Continuing Project

Stand and Tree Responses to Late-Rotation Fertilization

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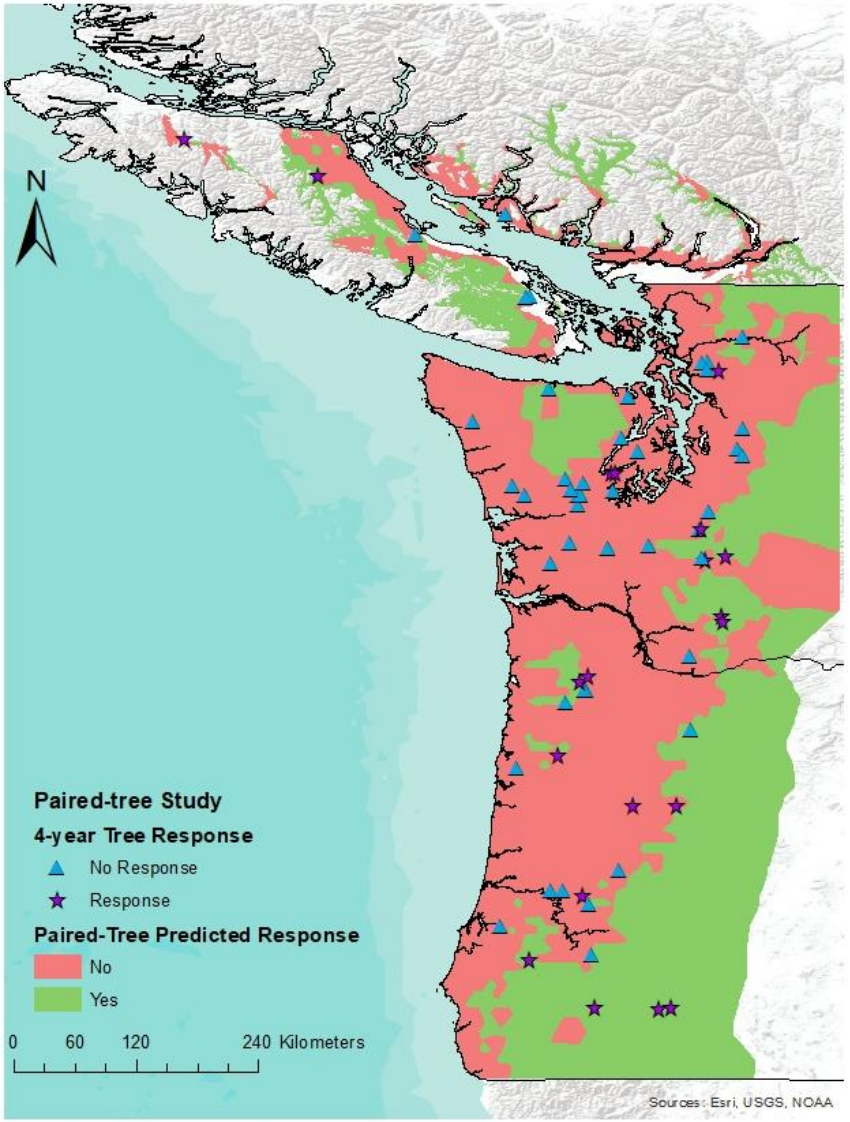
Justification

- Pacific Northwest Douglas-fir have responded the best to N fertilization
- Paired-Tree fertilization study found the greatest response on stands with:
  - High elevation
  - Low-moderate site index
  - Cold spring temperatures
  - Low summer precipitation
  - Southern latitudes
- Focusing fertilization on responding, late-rotation stands that are 8-10 years to harvest can decrease the risk and cost of fertilization

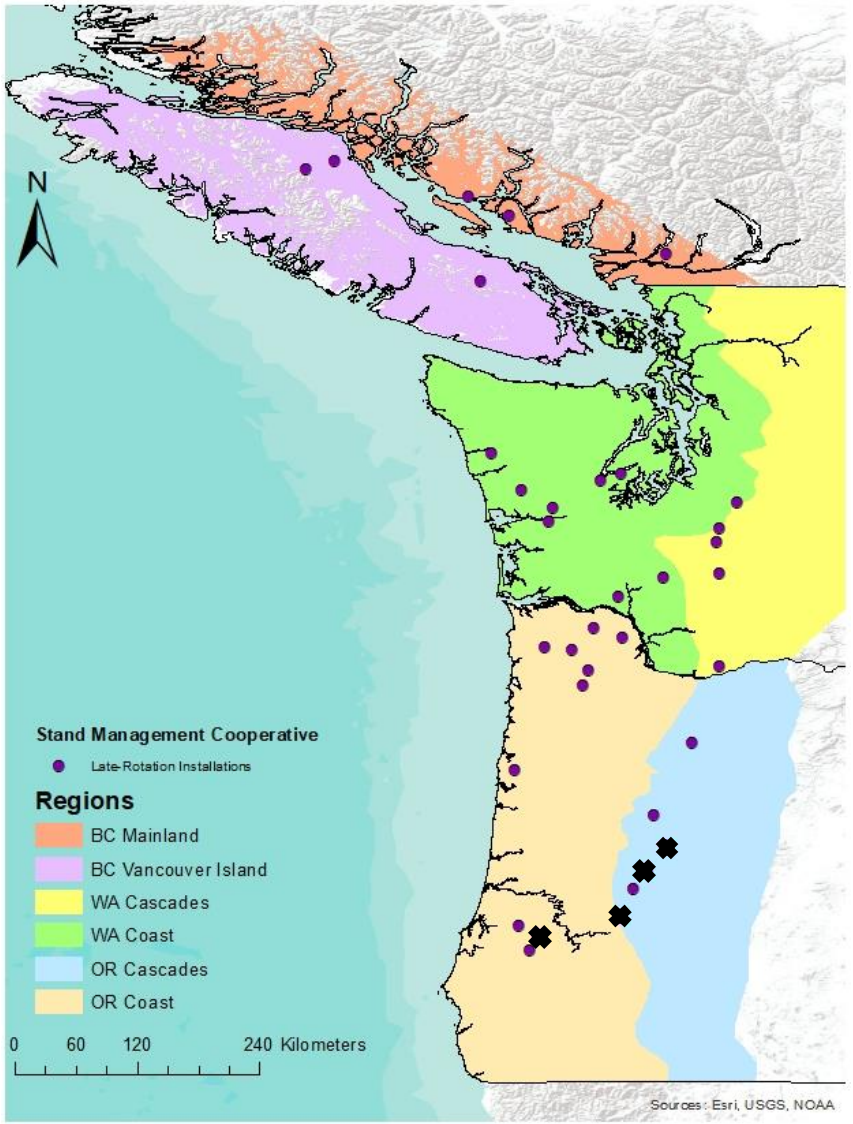


Objectives

- Determine the average, area-based volume response to late-rotation fertilization
- Estimate the regional economic returns of late-rotation fertilization
- Validate the models developed from the CAFS supported Paired-Tree Study
- Assess the ability to predict response to fertilization using plant root simulator (PRS) probes

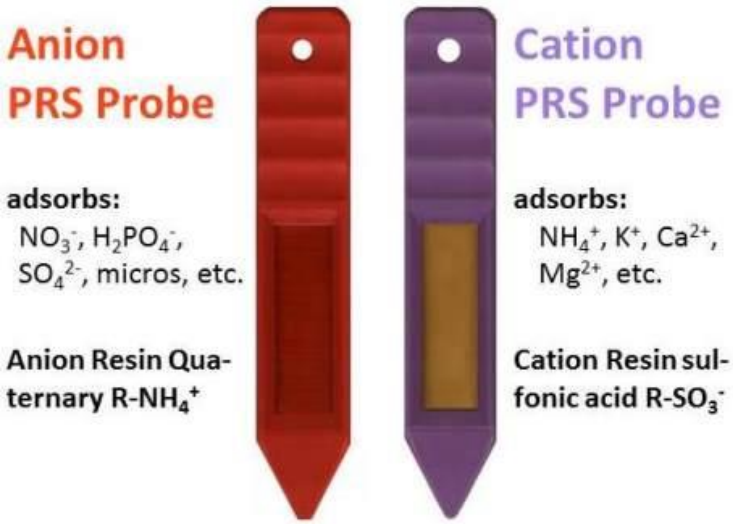
Methods

- Randomly chosen latitude/longitude coordinates
- 30-50 years total age
- Plots are 0.25-0.5 ac. circular
- Paired by most similar DBH distribution and plot TPA and BA (<10% difference)
- One plot in each pair randomly assigned the fertilizer treatment (224 kg N ha^{-1})
- Measure fertilizer response over 2-8 years and at harvest
  - All installations measured for two- and four-year response
  - 11/34 installations measured for 6-year response
  - Four installations destroyed by fire or windstorms will be replaced Spring 2024



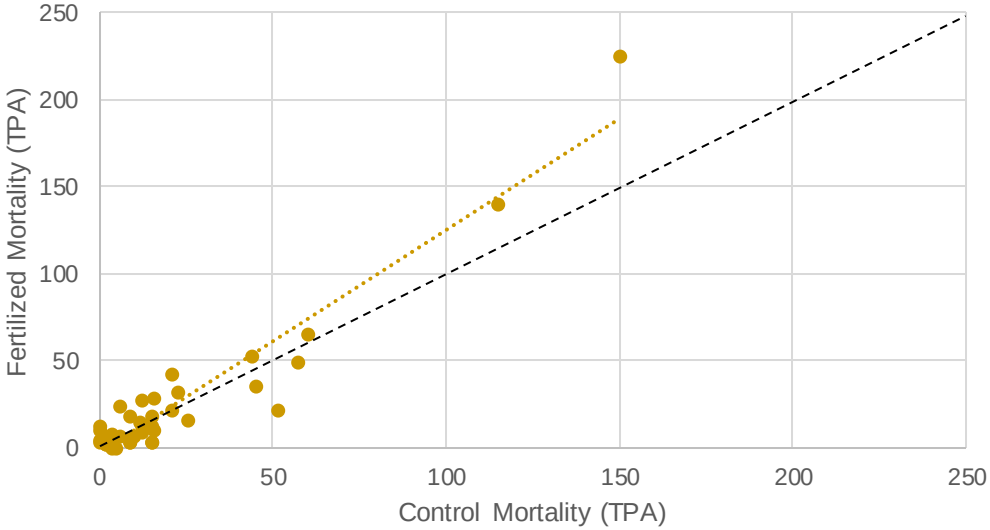
Methods

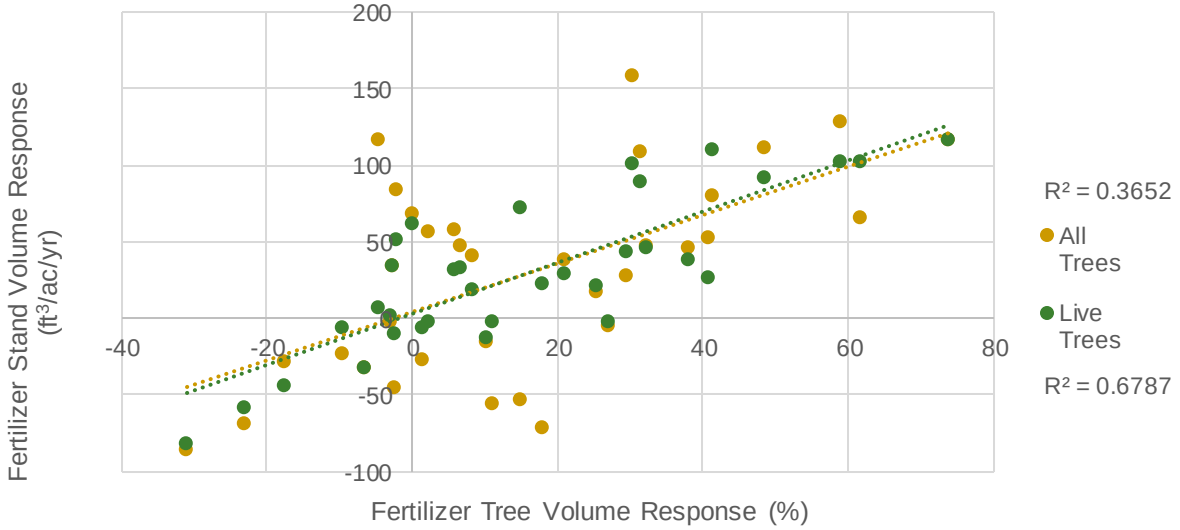
- At each paired plot, sampled one soil pit to 1 meter
- Installed Plant Root Simulator (PRS) probes over 12 weeks in control and fertilized plots prior to fertilization
- Foliage, branch, and tree core samples were sampled for total nutrients



Major Findings

- No significant effect of fertilization on mortality at 4-years
- Removing dead trees from stand volume response calculations reduces the noise from dead trees within a small plot
- Positive correlation between 4-year tree volume response and stand volume response (all trees and live trees)

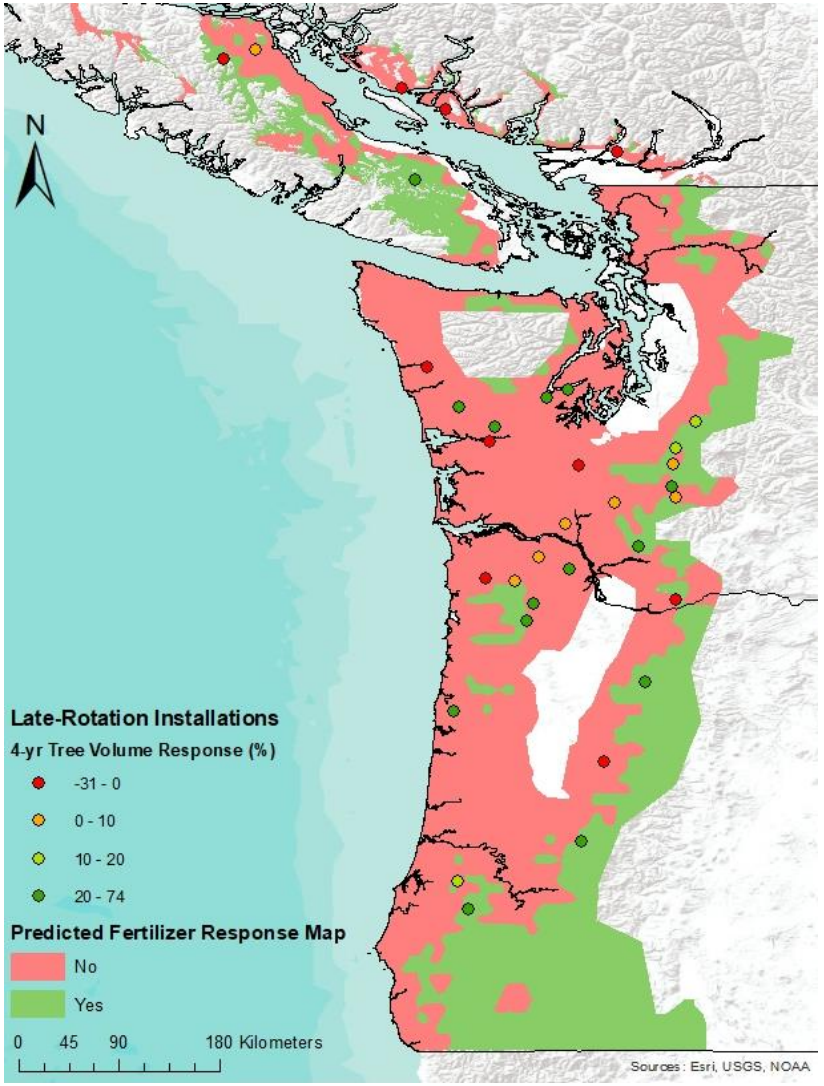




Major Findings

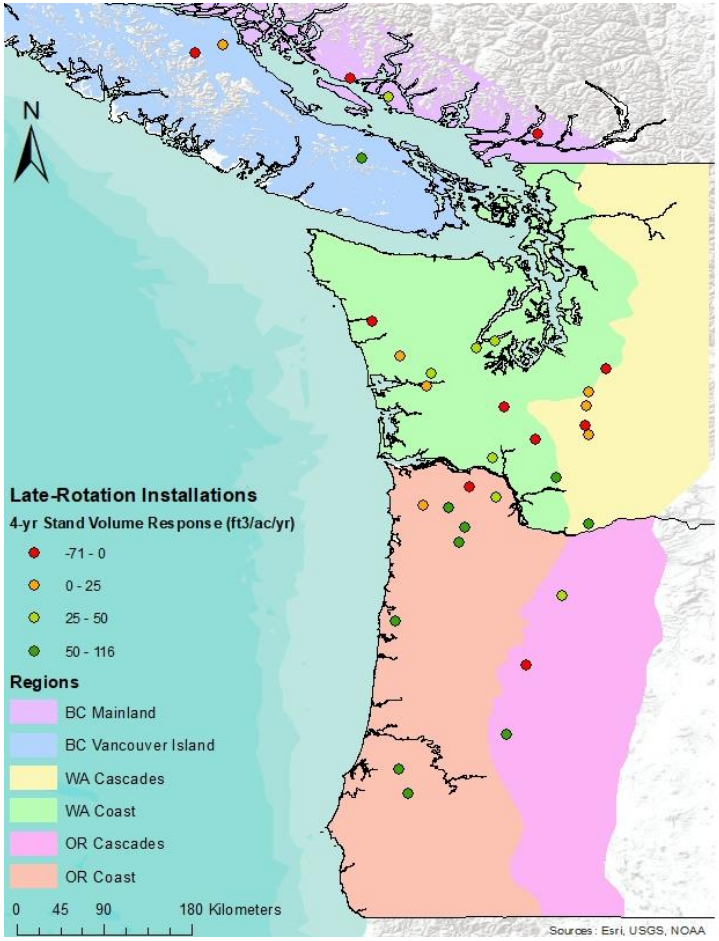
- Significantly greater tree and stand volume response in predicted response regions from the Paired-Tree Study
- Predicted response regions also contained lower site index, PRS NO_3, and foliar N and greater forest floor and surface soil C:N ratio
- Predicted response regions are responding due to N limitations

Predicted	4-year Tree (%)	4-year Stand (ft^3/ac/yr)	Site Index (ft at 50 years)	PRS NO_3 ($\mu g/10cm^2$/ burial length)	Foliar N (%)
Response	**27 ± 28**	**59 ± 45**	**132**	**14**	**1.21**
No Response	11 ± 22	17 ± 47	141	72	1.30



Major Findings

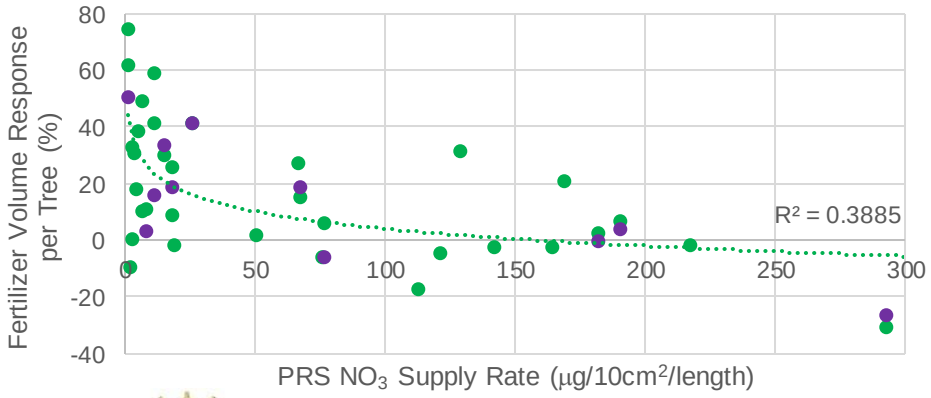
- No significant difference in response per acre within each region
- Greater volume response per tree and per acre in BC Vancouver Island and Oregon West

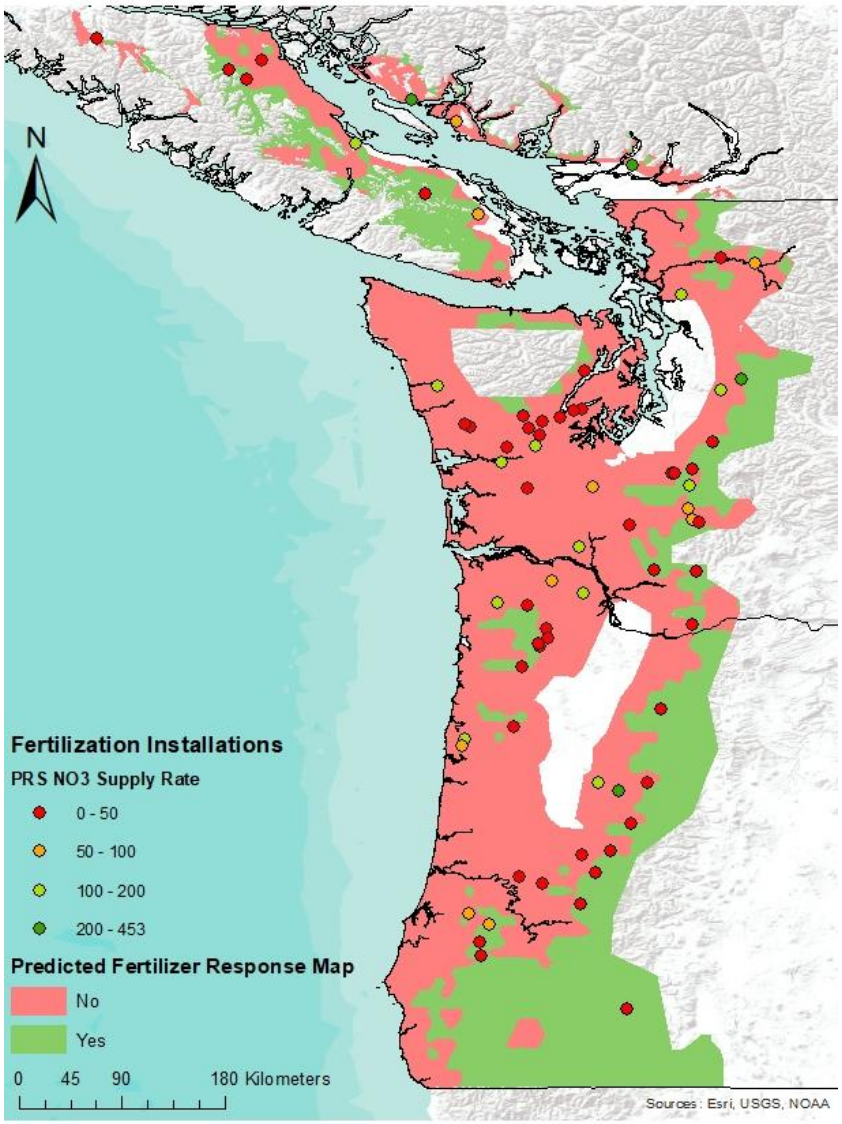


Region	4-year Tree Response (%)	4-year Stand Response (ft^3/ac/yr)
BC Vancouver Island (n=3)	24 ± 44	43 ± 65
BC Mainland (n=3)	-9 ± 12	-11 ± 46
WAW (n=10)	17 ± 23	17 ± 40
WAE (n=6)	10 ± 11	16 ± 22
ORW (n=9)	24 ± 24	62 ± 43
ORE (n=3)	13 ± 39	24± 98
All Regions	**16 ± 25**	**29 ± 50**

Recommendations

- Select fertilization stands based on models and maps from the Paired-Tree study
- Install more PRS probes to further understand nutrient availability and fertilizer response
- Prioritize fertilization in regions that have the greatest tree and plot response
  - Currently, Vancouver Island and Oregon West are responding the best to N fertilization





Deliverables

- 38 Late-Rotation Douglas-fir installations
- Soil, tree, and PRS probe nutrient data collected across the coastal Pacific Northwest
- Manuscripts planned:
  - Relationship between PRS probe nutrient supply, soil and site productivity, and four-year fertilizer response
  - Economic analysis of regional fertilization of late-rotation stands
- Inclusion of response data into growth models

Company Benefits

- Average area-based volume response in six distinct regions
- Examination into the economics of late-rotation fertilization
- Estimation of Paired-Tree response models to per area response
- Greater understanding of nutrient availability in predicting fertilizer response