



Niche-based grouping for mixed species growth and yield models: A preliminary exploration.

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eYield V.2 Project

- Decision support system for **small and medium-sized forest landowners in the southern US.**
- **Hardwood and natural pine.**
- Seven models currently in use, **three of which are hardwoods.**
- Dr. Pete Bettinger is leading a four-year project to update to V.2: **which will expand mix-species hardwoods models.**
- Partnership of UGA, UTK, Southern Regional Extension Forestry, and MSU staff.
- Website: <https://eyield.sref.info>



eYield V.2 Project



GROWTH & HARVEST REPORT

STAND NAME: LOBLOLLY PINE
ACREAGE: 120*

eYield Simulator

✓

 Simulator Reports

✓

 Basic Information

✓

 Stand Parameters

✓

 Site Index

✓

 Harvest Regime

✓

 Financial Parameters

✓

 Financial Transactions

Stand Name: Loblolly pine	Simulator Model: Natural Loblolly Pine	Number of Acres: 120	Basal Area: 90 ft ²	Site Index (@25): 75
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Simulator Reports

Seven reports are potentially available as outcomes from eYield simulations.

The bark beetle report is available only for natural pine forest simulations. This report provides a hazard rating (a value), class (1-5), and score (low-high) of susceptibility to bark beetle attack. The cashflow by transaction report details the financial and economic effects of each transaction that is specified to occur. Amounts, associated taxes, and accumulated totals are provided only for the years in which a transaction or activity occurs. The cashflow by year report details revenues, expenses, net, and accumulated totals for the activities specified during a simulation for the years in which a transaction or activity occurs. The present worth, benefit / cost ratio, and several other financial and economic indicators related to the simulation. The growth and harvest report provides a summary of standing and residual DBH, basal area per acre, and trees per acre for the years in which a harvest activity occurs. The market conversion report provides an indication of products produced through harvests and their values, for the years in which a harvest activity occurs. The woodflow summary report provides a summary by product of products produced through harvests, for the years in which a harvest activity occurs.

If all seven reports are desired, simply press the "All Reports" button below. Otherwise, select at least one report option below to get started.

Once the selection of reports has been made, press the "Submit / Next" button at the bottom of the page.

All Reports

Select this option to activate all reports

Bark Beetle

Hazard rating report for southern pine beetle*
* Only available for Pine models

Cashflow by Transaction

Type, amount, and taxes associated with each transaction

Cashflow by Year

Aggregate before- and after-tax revenues and expenses

Financial Profitability

Measures of financial value of the plan

Growth & Harvest

Standing and harvested character of the stand at the time of a harvest

Market Conversion

Product dimensions and applicable prices at the time of harvest

Woodflow Summary

Standing and harvested basal area, and marketable wood volumes

SUBMIT / NEXT

	Standing				Harvested			Residual		
	DBH	BA	TPA	%	BA	TPA	%	BA	TPA	%
2028	3	0	0	0	0	0	0	-	-	-
	4	0.3	3.44	0.27	0.3	3.44	0.74	-	-	-
	5	1.42	10.41	1.29	1.42	10.41	3.52	-	-	-
	6	3.12	15.89	2.83	3.12	15.89	7.74	-	-	-
	7	6.17	23.09	5.59	6.17	23.09	15.31	-	-	-
	8	9.74	27.9	8.83	9.74	27.9	24.16	-	-	-
	9	10.65	24.11	9.65	10.65	24.11	26.42	-	-	-
	10	12.29	22.53	11.14	8.92	16.35	22.13	3.37	6.18	4.81
	11	13.87	21.02	12.57	-	-	-	13.87	21.02	19.81
	12	11.9	15.15	10.79	-	-	-	11.9	15.15	17
	13	10.19	11.06	9.24	-	-	-	10.19	11.06	14.56
	14	9.21	8.62	8.35	-	-	-	9.21	8.62	13.16
	15	8.02	6.54	7.27	-	-	-	8.02	6.54	11.46
	16	5.1	3.65	4.62	-	-	-	5.1	3.65	7.29
	17	3.67	2.33	3.33	-	-	-	3.67	2.33	5.24
	18	2.74	1.55	2.48	-	-	-	2.74	1.55	3.91
	19	1.93	0.98	1.75	-	-	-	1.93	0.98	2.76

The eYield website is still in its testing phase. All information in this report is provided "as is" and "as available".

* All values are calculated on a per-acre basis.
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Plantation Management Research Cooperative
Warnell School of Forestry & Natural Resources
UNIVERSITY OF GEORGIA

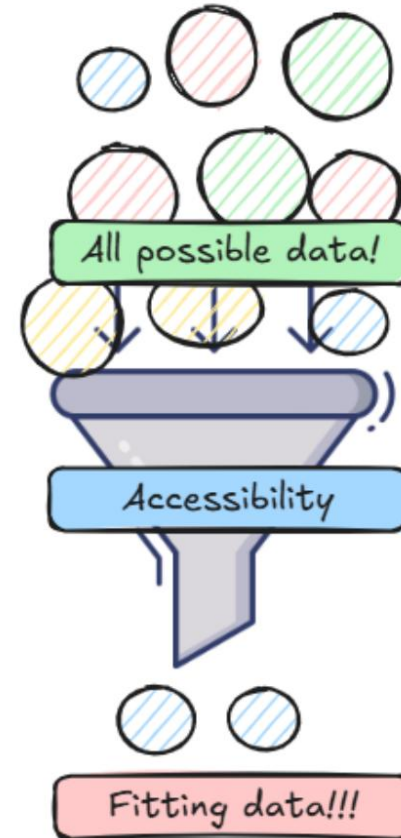
2025 SOMENS & NEMO
Joint Annual Meeting

Why mix-species forests?

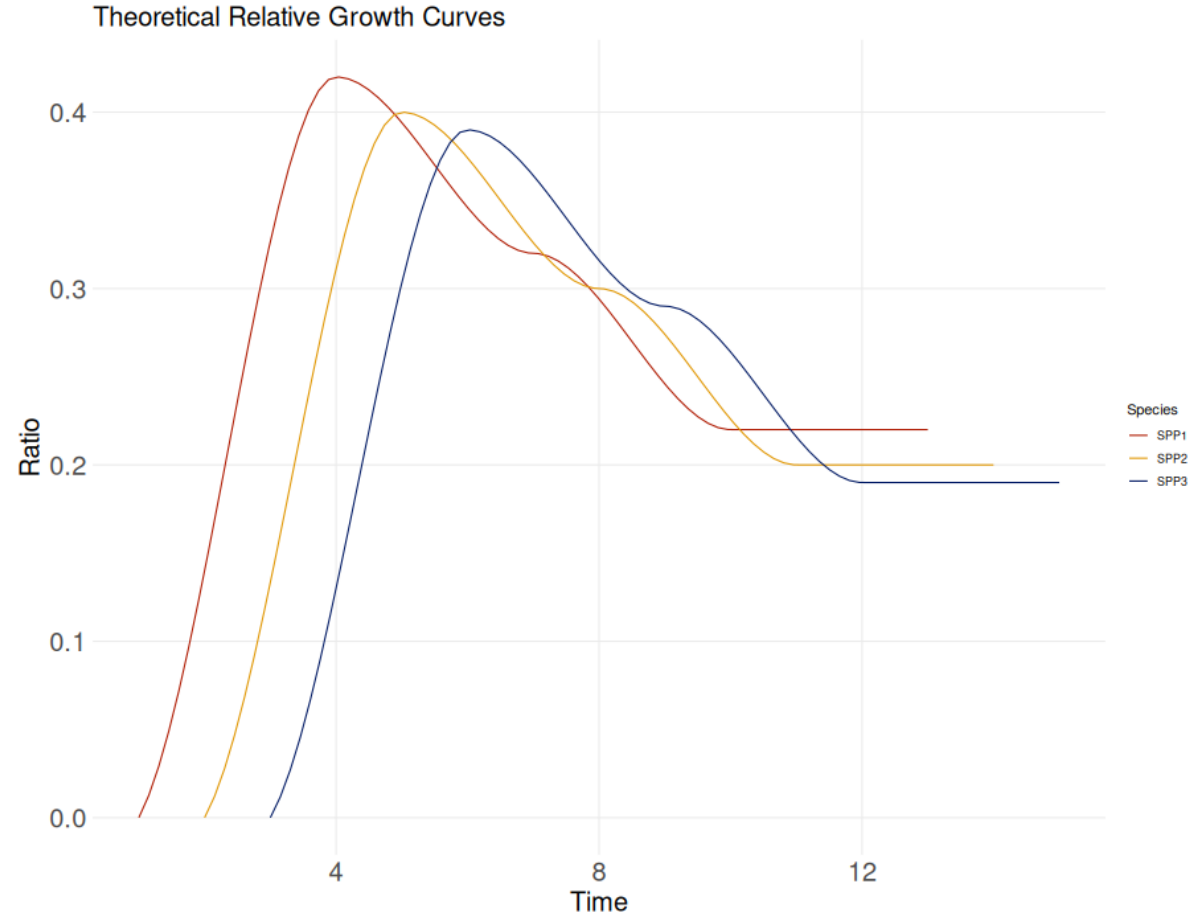
- **Over 50%** of Georgia forests are owned by **non-industrial private landowners**.
- Mix-species and uneven stands are complex to model and under-represented in the literature.
 - Over **250 unique native tree species** in the state of Georgia.
- Difficult for landowners to develop a **management timeline**.



The Great Struggle... Data!



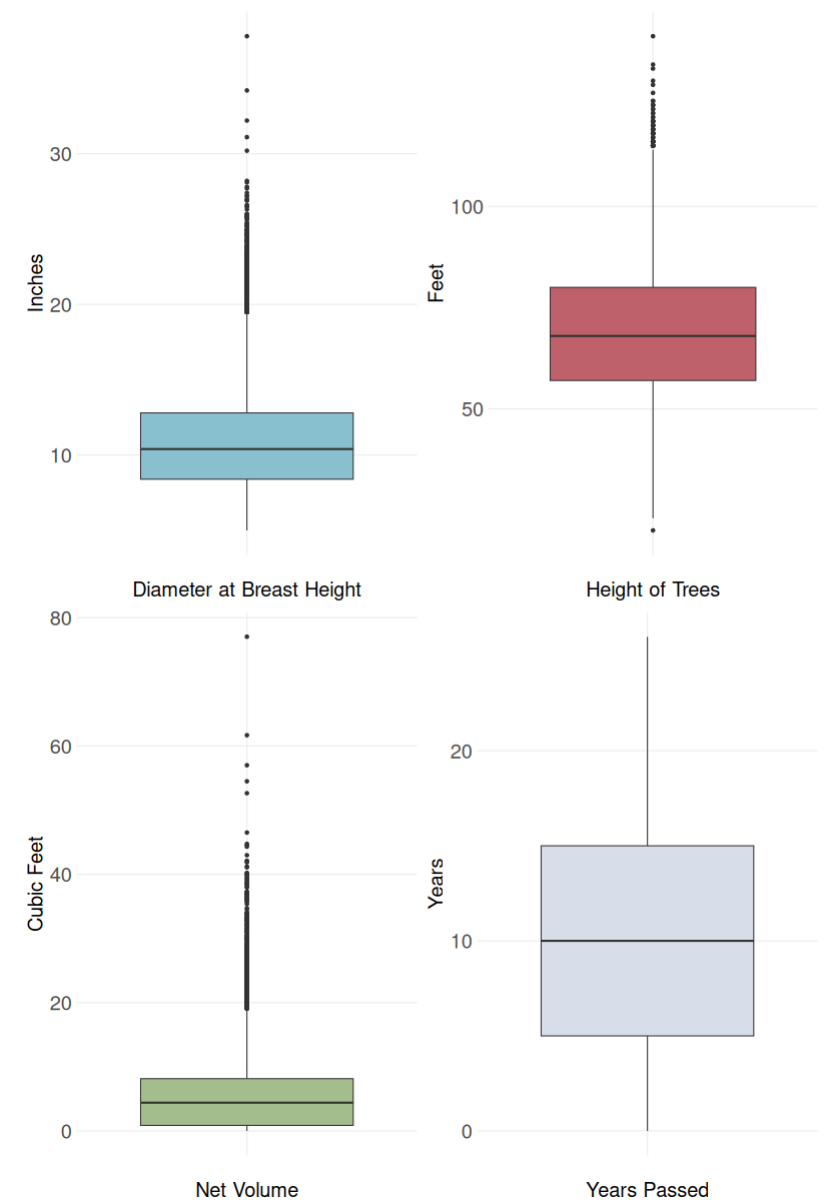
Going back to square one!



Methods

Use **Forest Inventory Analysis (FIA)** data to develop growth curves for a variety of species.

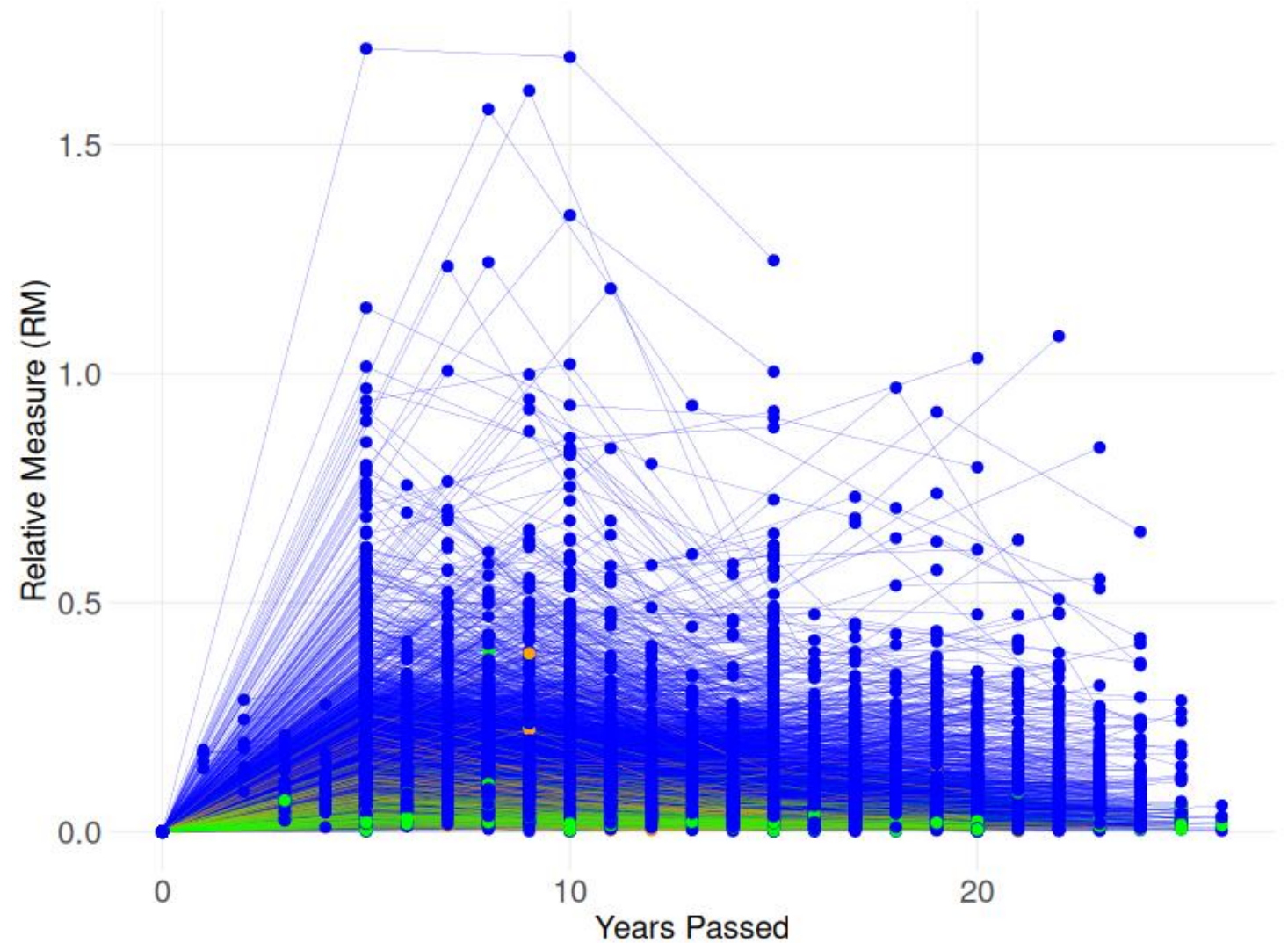
- FIA Data from Georgia.
 - **Loblolly, Shortleaf, Longleaf**
 - 1998 to 2023
 - 3 or more observations for each tree.
 - **5113** unique trees.
 - **Relative growth** based on net volume.



Results

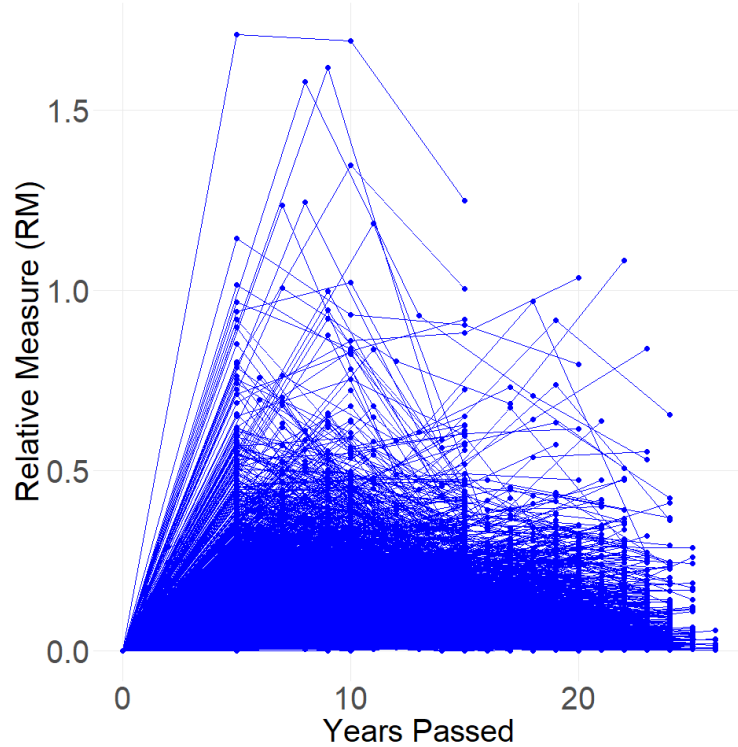
$$RM = \left(\frac{V_c - V_l}{V_f} \right) / Y_B$$

Where RM is relative measure, V_c is current volume, V_l is pervious volume, and V_f is first measured volume. Y_B is years between measurements.

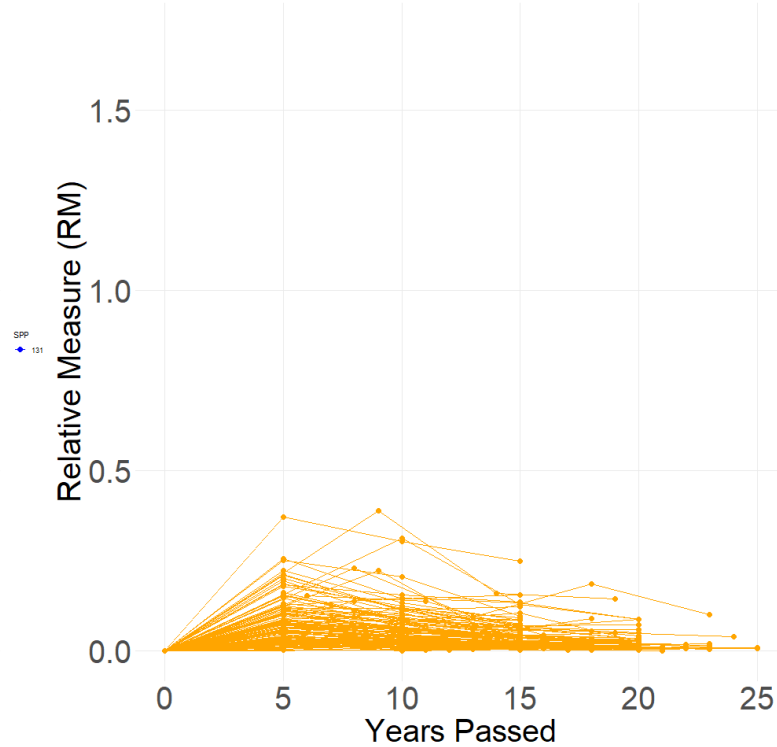


Results

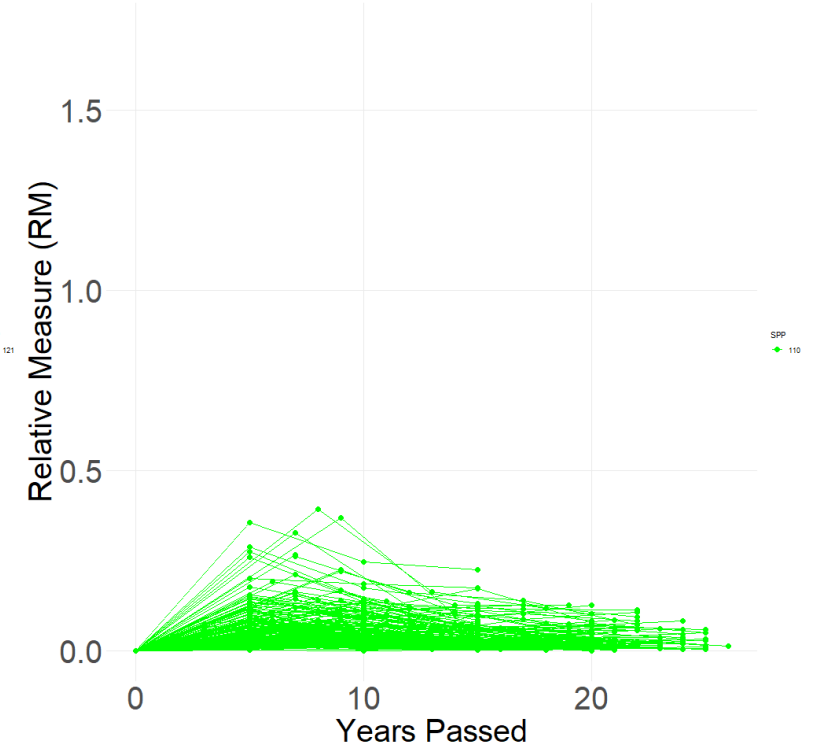
Relative Measure (RM) for Loblolly



Relative Measure (RM) for Longleaf



Relative Measure (RM) for Shortleaf



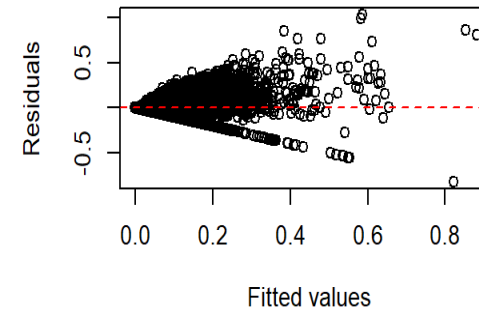
Results

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: RM2 ~ CDIA + CHT + Years_Passed + (1 | Unique_Tree_Identifier)
## Data: dat2
##
## REML criterion at convergence: -42251.2
##
```

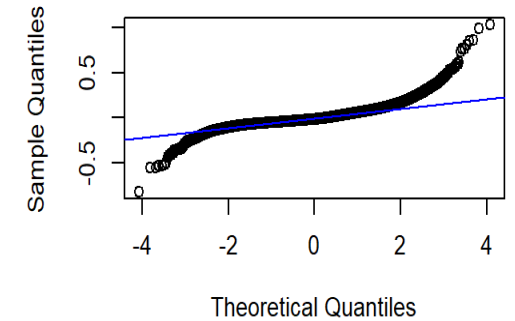
Fixed Effects Estimates

Term	Estimate	Std_Error	t_value
(Intercept)	-0.0067720	0.0042950	-1.577
CDIA	0.0014830	0.0004080	3.634
CHT	0.0009495	0.0000918	10.346
Years_Passed	0.0014620	0.0001456	10.045

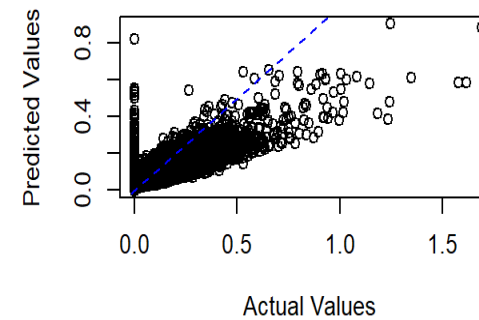
Residuals vs Fitted



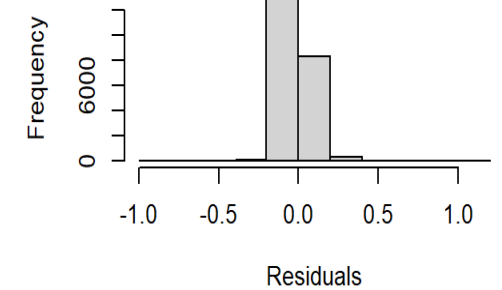
Q-Q Plot



Predicted vs Actual



Histogram of Residuals



Future Work

- **Non-linear regression.**
 - Adjustments to RM Value.
- **Clustering Growth Curves.**
 - **Grouping site and regional parameters.**
- Apply and adjusting modeling framework to hardwoods species.
- Considerations and Trail Markers.
 - Dr. Montes UGA lecture.
 - Ogana et al. (2025)



Acknowledgements



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