Continuing Project

Variation in productivity, wood quality and soil carbon of ten conifer species across a gradient in water deficit

CAFS.21.85

Carlos Gonzalez (OSU), Kim Littke (UW), Jeff Hatten (OSU), Doug Mainwaring (OSU), Aaron Weiskittel (UM)

Presenters: Emily Von Blon (OSU), Erkan Babat (OSU)

Justification

Quantifying productivity and understanding how commercially and ecologically valuable species are sensitive to climate and water deficits can help to guide species selection and management decisions to enhance stand resistance and resilience to projected climate changes while serving as a mitigation tactic through increased carbon sequestration.

Grand fir (Wet site): 57 m^2 ha^{-1}

Grand fir (Intermediate site): 42 m^2 ha^{-1}

Grand fir (Dry site): 6 m^2 ha^{-1}

Objectives

For 10 species across a water deficit gradient in western Oregon:

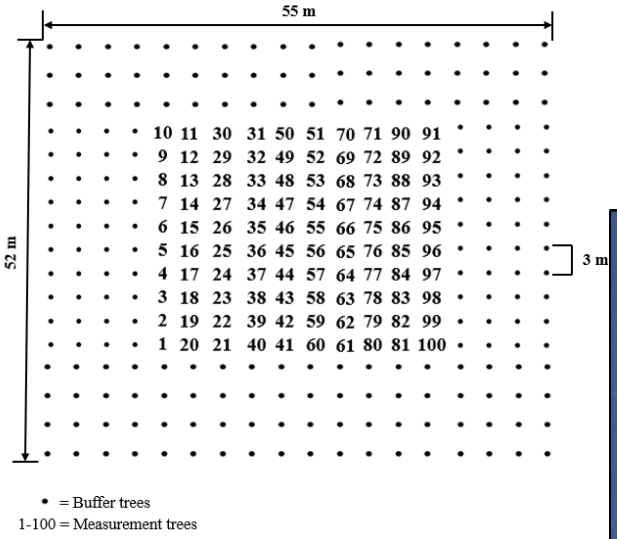
1. Measure and compare the cumulative, annual, and intra-annual growth rate.
2. Determine how each species' growth responded to seasonal climate variability and drought conditions through dendrochronology and growing season phenology.
3. Measure and compare the aboveground biomass stock, NPP, soil organic matter, and nutrient pools.
4. Correlate environmental factors with NPP, intercepted radiation, litterfall, LAI, and soil OM.

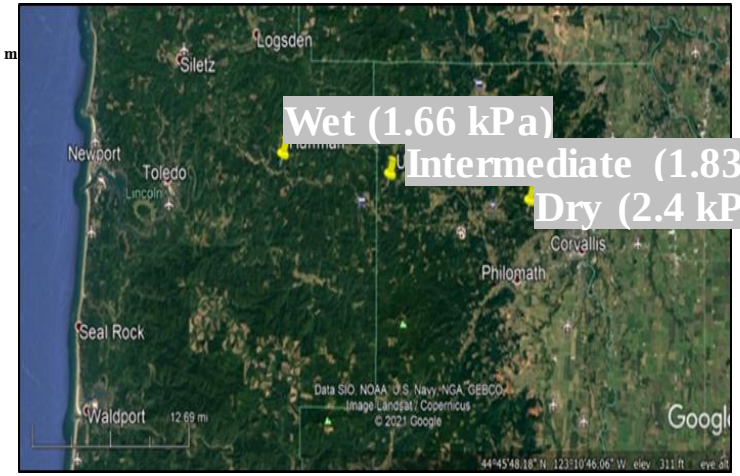
Project Overview

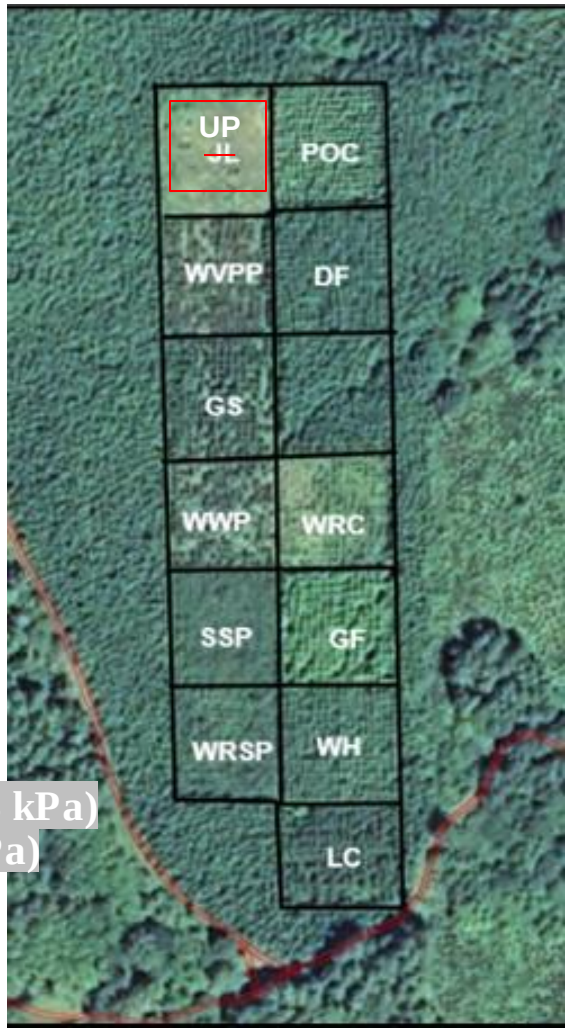
A species comparison study was installed in 1996 by Starker Forests in western Oregon.

11 native and non-native conifer species were planted in three sites along a water deficit gradient from the western Coast Range to the Willamette Valley.

Species	Abbreviation
Douglas Fir	**DF**
Grand-Fir	**GF**
Giant Sequoia	**GS**
Natural Regeneration	**UP**
Leyland Cypress	**LC**
Port Orford Cedar	**POC**
Sitka Spruce	**SSP**
Western Hemlock	**WH**
Western Redcedar	**WRC**
Sitka Spruce (Weevil Resistant)	**WRSP**
Willamette Valley Ponderosa Pine	**WVPP**
Western White Pine (Blister Rust Resistant)	**WWP**







Current Progress

Activities	2021				2022				2023				
	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Plot Layouts & Weather Station Installation	✓												
Tree Inventory	✓				✓				✓				
Diameter Growth Measurements	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Litterfall & LAI	✓	✓	✓	✓	✓	✓	✓	✓	✓				
Midstory & Understory Sampling			✓				✓						
Soil Sampling (forest floor, mineral soil, PRS)						✓							
Tree Core Collection					✓								
Tree Ring Measurements						✓							
Data Analysis						✓	✓	✓	✓	✓			

Summary of Past Findings

Across all species and sites, we explored:

- CAI, volume, and survival at age 25, 26, and 27

- Annual BAI, latewood BAI, and latewood percentage as derived from wood cores
  - Species by site by year interactions
  - Influence of climate variables
  - Wood basic density

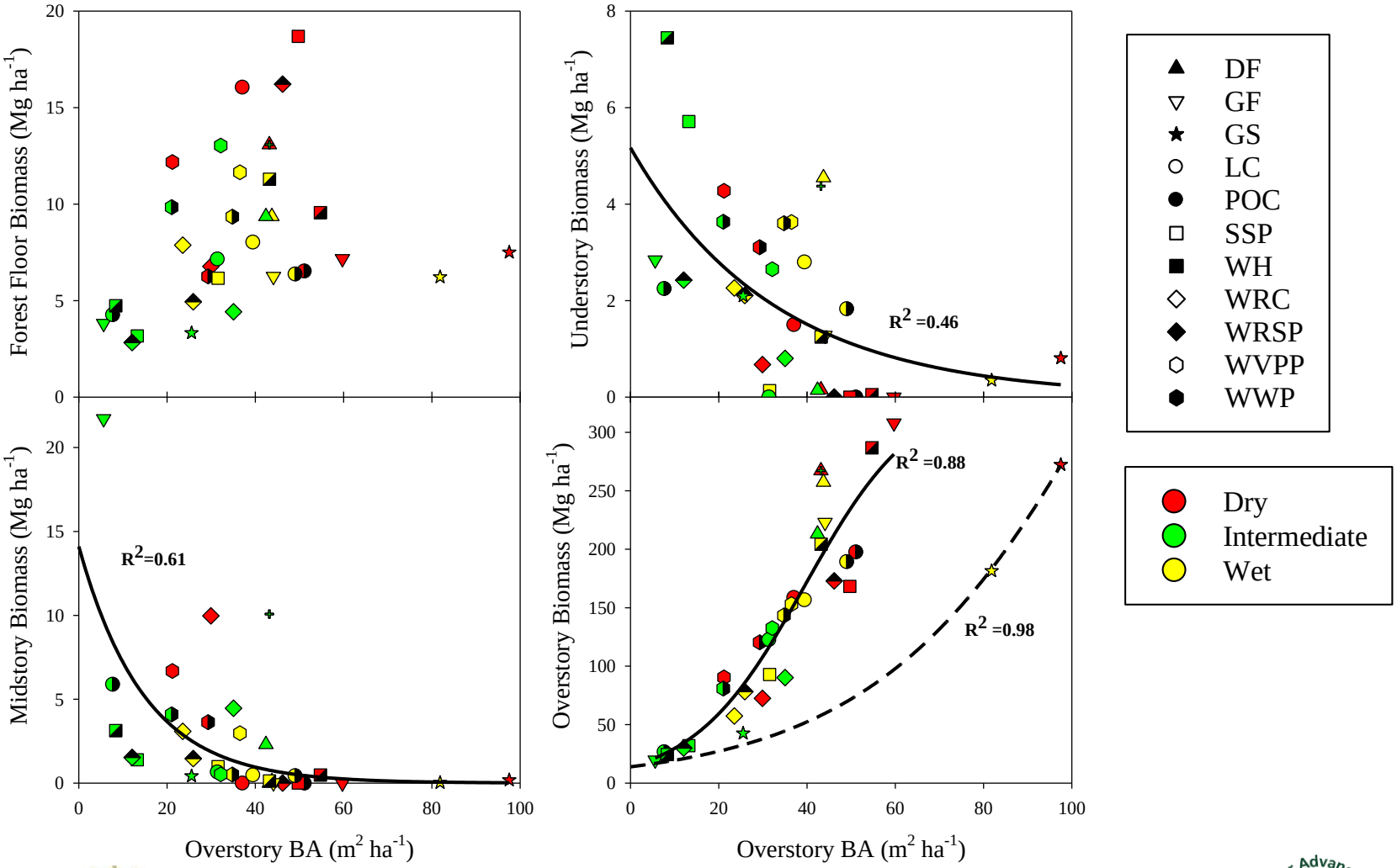
- Growing season phenology (cumulative BAI, growing season length, and timing of growth initiation and cessation)
  - Species by site by year interactions
  - Influence of climate variables

- Above and belowground biomass by ecosystem component

- Soil nutrient bioavailability

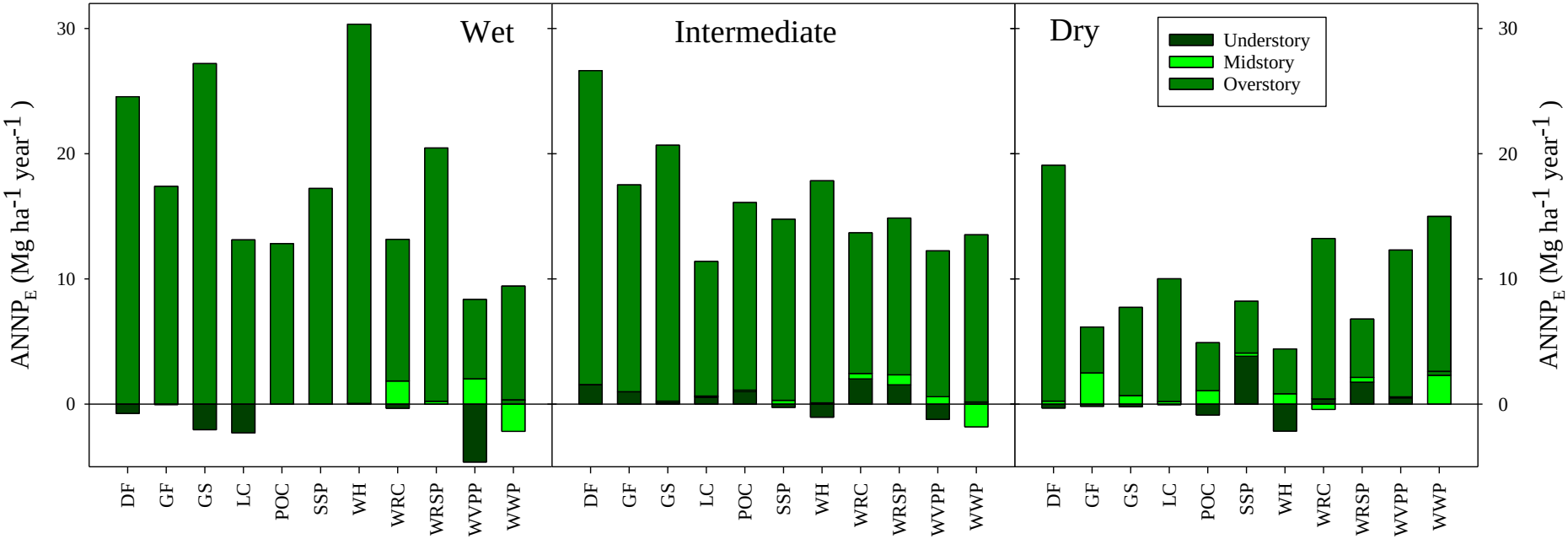
Recent Findings

Relationship between Overstory Basal Area and biomass of Ecosystem Components



Recent Findings

Ecosystem Annual Net Primary Productivity

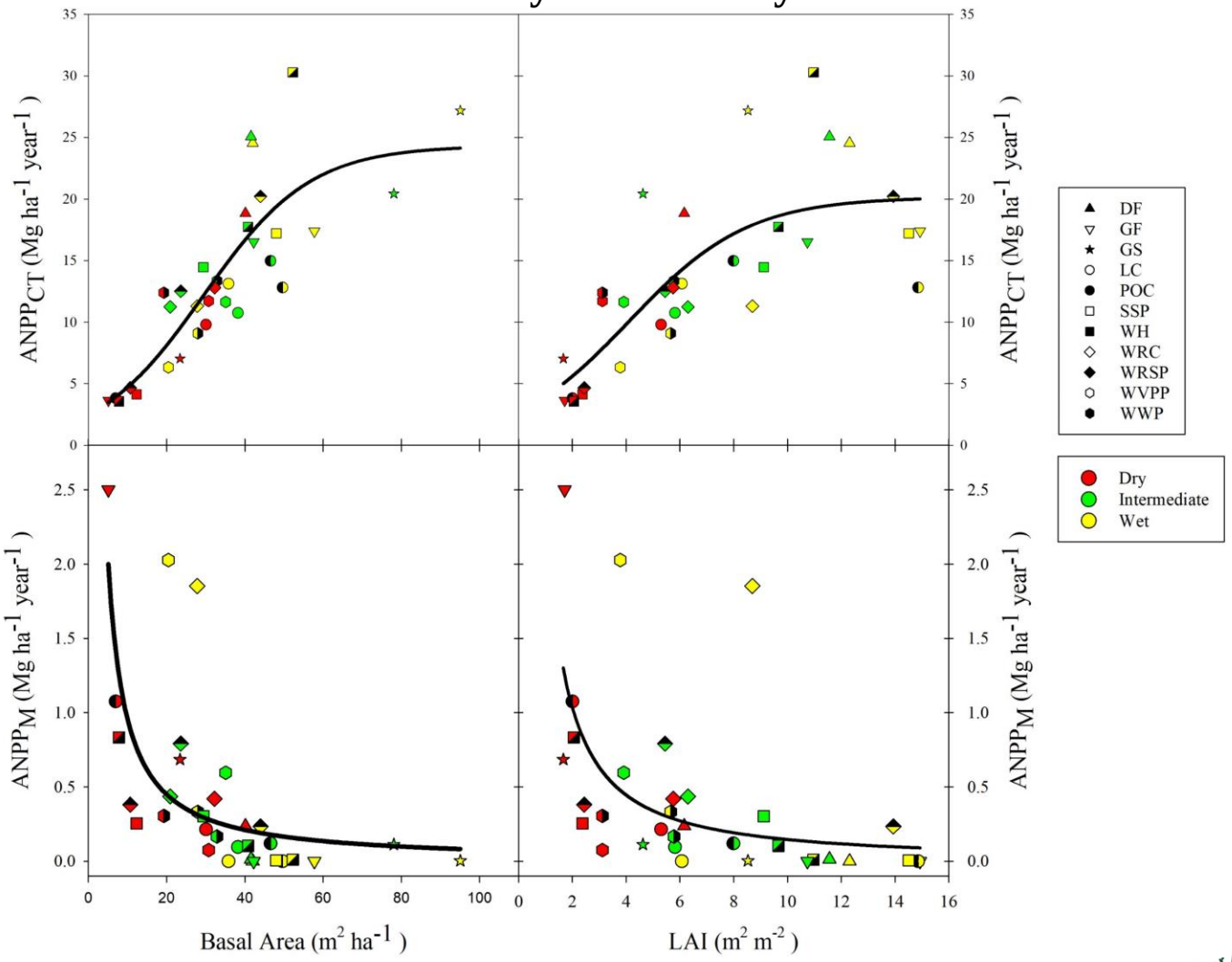


Recent Findings

Relationship between LAI and Basal Area with Annual Net Primary Productivity

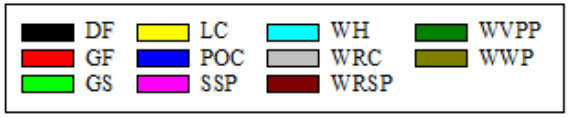
Crop Tree

Midstory

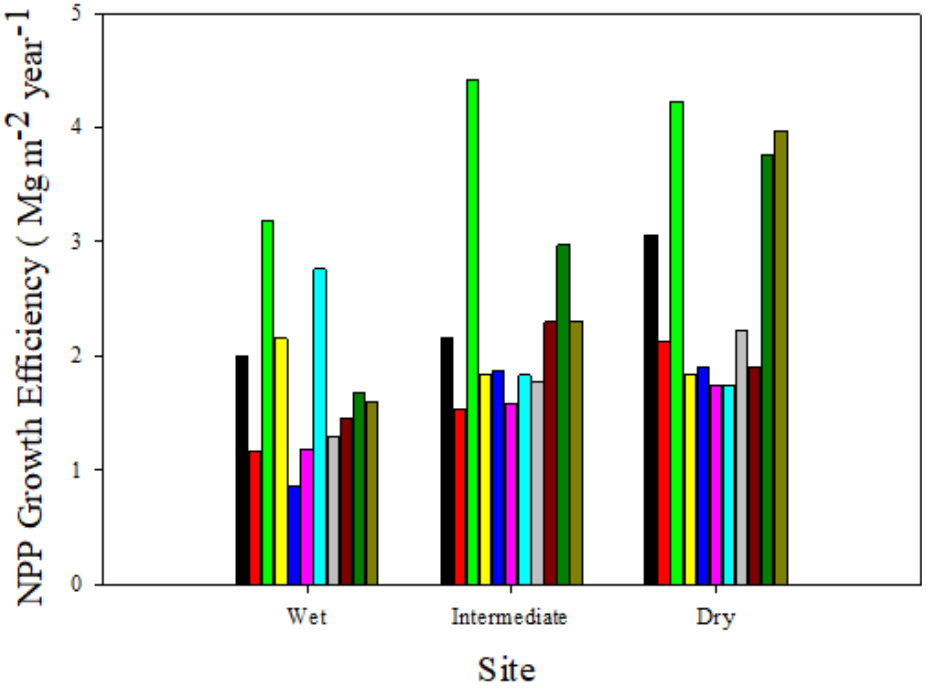


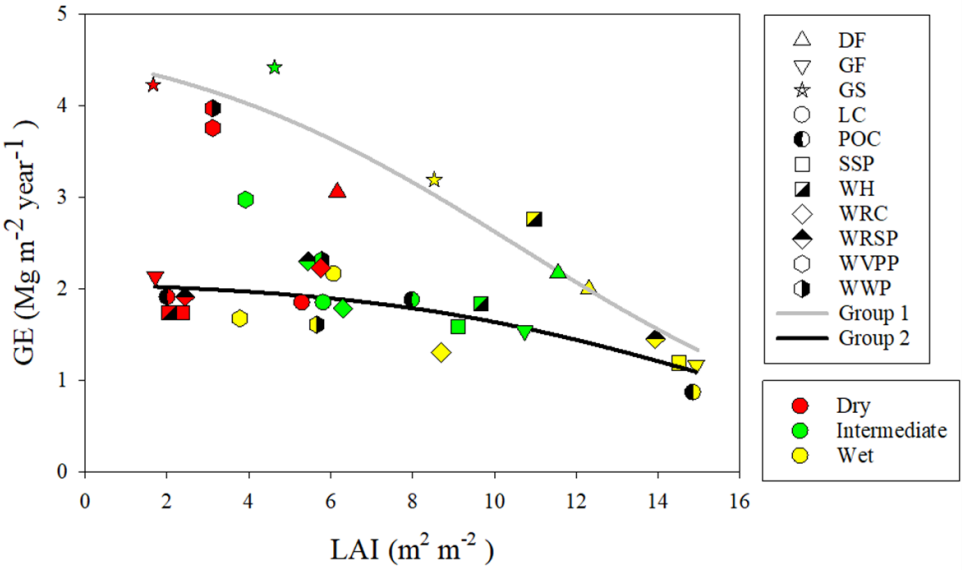
Recent Findings

Net Primary Productivity Growth Efficiency (Mg m^{-2} year^{-1})



$$Growth\ Efficiency = \frac{NPP}{LAI}$$





Means (Mg m^{-2} year^{-1})		
Wet	Intermediate	Dry
1.75	2.39	2.59

	Species
Group 1	DF, GS
Group 2	GF, LC, POC, SSP, WRC, WRSP

Future Plans

Ongoing Activities (to be completed in 2023):

- Measure Midstory (DBH) and Understory (cover, height)
- Measure Forest Floor on UP plots
- Collect soil samples
- Measure dendrometer bands

Next Steps:

- Incorporate all information collected in this study into 3-PG forest growth model
- Develop manuscripts

Potential Research:

- Evaluate climate change effects on growth of all species
- Ring-specific density
- Intrinsic water use efficiency during particularly droughty and wet years

Company Benefits

This study can inform:

•Forest growth models to predict forest response to climate change and carbon sequestration potential.

•Where proactive management is required across species ranges and prioritize the management of potentially vulnerable forests under climate change.

• Where species are predicted to expand their range and inform assisted migration efforts.

Giant sequoia (Wet site)

Giant sequoia (Intermediate site)

Giant sequoia (Dry site)