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Field Parameterization of a Model for Secondary Forest Succession by Shade Tolerance

Five studies investigated and field parameterized a mathematical model on how forest composition changes over time through shade tolerance. I hypothesized that if the forest was organized by shade-tolerance, then the most shade-tolerant species should dominate the old-growth forest.

Study 1 investigated which species was most shade-tolerant. I measured light at seedlings of Douglas fir, Engelmann spruce, trembling aspen, and limber pine, the four dominant species, and found that spruce was most shade-tolerant. Study 2 measured light under the adults of the same species and found that spruce casted the deepest shade.

Study 3 began the parameterization by studying which species was the most common replacer. Thirty canopy trees of each species were sampled and the species of the most likely replacer (the tallest, healthiest sapling under that tree) were identified. I calculated the proportion of the each species that would be replaced by each sapling species. Spruce was the most likely replacer to all species.

In Study 4 compared the composition of the secondary and old-growth forest. I sampled five 20-tree transects in each forest. The old growth forest is dominated by Spruce. The secondary forest was not dominated by one species.

In study 5, I made a mathematical model to predict succession with the secondary forest composition (Study 4) and the matrix of replacement probabilities (Study 3). Spruce became dominant in one generation. Further modeling using the Markov chain process showed that the old-growth forest converged on a composition dominated by spruce from different initial secondary forest compositions.