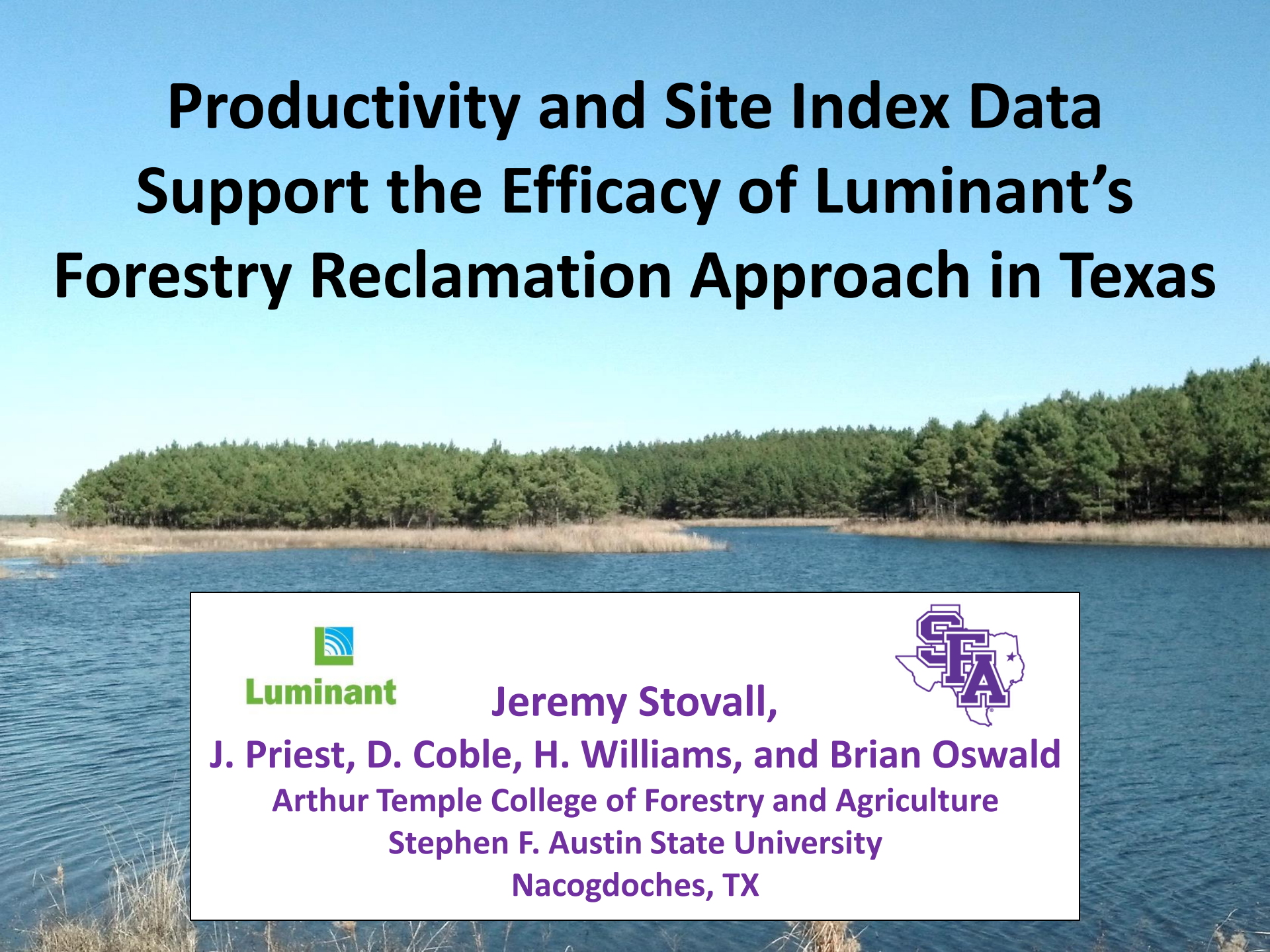
Productivity and Site Index Data Support the Efficacy of Luminant's Forestry Reclamation Approach in Texas



Luminant

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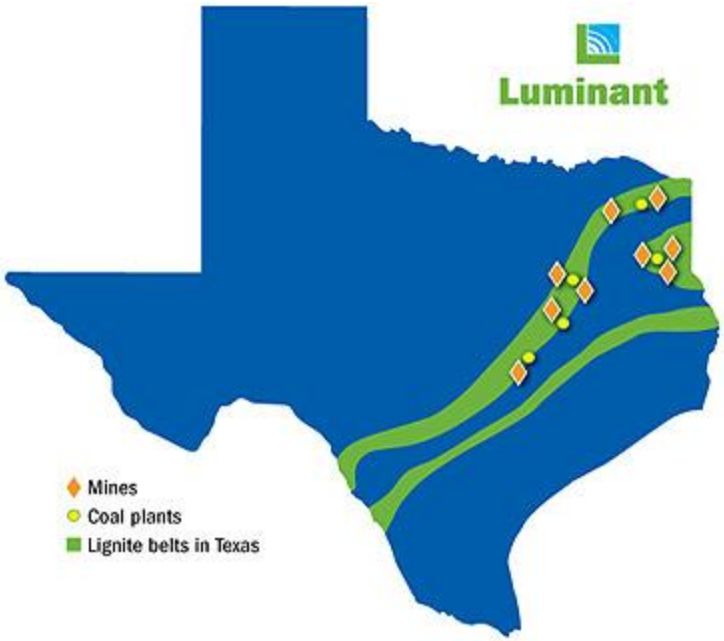
J. Priest, D. Coble, H. Williams, and Brian Oswald

Arthur Temple College of Forestry and Agriculture

Stephen F. Austin State University

Nacogdoches, TX

Lignite Mining in Texas



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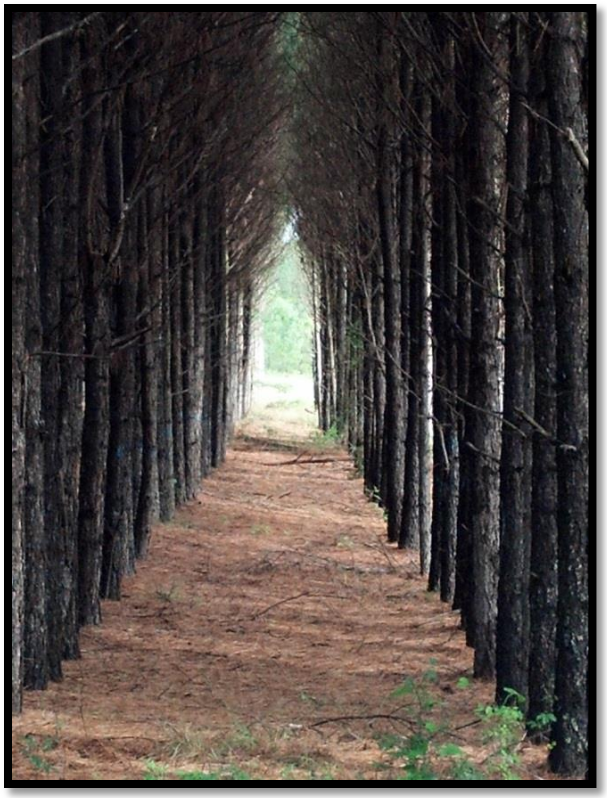
Pine Plantations Are a Common Reclamation Land Use



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Surface Mining Control and Reclamation Act (1977)

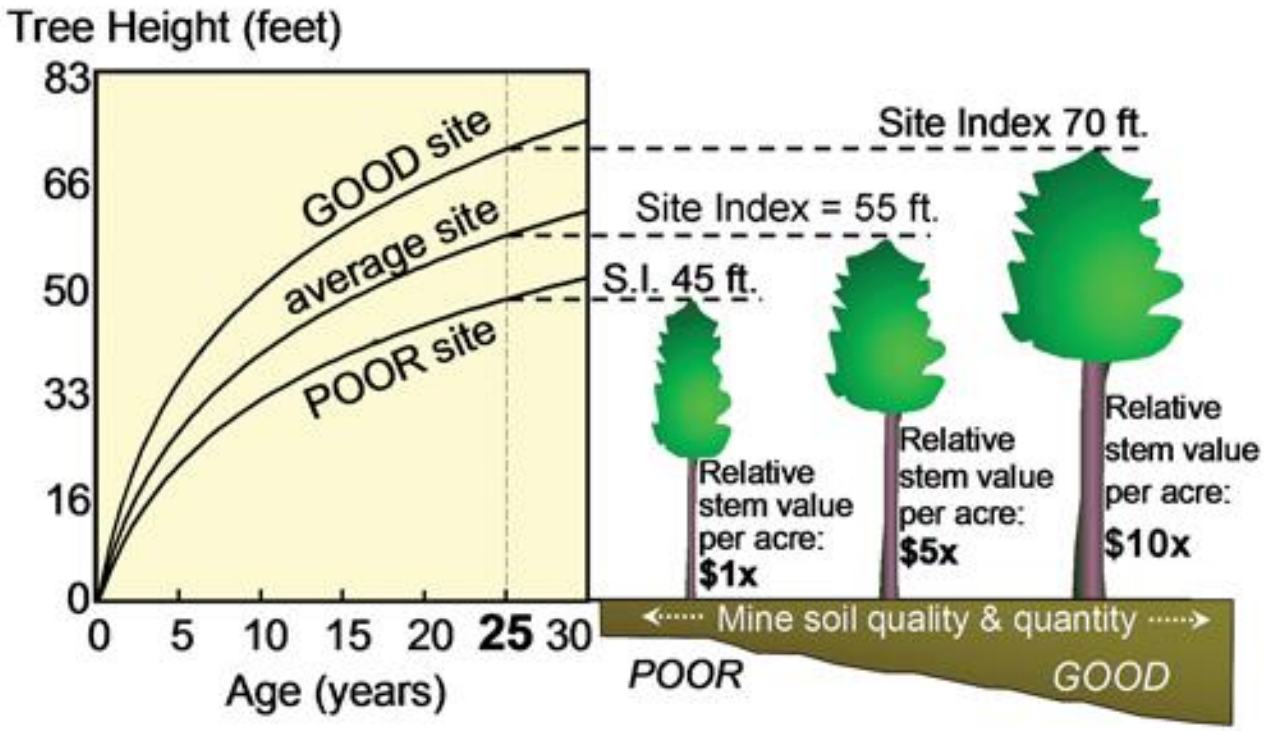

Figure Credit: *Burger and Zipper 2009 http://pubs.ext.vt.edu/460/460-138/460-138.html*

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Research Questions

- Are Luminant's reclaimed pine plantations as productive as the site prior to mining?
- Are Luminant's reclaimed pine plantations as productive as stands on non-mined land in the area?
- What are the tree biomass development patterns on these mines, and do they differ from plantations on non-mined lands?

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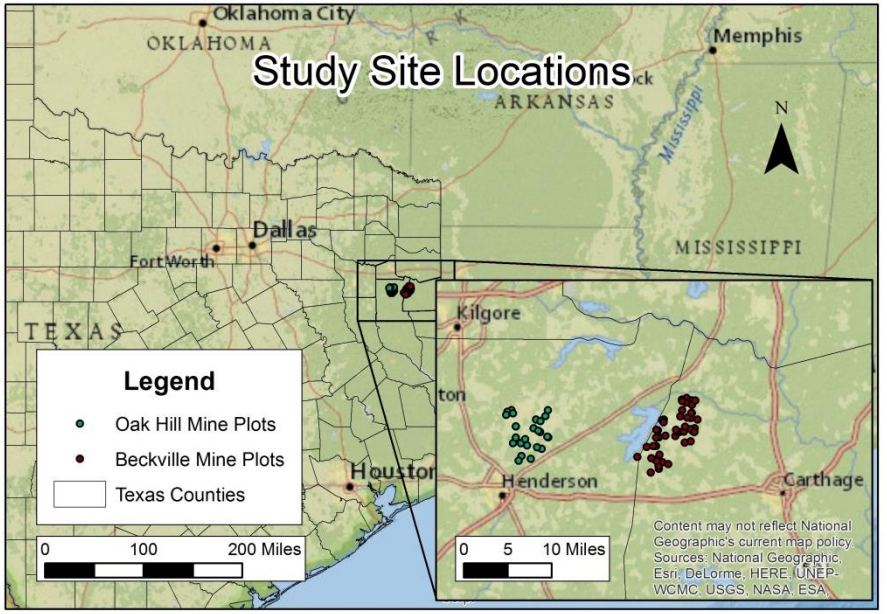
Study Sites

- Research conducted on Luminant's Beckville and Oak Hill Mines located near Martin Lake in East Texas
- 48 study plots established at Beckville
- 24 study plots established at Oak Hill



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Beckville and Oak Hill Mines

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Study Plots

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Methods: Destructive Sampling

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Methods: Stem Analysis

- Annual rings were analyzed using the Carmean (1972) method
- Height-Age models were fit following the procedures of Coble and Lee (2006)

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Methods: Biomass

- Harvested 5 representative branches
- Weighted the entire tree and samples green
- Oven dried and weighed needles, cones, branches, cookies (debarked), and bark
- Scaled whole-tree to dry mass, and then scaled to stand level using inventory

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Original Site Index

- Average site index prior to mining was estimated from the USGS Web Soil Survey
- Prior site index used base age 50 for natural stands
- We extrapolated to current site index methods by adding an estimated 10 feet to the height at age 25 to account for improved genetics and silviculture

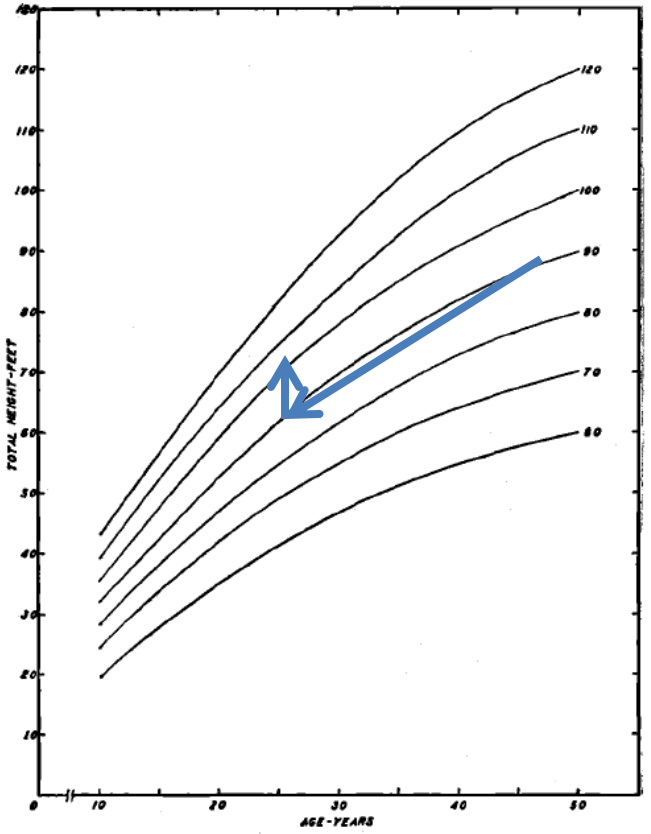

FIG. 4.—Adjusted site index curves for young loblolly pine stands.

Figure from Coyle and Schumacher 1953

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Original Site Index

- Using the +10 ft. method:
  - The average site index at BM was 70’ at 25 yrs.
  - The average site index at OHM was 66’ at 25 yrs.
- This seems to be an appropriate estimation as Coble and Lee found an average site index in east Texas of 71’ at 25 yrs.

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Methods: Statistical Analysis

- Non-linear age-height models were tested for statistical significance using parameter estimates
- This was only possible using Coble and Lee's parameter estimates
- Parameters represent shape and asymptote
- 95% confidence intervals allow heights to be compared at a given age, but p-value cannot be calculated

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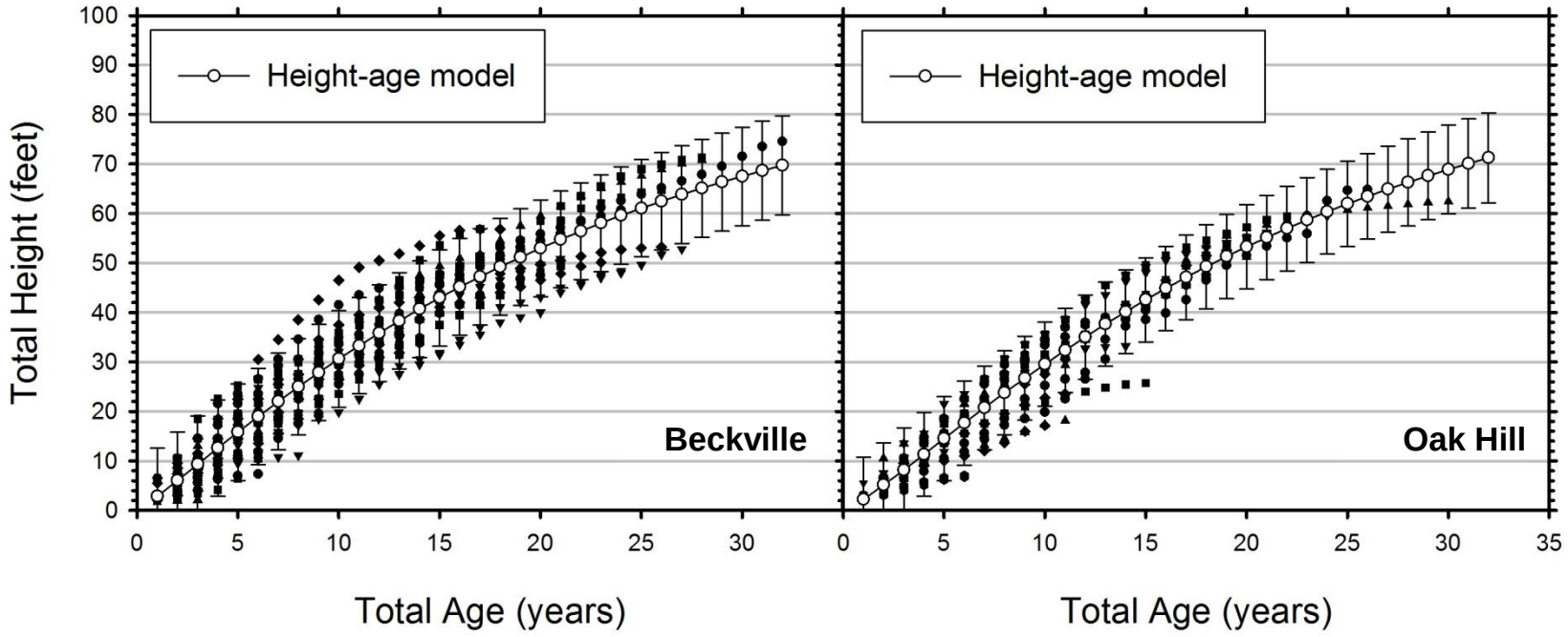
Stem Analysis Results



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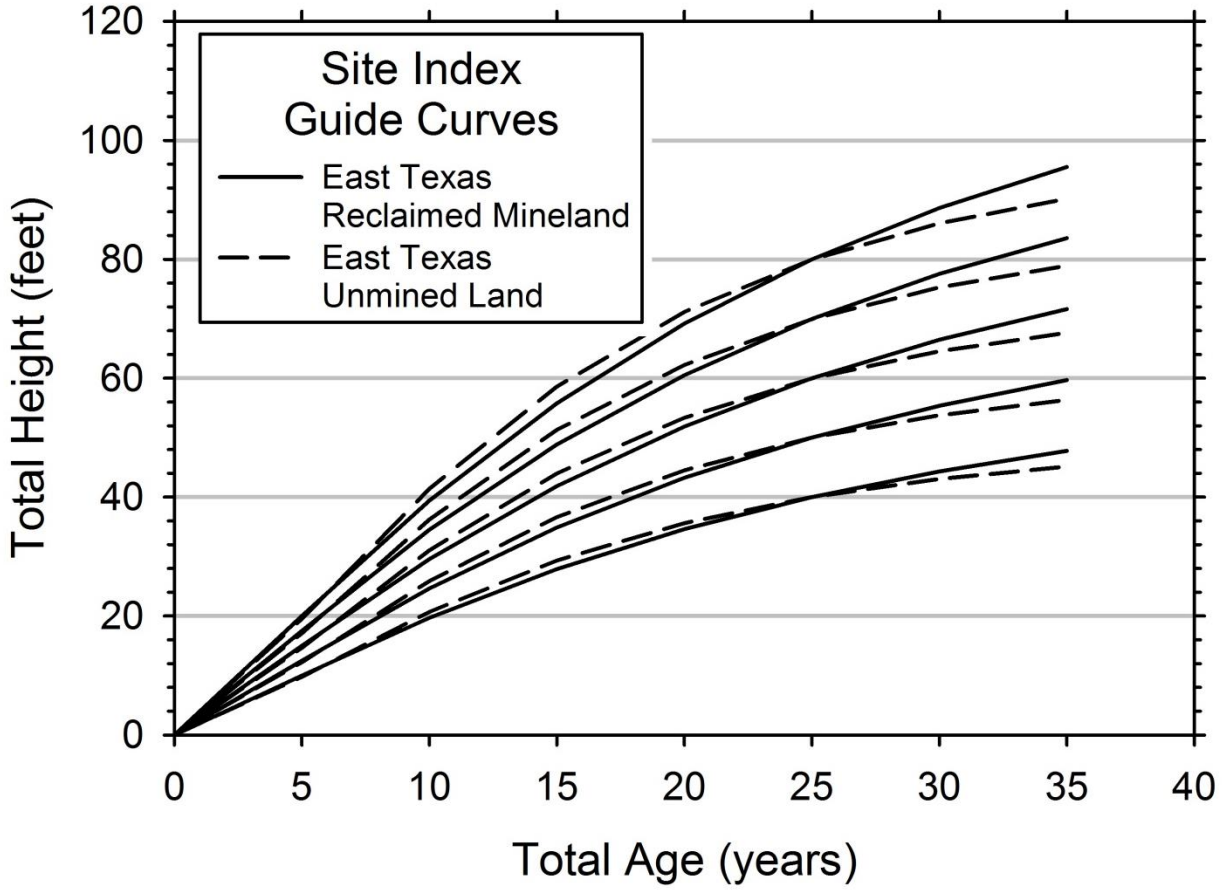
Site Index Curves for Mined Land



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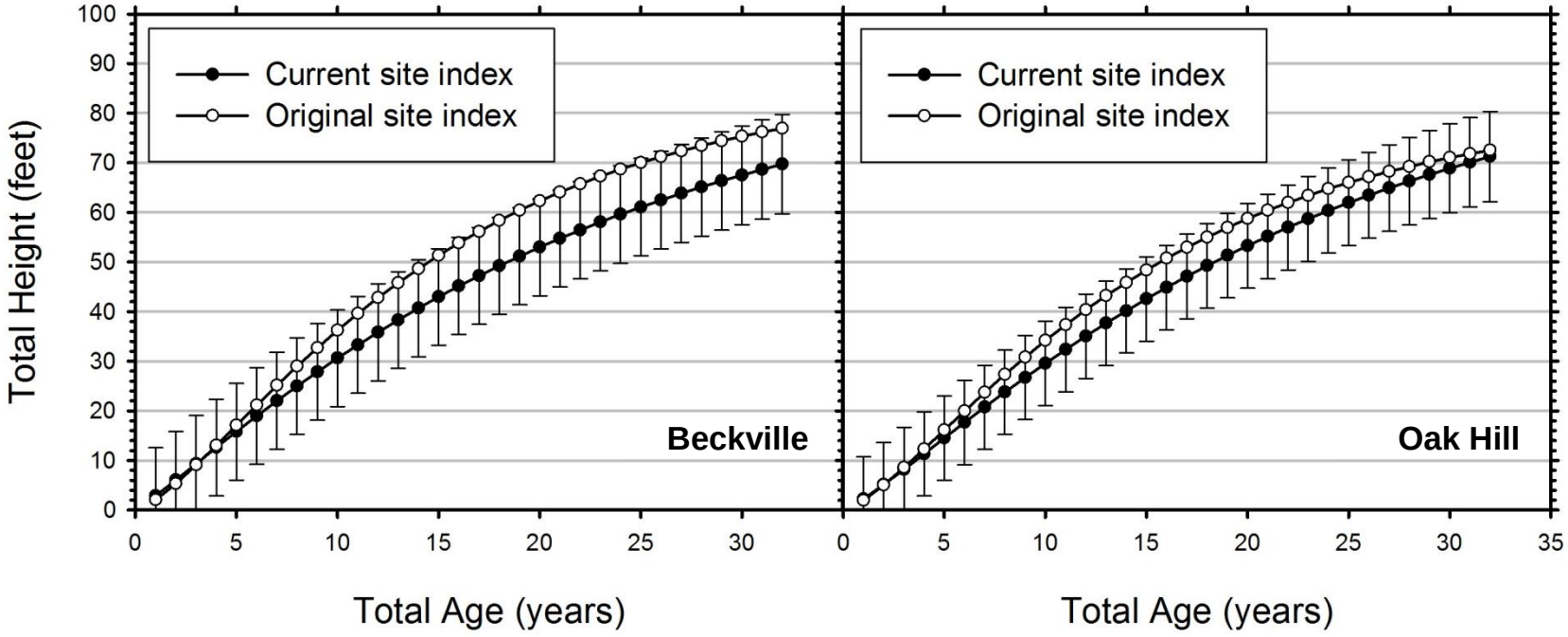
Site Index
Post-Mining vs. Soil Survey



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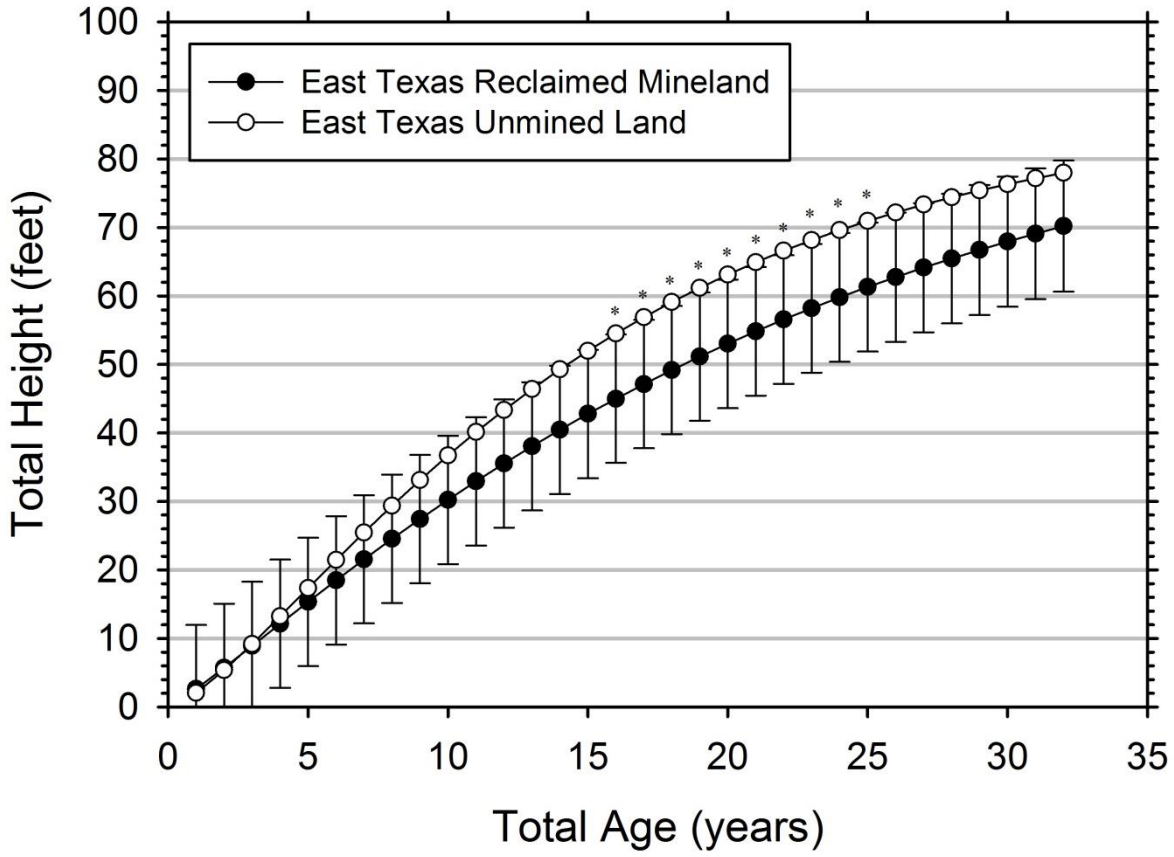
Site Index
Post-Mining vs. ETPPRP Non-Mined



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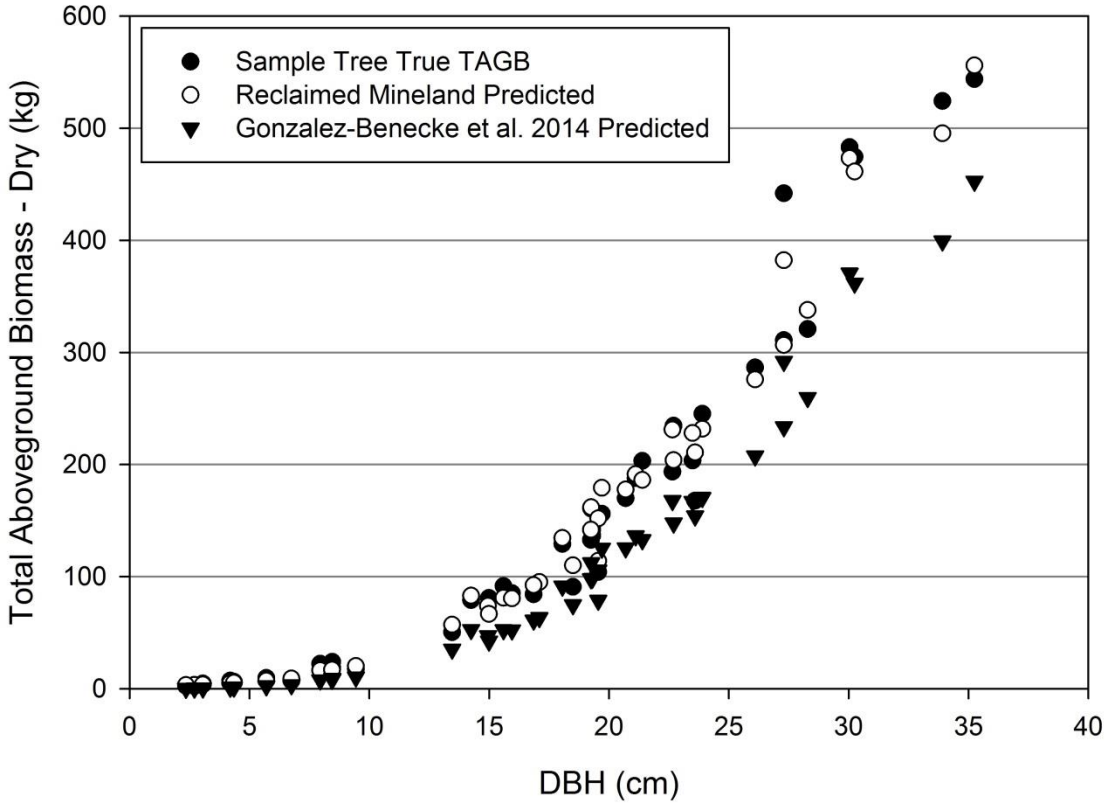
Aboveground Biomass



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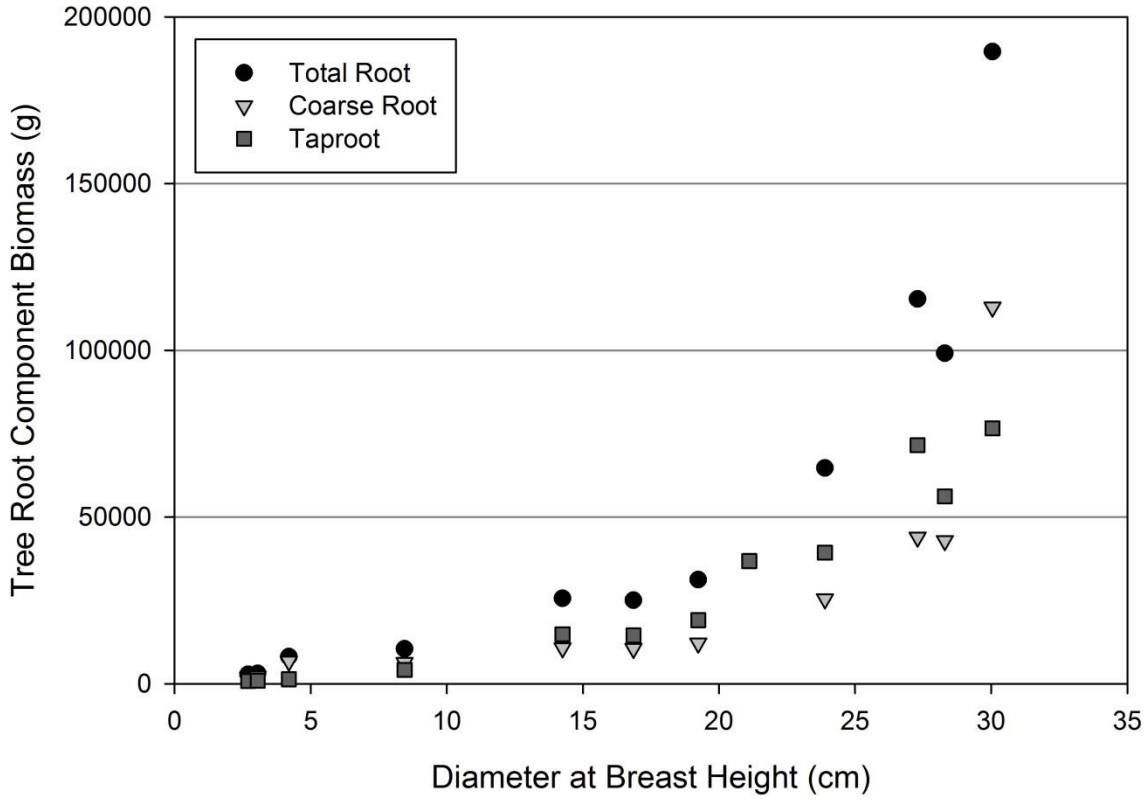
Belowground Biomass



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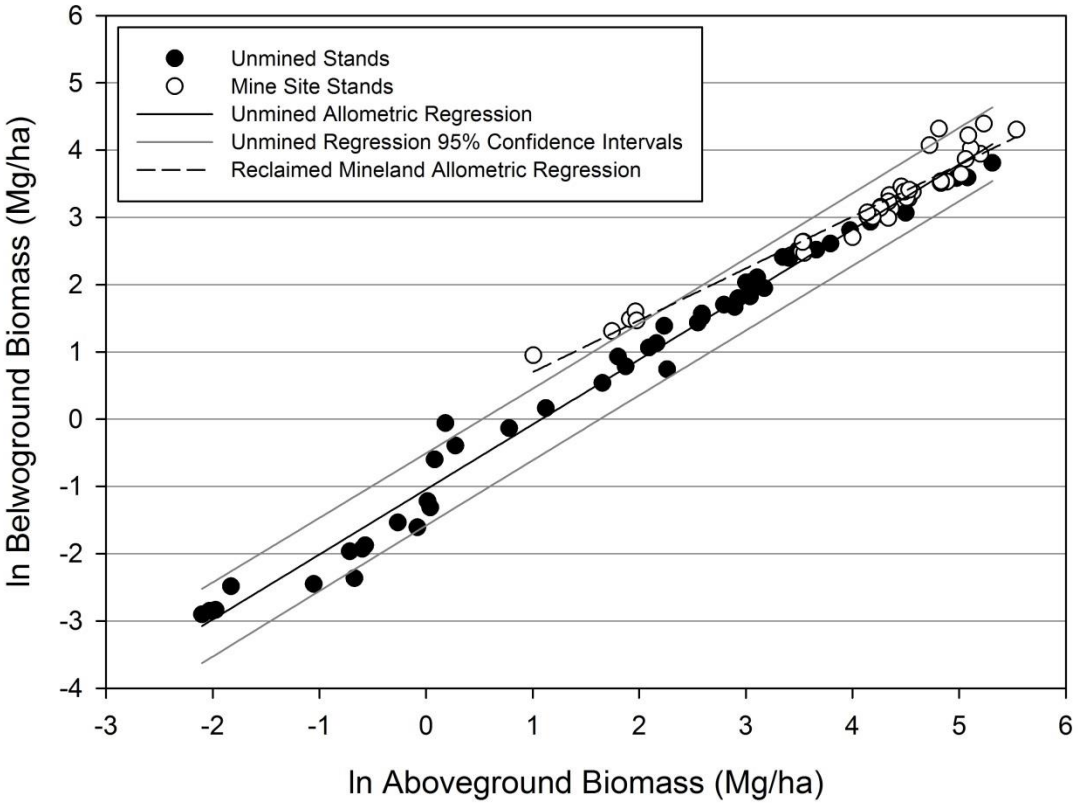
Allometric Comparison



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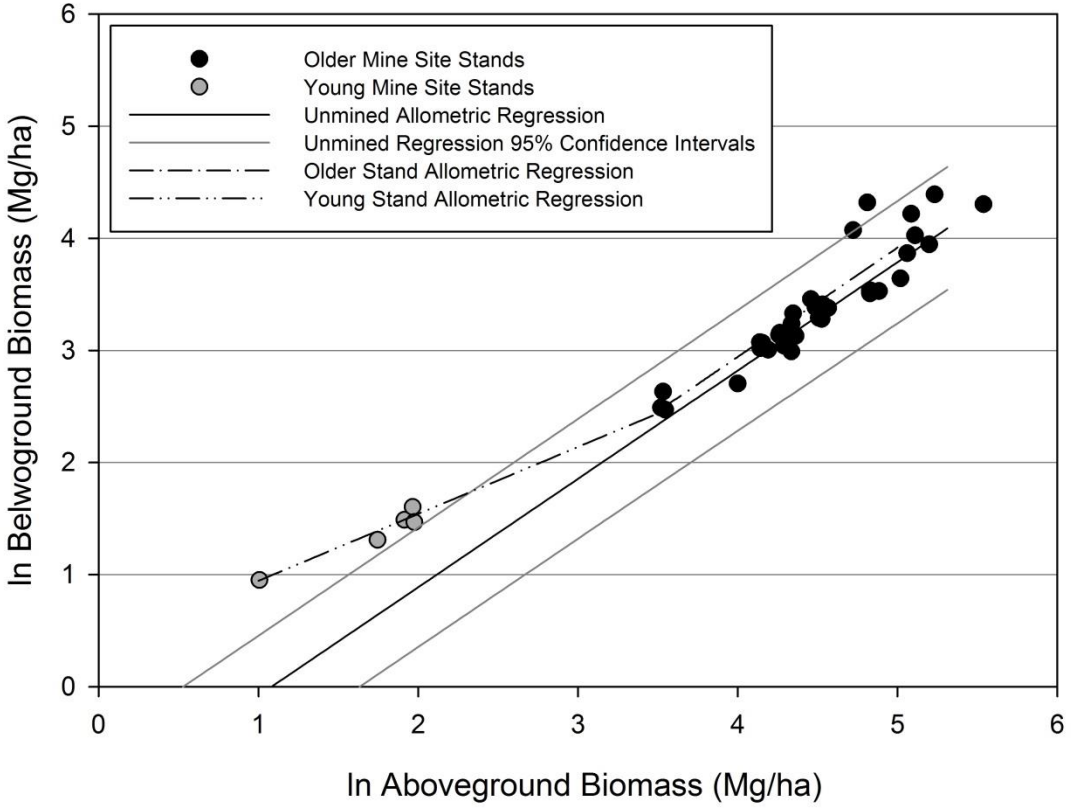
Allometry Differs by Age



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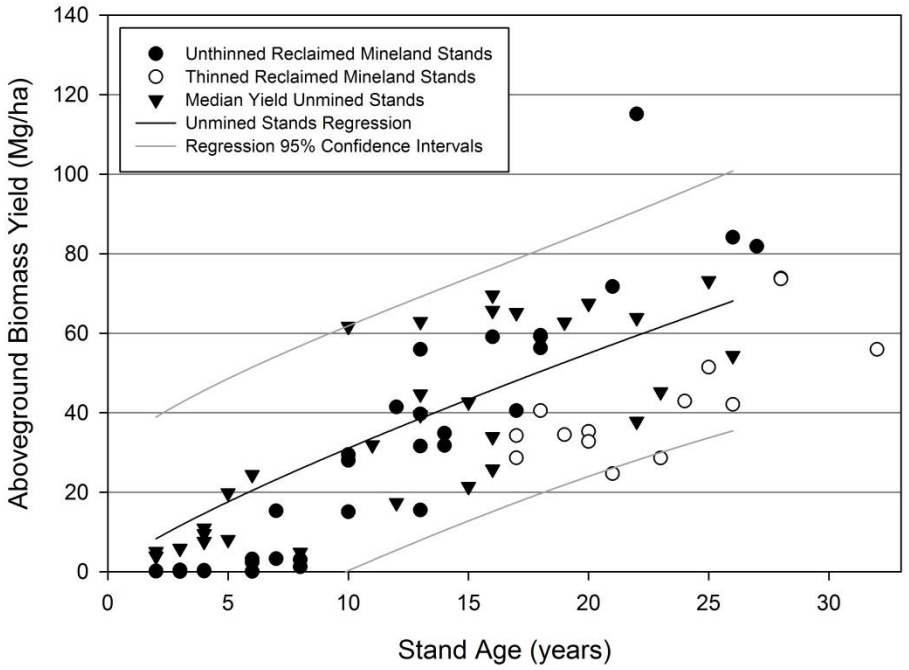
Comparison to Gonzalez-Benecke et al. (2014)



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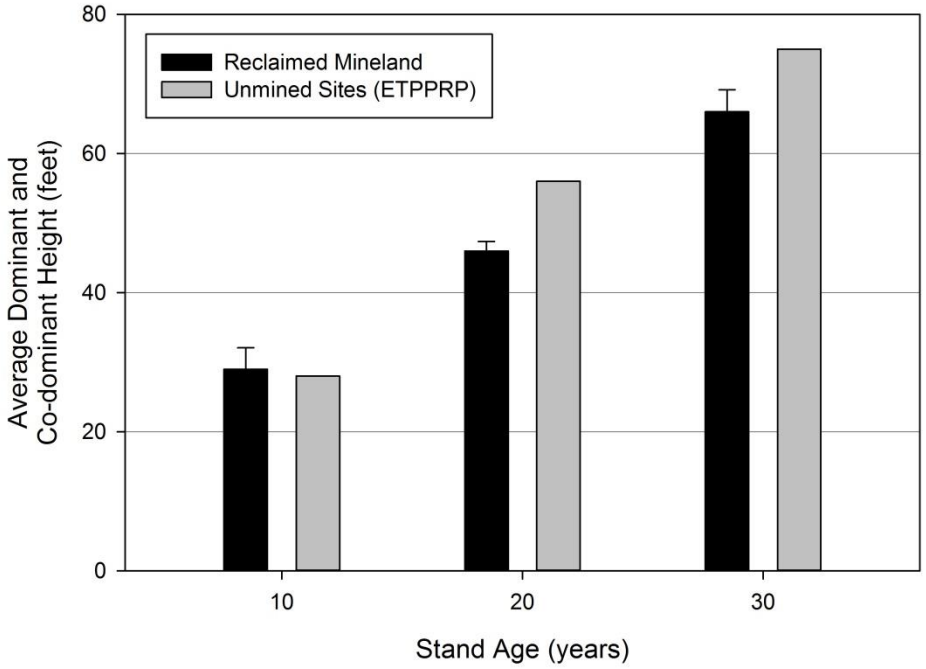
Comparison to Coble and Pendergast (2014)



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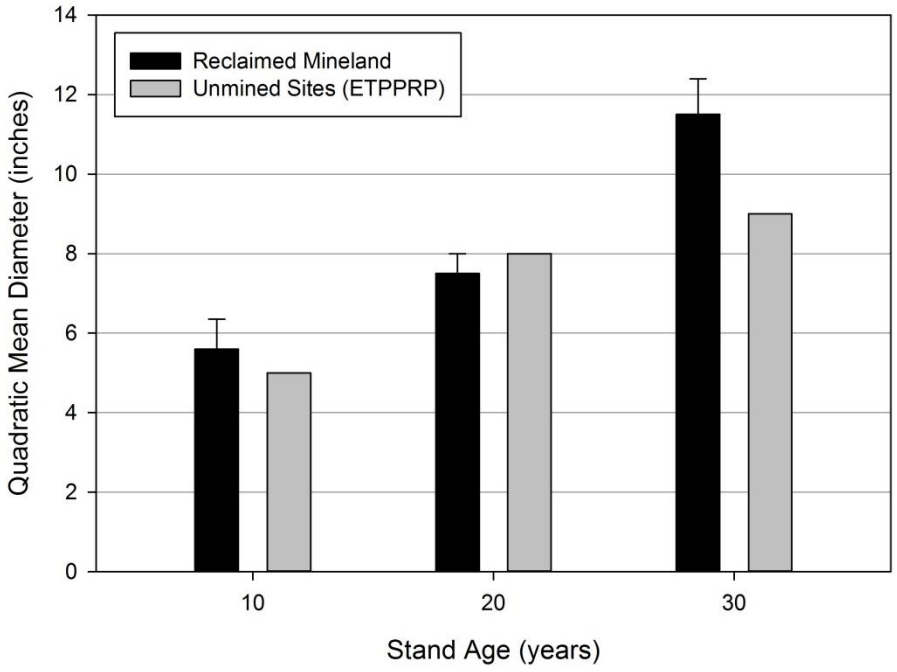

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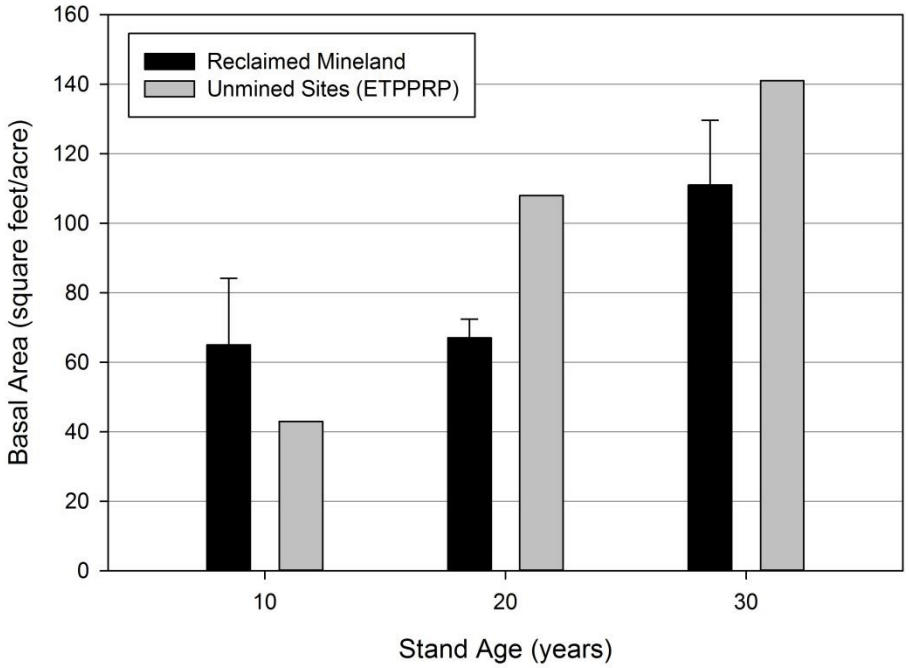

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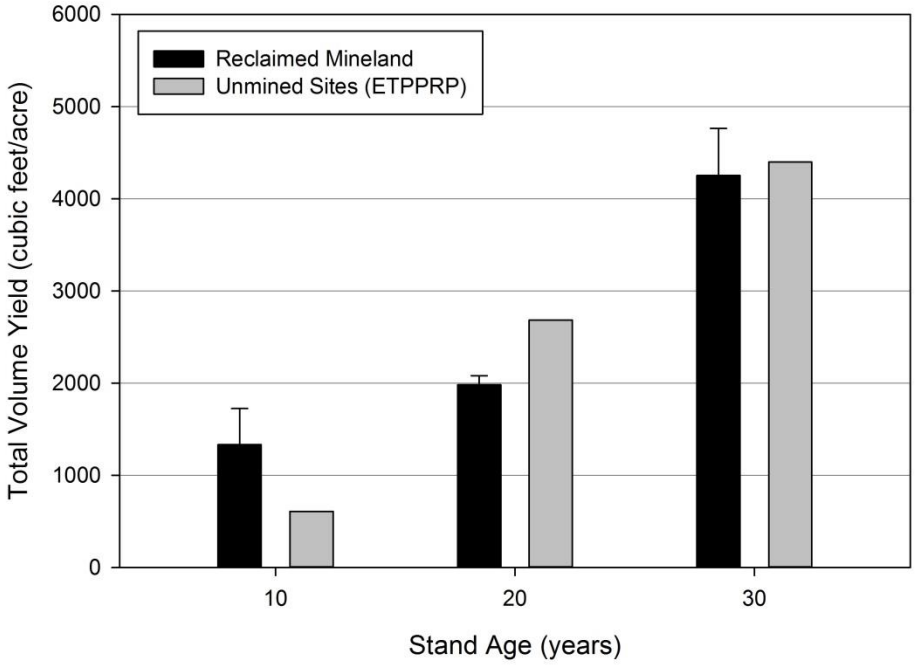
Comparison to Coble and Pendergast (2014)



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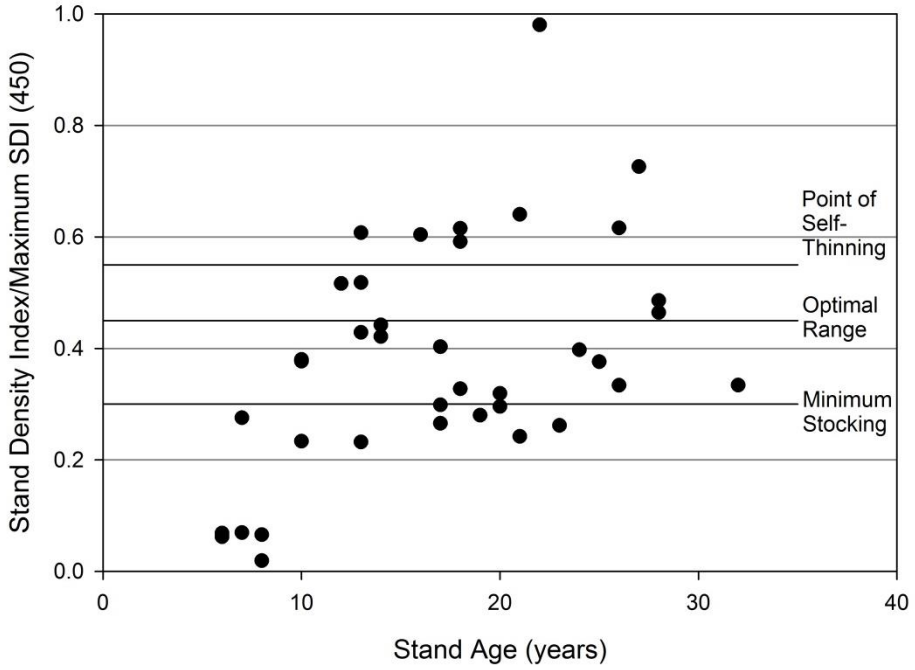
Stand Density Index (Reineke 1933)



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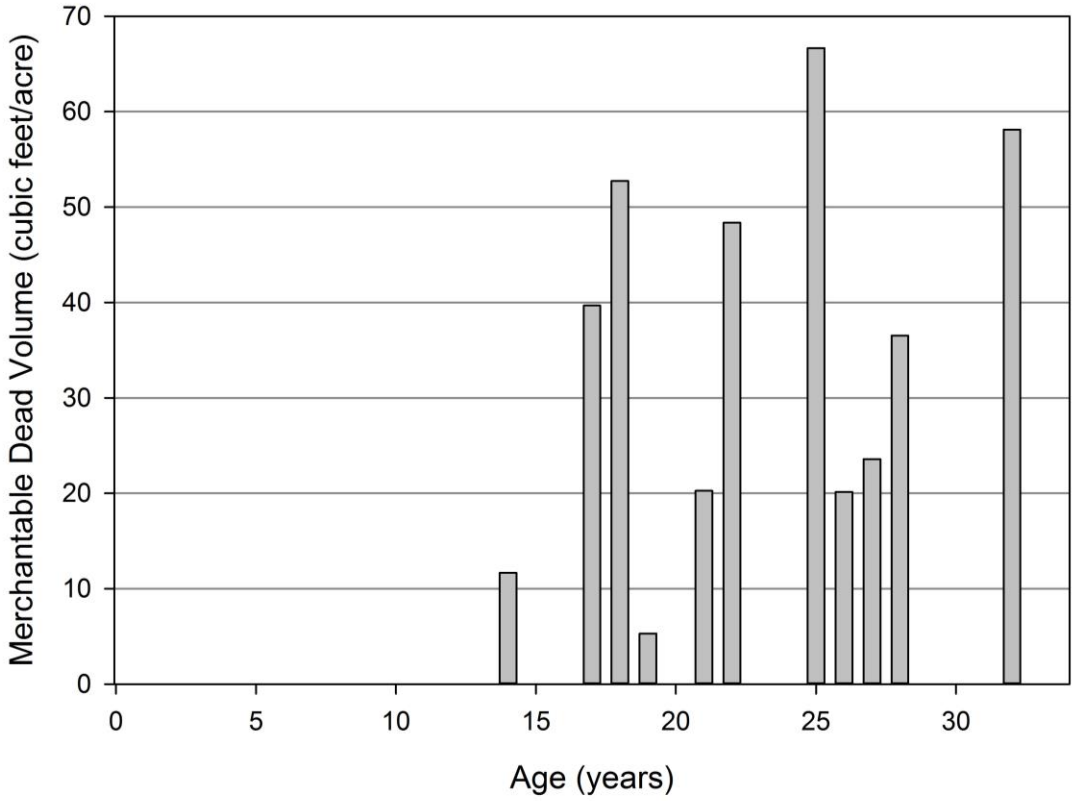
Lost Volume from Mortality



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Conclusions

- Average site index at each mine is not statistically different from pre-mining site index (AS BEST WE CAN ESTIMATE IT)
- Mid-rotation heights (16-25 years) significantly lower than ET average by about 10 feet
- Other ages showed no significant difference compared to non-mined lands

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Conclusions

- Per-tree biomass is greater on mined lands (taper?)
- Aboveground biomass is consistent with unmined lands for loblolly in the US South
- Allometry differs in young trees, but not as much in old trees

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Acknowledgments

- Funding: Luminant Environmental Research Program
- Bryent Daugherty, Jason Grogan, many folks at Luminant, many student workers who processed samples

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Questions?

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