Utilizing FVS Growth Predictions for Reforestation in Northern California

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Overview:

- We leveraged 20 years of growth data from the Garden of Eden experimental plots in Northern California, evaluating the effect of FVS variant, age, competing vegetation control, fertilizer, and site index on top height, basal area, and quadradic mean diameter of ponderosa pine trees.
- FVS bare ground predictions were most accurate for top height in control plots (fig. 1). Growth predictions did not often align with each site's geographic variant. Furthermore, the best fit models for top height, basal area, and quadratic mean diameter included sites with competing vegetation control (herbicide), grown to 20 years old, and with high site index (fig. 2).
- Top height FVS predictions can be accurately used with or without intensive management. However, basal area and quadratic mean diameter predictions are most accurate when planning to use competing vegetation control and to grow stands for at least 20 years.

Summary:

- In California, climate change, dramatically manifested in the increasing severity and extent of wildfires, is renewing interest in tools to guide silvicultural treatments for reforestation. Managers often face difficult decisions regarding the potential use of herbicides, which are commonly an essential competing vegetation control method for assuring reforestation success in the region. Young stand fertilization may also help quickly achieve forest resilience and resistance to reburns.
- The Forest Vegetation Simulation (FVS) is a commonly used tool for silvicultural planning on National Forest System lands in the region. However, regional FVS variants currently lack a way to integrate the effects of vegetation control or young stand fertilization.
- We leveraged 20 years of growth data from the Garden of Eden experimental plots in Northern California. Six study sites represent a gradient of site quality, from the poorest to the best, within the natural range of the ponderosa pine forest type in the Coast Ranges, Klamath Mountains, southern Cascades, and Sierra Nevada. The experimental plots have a factorial experimental design, with two levels of fertilization (applied or

not applied) and two levels of vegetation control (complete or none). Treatments were applied for the first several years of growth.

- We compared FVS bare ground simulations to measured growth data (top height, basal area, and quadratic mean diameter) at 10 and 20 years old. We also compared FVS models using the Inland California (CA), Northern California Klamath Mountain (NC), and Western Sierra Nevada (WS) variants.
- With this dataset, we evaluated potential benefits and trade-offs of competing vegetation control and fertilization for reforestation success. In addition, we plan on developing a simple workflow for managers to incorporate these treatments into planning.

Key Concepts for FVS Users:

- FVS bare ground simulations (density = 681 trees/acre, 100 percent survival, uniform spatial distribution, no sprouting) accurately predicted top height (fig. 1), but not basal area and quadratic mean diameter for the Garden of Eden experimental plots.
- Growth predictions did not align with their geographic variant. Top height was most accurately predicted by the Inland California (CA) variant, which overlays the geographic location for most of the study sites. Basal area and quadratic mean diameter were best predicted by the Northern California Klamath Mountains (NC) variant, which does not correspond with any of the study sites' geographic location.
- The most accurate FVS predictions for top height, basal area, and quadratic mean diameter were for plots with competing vegetation control (herbicide), grown to 20 years old, and in high quality (high site index) sites (fig. 2).

Management Applications/Future Directions:

- For California forest managers not planning to use competing vegetation control in their reforestation management plans, utilizing top height predictions from FVS bare ground simulations will most accurately reflect actual growth data in the field (compared to basal area and quadratic mean diameter). Additionally, focusing efforts in areas with high site indices and growing stands to at least 20 years old will also increase FVS model accuracy. Accurate top height estimates are important as indicators of susceptibility to crown scorch during reburns.
- For managers planning to use competing vegetation control in their reforestation management plans, top height, basal area, and quadratic mean diameter can accurately be used to predict growth. However, it is important to note that the FVS bare ground simulations will accurately predict growth only with competing vegetation control and when stands are grown for at least 20 years. Assuring the accurate prediction of basal area and quadratic mean diameter would be important for anticipating effects on carbon stocks and stem fire resistance.

- Our next steps are to re-evaluate the models, calibrate them with 5-year height and mortality data, and bin site indices. Furthermore, we plan on creating an updated scientific guidance and decision support tool for California national forest managers to aid the planning and monitoring of silviculture treatments using FVS.

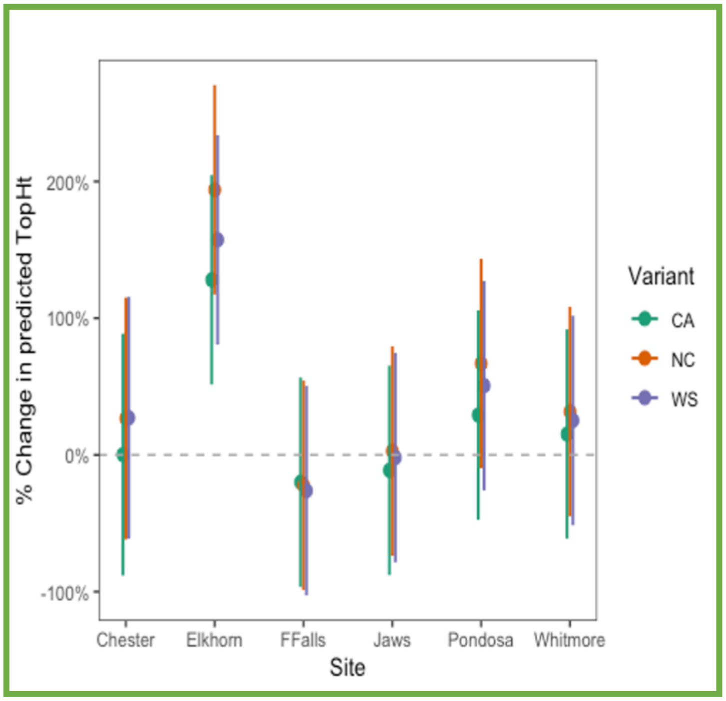

Figure 1—Percent difference in predicted top height between FVS bare ground simulations and measured data from the Garden of Eden experiment. Data are pooled from stands at both 10 and 20 years old. Top height was accurately predicted by FVS for 5 of 6 sites, across the 3 tested variants (Inland California [CA], Northern California Klamath Mountains [NC], and Western Sierra Nevada [WS]).

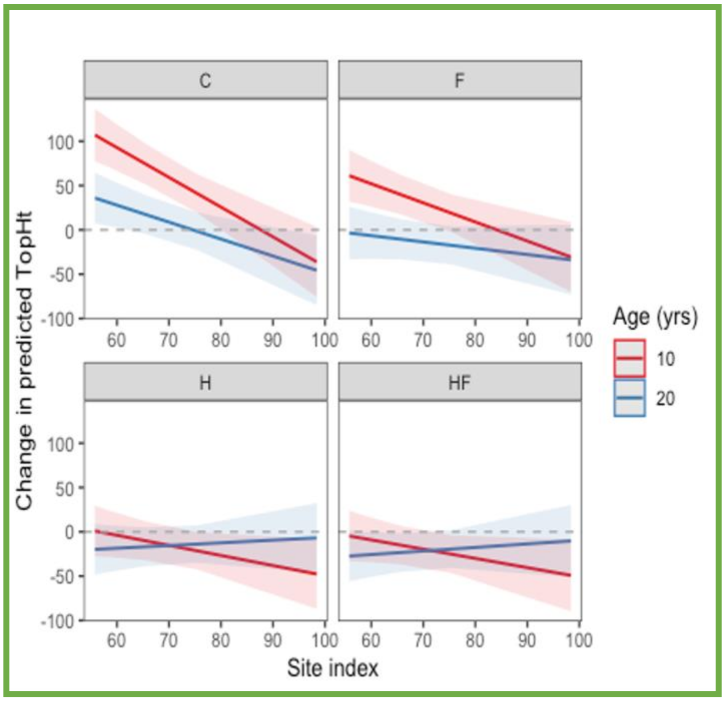

Figure 2—Percent difference in predicted top height between FVS bare ground simulations and measured data from the Garden of Eden experiment. The best fit model was for the Inland California (CA) variant:
top height = age × SI + age × trt + SI × trt,
where SI = site index and trt = treatment.