

Carbon sequestration and storage in replanted riparian forests

Examples from Oregon riparian restoration efforts

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1.



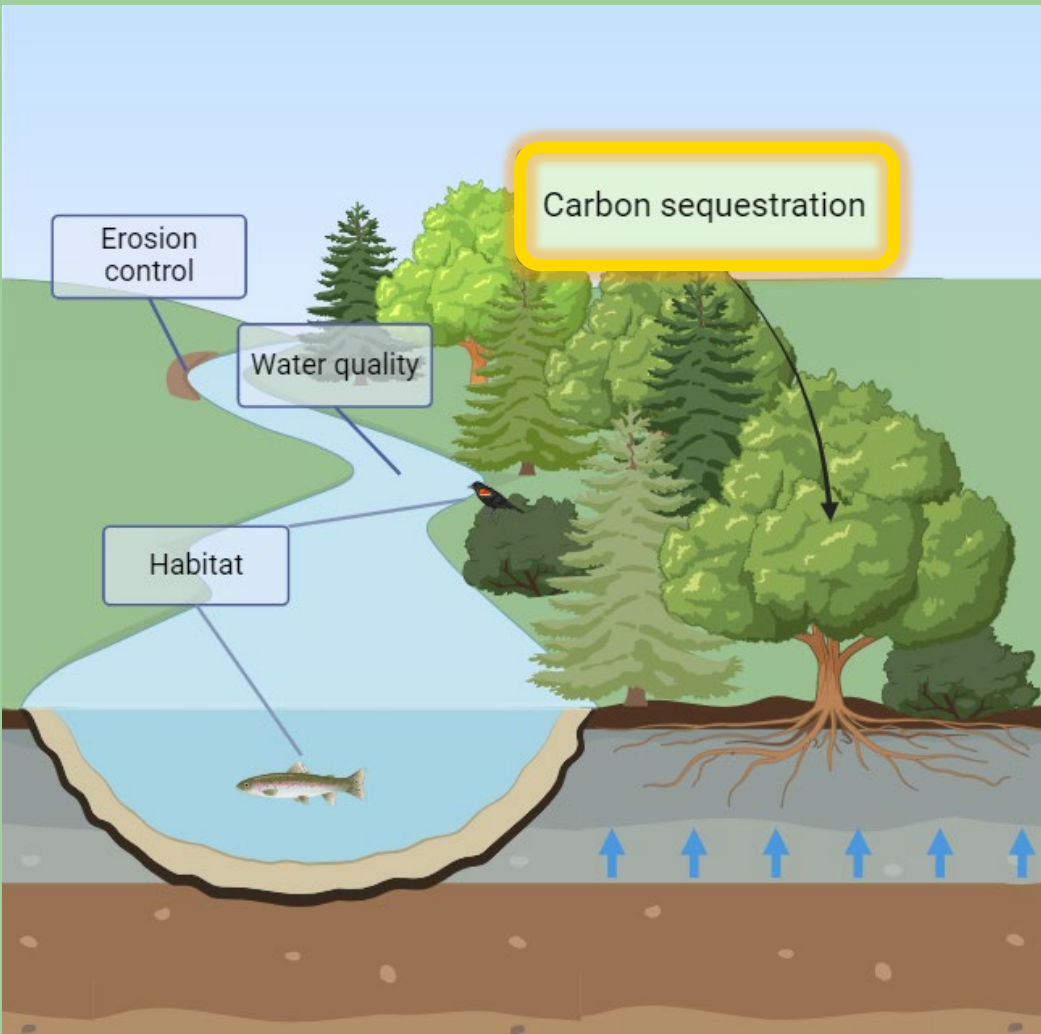
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2.

The Nature
Conservancy 



Riparian reforestation for ecosystems

- Supporting habitat connectivity
- Regulating water flow
- Enhancing streambank stability



9-year-old planting

Riparian reforestation for climate

Riparian forests are
carbon storage superstars

Co-benefits include improved erosion control, wildlife habitat, and water quality

Reforestation could boost sequestration with a small footprint

But there's a need
for empirical data.

Replanted forest \neq Remnant forest

Restoration reforestation \neq Replanted timber



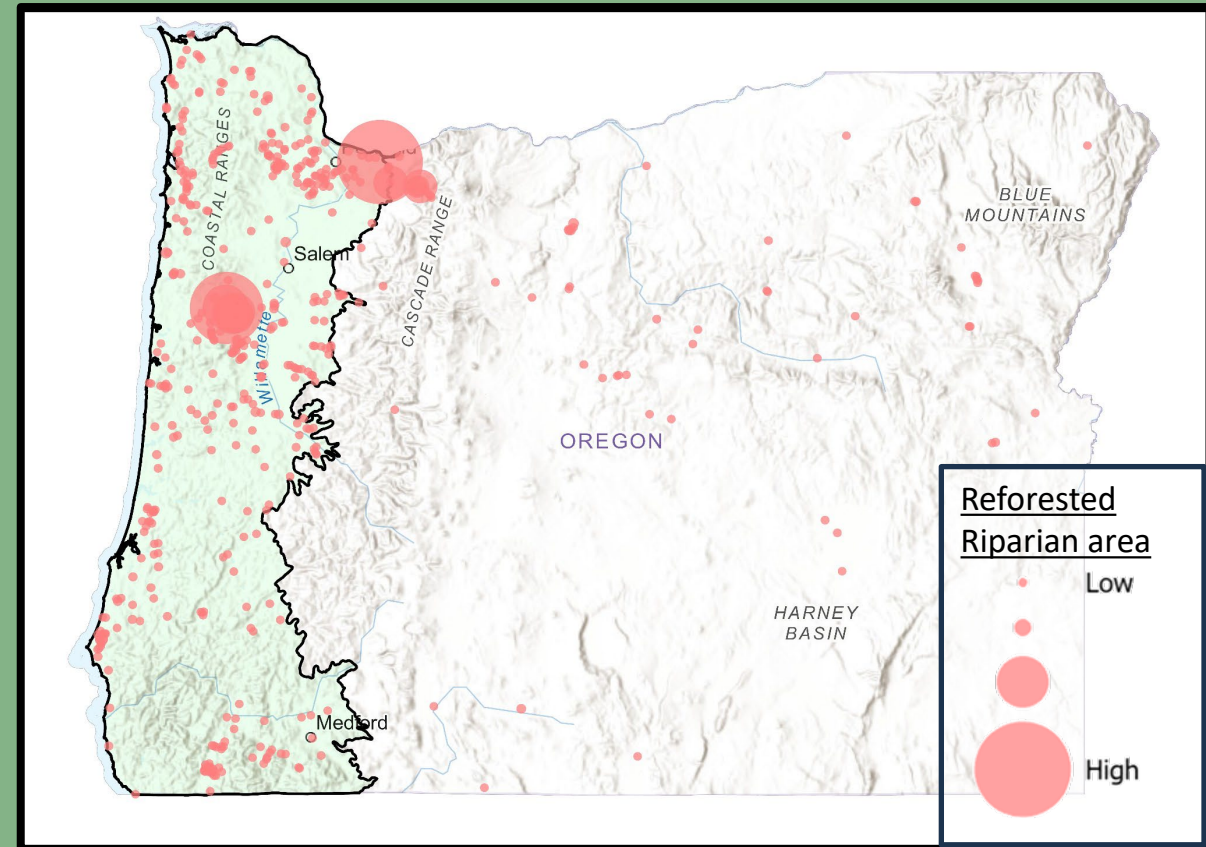
Opportunity Knocks

Oregon Riparian Restoration: 8900 riparian hectares reforested from 1995-2020

- What is the rate of carbon accumulation in riparian reforestation projects?
- What factors are the main controls on this rate?
 - Climate
 - Soil
 - Geomorphic
 - Management characteristics

Distribution of reforested riparian area

Clusters scaled by reforested area in cluster

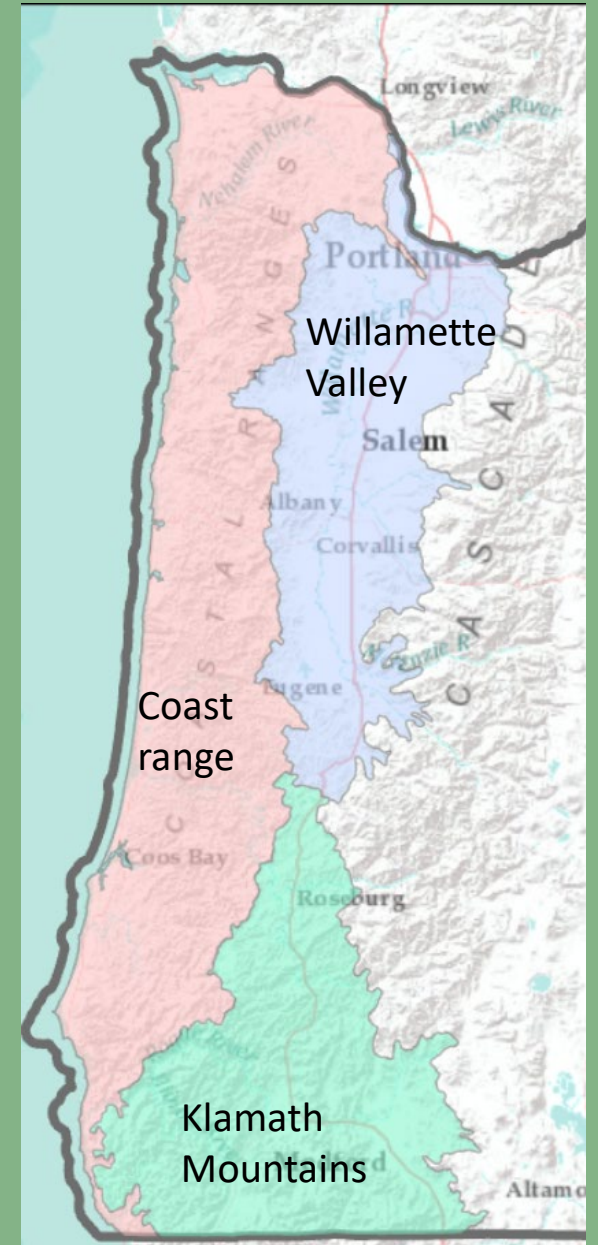


Study approach

Quantify above and belowground carbon reforested riparian zones across western.

Site Selection

1. Stratified by planting age, climate, and soil type
2. Randomly selected from database of **successful** restoration projects
3. Filled out strata opportunistically where needed



Study area

Study Approach



Woody carbon

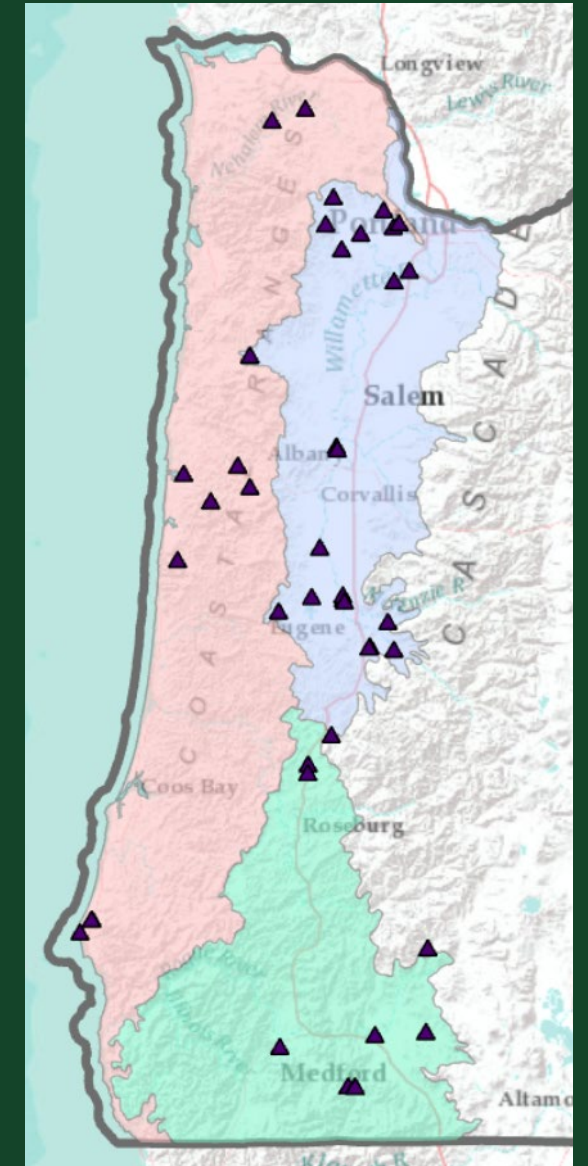
- Modified forest inventory survey for coarse wood, trees and shrubs
- Allometric equations for carbon

Soil carbon

- Soil organic carbon stock 0 – 45 cm



Measuring tree diameters can be “sticky” work

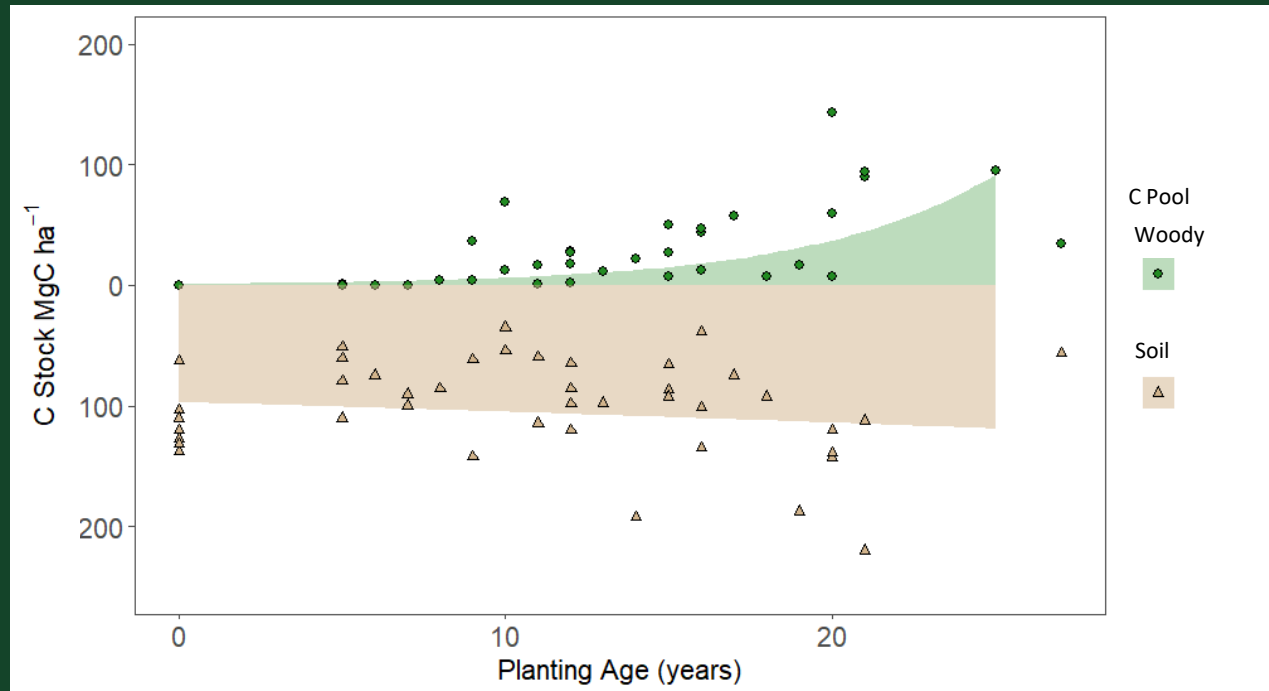




Results



Carbon Stocks



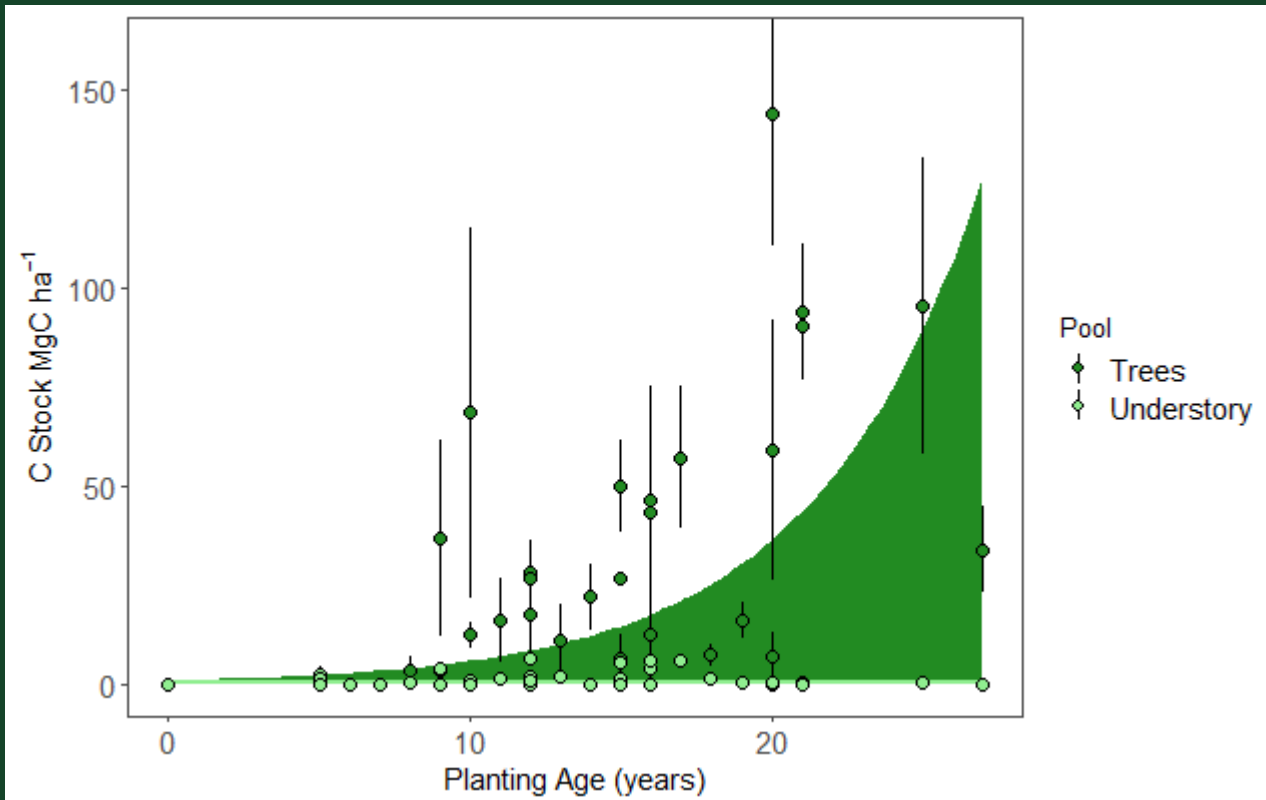
Woody C

- Increase of 19% per year
- 34 Mg C per hectare over 20 years

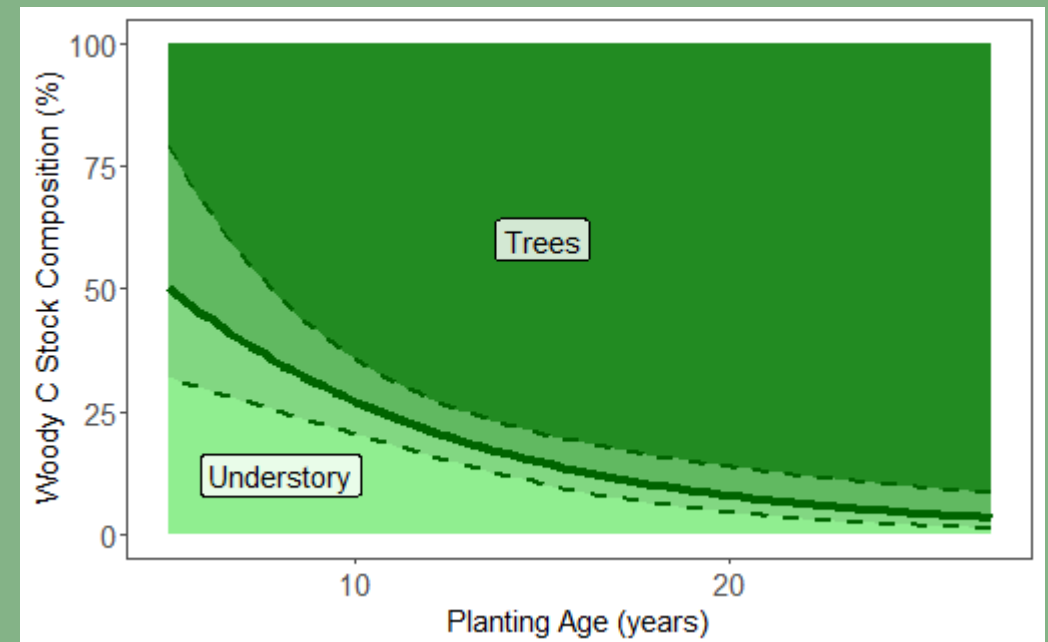
Soil C

- Increase of 1% per year
- 17 Mg C per hectare over 20 years

Woody Carbon



Understory C important in young sites

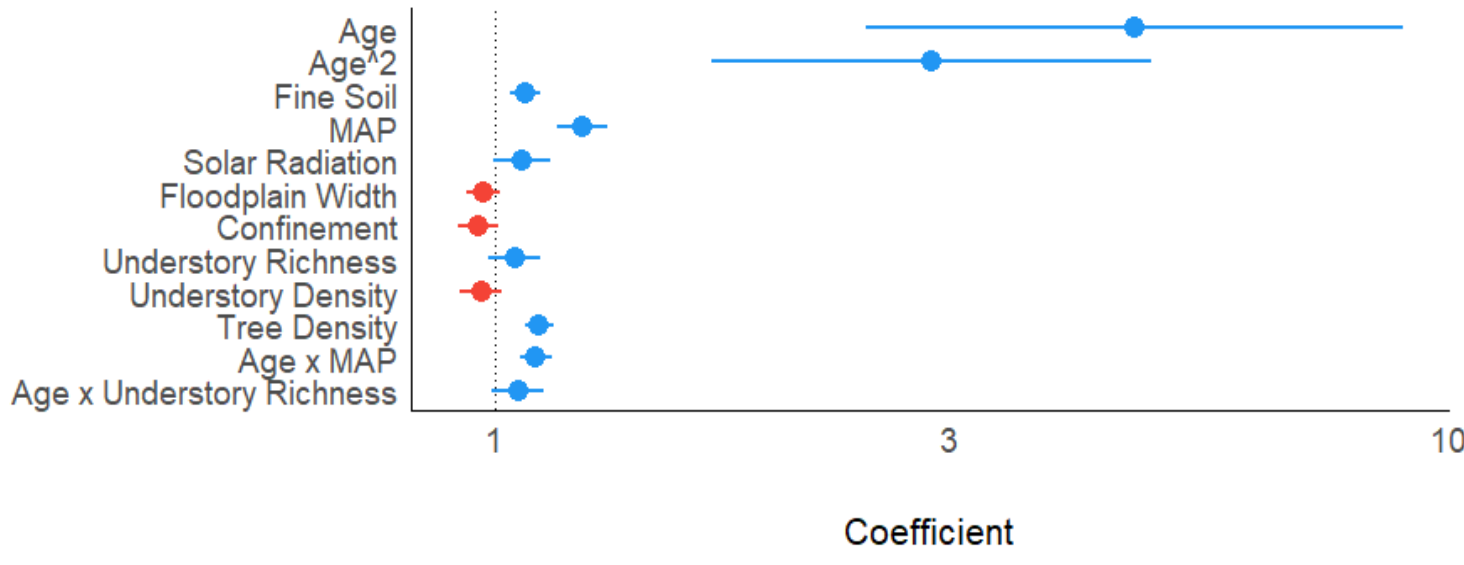


Model results

Negative effect

Positive effect

Total C

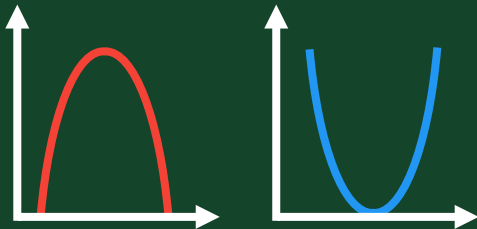


Planting age, precipitation (MAP), and stand characteristics most important

Soil type, floodplain characteristics also play a role

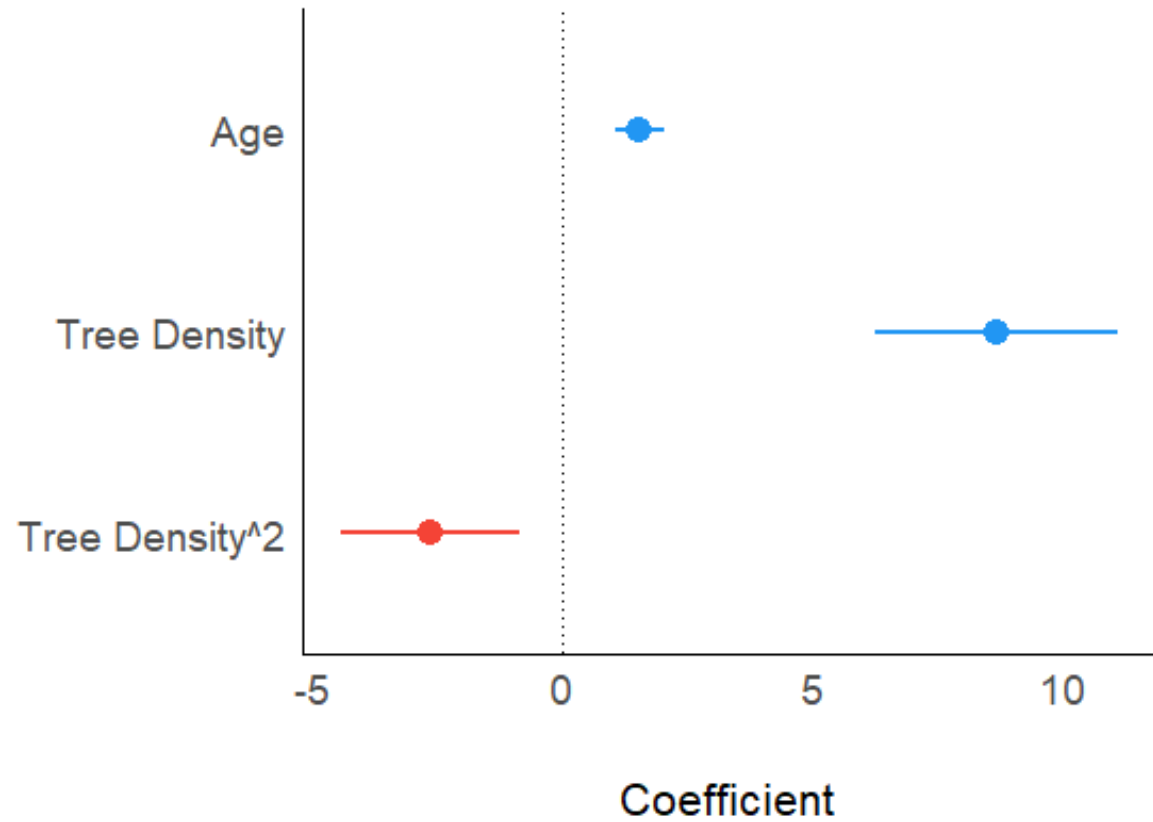
Effect of planting age increases with precipitation, understory richness

Polynomial terms

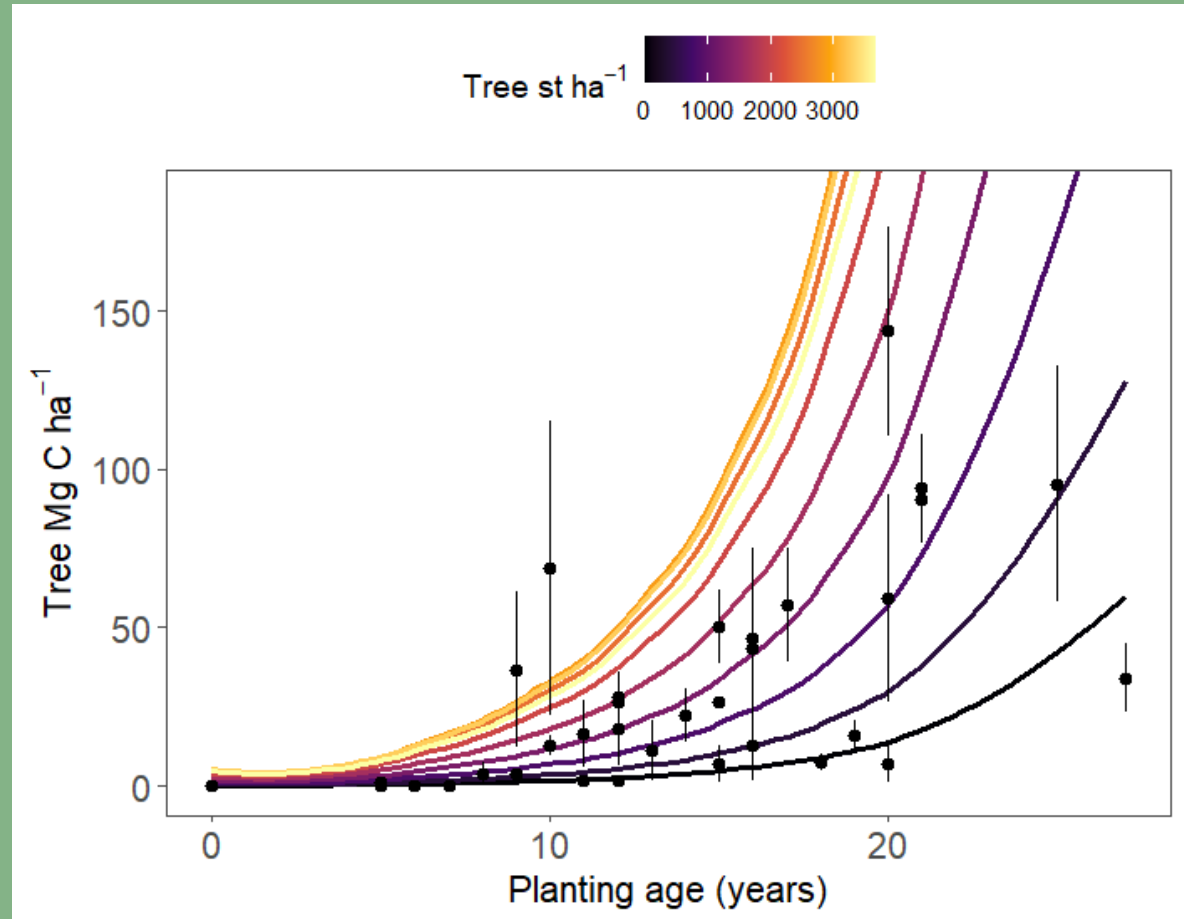


Tree Carbon Stock

Tree C

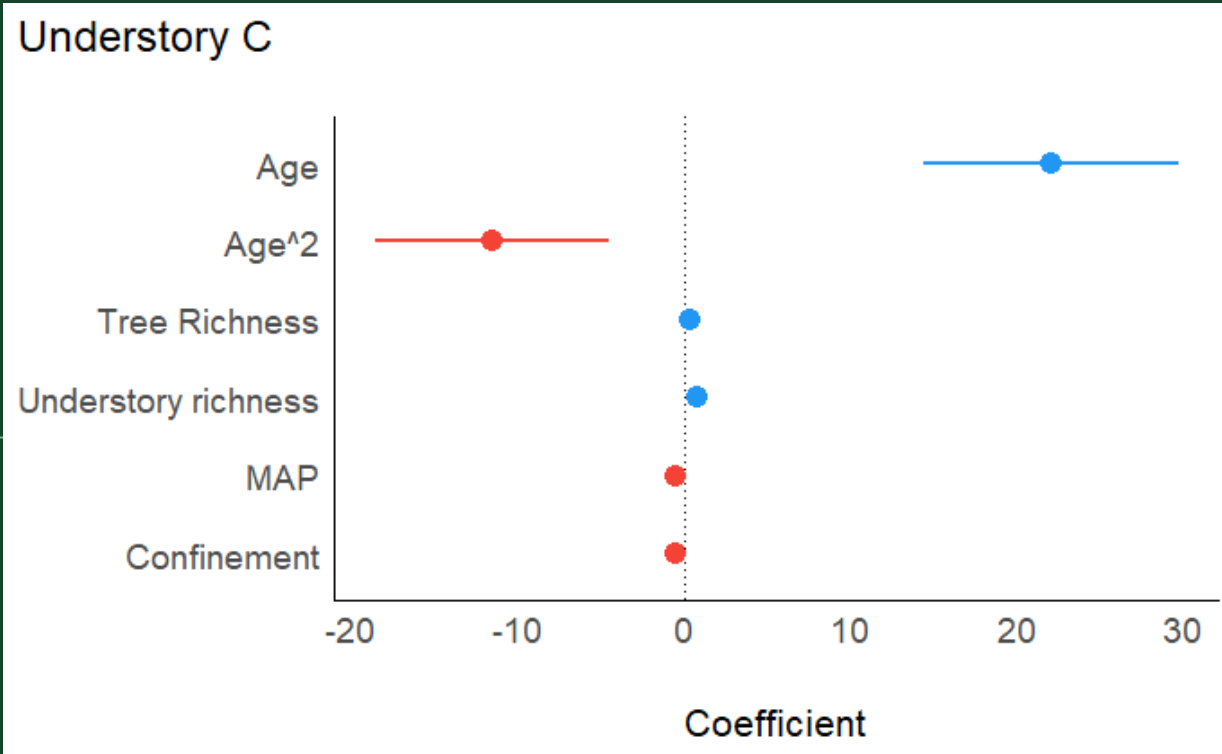


Planting age & stem density have largest influence

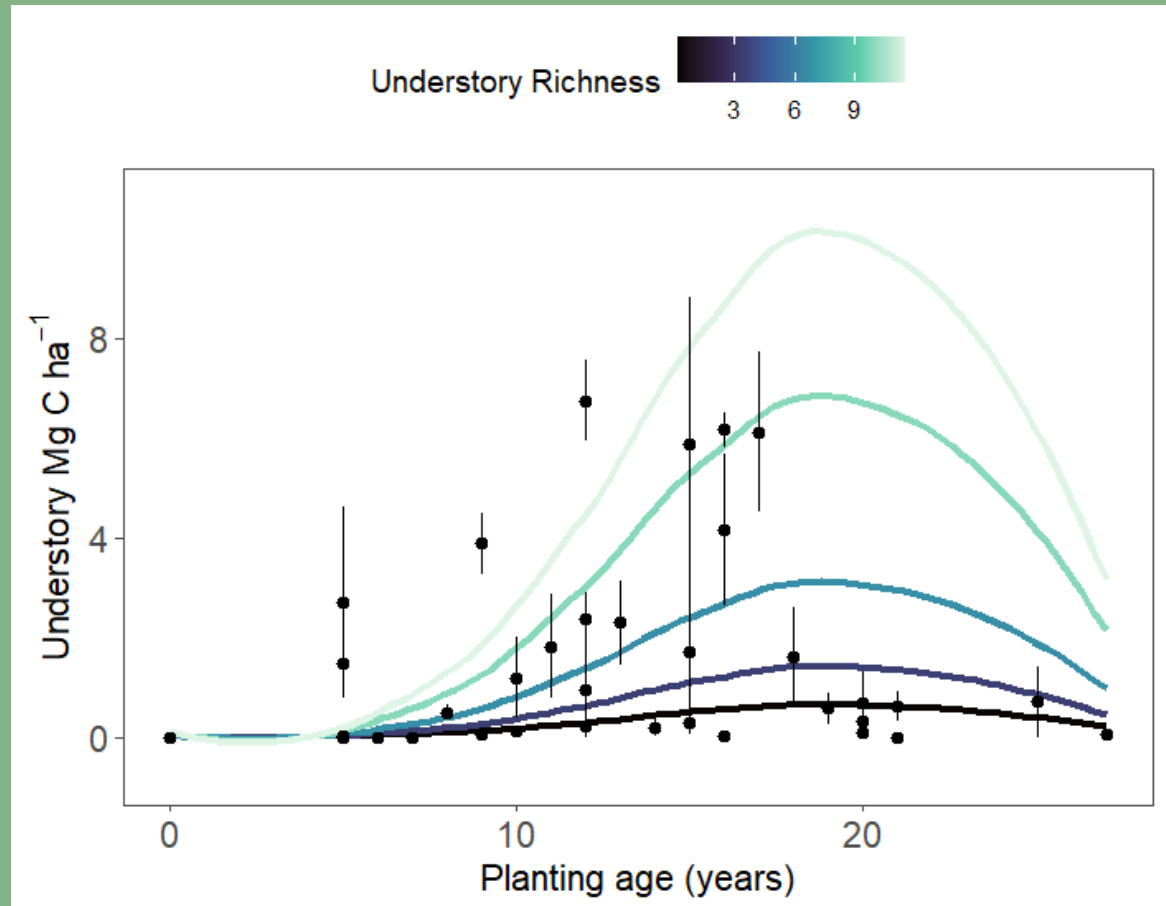


Lines are model predicted curves

Understory Carbon Stock



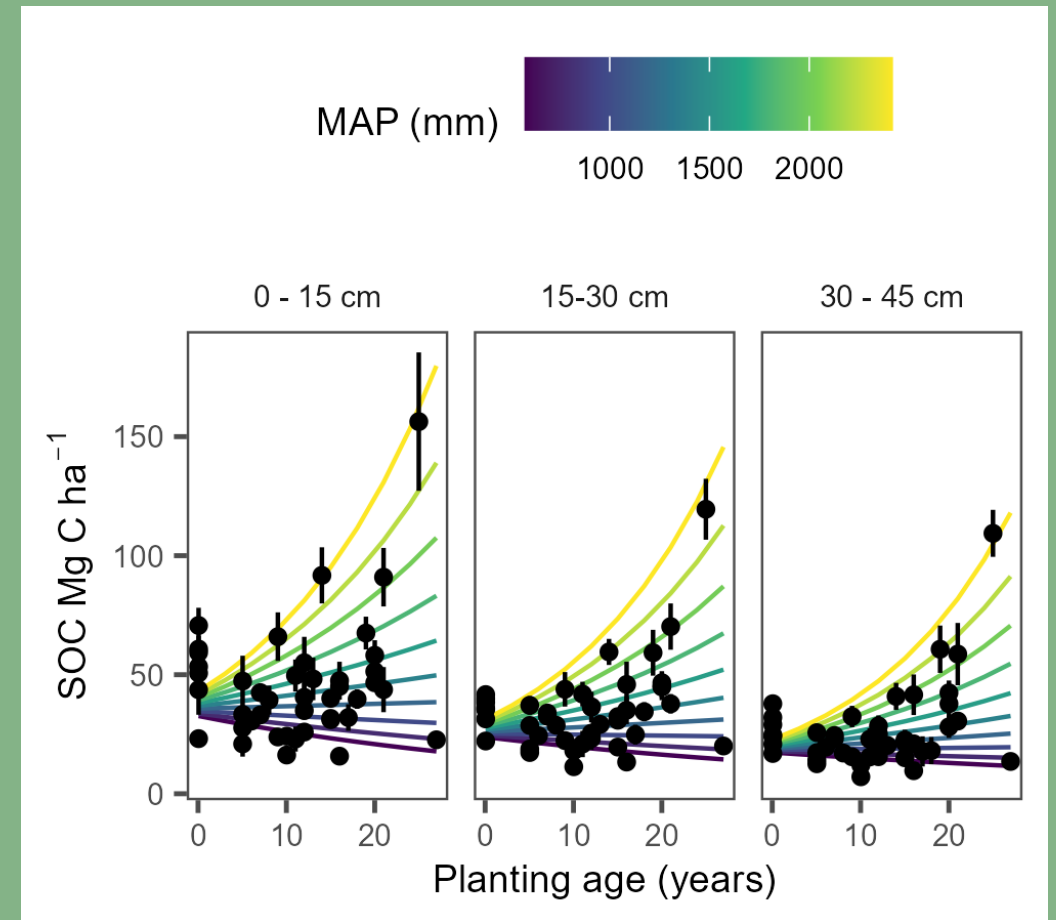
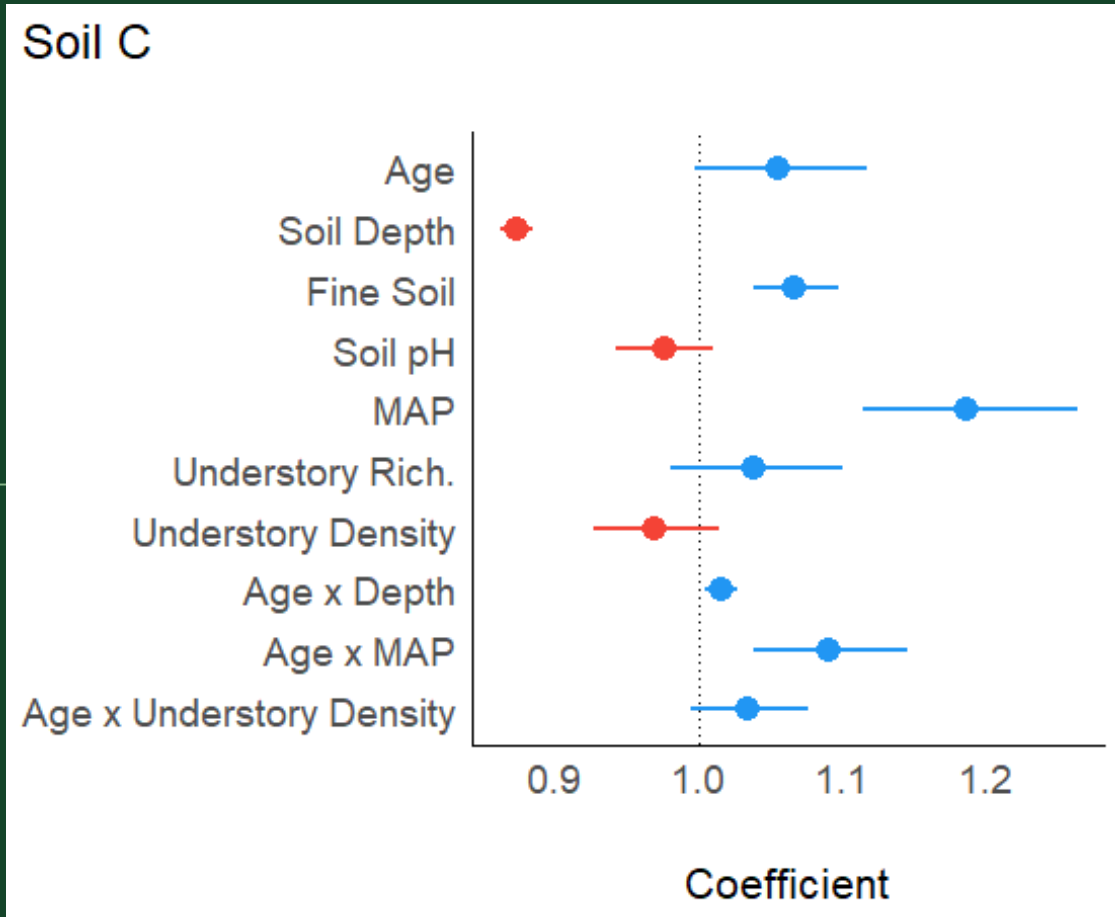
Understory richness modulates relationship with planting age



Lines are model predicted curves

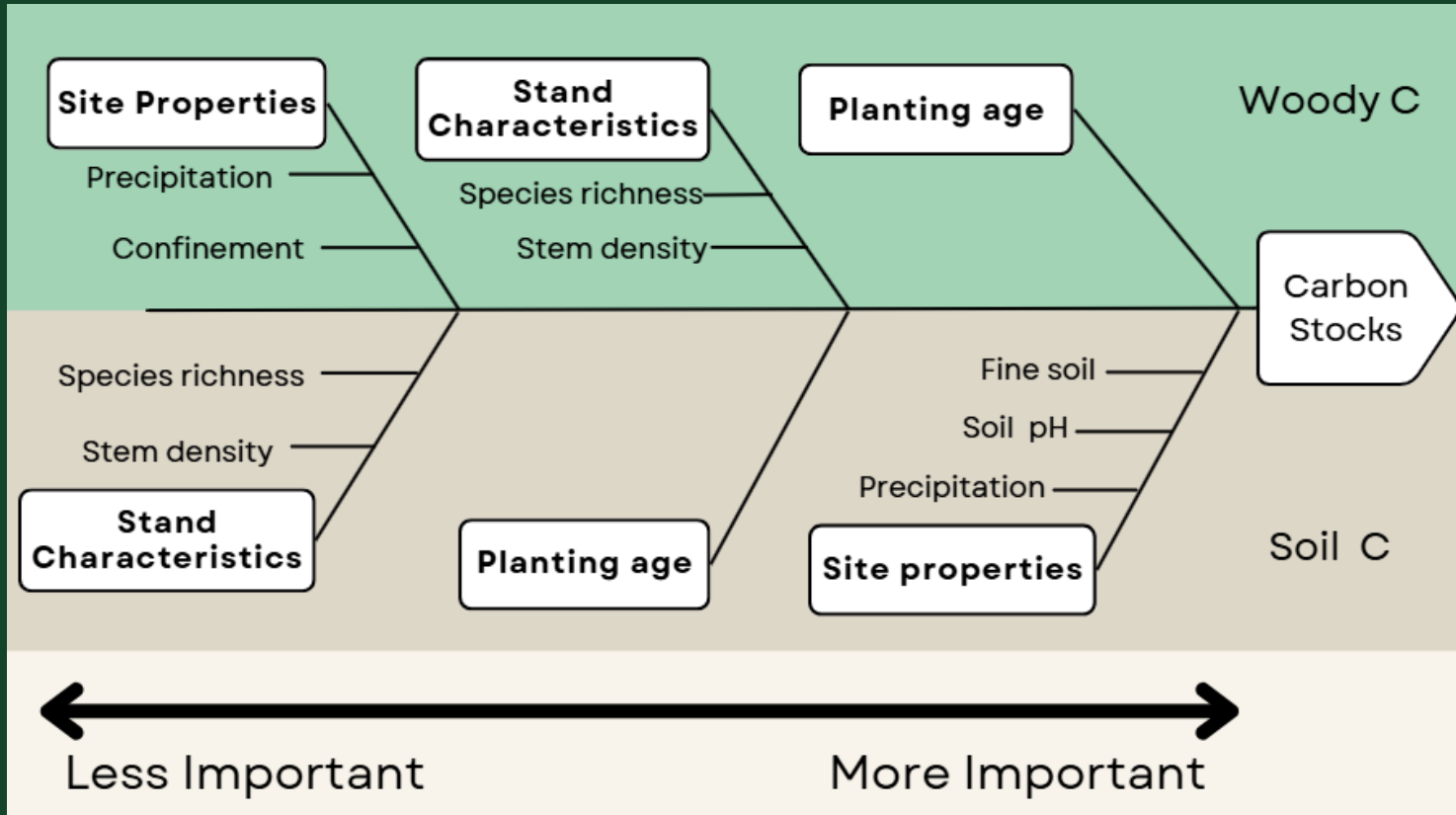
Soil Carbon Stock

Effect of planting age on soil C increases with precipitation and understory density



Lines are model predicted curves

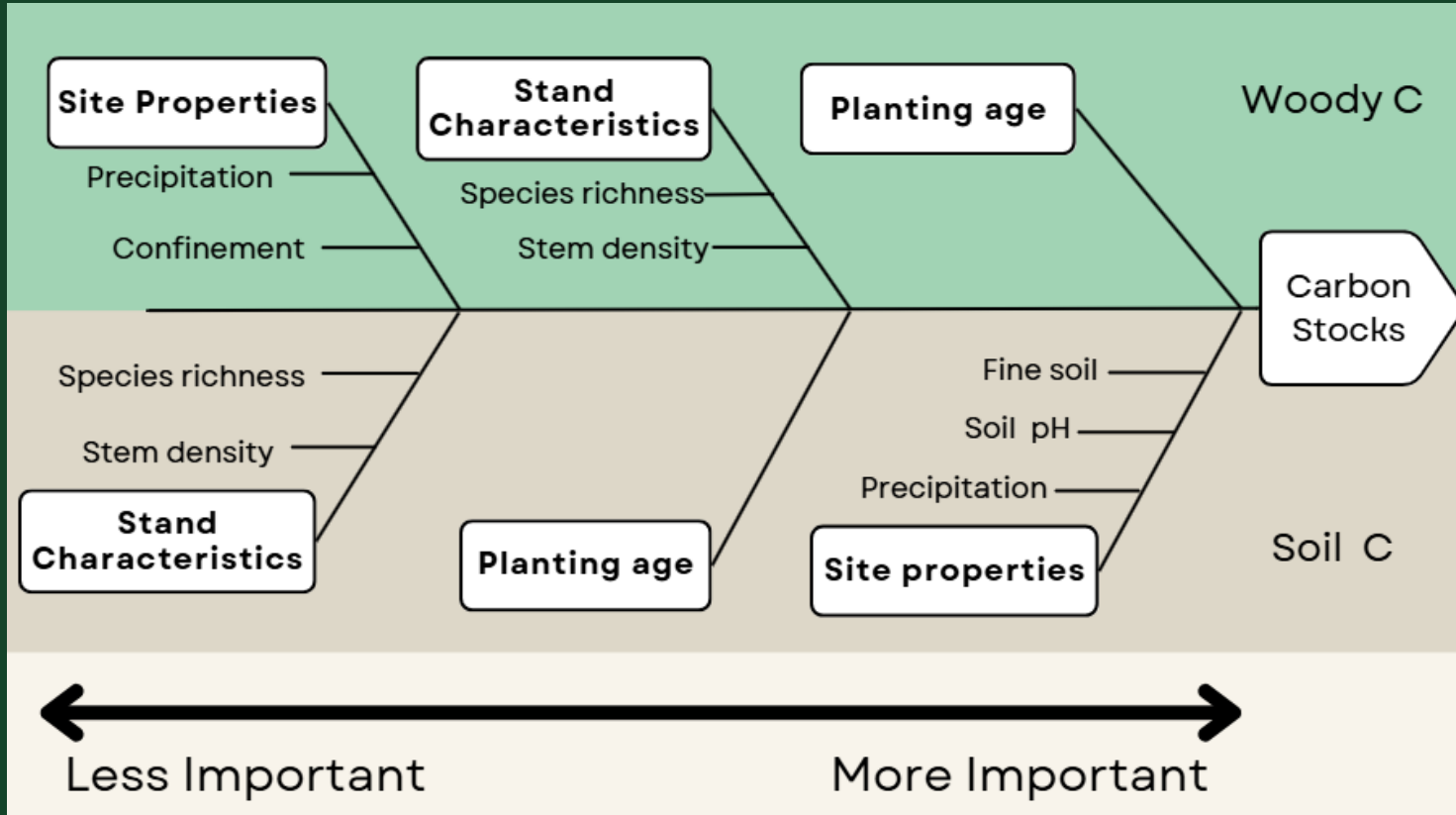
Carbon Sequestration Takes Time



Continued Uncertainties

- Low precipitation soil C stocks
- Durability of soil carbon gains
- Supplemental planting projects

Carbon Sequestration Takes Time



Scale of carbon sequestration depends on climate, stand characteristics

- Woody carbon sequestration strongly influenced by stand age & characteristics
- Soil carbon sequestration benefit is **secondary** to woody carbon

Continued Uncertainties

- Low precipitation soil C stocks
- Durability of soil carbon gains
- Supplemental planting projects



Carbon Sequestration Takes Time

Protect remnant riparian forest and implement riparian reforestation **soon**

Acknowledgements

Project Team

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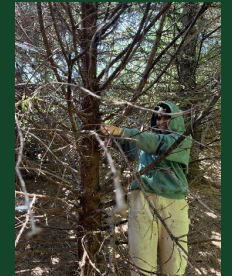
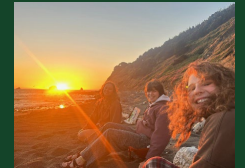
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