



Plantation Management Research Cooperative

Warnell School of Forestry & Natural Resources

UNIVERSITY OF GEORGIA

Fact Sheet

Plantation Management Research Cooperative (PMRC)

March 2022

Mission

Create value for its members by improving knowledge about forest plantations under different silvicultural management regimes, and by developing growth and yield systems and decision support tools that result in improved valuation of the plantation resource in a sustainable manner.

Approach

- Partnership between forest investors/management/service providers and The University of Georgia's Warnell School of Forestry and Natural Resources.
 - Forest investors/management/service providers and product manufacturers contribute annual dues and guide PMRC direction via participation on an Advisory Committee. Research plots are located on members' lands.
 - Warnell provides excellent faculty and staff support to direct and coordinate PMRC activities.

- South's most comprehensive series of designed research field trials to quantify the impact of silvicultural management activities and inform growth and yield decision support systems.
 - Allows evaluation of forest management regimes with objectives ranging from biomass to sawtimber production. Field trials are located from Virginia to Texas to Florida.
 - Singularly strong field trial program in planting density, vegetation control treatments, thinning intensity, treatment combinations and silvicultural regimes for both loblolly and slash pine.
 - South-wide field trials on pine plantation performance of thinned stands with fertilization and competition control combinations.

- Field testing emphasis is on true region-wide analysis to ensure widest applicability of resulting management tools and decision support systems.

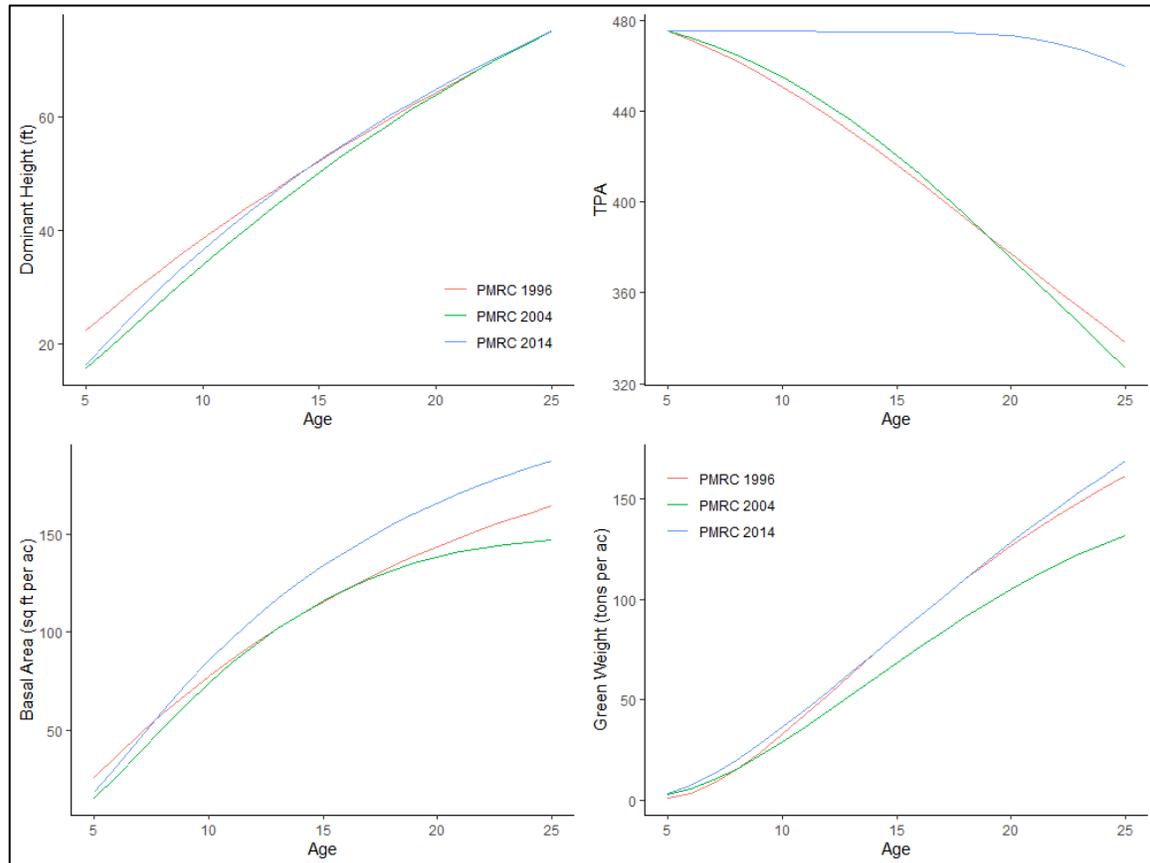
- PMRC field crew does 99% of the field related work, freeing member companies of these responsibilities and promoting greater quality and uniformity in maintenance and measurements.



A member of the PMRC field crew using a terrestrial LiDAR unit.

Products

- Growth and yield systems for loblolly and slash pine plantations
 - Whole-stand models including prediction and projection equations for dominant height, mortality, and basal area. Most PMRC models also include stand table prediction and projection equations, along with yield prediction equations (volumetric and tonnage-based) including breakdown functions for estimating product class distributions.

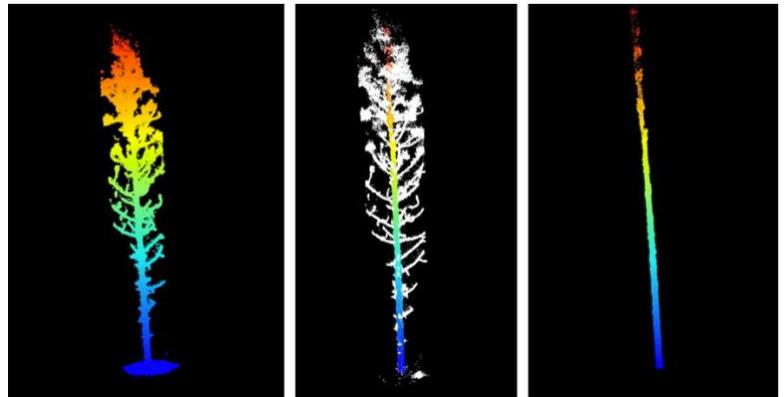
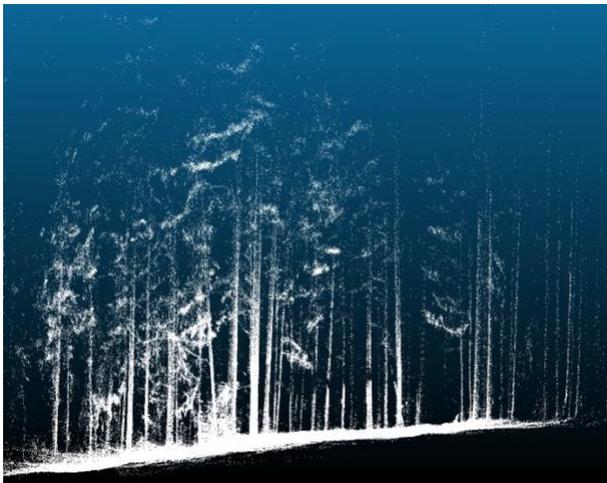


Dominant height, TPA, basal area, and green weight outputs from ages 5 to 25 for the PMRC 1996, 2004, and 2014 sets of growth and yield equations developed for loblolly pine plantations. Simulations were initiated assuming a planting of 500 TPA and a site index of 75 ft at base age 25.

- Stand response estimates for a comprehensive set of silvicultural treatments
 - Both height and basal area response models for common silvicultural treatments
 - Stocking control via planting density and thinning, mechanical and chemical site prep, tillage, herbaceous weed control, woody release, and fertilization, culture x genetic improvement
- Technology transfer integrating soils, silviculture, and growth and yield modeling
 - Reports, meetings, workshops, online decision support tools
- Loblolly, slash, and longleaf pine taper equations
- Comprehensive databases for loblolly and slash pine growing in the southeast US

Priorities

- Improve response models for mid-rotation treatments including thinning, release, and fertilization so they accurately reflect responses for a range of site and forest stand conditions.
- Enhance state of the art loblolly and slash pine growth and yield systems.
 - Use new data and approaches to improve base growth models, refine response models, and evaluate value of additional predictive variables (location, climate, soils, leaf area, etc.).
 - Refine understanding of the effects of genetics, soils, physiology and silviculture on pine plantation growth and yield and value.
 - Evaluate ways to incorporate new, remotely sensed data including easily accessible, satellite imagery and both aerial and terrestrial LiDAR measurements into future growth and yield systems.



- Develop growth and yield systems that accurately portray performance of advanced pine genotypes.
- Identify new approaches to enhance forest inventory quality and efficiency including the use of remotely sensed data.
- Improve predictions of biomass and carbon production and yields associated with southern pine plantations.
- Develop collaborative relationships with other institutions and researchers and grant funding to advance PMRC research objectives and increase the scope and efficiency of PMRC research.

Flagship Research Trials

➤ Mid-rotation Treatment Study (MRT)

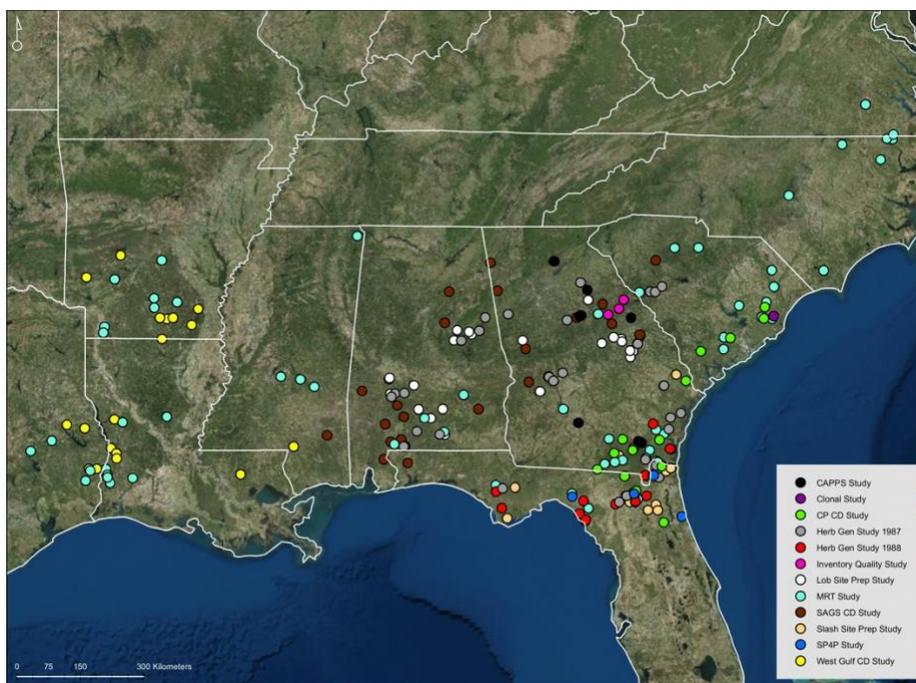
- Objective: Develop thinning and mid-rotation treatment response models for first- and second-thinned loblolly and slash pine plantations across the southeast US.
- Established: 2010 - 2018
- Design: 50 loblolly pine installations (25 first- and 25 second-thin) across the Lower Coastal Plain and Piedmont/Upper Coastal Plain of the southeastern USA along with 12 first-thin, slash pine installations. Each installation contains five plots including a control plot, thin-only plot, thin and fertilize plot, thin and herbicide plot, and thin + fertilize + herbicide plot. Installations were thinned to one of three basal areas: 50, 70, or 90 sq ft. Installations receive full remeasurements every other year.

➤ Coastal Plain and South Atlantic Gulf Slope Culture Density Studies (CPCD/SAGSCD)

- Objective: Evaluate the effects of intensive (multiple fertilizations, complete competition control) vs. high intensity operational management (fewer fertilizations, one year of banded weed control) on loblolly and slash pine plantations. The interaction of the intensity of the culture with planting density is also being studied.
- Established: 1996 – 1997 (CPCD) and 1998 – 1999 (SAGSCD)
- Design: 16 loblolly pine installations across the Lower Coastal Plain of Florida, Georgia, and South Carolina (CPCD) along with 24 loblolly pine installations across the Piedmont/Upper Coastal Plain of Alabama, Georgia, and South Carolina (SAGSCD). Each installation contains six intensive and six operational treatment plots planted at one of six densities: 300, 600, 900, 1200, 1500, and 1800 trees per acre (TPA). There is also a smaller slash pine component at nine of the CPCD installations. These six (three intensive and three operational) plots received the same treatments as the loblolly pine plots; however, the slash component was established at three different densities: 300, 900, and 1500 TPA. Installations receive full remeasurements once every three years and diameter only measurements during the two off years.

➤ Western Gulf Culture Density Study (WGCD)

- Objective: Evaluate the effects of intensive vs. operational management and to develop region specific silvicultural response models for loblolly pine plantations in the Western Gulf region of the southeast US. The interaction of the intensity of the culture, planting density, and thinning is also being studied.
- Established: 2000 - 2003
- Design: 18 loblolly pine installations established across Arkansas, Louisiana, Mississippi, and Texas. Each installation consists eight intensive and eight operational treatment plots planted at 200 (1 plot), 450 (2 plots), 700 (3 plots), 950 (1 plot), and 1200 (1 plot) trees per acre (TPA) for a total of 16 plots per installation. Additionally, one of the 450 TPA plots was thinned to 200 TPA, and two of the 700 TPA plots were thinned – one to 200 TPA and the other to 450 TPA. Installations receive full remeasurements every other year.



Geographic distribution of PMRC research trials. Data collected from all appropriate studies is used in PMRC modeling efforts.

Future Research Trials and Areas of Interest (in addition to current projects)

- The PMRC is currently developing two new region-wide research trails.
 - Enhancing forest productivity through optimizing management regimes for genetically improved southern pines
 - Quantify growth gains from genetically improved materials and intensive silviculture
 - A permanent sampling plot design to improve and validate current G&Y models
 - Operational validation plots located throughout the southeast US on industry land
- The PMRC is also becoming heavily involved in research related to the use of remotely sensed data including satellite imagery and both terrestrial and aerial based LiDAR data. These data are used to estimate important stand characteristics such as leaf-area index and standing volume and are also being used to develop taper and other biomass equations.

Active Research Trials (2022)

1. Coastal Plain Culture Density Study (CPCD)
2. Consortium for Accelerated Pine Production Studies (CAPPs)
3. Guyton Enhanced Genetics Trial
4. Mid-rotation Treatment Study (MRT)
5. PineMap – Tier III site
6. South Atlantic Gulf Slope Culture Density Study (SAGS)
7. Silviculture and Herbicide Cooperative SP4P Study
8. Western Gulf Culture Density Study (WGCD)

Recent Publications (2020 – 2021)*

- Kinane, S.M., C.R. Montes, T.J. Albaugh and D.R. Mishra. 2021. A model to estimate leaf area index in loblolly pine plantations using Landsat 5 and 7 images. *Remote Sensing*. 13-1140: 16 p.
- Kinane, S.M., C.R. Montes, and B.P. Bullock. 2021. A non-parametric framework to estimate fertilization response in loblolly pine plantations using environmental covariates. *Forestry*. 10 p.
- Munro, H.L., C.R. Montes, S.M. Kinane and K.J.K. Gandhi. 2021. Through space and time: Predicting numbers of an eruptive pine tree pest and its predator under changing climate conditions. *Forest Ecology and Management*. 483: 1 – 11.
- Koirala, A., C.R. Montes, and B.P. Bullock. 2021. Modeling dominant height using stand and water balance variables for loblolly pine in the Western Gulf, US. *Forest Science*. 479: 10 p.
- Zapata-Cuartas, M., B.P. Bullock and C.R. Montes. 2021. A taper equation for loblolly pine using penalized spline regression. *Forest Science*. 67-3: 1 – 13.
- Restrepo, H.I., B. Mei and B.P. Bullock. 2020. Long-term timber contracts in the southeastern United States: Updating the primer valuation framework. *Forest Science*. 66(6): 653 – 665.
- Zhao, D., C.R. Montes, B.P. Bullock, M. Wang. 2020. Culture/Density Studies: Results through age 21 on non-thinned loblolly pine plots. *PMRC Technical Report*. 2020 – 2. Warnell School of Forestry and Natural Resources. University of Georgia. Athens, GA. 43 p.
- Orrego, S., C.R. Montes, H.I. Restrepo, B.P. Bullock and M. Zapata-Cuartas. 2020. Modeling height growth for teak plantations in Colombia using the reducible stochastic differential equation approach. *Journal of Forestry Research*. 11 p.
- Restrepo, H.I., W. Zhang and B. Mei. 2020. The time-varying role of timberland in long-term, mixed-asset portfolios under the mean conditional value-at-risk framework. *Forest Policy and Economics*. 113 (2020): 10 p.
- Zhao, D., B.P. Bullock, C.R. Montes and M. Wang. 2020. Rethinking maximum stand basal area and maximum SDI from the aspect of stand dynamics. *Forest Ecology and Management*. 475 (2020): 1 – 10.
- Zhao, D., B.P. Bullock, C.R. Montes, M. Wang, J. Westfall and J.W. Coulston. 2020. Long-term dynamics of loblolly pine crown structure and aboveground net primary production as affected by site quality, planting density and cultural intensity. *Forest Ecology and Management*. 472 (2020): 1 – 14.
- McTague, J.P. 2020. Modelling stand-level attributes of loblolly pine in the Southern USA at age 11 as a function of breeding or genetic values. *PMRC Technical Report*. 2020 – 1. Warnell School of Forestry and Natural Resources. University of Georgia. Athens, GA. 38 p.

*These represent only a small sample of the most recent publications from PMRC sponsored work.

Membership

- Entities that own or control forest land, provide forestry management and consulting services, utilize forest products, have pine plantation allied businesses, or interest in the U.S. South plantation resource should consider membership.
- 2022 membership consist of sixteen full members, four supporting members, three allied members and three contributing members.
- Membership – The PMRC has a total of 29 forest industry members!
 - *Full Members:* American Forest Management, Campbell Global, CatchMark Timber Trust, Domain Timber Advisors, Forest Investment Associates, Four Rivers Land & Timber, Green Diamond Management Company, Hancock Timber Resource, Molpus Woodlands Group, PotlatchDeltic Forest Holdings, Rayonier, Resource Management Service, Superior Pine Products Company, Threshold Timber Corp, Timberland Investment Resources, The Westervelt Company, and Weyerhaeuser
 - *Supporting Members:* F&W Forestry Services, Forest Resource Consultants, Greenwood Resources, Roseburg Forest Products
 - *Allied Members:* ArborGen, International Forest Company, NCASI, NCX
 - *Contributing Members:* Beasley Timber Management, ForesTech International, The Rohatyn Group, Varn Wood Products
- 2022 full membership dues of \$26,000/year leverages about \$41 for every \$1 dedicated to core PMRC efforts. Dues are reduced for organizations based on the scale of operations and type of operations.
- Membership represents over 23.5 million acres of plantations in the U.S. South.

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Website

<http://pmrc.uga.edu>

(There is a members only website available as well with more detailed information)