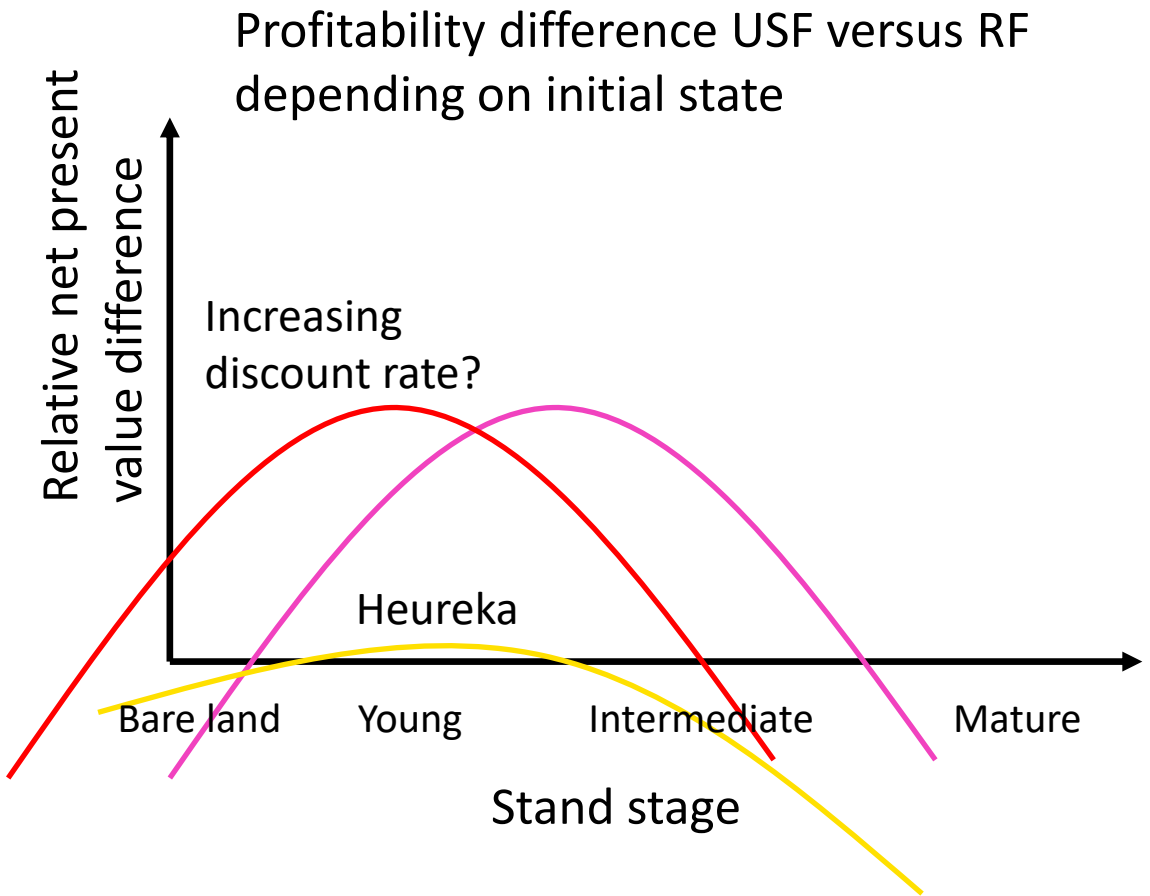
- a more developed uneven-sized structure
- lower basal area
- lower mean diameter
- higher temperature sum
- larger roundwood market price variation
- higher establishment costs (starting from bare land)
- lower site quality

The impact from discount rate is large but results point in different directions

Similar results apply for Scotch pine and to some extent for Birch

State of knowledge

- Comparing profitability of uneven-sized forestry (USF) with rotation forestry (RF) in boreal forests



What happens if we move from stand level optimization to tree level optimization?

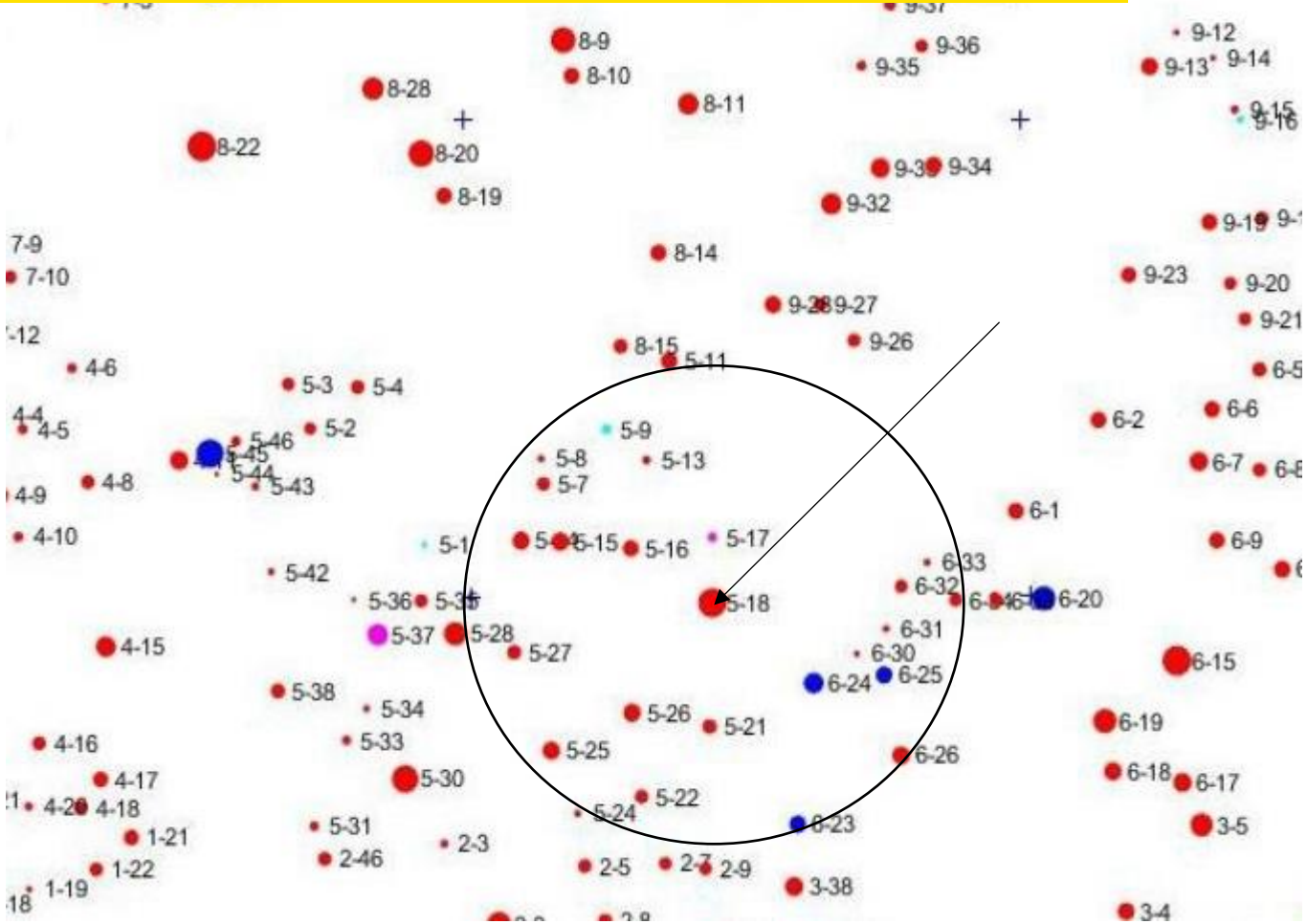
General rule:
It is more profitable to harvest the largest tree first when two trees compete for the same resources.

Three terms decide what is the optimal decision:

1) + The net value growth of the subject tree
2) − The opportunity cost of not harvesting the tree
3) − The reduced net value growth of the competitors caused by retaining the subject tree

Sum>0 ⟶ retain

Sum<0 ⟶ harvest



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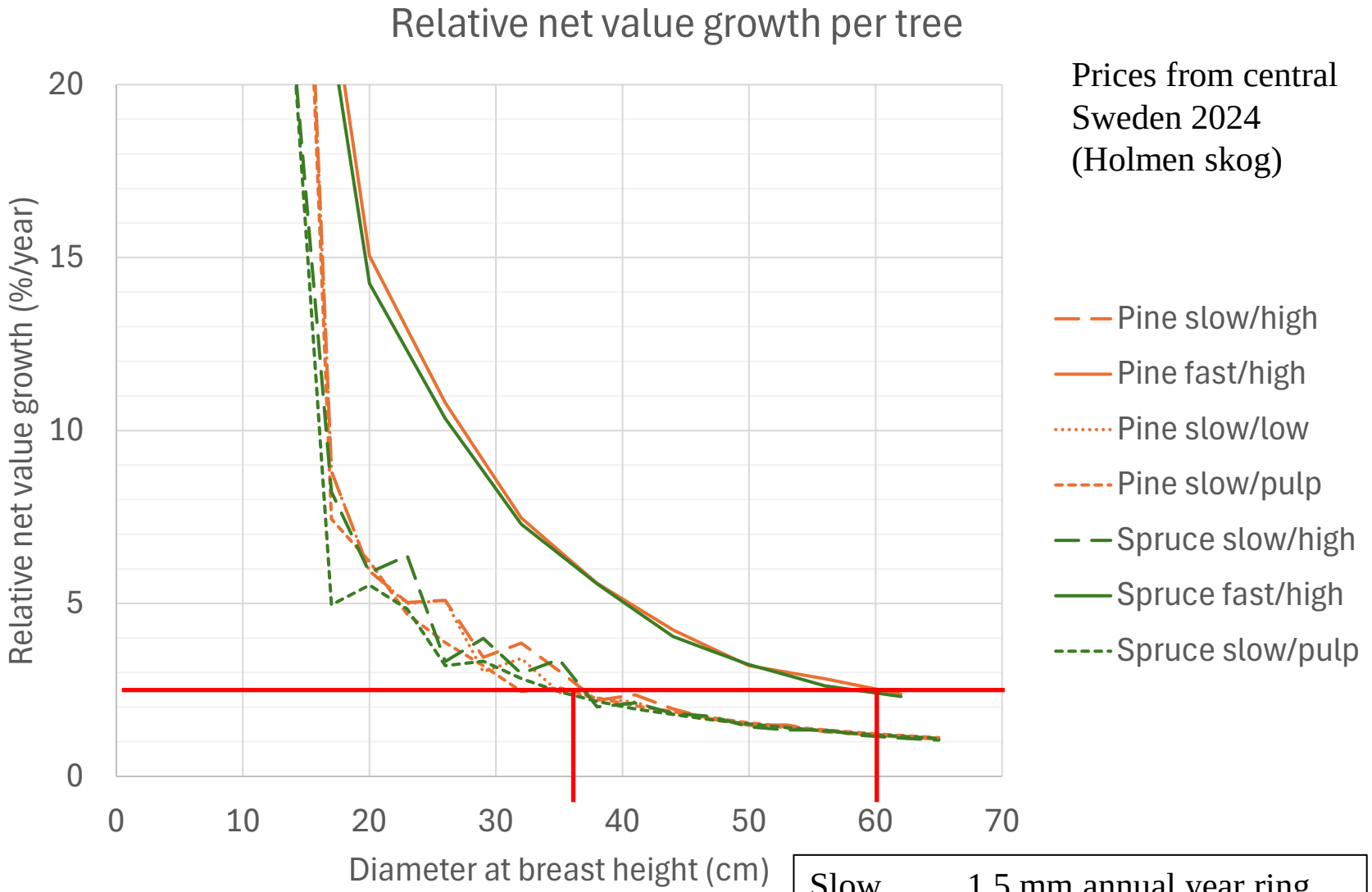
1) + The net value growth of the subject tree

2) – The opportunity cost of not harvesting the tree

Discount rate affects the optimal target diameter in boreal forests



Prices from central Sweden 2024 (Holmen skog)

Slow	1.5 mm annual year ring
Fast	3 mm annual year ring
High	highest quality
Low	low quality
Pulp	pulpwood quality

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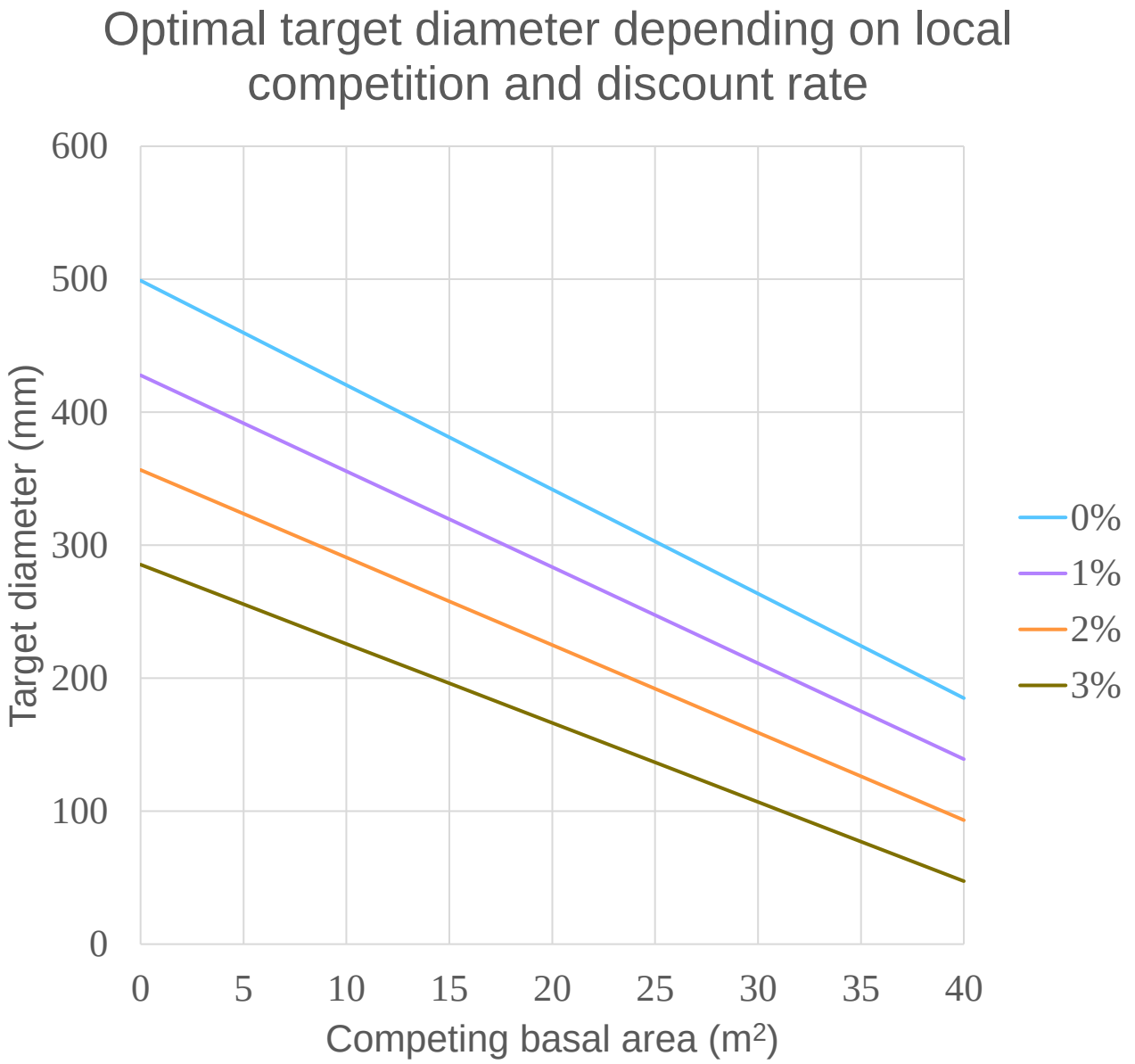
3) – The reduced net value growth of the competitors caused by retaining the subject tree

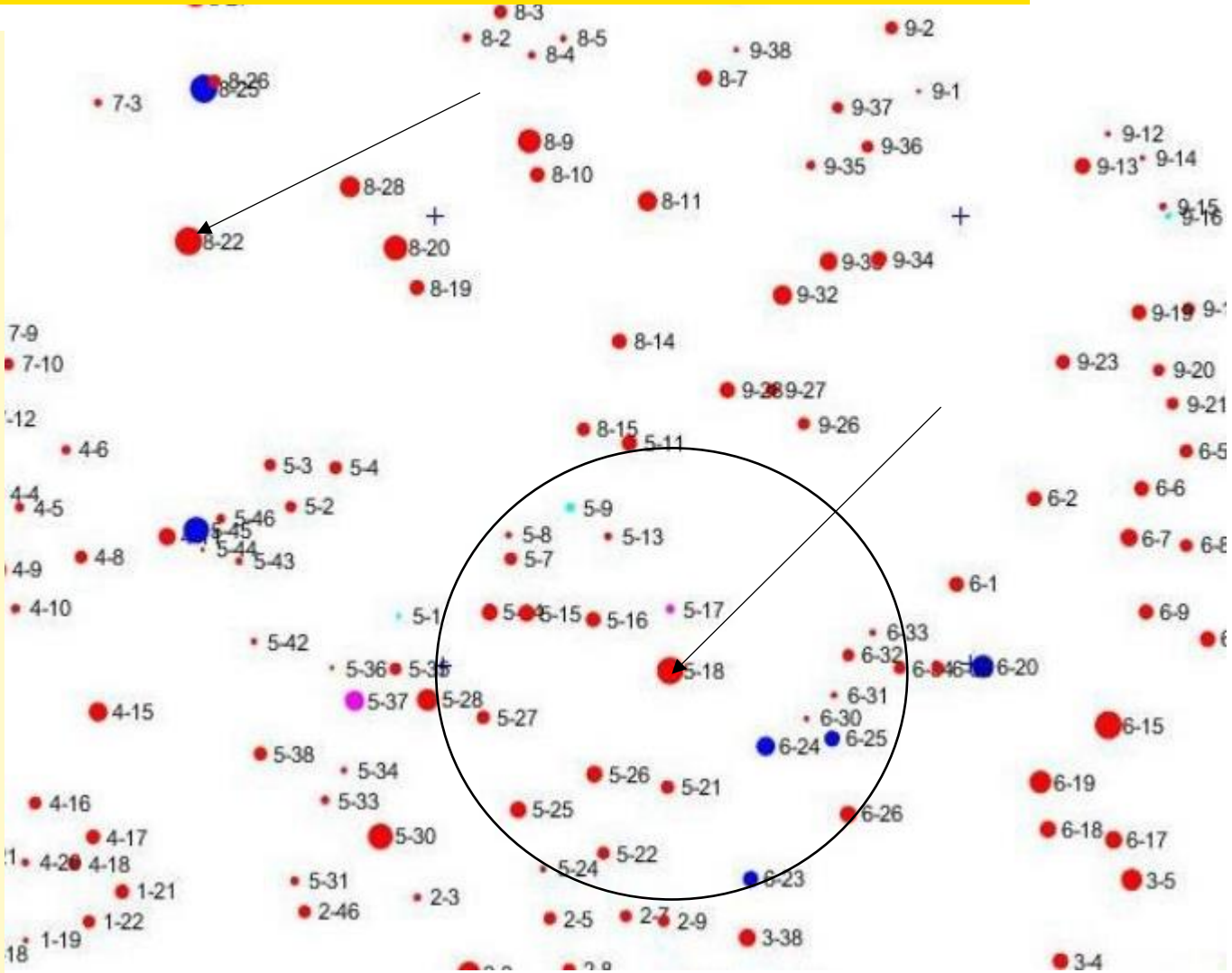
The diagram represents Norway spruce on fertile sites in southern Sweden

Impact from local competition is expected to increase with latitude



Consequences of optimization at individual-tree level

- Thinning from above is the most profitable treatment (with exception of dense even-sized stands)
- Optimal target diameter is individually unique.
- Optimal timepoint for harvest occurs at different points in time för different trees.
- Optimal treatment supports diverse diameter distributions.
- Optimal treatment leads to uneven-sized forestry.



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