Continuing Project

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

CAFS.21.85

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Presenter: Carlos Gonzalez

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 diameter 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.

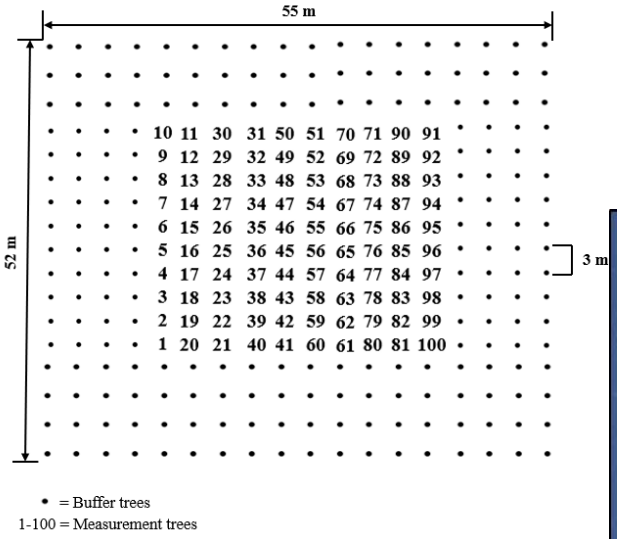
4. Correlate environmental factors with NPP, intercepted radiation, litterfall, LAI, and soil OM.

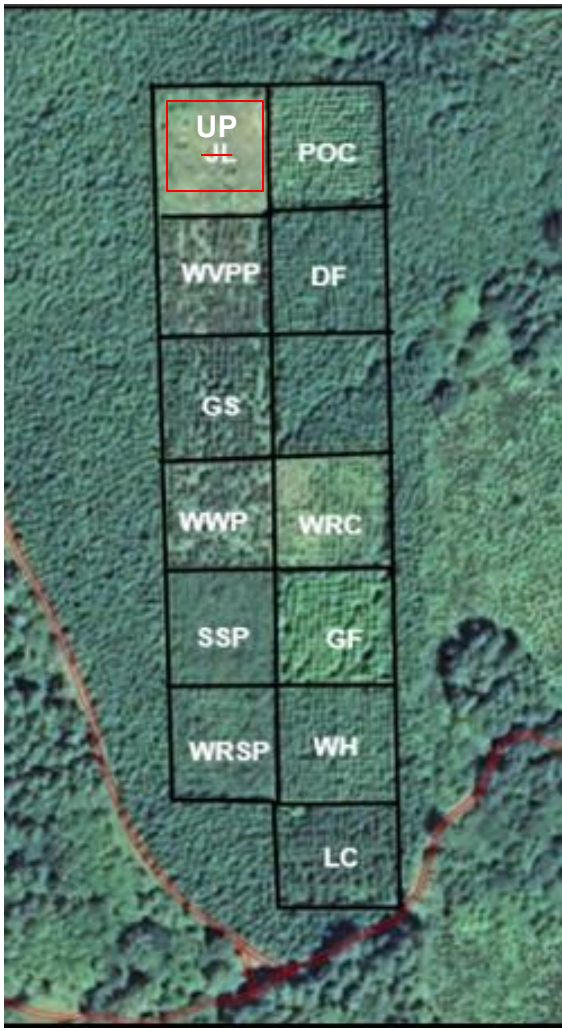
Project Overview

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 (Unplanted)	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





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)

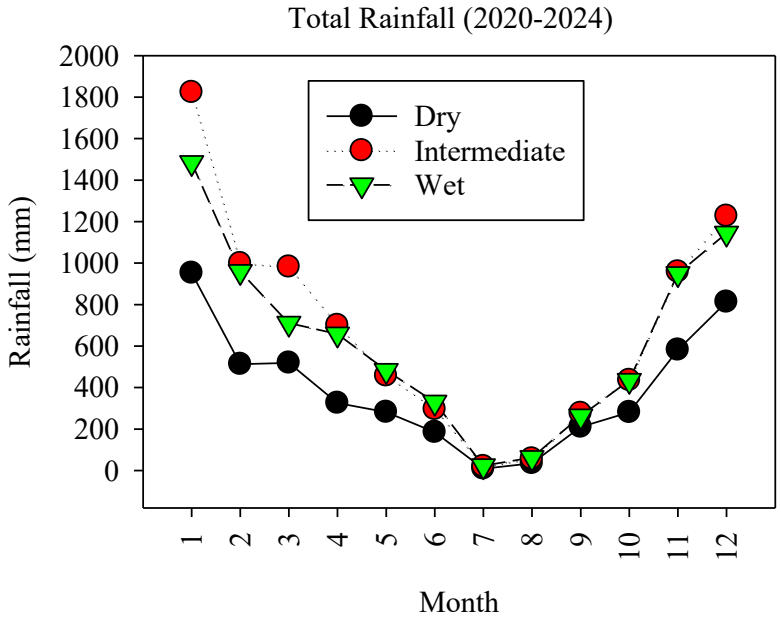
Giant sequoia (Dry site)

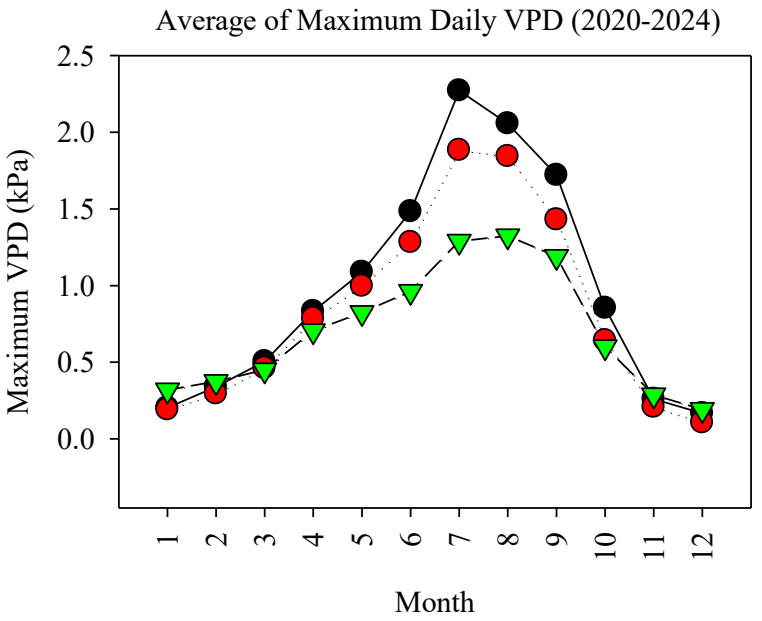
Completed Measurements

Measurements	Timeline
Overstory Inventory (Height, Diameter, Survival)	Annually (2021-2024)
Midstory Inventory (Diameter, Species ID)	Annually (2021-2024)
Understory Sampling (% Cover, Height, Species ID)	Annually (2021-2024)
Forest Floor Sampling	2022 and 2023
Soil Sampling (3 Points, 4 Depths)	2022 and 2025
Litterfall and LAI	Bi-Monthly (2021-2023)
Tree Core Collection and Measurements	2022
Growing Season Phenology	Monthly (2021-2023, 2025)




New Results: Weather





Growing Season Conditions (May-Sept, 2020-2024)

Site	Rain (mm)					Max VPD (kPa)					Water Balance (mm)				
	2020	2021	2022	2023	2024	2020	2021	2022	2023	2024	2020	2021	2022	2023	2024
Wet	317.9	163.7	325.6	131.1	250.6	0.76	1.31	0.98	0.97	1.57	205.6	56.4	224.7	30.1	180.1
Intermediate	272.9	156.9	318.6	114.9	243	0.97	1.63	1.46	1.86	1.53	156.4	46.0	210.2	1.1	172.9
Dry	181.2	111.2	192.2	85.1	150.5	1.15	2.06	1.81	1.63	1.97	58.4	-15.6	70.2	-39.4	70.7

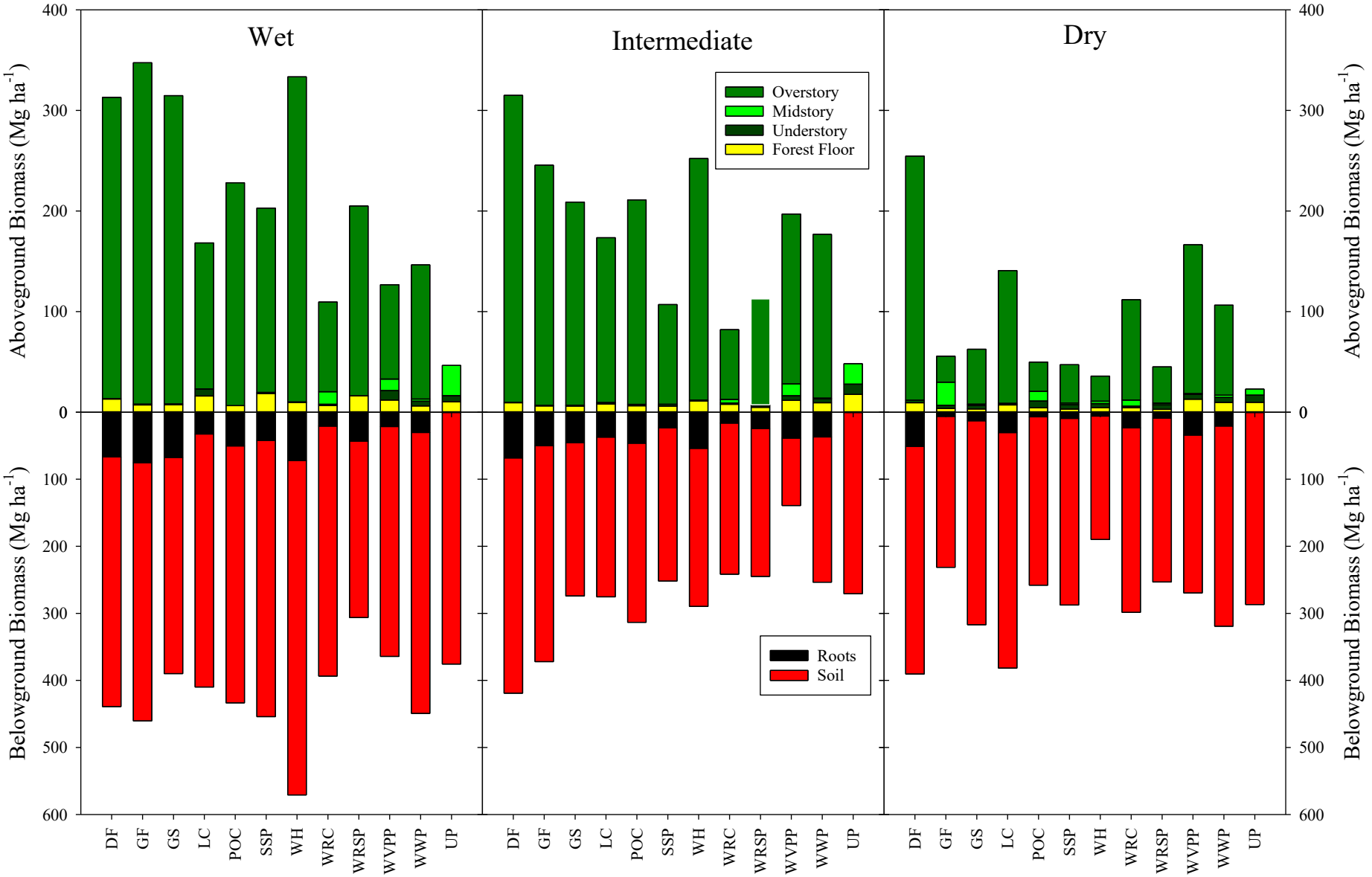
Collection of 2 additional soil samples (288 total) at depths:

- 0-15cm
- 15-30cm
- 30-50cm
- 50-100cm

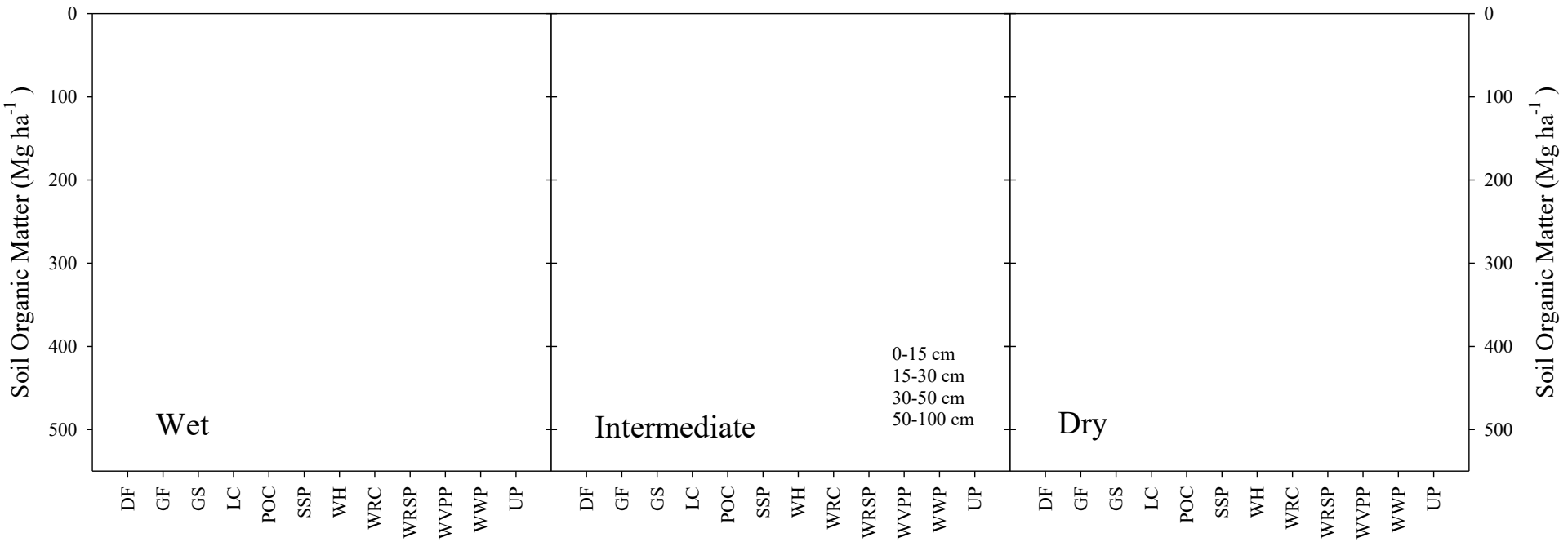
Protocol:

- Dried for 72hr at 70°C
- Separated roots
- Grinded soil (manual/blender)
- Sieved (2mm)
- Weighed roots, soil and rocks

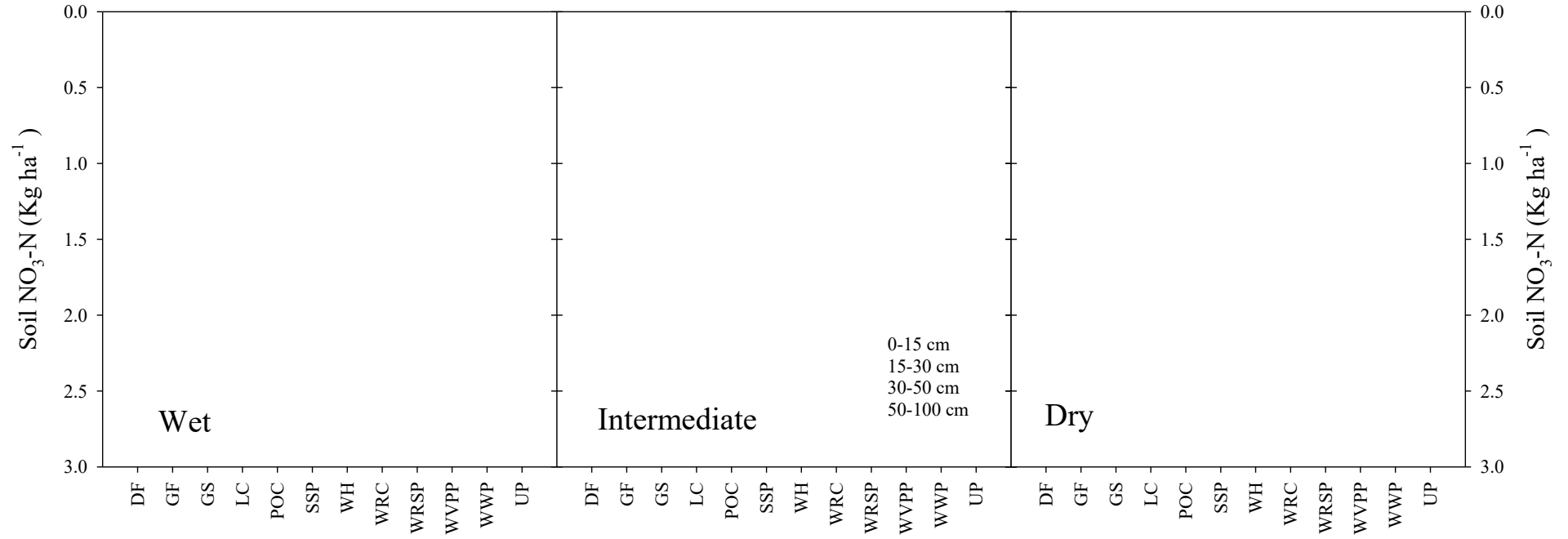
New Results: Ecosystem Biomass



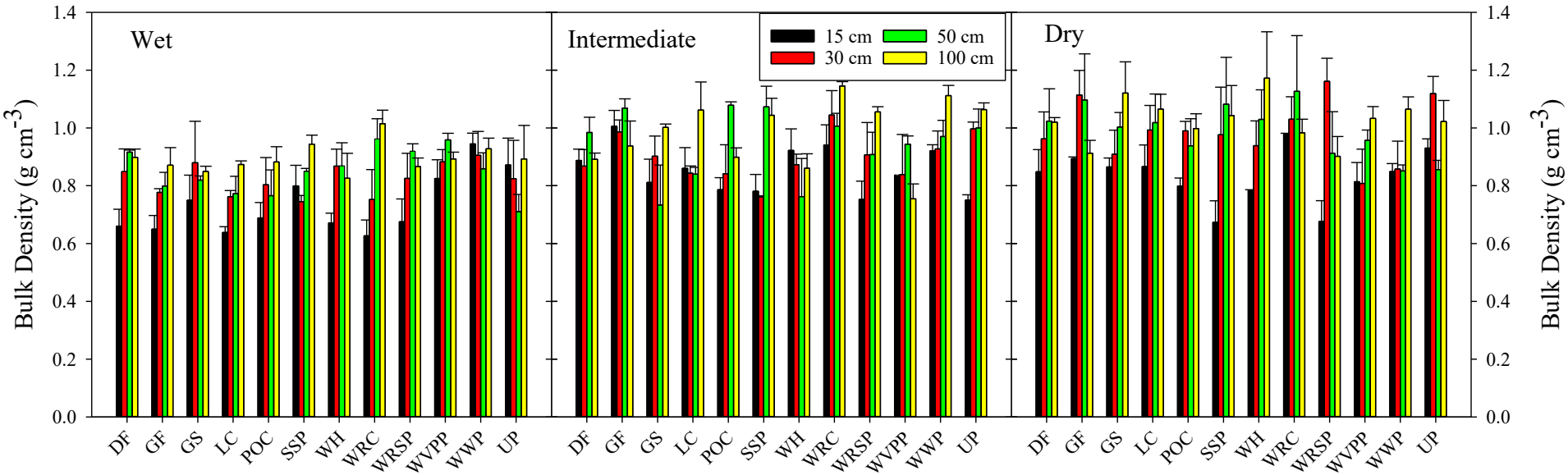
New Results: Soil Organic Matter



New Results: Soil $NO_3 - N$



New Results: Soil Bulk Density



Future Plans

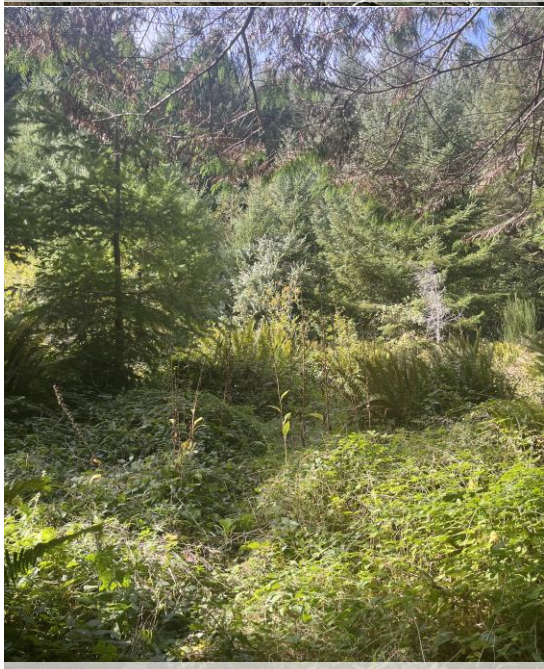
Ongoing Activities:

- Update climate-growth relationships using new data (Summer 2025)
- Develop manuscripts to submit for publication (Fall/Winter 2025)

Future Research:

- Ring-specific density
- Intrinsic water use efficiency during particularly droughty and wet years ($\delta^{13}C$)
- Calibrate 3-PG forest growth model from study data
- Evaluate climate change effects on growth of all species

Western Hemlock (Wet Site)



Unplanted (Wet Site)