

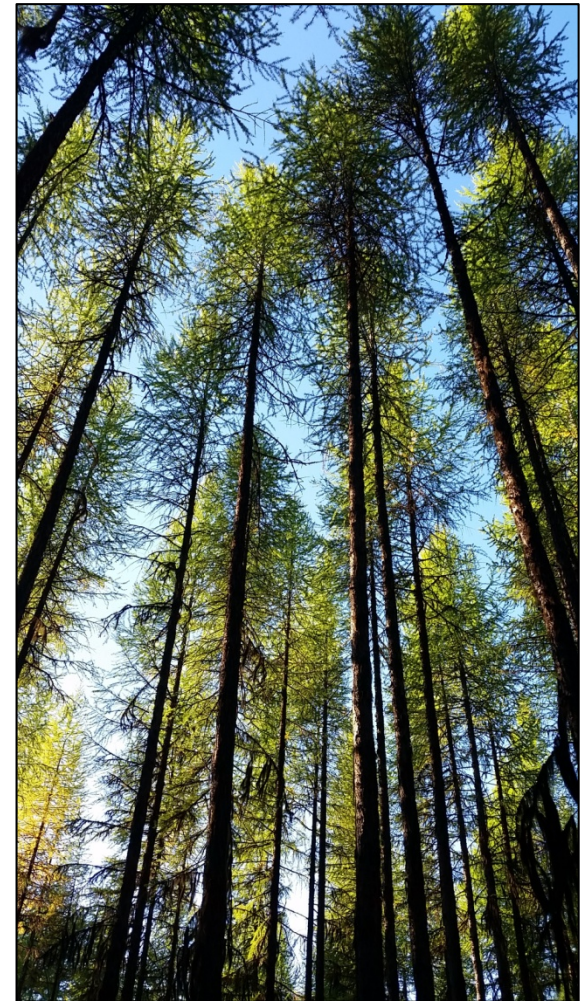
Western Larch Long-term Response to Precommercial Thinning: Growth and yield, carbon and woody debris after 54 years

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Western Montana Forester, TNC
March 27, 2018



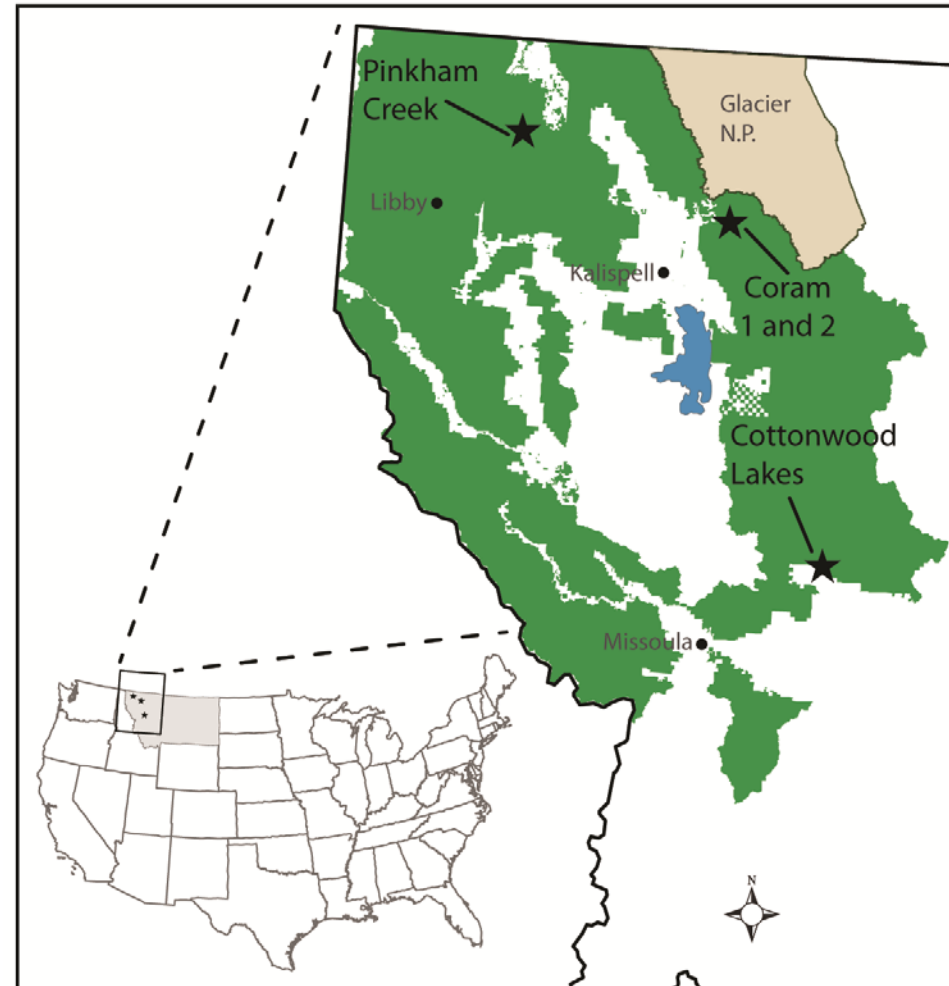
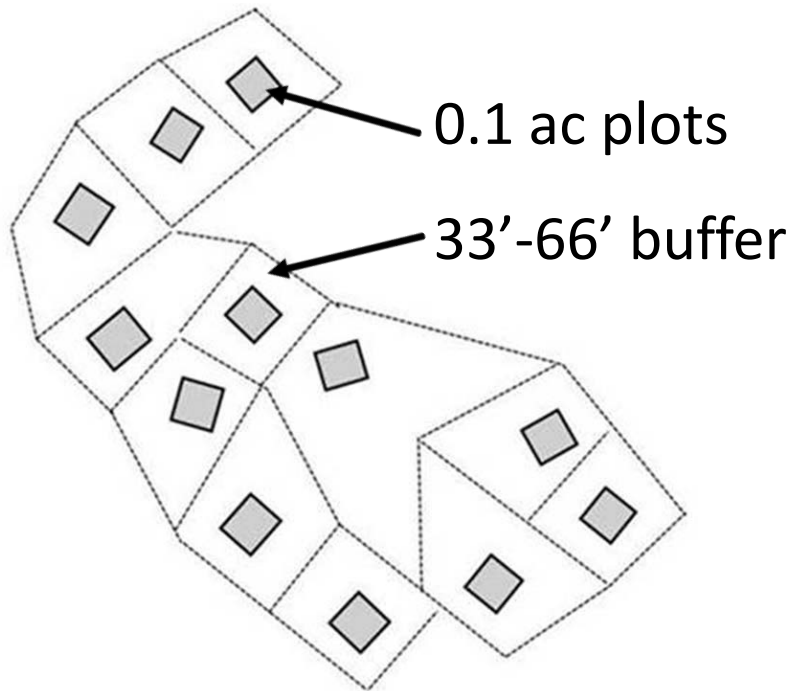
Presentation outline

- I. Study background
- II. Tree size and stand yield
- III. Aboveground carbon
- IV. Wood debris accumulation



Western Larch Density Management Study

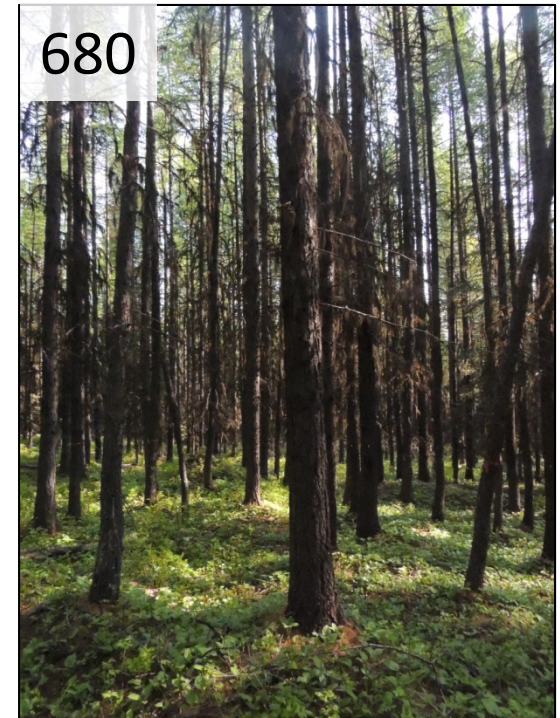
- Harvested 1951-53
- Natural regeneration
- Up to 22,000 trees ac^{-1}
- First thinning at age 7-9



Study design

Two experimental factors:

- **Density: 200, 360, 680 trees ac⁻¹**
(494, 890, 1680 trees ha⁻¹)
110 trees ac⁻¹ (272 TPH) and unthinned at two site
- **Number of entries: 1, 2, and 4**
- **Number of entries nested within density**



Methods

Measurement cycle

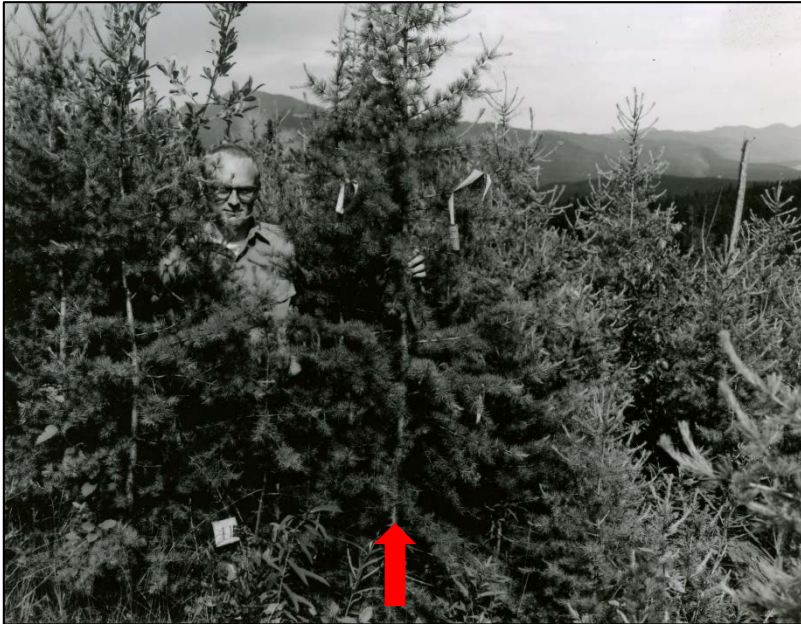
Every 5 years: 1961-1991, 2001, 2015

Measurements on every tree

- DBH
- Total height
- Crown base height
- Crown width
- Height of max. crown width
- Damage



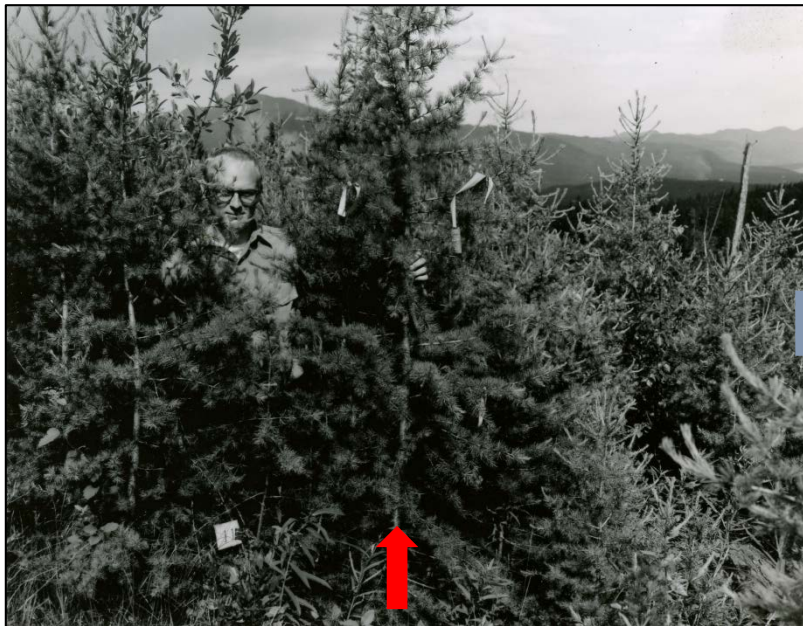
Unthinned, 1963



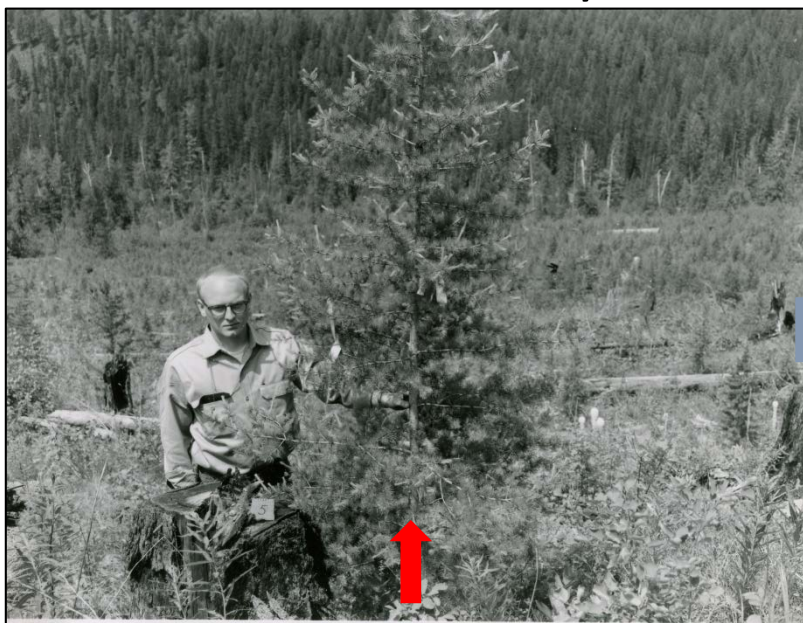
200 trees ac^{-1} , 1 entry, 1963



Unthinned, 1963



200 trees ac^{-1} , 1 entry, 1963



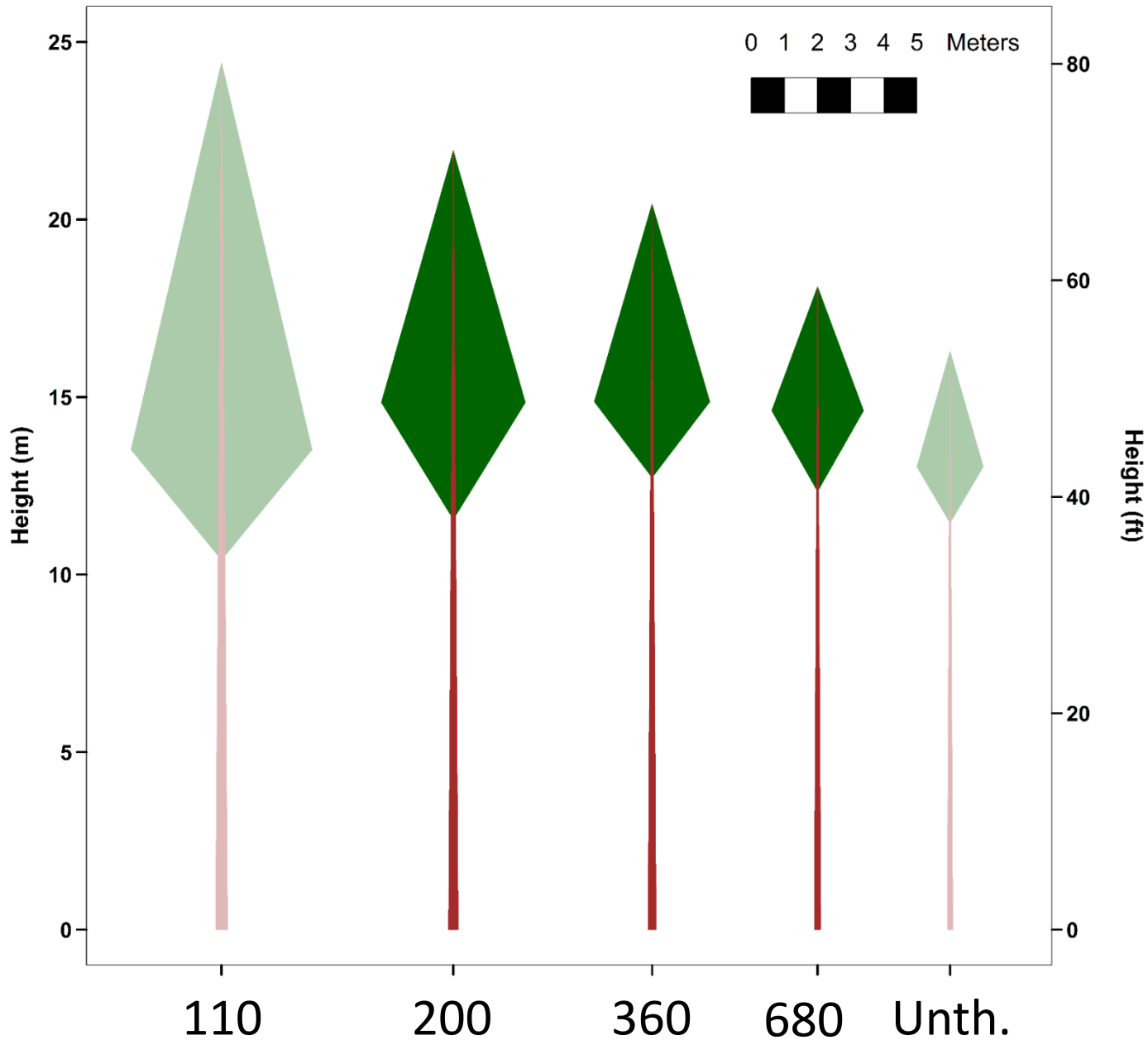
Unthinned, 2015



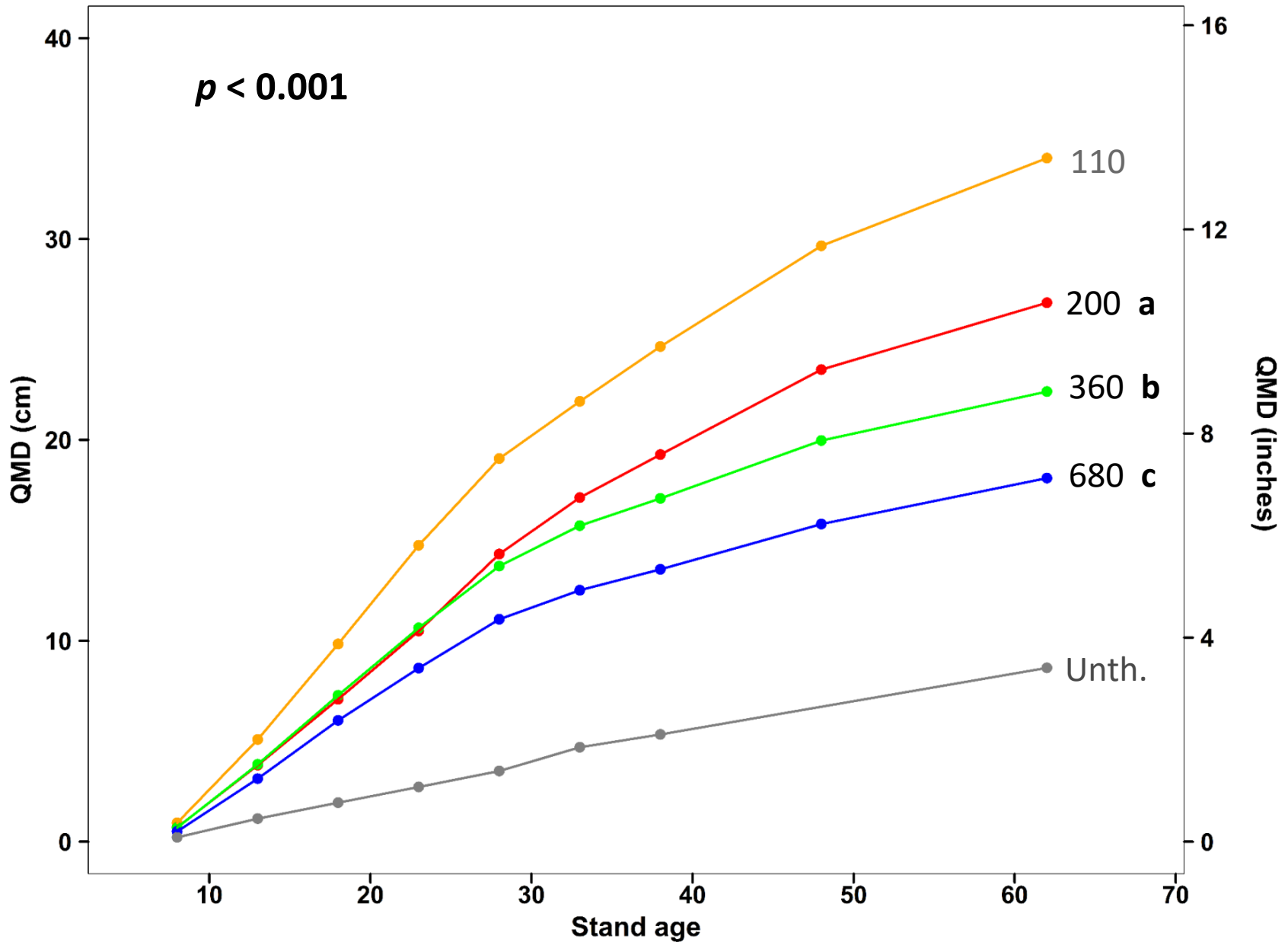
200 trees ac^{-1} , 1 entry, 2015



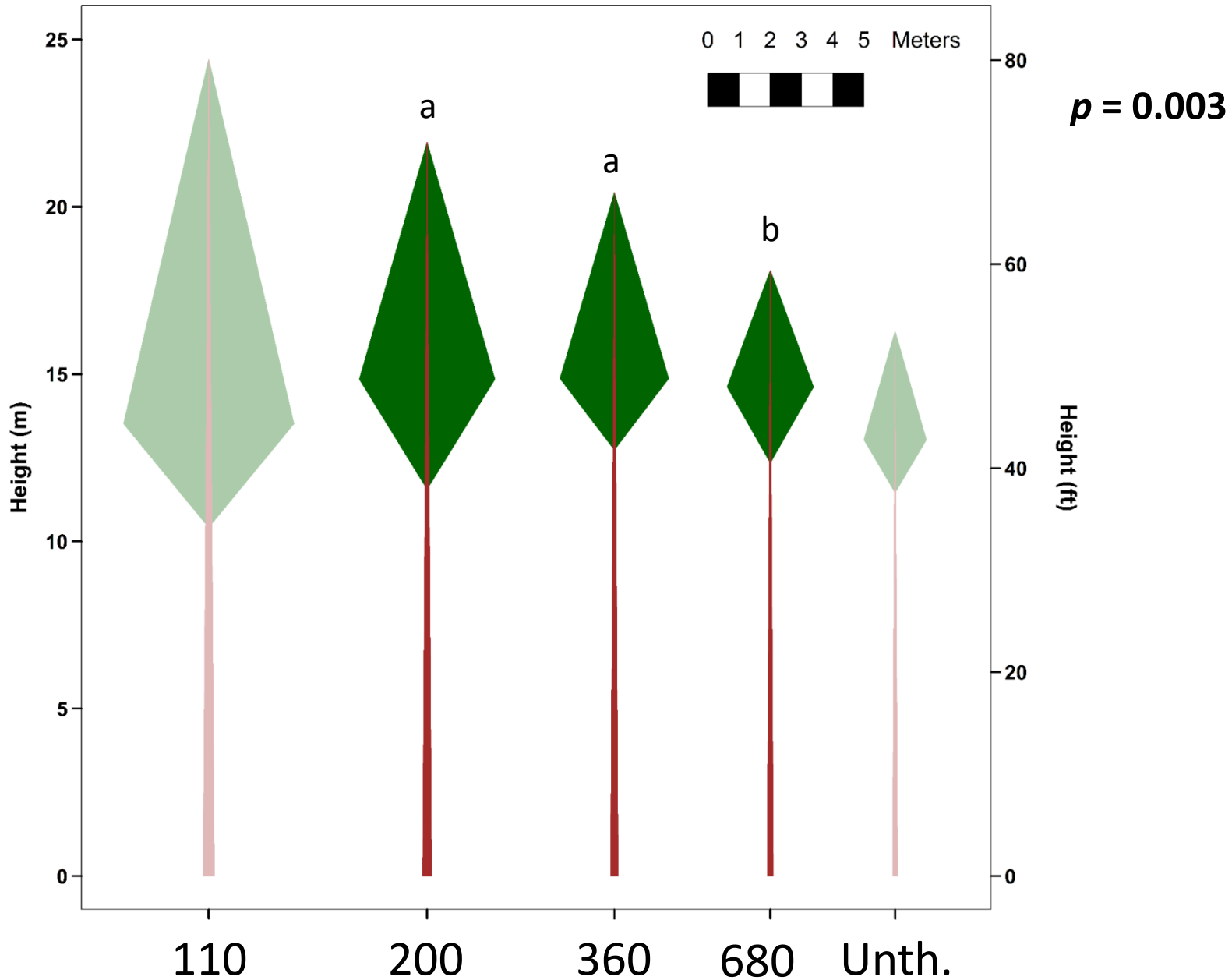
Tree form (one entry, 2015)



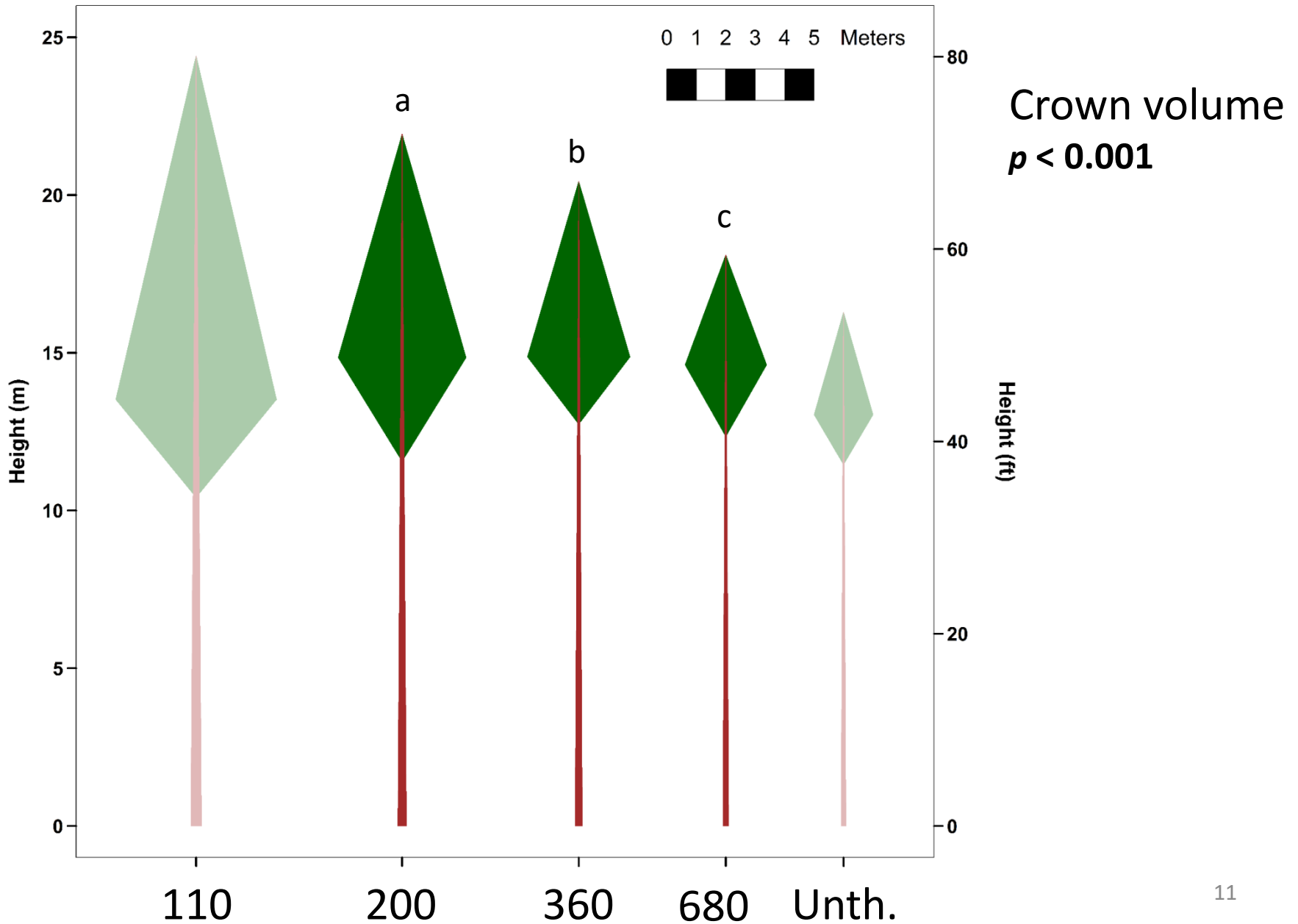
Diameter (one entry)



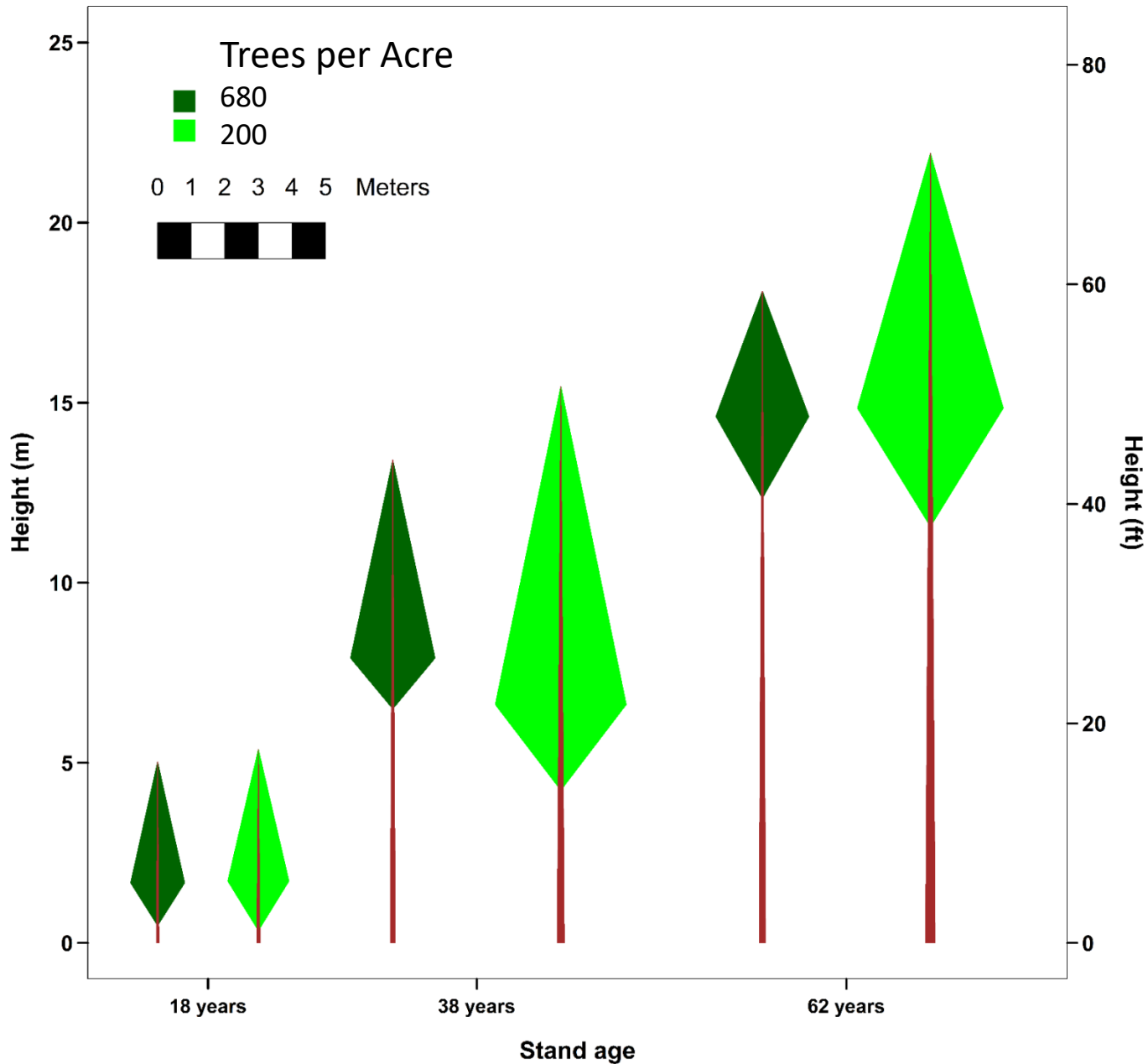
Average Height (one entry, 2015)



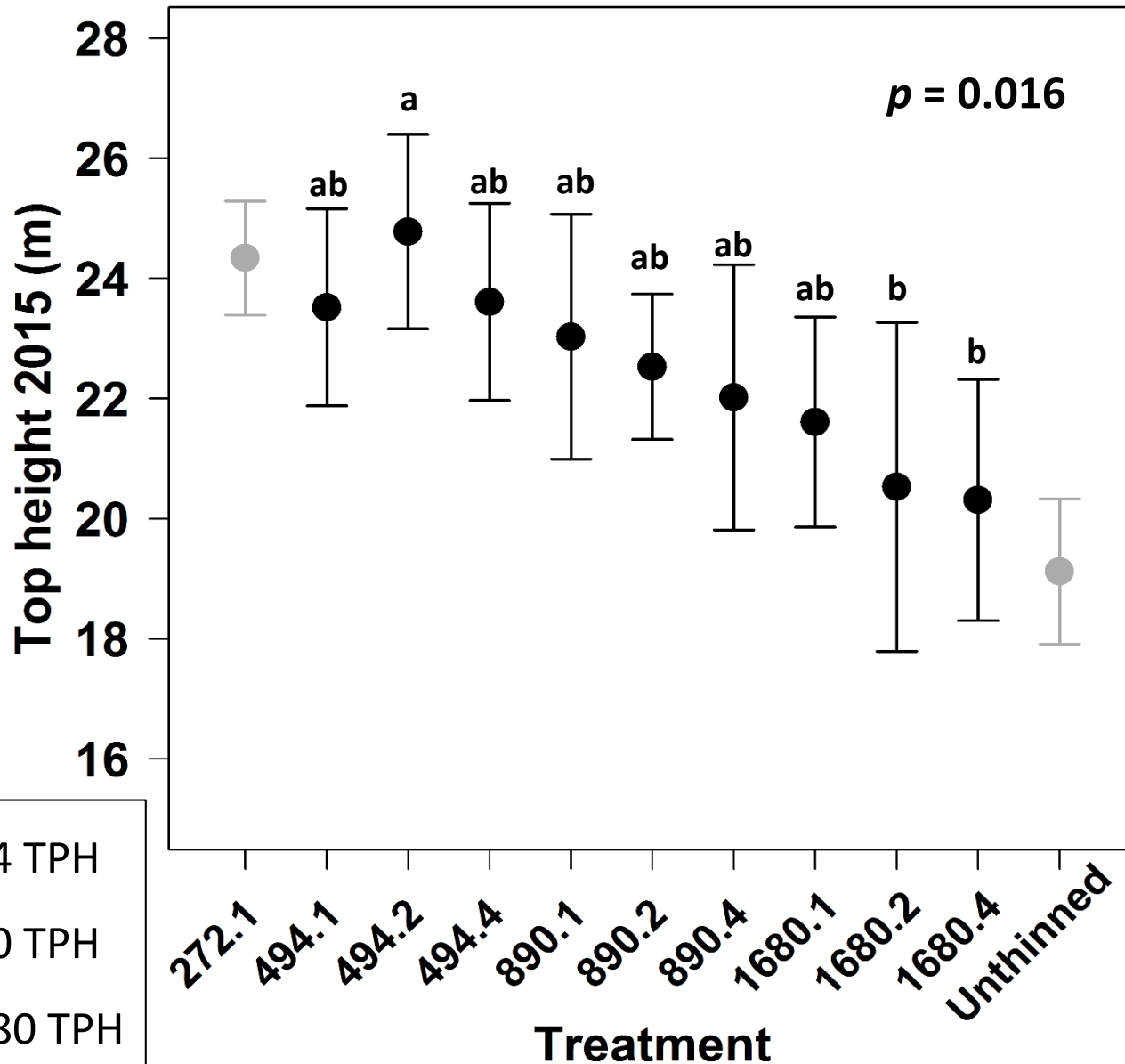
Crown volume (one entry, 2015)



Average tree size (one entry)



Top height (all entries)

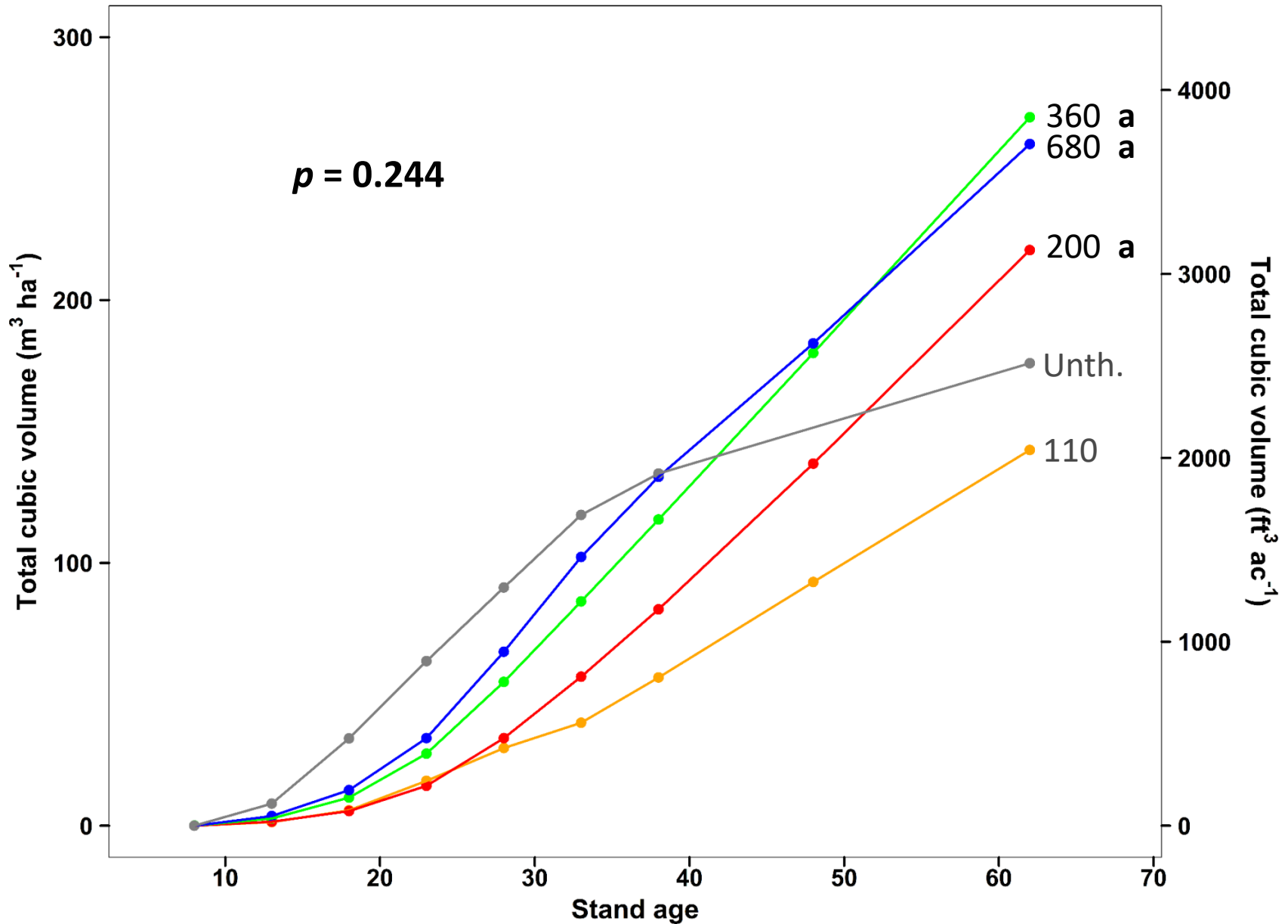


200 TPA = 494 TPH

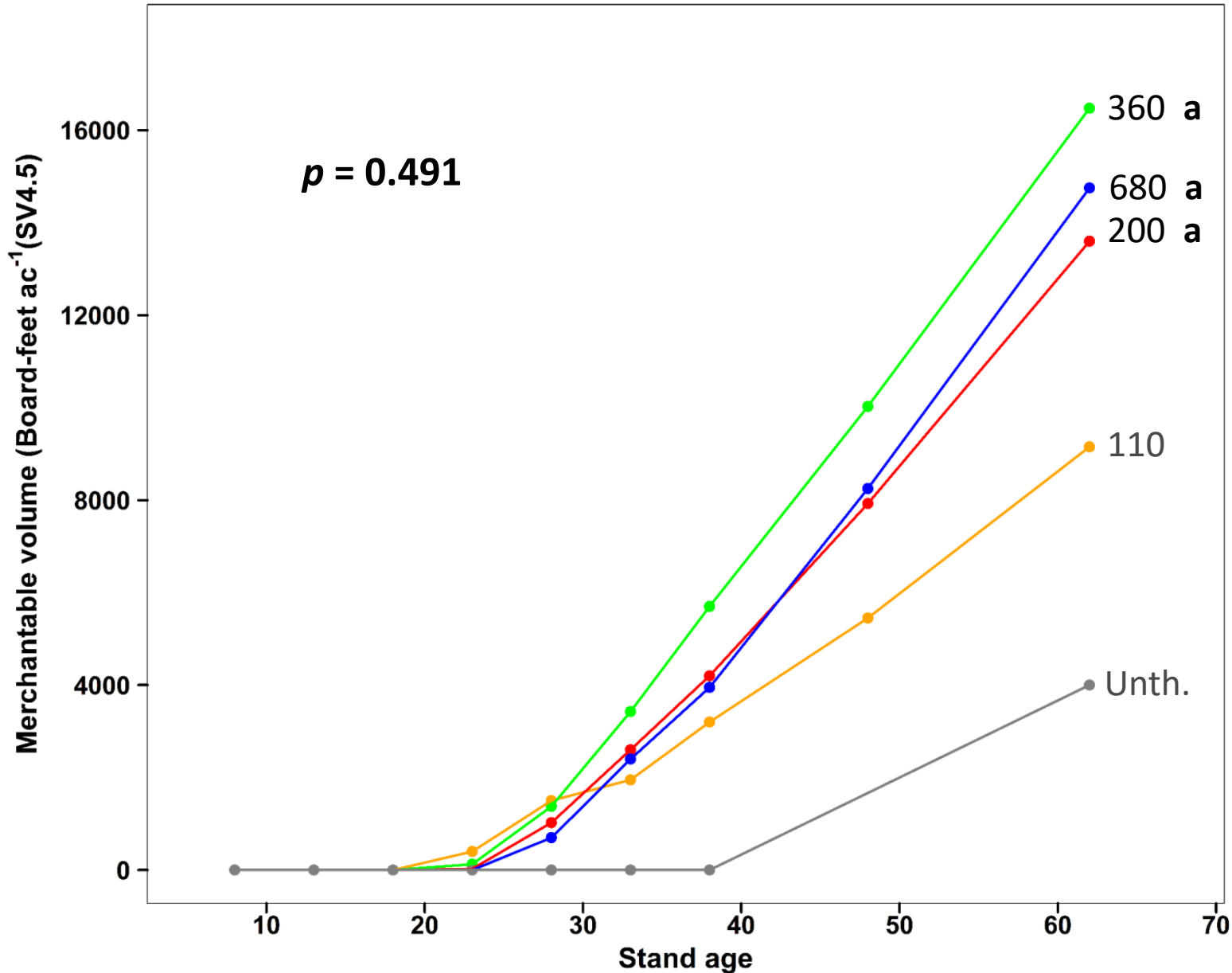
360 TPA = 890 TPH

680 TPA = 1680 TPH

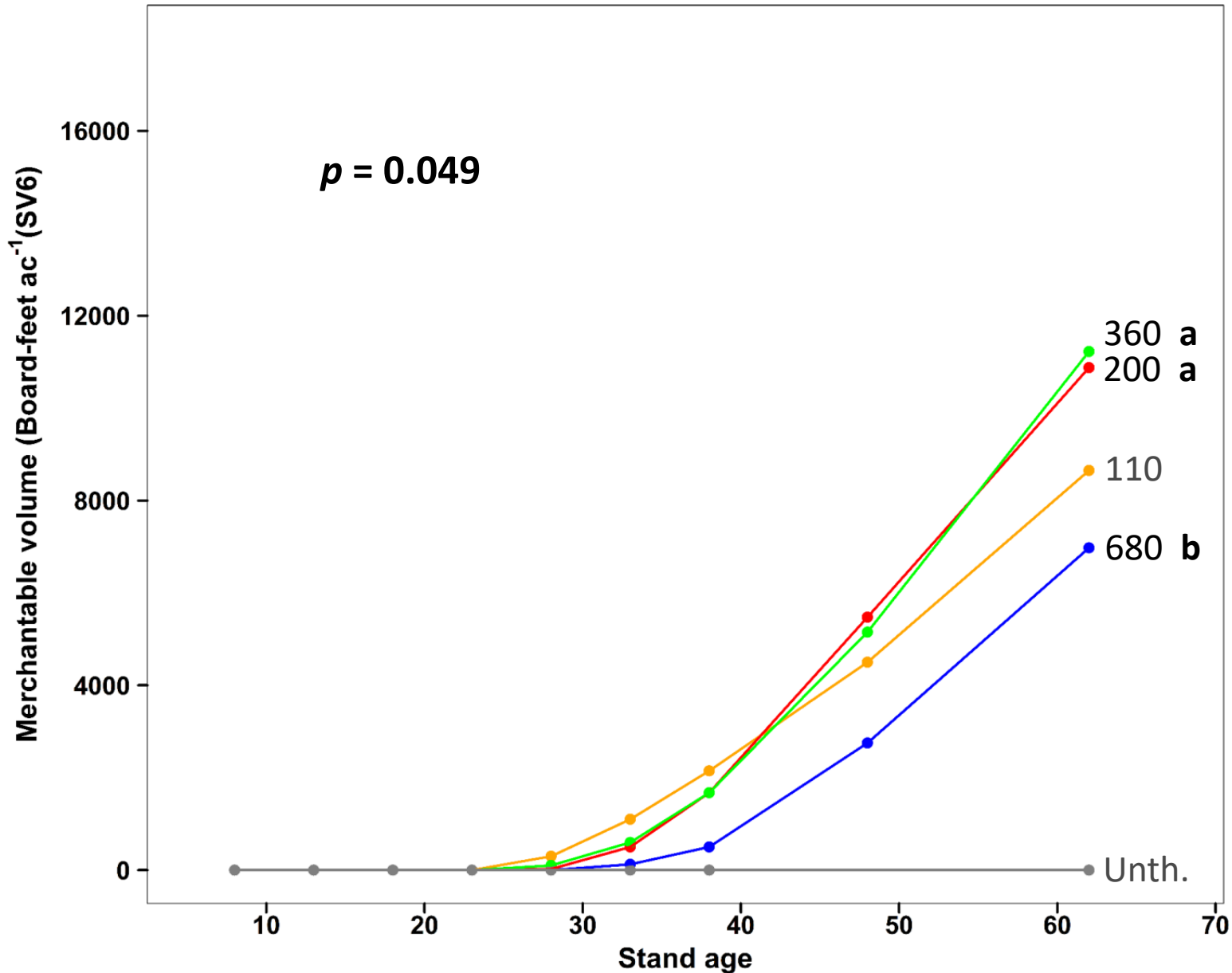
Total cubic volume



Gross Merchantable Volume (4.5" top)



Gross Merchantable Volume (6" top)



Tree size and stand yield conclusions

At stand age 62...

1. Tree size is highly sensitive to density
2. Stand yield not sensitive to density across tested densities
3. Changes tree size distribution (few large vs. many small)
4. No effect of multiple thinnings



Forest Carbon



Research question

What is the effect of density management on aboveground carbon 54 years after thinning?

Can early thinning be used as both a climate change **adaptation** and **mitigation** strategy?

Unthinned, 2015



200 trees ac⁻¹, 2015



Forest Carbon

Aboveground carbon pools

Live

Dead

Overstory

Understory

Woody debris

Forest floor



Woody debris

Legacy woody debris



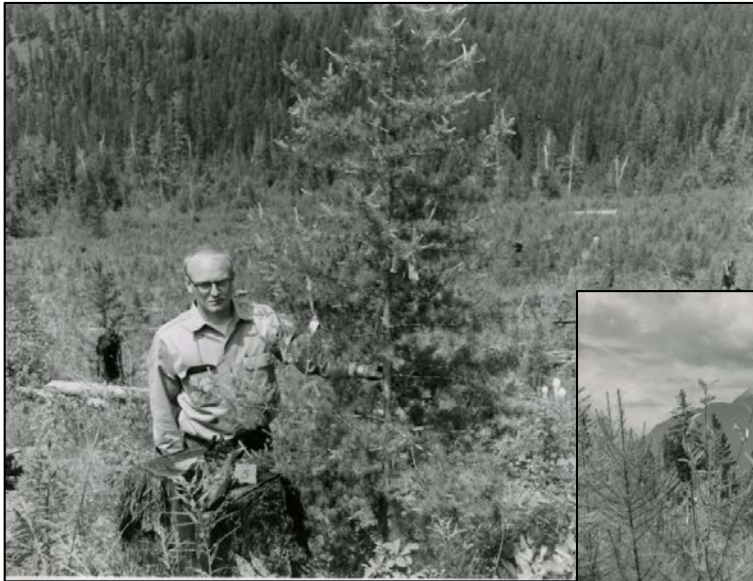
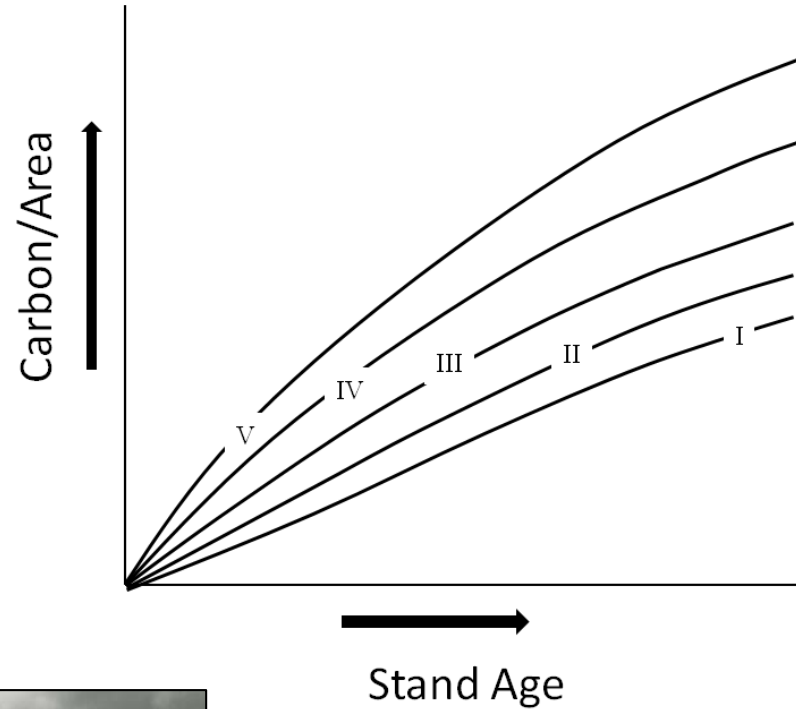
Non-legacy woody debris



Predictions

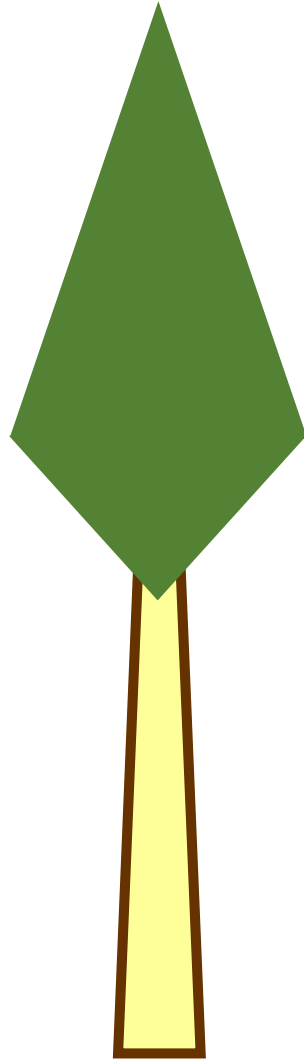
Conventional wisdom

- Short-term: thinning = lower C
- Thinning older stands always reduces C storage



Methods

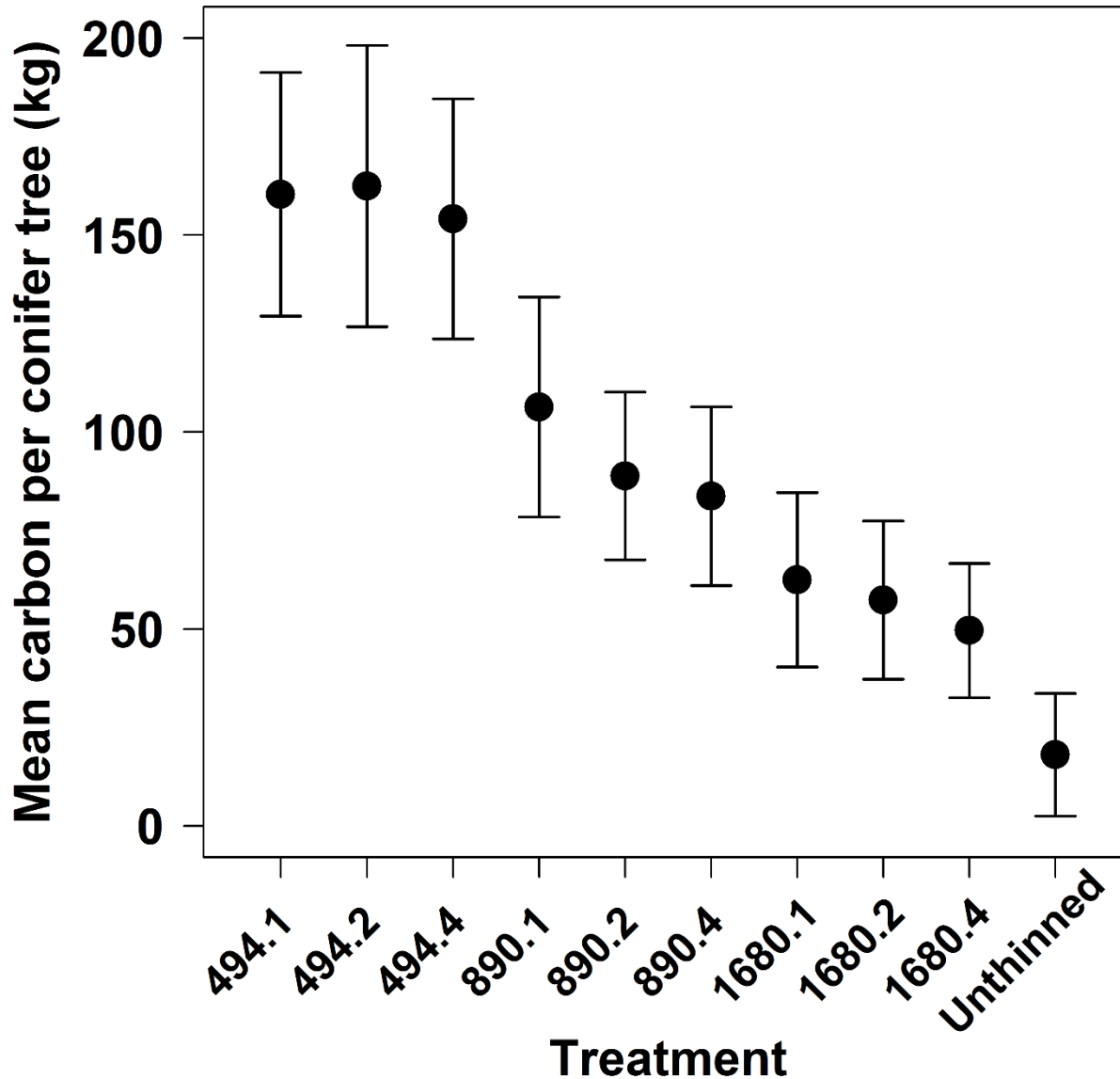
Tree carbon = Stem wood + Bark + Crown



Methods



Individual tree carbon



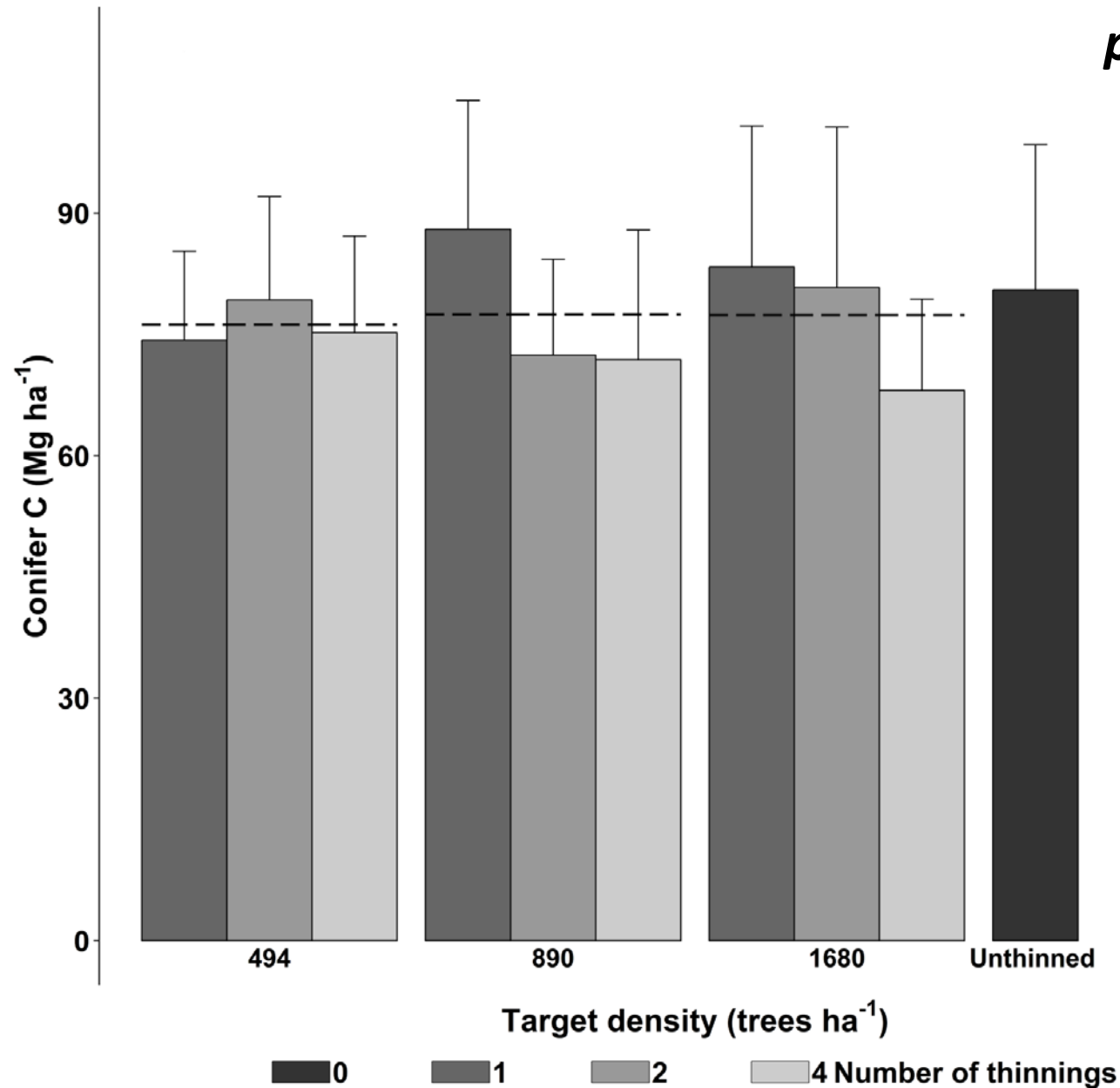
200 TPA = 494 TPH

360 TPA = 890 TPH

680 TPA = 1680 TPH

Overstory

$p = 0.993$



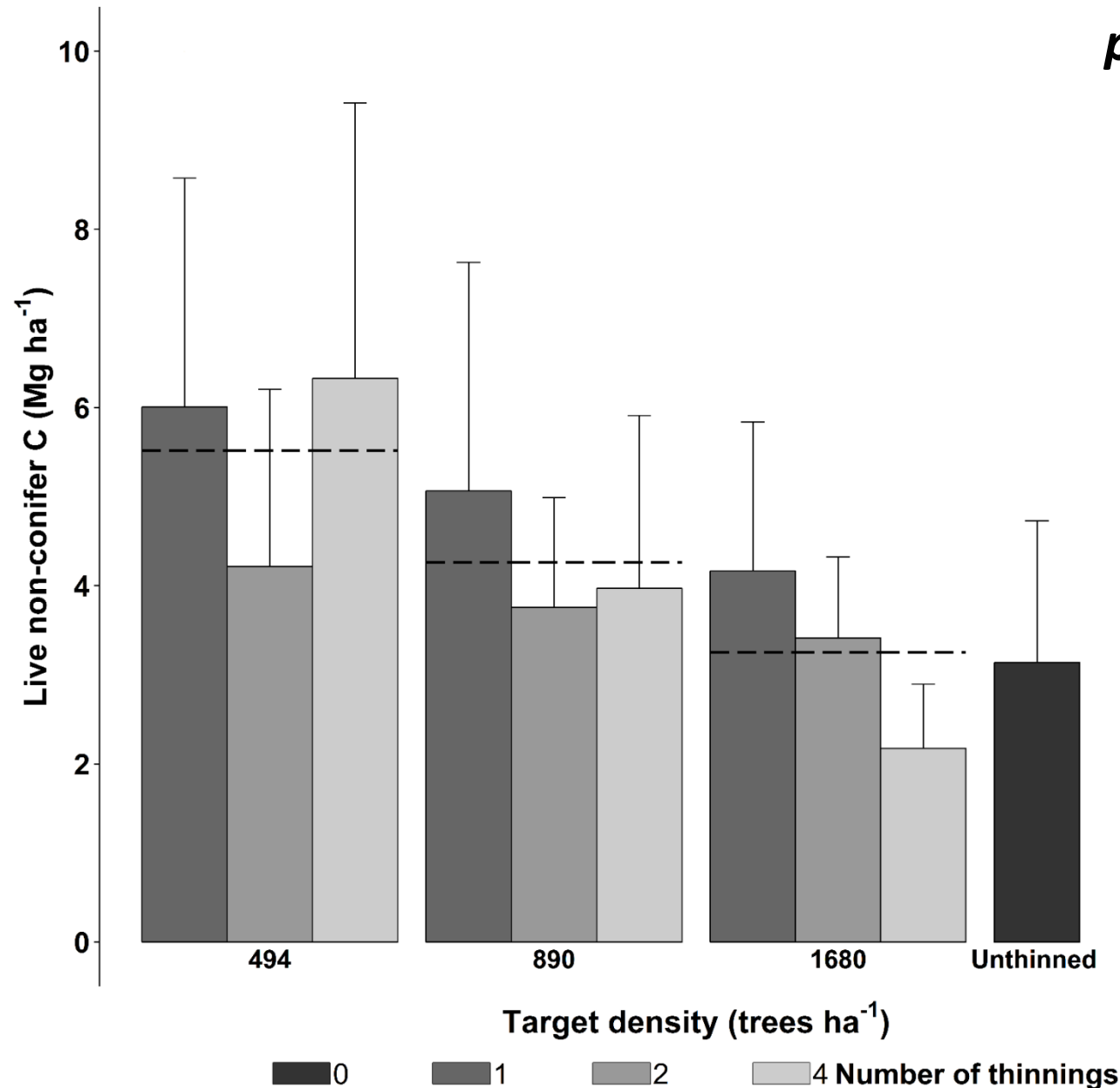
200 TPA = 494 TPH

360 TPA = 890 TPH

680 TPA = 1680 TPH

Understory

$p = 0.006$

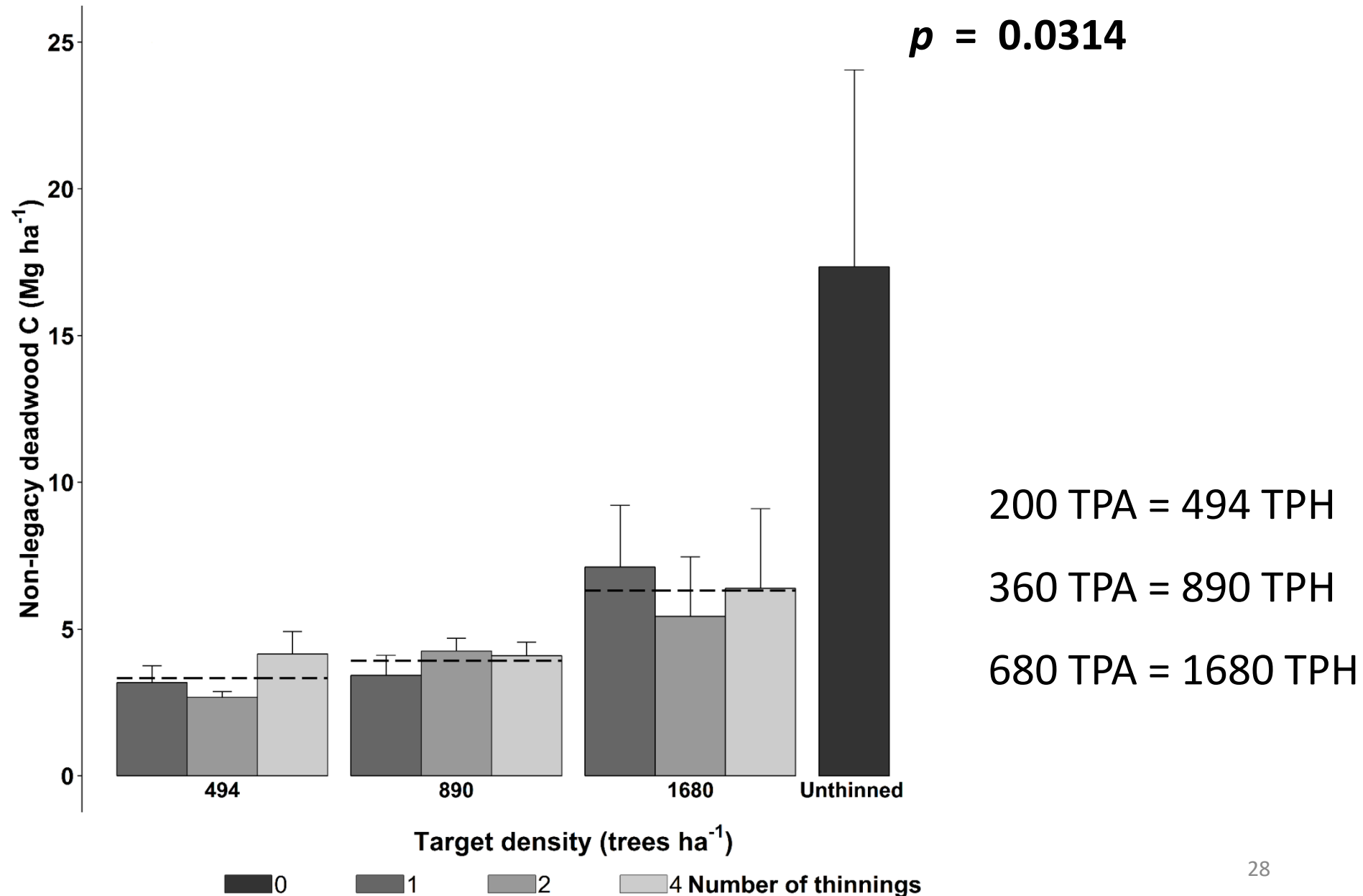


200 TPA = 494 TPH

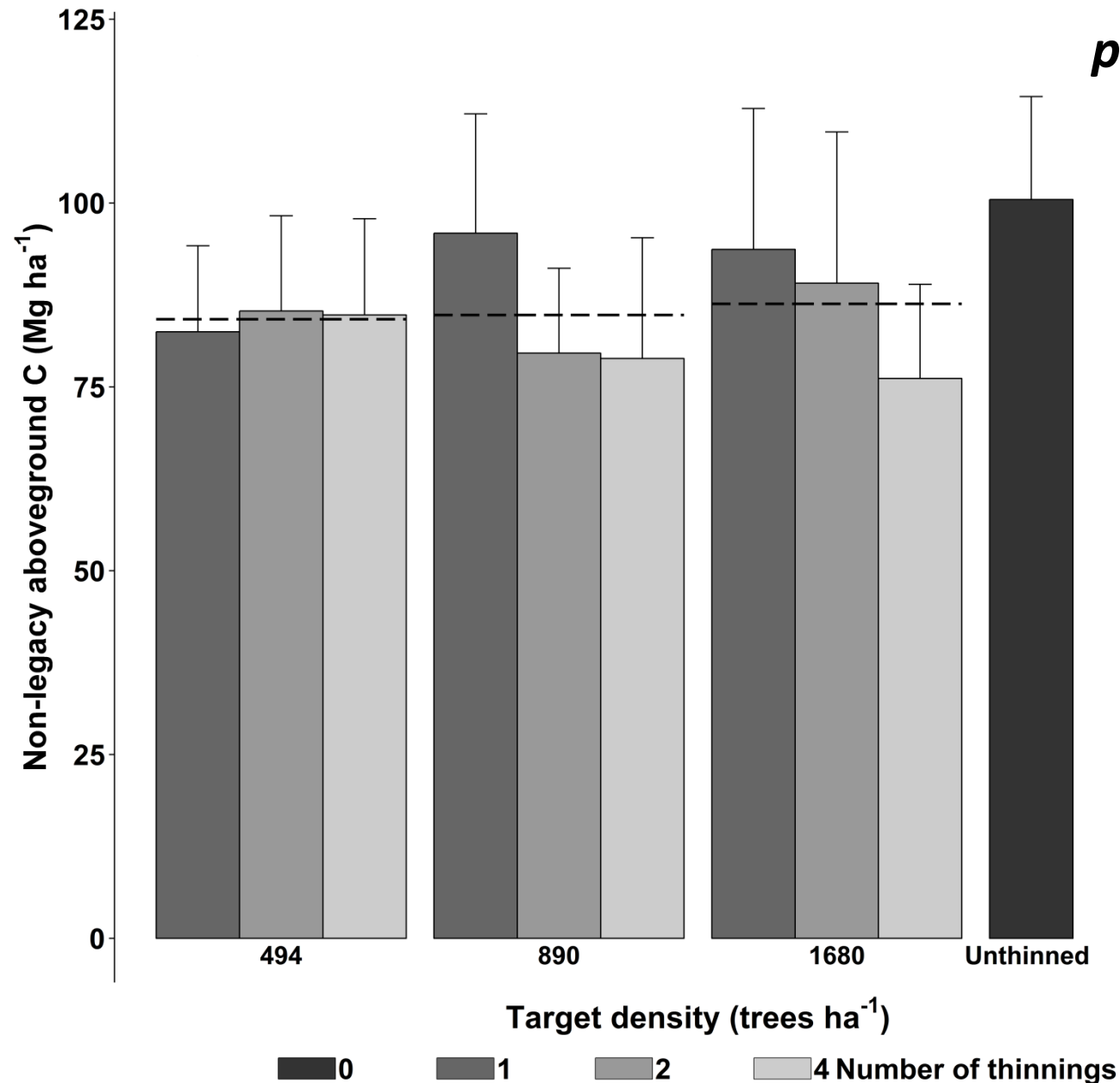
360 TPA = 890 TPH

680 TPA = 1680 TPH

Non-legacy woody debris



Total aboveground carbon

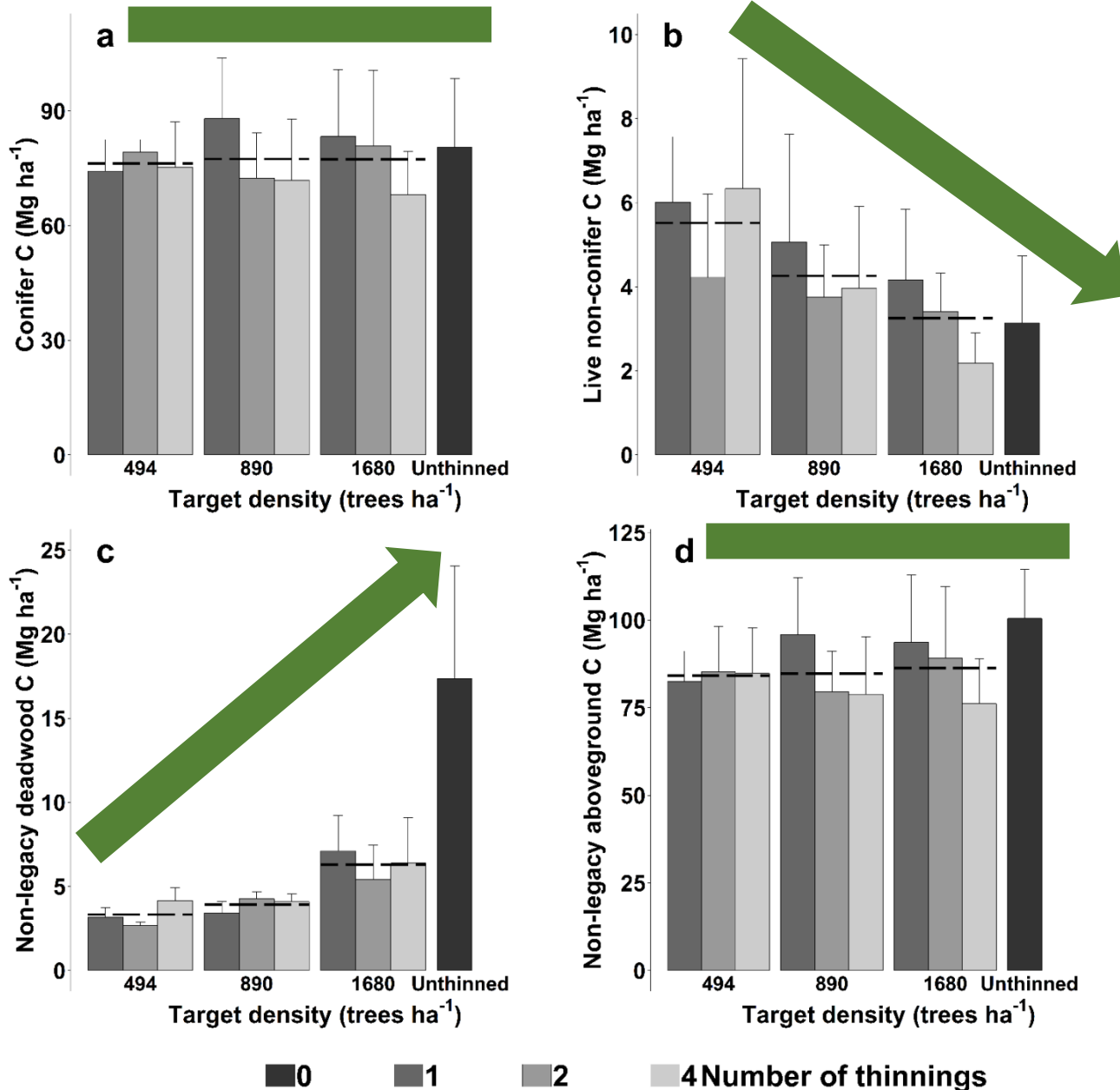


200 TPA = 494 TPH

360 TPA = 890 TPH

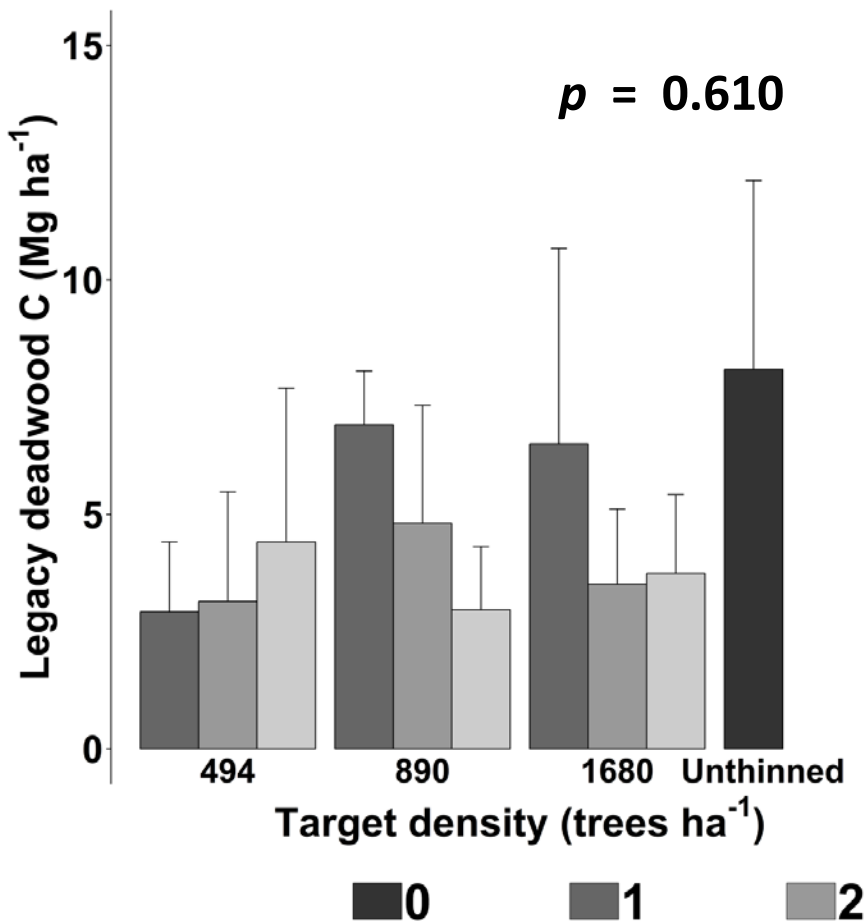
680 TPA = 1680 TPH

Total aboveground carbon

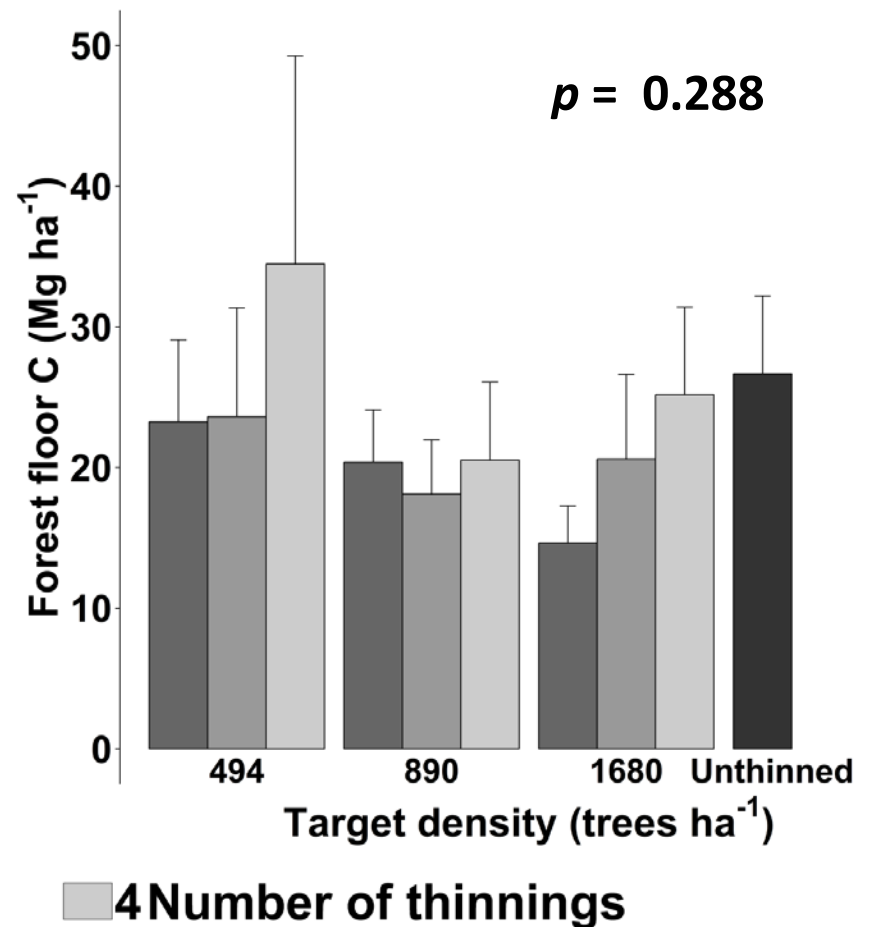


Legacy carbon pools

Legacy woody debris



Forest floor



Carbon conclusions

1. Constant yield of aboveground carbon across densities
2. Larger tree mass compensates for fewer trees
3. Changes carbon allocation between live and dead pools
4. Legacy carbon still makes up 20-25% of total

494 trees ha⁻¹, 2015



1680 trees ha⁻¹, 2015



Woody Debris Accumulation

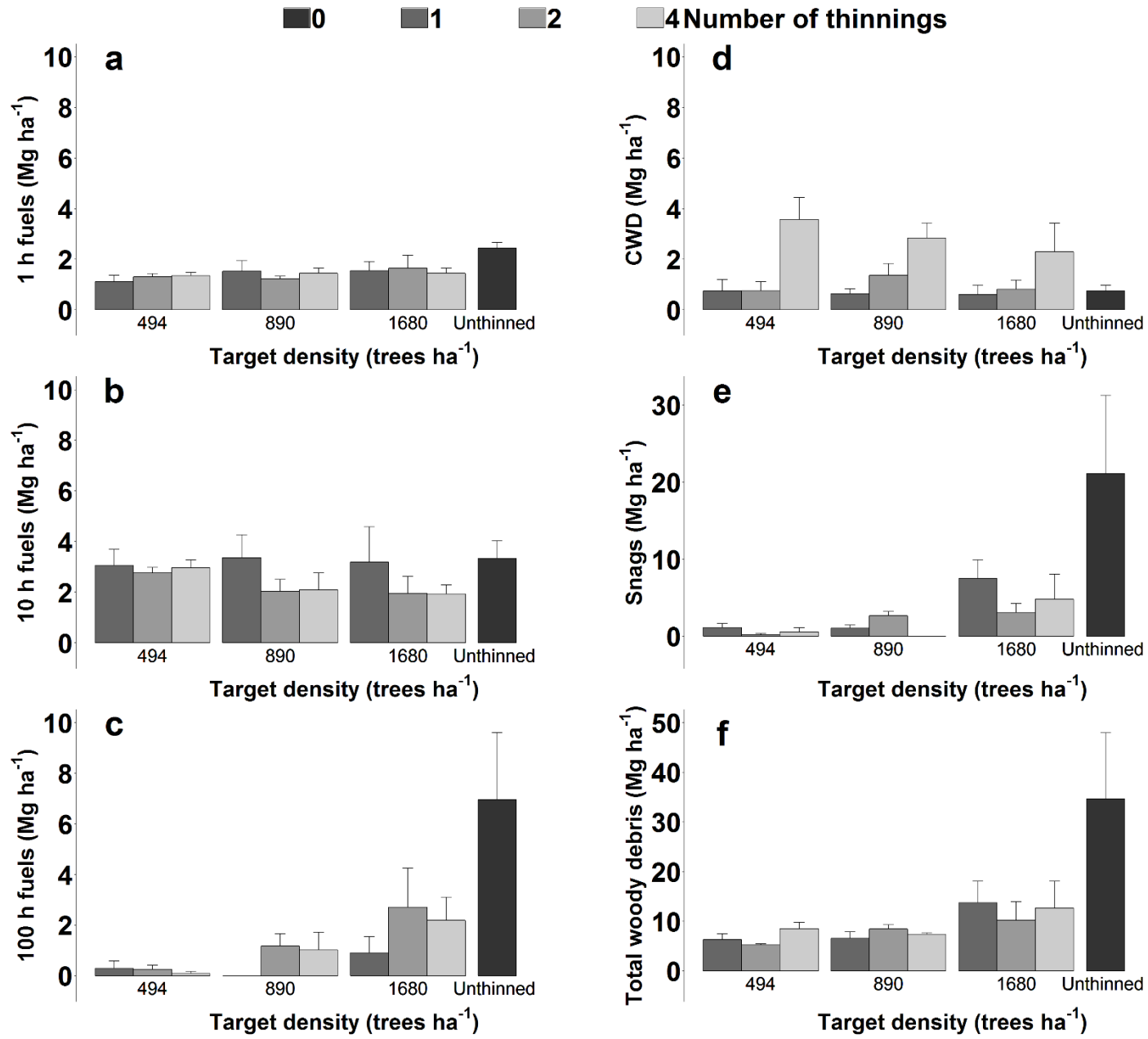


200 trees ha⁻¹

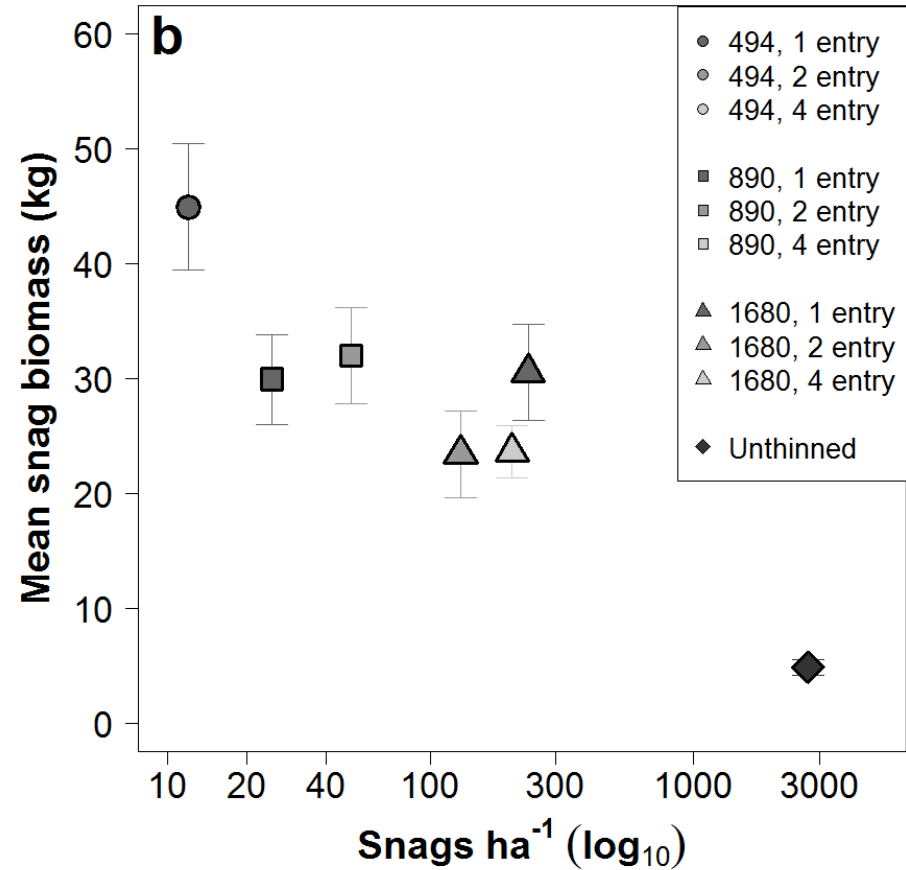
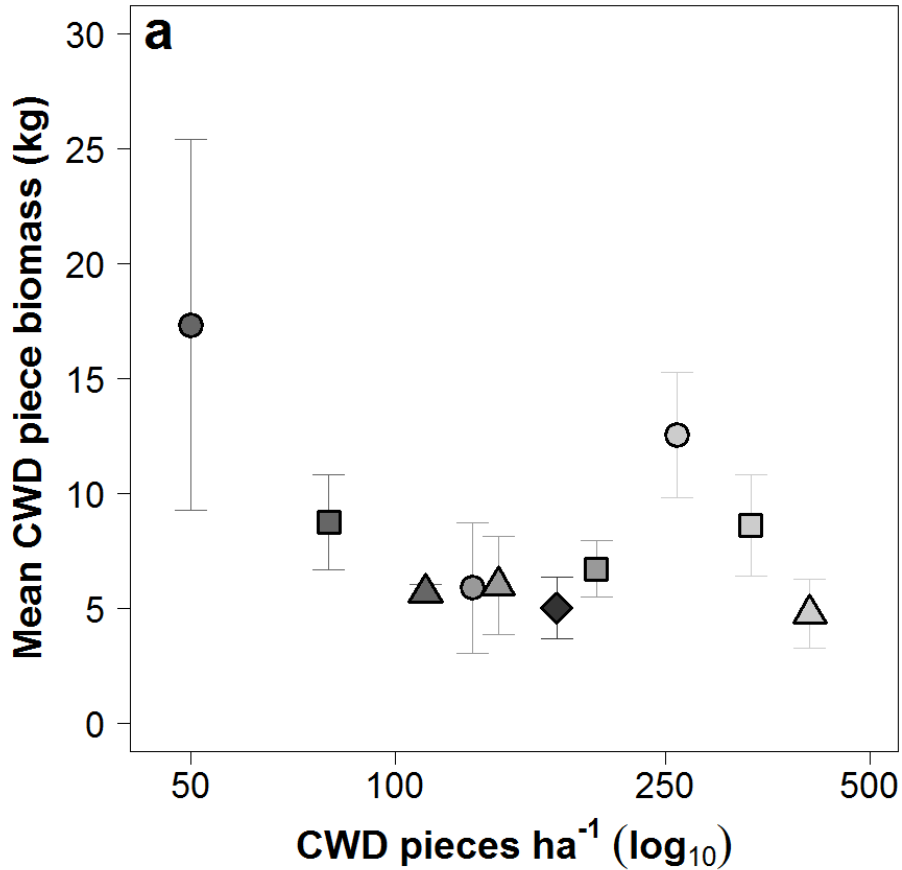


680 trees ha⁻¹

Woody Debris Accumulation



Woody Debris Accumulation



Summary

54 years post-thinning:

1. Changes tree size distribution (few large vs. many small)
2. Constant yield in volume and carbon across densities
3. Meet alternative objectives and maintain carbon storage

494 trees ha⁻¹, 2015



1680 trees ha⁻¹, 2015



Acknowledgements

Committee

- Andrew Larson
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- Travis Belote

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- Jack Schmidt
- Raymond Shearer

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- Jim Reardon
- Debbie Page-Dumroese
- Joanne Tirocke

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- Mic Holms, Weyerhaeuser
- The Wyman and Patricia Schmidt
Scholarship in Forest Ecology

Fieldwork

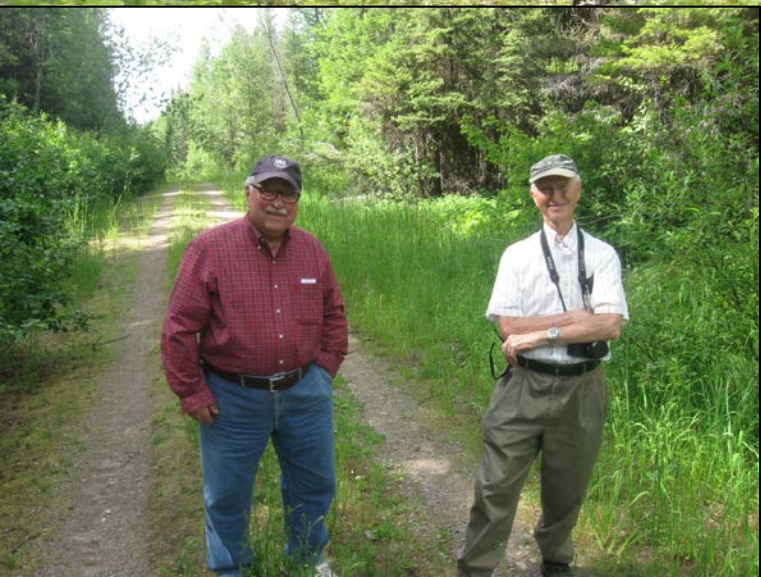
- Eryn Schneider
- CJ Weisbrod
- Lance Glasgow
- Colin Maher and more

Family

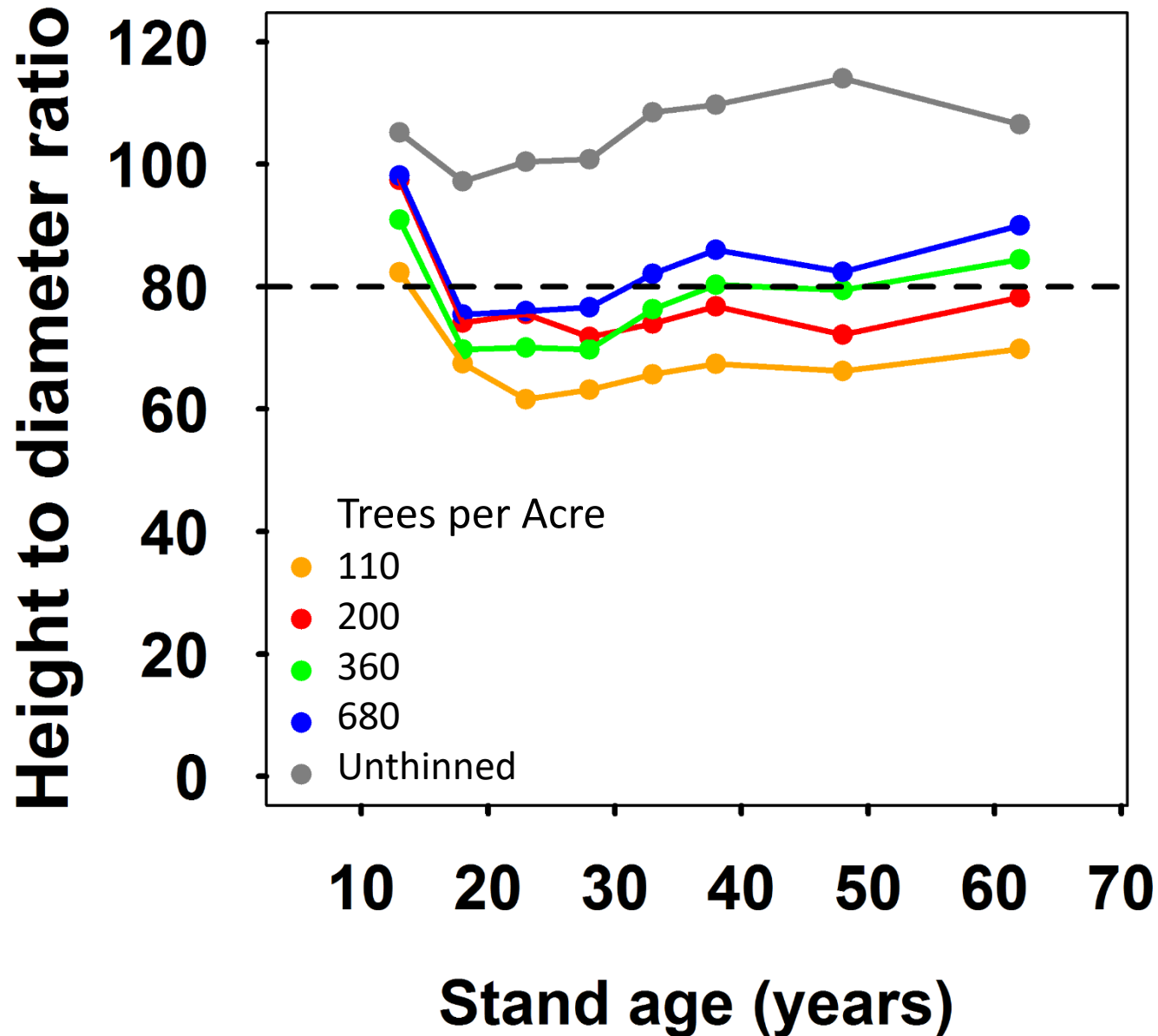
- Abrei Cloud
- Andy and Sue Schaedel
- Patricia and Henry Cloud
- Soren and Quinn Cloud-Schaedel



Questions?



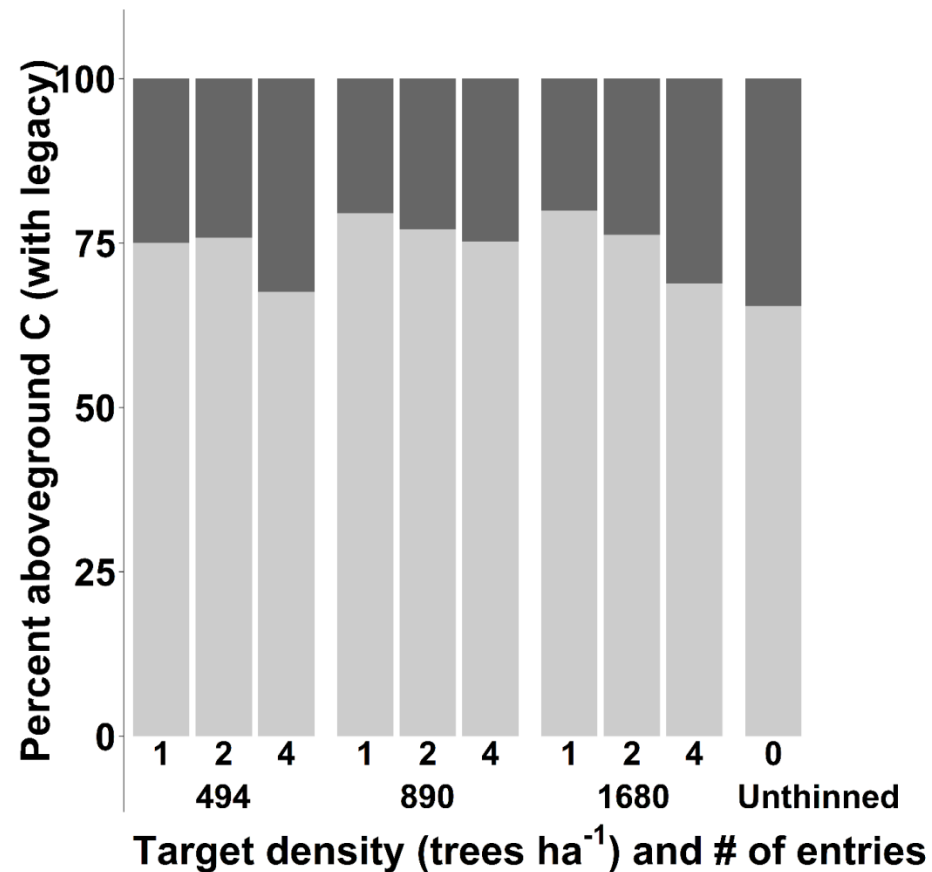
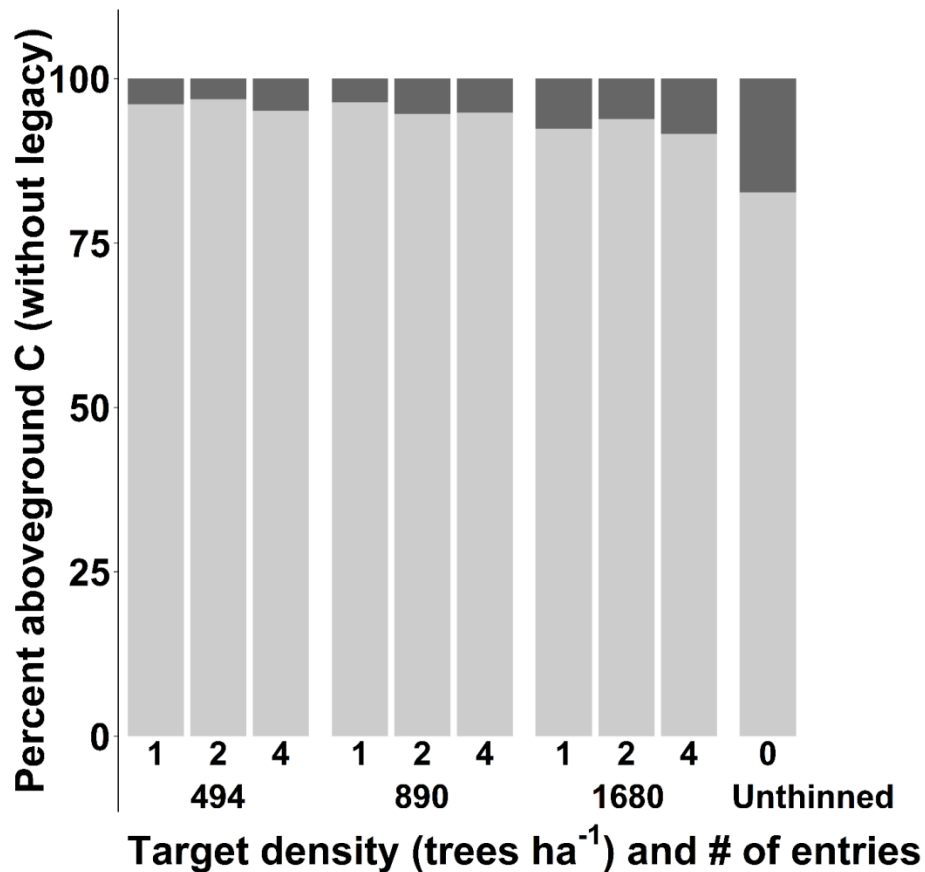
Height to Diameter Ratios



Proportion live vs. dead

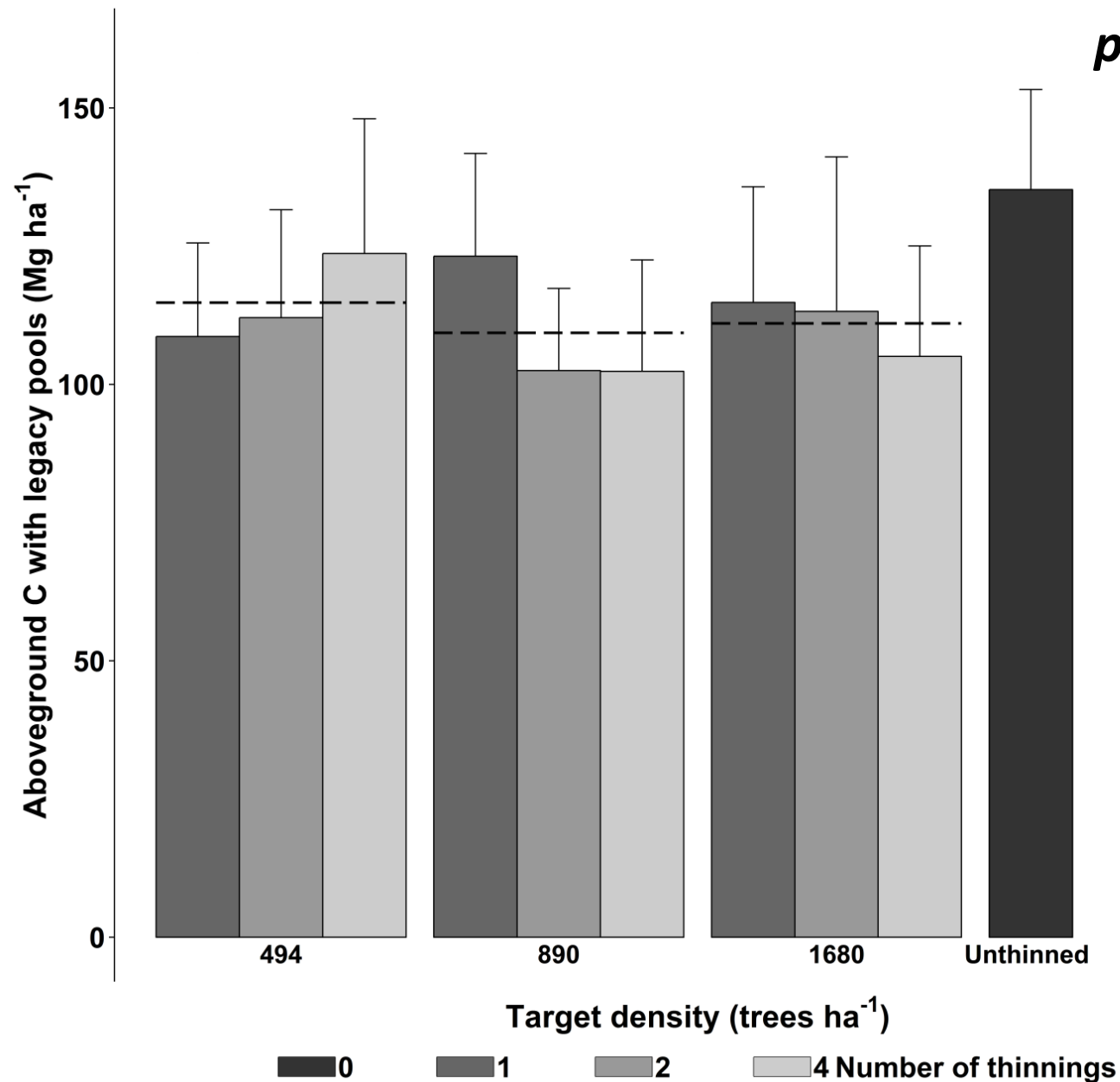
Without legacy

With legacy



Carbon pool ■ Dead ■ Live

Total carbon (non-legacy + legacy)



200 TPA = 494 TPH

360 TPA = 680 TPH

680 TPA = 1680 TPH

Woody Debris Accumulation

