

## Background

- Forest Park is a 5,100-acre, 2nd growth, urban forest located northwest of Portland, Oregon.
- Impacted by disturbances including logging, wildfires, invasive species, and urbanization
- Goal to manage Forest Park towards a structurally complex, late-successional forest (NRMP 1995).
- Shade-tolerant conifer juveniles lacking in urban unit of the park (Broshot 2007).
- This study examines patterns & trends in environmental conditions where Western hemlock & Western red cedar juveniles are found.

## Field Methods

- Location of seedlings/saplings of Western hemlock (TSHE), Western red cedar (THPL) were mapped in 3 park units (Fig 3)
  - 79 plots in North and South Management Units
- Search intensity was tracked to measure number of individuals found per hour per species (Fig 4).
- Paired plots were installed at seedling/sapling site
  - 1 regeneration microsite plot with seedling/sapling and 1 control microsite plot located randomly within 1-2 meters (Fig 1, 2)
- Biotic, abiotic measurements at sites & microsities
  - Vigor qualitatively measured for each juvenile



Fig 1. TSHE seedling in 1 m<sup>2</sup> quadrat established on coarse woody debris substrate.

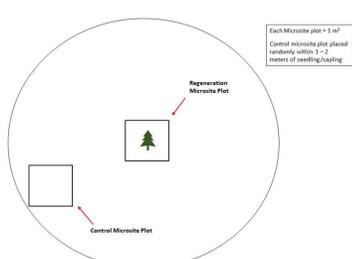


Fig 2. Schematic of plot layout. Control plot randomly placed within 1-2 m of regeneration plot.

## Data Analysis

- Wilcoxon rank-based tests to compare in regeneration and control microsite plots
- Classification tree model to identify best predictors for presence/absence of each species.
- PCA used to reduce dimensionality of microsite plot variables and to detect patterns and trends.

## Results

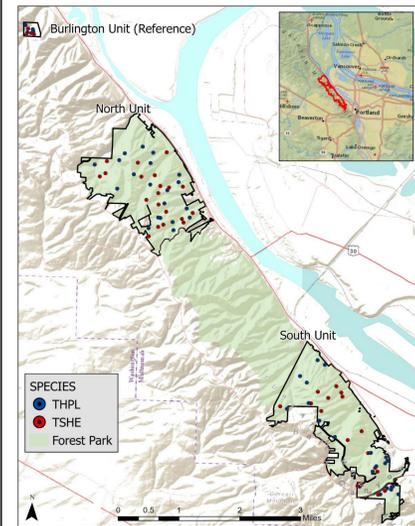


Fig 3. Plot locations of each species found in the sampled management units in Forest Park.

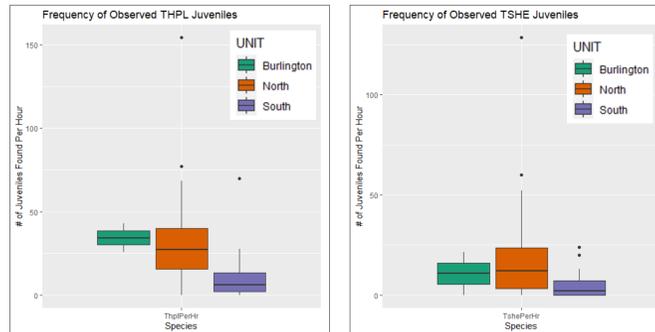


Fig 4. Number of THPL and TSHE juveniles observed per hr in each unit.

Table 1. Mean number of juveniles of each species observed per hr in each sampled unit.

Unit	TSHE Per Hour	THPL Per Hour
South	5	11.2
North	18.6	32.2
Burlington	10.7	34.3

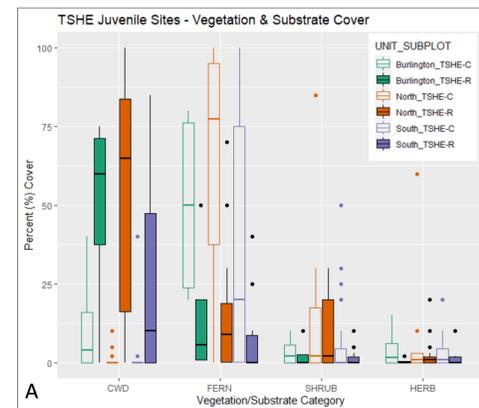


Fig 5. Significant substrate and vegetation cover categories for TSHE (A) and THPL (B) juveniles.

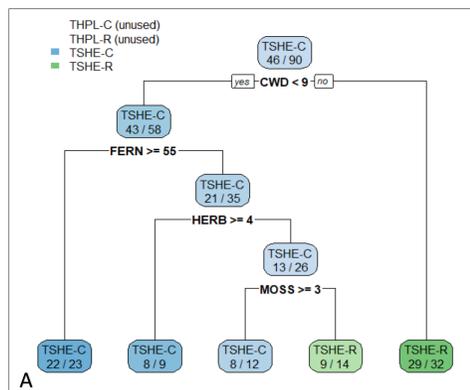
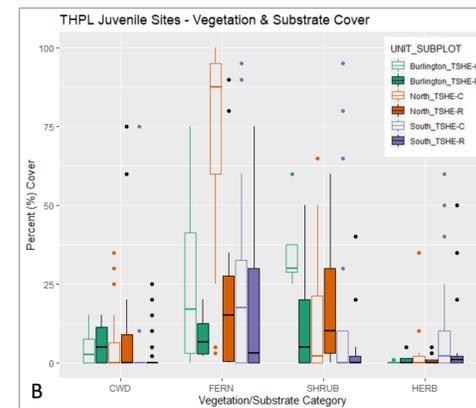
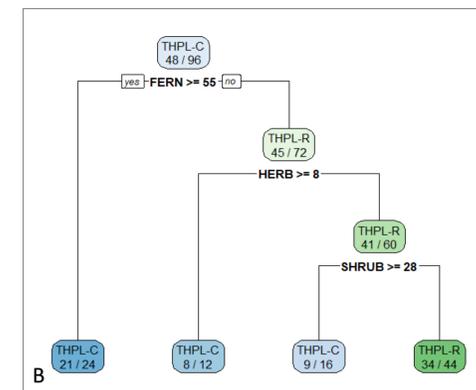


Fig 6. Classification tree model outputs for TSHE (A) and THPL (B) identifying significant substrate and vegetation cover variables that best categorize juveniles into regeneration (presence) or control (absence) plots.



## Western Hemlock (TSHE):

- 84% of regenerating juveniles were found on CWD; CWD identified as most significant predictor variable for TSHE presence in classification tree model (Fig 5A).
- Fern, herb, and moss cover identified as important predictor variable in TSHE classification tree model (17% misclassification rate; Fig 6A).

## Western Red Cedar (THPL):

- Fern, herb, shrub cover identified as significant predictor variables in THPL classification tree model (38% misclassification rate; Fig 5B, 6B).

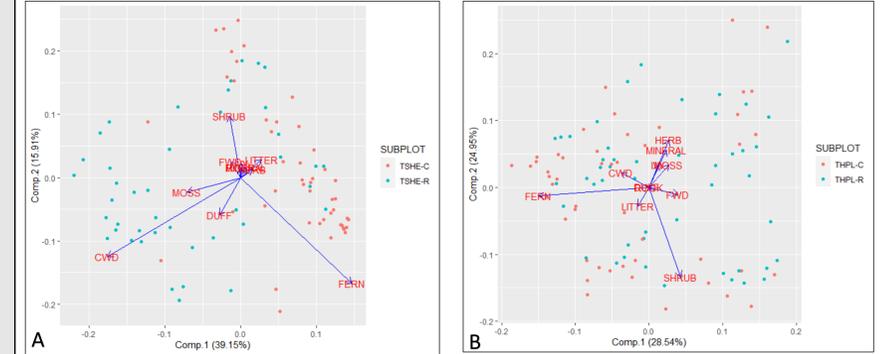


Fig 7. Bi-plots of principle component analyses of microsite vegetation and substrate cover variables for TSHE sites (A) and THPL sites (B).

## Western Hemlock (TSHE):

- PCA components 1 & 2 account for 56% of variation in microsite presence/absence data (Fig 7A).
- TSHE plots clustered and displaying separation on ordination biplot with presence site associated CWD and absence sites associated with fern cover (Fig 7A).

## Western Red Cedar (THPL):

- PCA components 1 & 2 account for 53% of variation in THPL microsite data (Fig 7B).

## Preliminary Conclusions

- TSHE and THPL regeneration patterns are significantly affected by understory competition dynamics.
- Denser understory vegetation can shade and outcompete seedlings, inhibiting regeneration in mid - late seral forests.
- Coarse woody debris is a critical component to TSHE regeneration in Forest Park.

## Limitations

- Seed production and dispersal were not measured in this study and are critical components to the tree regeneration.
- Targeted sampling approach potentially introduces biases in seedling/sapling detection.

## Next Steps

- Further modeling of seedling/sapling vigor and exploration of additional environmental predictor variables.
- Analysis of canopy structure at species plot locations.
- Further comparison of regeneration habitats between the North, South and Burlington units.

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