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Log Proximity and Moss as Indicators of Conifer Seedling Abundance in Old-Growth Douglas-Fir/ Hemlock Forests

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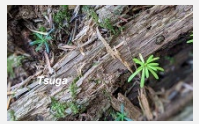


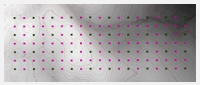
Objectives

1. **Do logs facilitate seedling establishment?**
2. **Does moss limit seedling establishment?**
3. **Can a log proximity and moss index predict seedling abundance?**
4. **Does the relationship between seedlings and log proximity/ moss differ in dry and wet conditions?**
5. **Which factors may influence seedling establishment on logs instead of the forest floor?**

Methods

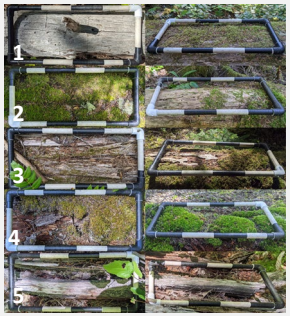
Study site: **Wind River Forest Dynamics Plot** (WFDP)

- old-growth Douglas-fir (*Pseudotsuga menziesii*) and western hemlock (*Tsuga heterophylla*) in the southern Washington Cascades
- WFDP is 800 m x 340 m, >525 years old
- mean annual precipitation is 2225 mm
- mean annual temperature is 8.7 °C
- elevation ranges from 384.7 m- 352.4 m



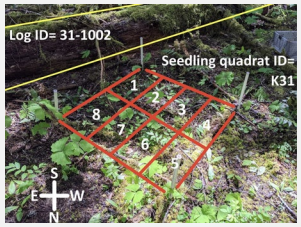
- all 31,157 woody stems ≥ 1 cm diameter and all 9,987 pieces of coarse woody debris with a large end diameter ≥ 10 cm are identified, measured, and mapped
- 133 seedling quadrats placed in a regular grid, 20 m apart

I visited 60 seedling quadrats and took measurements of conifer seedling species count and height, moss cover and height, herb height, and -for logs within 2 m of the quadrat- log distance from quadrat, log diameter, length, azimuth, decay class, and rugosity class.



Left: Pictures demonstrating each of the 5 rugosity classes I developed. Class 1 logs are very smooth, conical surface. Class 5 logs have much greater surface roughness, usually due to deep fractures or bark sloughage.

Below: Example of approach to collecting data in the field. 8 Daubenmire frames (20 cm x 50 cm) were placed in a clockwise direction from the southwest pin of the 1 m x 1 m seedling quadrat to obtain subsample measurements.



Results

Less tree seedlings were found on the forest floor where moss cover was high, but log surfaces had higher moss cover than the ground and more seedlings.

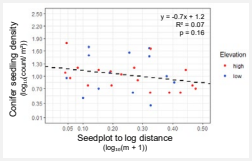


Fig 1. Conifer seedling density and seedling plot to log distance. The linear regression indicates that seedling density decreases with increasing log distance.

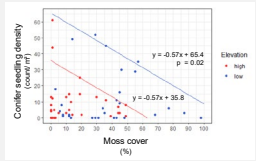


Fig 2. The 90th percentile quantile regression demonstrates how moss cover acts as a limiting factor on seedling establishment. This relationship is the same in high (dry) and low (wet) areas, with an increased low elevation y-intercept due to increased mean moss cover in these wet areas.

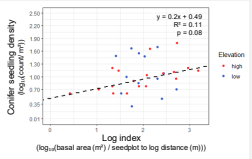


Fig 3. Introducing log basal area to the distance model for seedling density allows the model to better explain variation in the seedling density, indicating that seedling density increases with increasing log basal area and decreasing seedling plot to log distance.

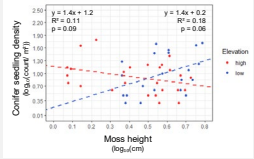
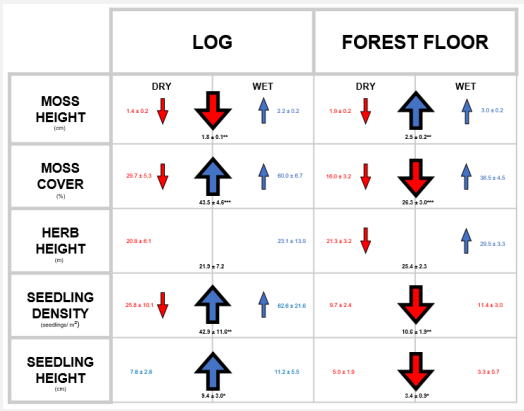
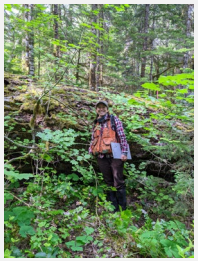


Fig 4. Results of this linear regression indicate different relationships between moss height and seedling density in high (dry) and low (wet) regions of the WFDP.





Old growth forests provide a plethora of ecosystem services and are in significant decline[156]. It is increasingly essential to comprehensively understand forest processes so that we may better conserve and maintain our remaining old-growth forests in the face of climate change.

A defining quality of old growth forests is the presence of large diameter live trees and snags, as well as the canopy gaps and large woody debris that are created when they fall[16]. In the Pacific Northwest, most seedlings that survive more than several years are found on logs[2].

Logs may facilitate conifer seedling establishment by providing a cool, moist microclimate which can offer protection from drought summer conditions and direct solar radiation[3]; seedlings growing on top of elevated log surfaces might benefit from decreased moss and herb competition for light than on the forest floor[4]. The relative importance of these microsite conditions and factors which may influence seedling establishment on top of logs rather than on forest floor near them is not known.

In the WFDP, conifer seedlings were taller and more abundant on top on logs and, on the forest floor, seedling density and log proximity data was consistent with the hypothesis that logs facilitate seedling establishment (Fig.1). Moss cover limited seedling establishment in both wet and dry areas, but data indicated seedlings had different relationships to moss height in wet and dry areas (Fig. 2, Fig. 4). My findings suggest that moss is a better indicator of seedling abundance than log proximity, but these relationships may change when seedlings have different limiting pressures such as moisture in dry areas or light in wet areas of the WFDP.

Acknowledgements

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