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Structure and Regeneration of Old-growth Stands in the Engelmann Spruce - Subalpine Fir Zone

Introduction

Old-growth stands are important for management, conservation, wildlife, recreation, and maintaining biological diversity in forested landscapes. However, we are lacking the information needed to adequately identify and characterize old-growth stands. This is especially true for high elevation, interior forests. The characterization of stand structure and regeneration pattern will help in the development of site-specific guidelines for identifying old-growth stands and restoring some of the old-growth characteristics in managed stands.

This pamphlet presents a synopsis of a study investigating stand structure and regeneration of old-growth stands in the Moist Cold Engelmann Spruce - Subalpine Fir (ESSFmc) Subzone near Smithers, B.C. The three stands selected for the study were located on zonal sites, each in different watersheds, and the stands were established after fire. The criteria used for selection were: i) absence of lodgepole pine, ii) presence of advanced regeneration, and iii) abundant snags and coarse woody debris. These stands were presumed to represent the old-growth stage of stand development or the final (climax) stage of secondary succession.

Tree species composition

Depending on climate, either subalpine fir, Engelmann spruce or both can be present in old-growth stands in the ESSF zone. In the study stands, subalpine fir was clearly predominant (96%) while the trees, saplings, and seedlings of Engelmann spruce formed only a minor component (<4%). In the absence of a large scale disturbance, I expect subalpine fir to be the dominant tree species in the old-growth stage.

Diameter distribution of subalpine fir

The diameter (dbh) distribution of subalpine fir in the study stands was close to a balanced, or inverse-J shape (Figure 1). This type of distribution is characteristic of a balanced or steady state, where the distribution will not change over time until the occurrence of a large-scale disturbance. Similar dbh distributions were found in high-elevation spruce-fir stands in Colorado.

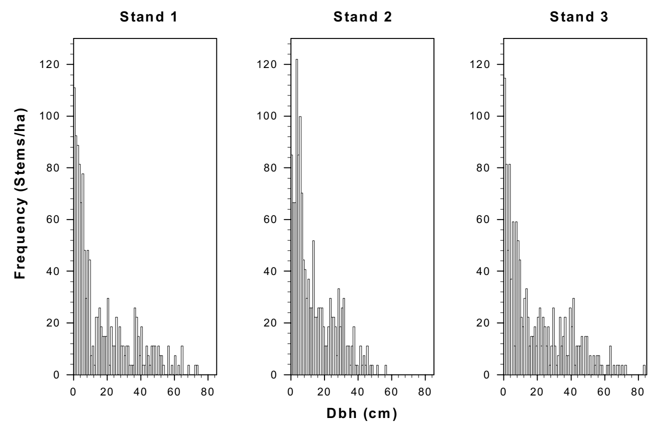

Figure 1. Dbh distributions.

Height distribution of subalpine fir

Compared to the diameter distribution, the height distributions were modal (Figure 2). The absence of trees at certain heights (depressions in the height frequency distribution) is believed to indicate canopy boundaries. Trees in the lower canopy layer have greatly reduced height growth (unless released), so they will remain in the lower canopy for a long time. Trees in the upper canopy will continue to grow, so almost no trees will remain at the canopy boundary.

Modality was an unexpected characteristic as the height distribution in high-elevation spruce-fir stands in Colorado was reported to approximate the inverse-J shape. Considering that the oldest stand (Stand 2) showed the most pronounced modal distribution, I conclude that this height structure will not change with time and that the modal distribution is characteristic of the old-growth stage.

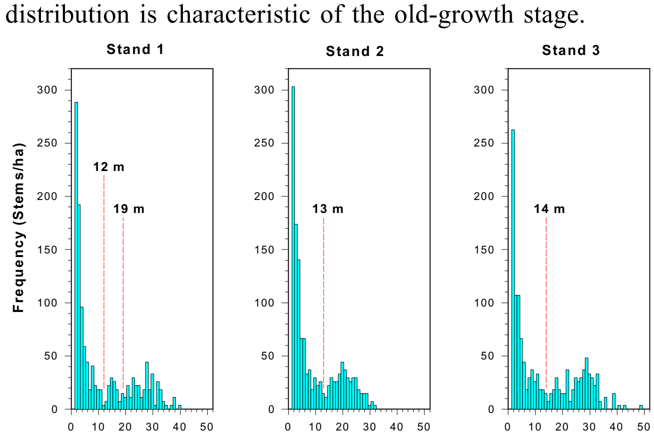

Figure 2. Height distributions. Dashed lines indicate the boundary of canopy layers.

Age distribution of subalpine fir

Even though the dominant trees were old (close to 400 years at breast height) and approached the maximum life span of subalpine fir, the age distributions did not show an inverse-J shape (Figure 3). This was unexpected as the age structure of many high-elevation, old-growth stands was reported to be close to an inverse-J. Because of weak relationships between size and age, and lack of information on mortality, it is difficult to predict the future age structure.

Since trees were cored at 1.3 m, it is important to know how long it takes for subalpine fir seedlings to reach breast height. The data showed that seedlings growing under the canopy reach 1.3 m in 11 to 140 years. Nevertheless, even 100-year old seedlings still respond to release.

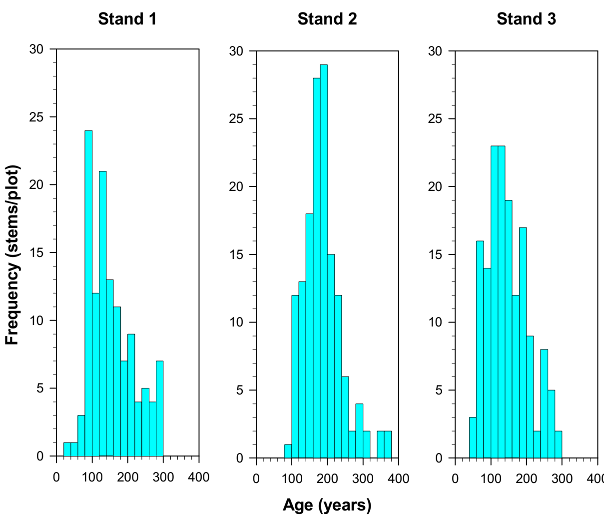

Figure 3. Age (determined at 1.3m) distributions of trees.

Factors influencing the regeneration pattern of subalpine fir

The most important environmental factor influencing the establishment of seedlings was decaying wood. Although regeneration also occurred on the forest floor, there were at least twice as many seedlings on decaying wood when compared with substrate cover (Figure 4).

Another factor that showed significant correlation with regeneration was time of snowmelt. The zone with intermediate snowmelt time had the highest density of seedlings. Snowmelt progresses from around the tree stems and on downed large coarse woody debris to canopy gaps where the highest snow accumulation and the latest snowmelt occur.

Other factors such as understory vegetation, light, or canopy gaps were weak predictors of the presence of regeneration.

The relative density of regeneration was the same in gaps and under the canopy. This suggests that gaps are not the major factor controlling the regeneration.

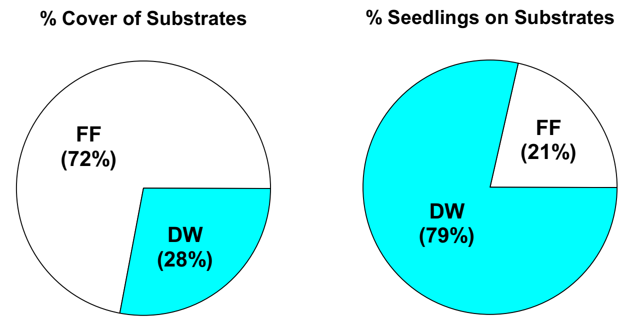

Figure 4. Percent cover of substrates (FF = forest floor, DW = decaying wood) and the percent of subalpine fir seedlings on these substrates in Stand 1.

Summary

The following conclusions can be made on old-growth stands in the ESSFmc subzone: (1) subalpine fir will be the dominant species; (2) the diameter distribution of subalpine fir will be balanced or inverse-J shaped; (3) height and age structures of subalpine fir will feature a modal distribution; (4) the regeneration pattern of subalpine fir will be most strongly influenced by the presence of decaying wood; and (5) canopy gaps may not improve the abundance of subalpine fir regeneration.

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