Biol 112 Lab Assignment: Modeling Succession
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1. What are the consequences of changing elevation in the mountains at Hubbard Brook?

The JABOWA model suggested that elevation has no influence on what species are early successional; these were always pin cherry and choke cherry, though only pin cherry persisted over 1100 m. Instead, elevation had more of an influence on the growth of middle and late successional species. Perhaps this could be due to the slow growth of late-successional species. At elevations other than where a slow-growing species grows best, there would be sub-optimal temperatures and moisture levels that would hamper its growth. Early-successional species tend to be very hardy, and so might be more tolerant of these conditions.

All species except for pin cherries had elevations where they grew best. Up to 500 m, white birch is competitively inhibited by the shading of maples, but it increasingly dominates as elevation increases because maples grow more poorly at higher elevations. Beeches were another important late-successional species from 300-900 m that had poorer growth at higher elevations. Balsam fir, a cold-loving tree, doesn't become an important middle to late-successional species until above 900 m. Also, as elevation increases, species diversity declines. After 100 years of primary succession at 1500 m, the only species present are usually just white birch and balsam fir.

A more detailed table of the species visible at each elevation and at each successional stage is on the reverse side of this paper.

2. What are the consequences of allowing windthrows and/or logging at a few different intervals?

Since it looked like white birches might have been shading the maples at 900 m, I wanted to test that idea by allowing a 0.5 probability of windthrows beginning at 30 years into the simulation. This would get rid of trees with a DBH > 20 cm, which would likely be the white birches. If they were indeed shading the maples, then the maples should grow more after the trees are gone. The results partly confirmed my hypothesis; more yellow birches and sugar maples grew, but red maples were not found in any greater abundance than before. This suggested that the decline in red maples from 300 to 900 m was more likely due to the elevation increase rather than the shading by white birches.

I also tried logging beginning at 30 years into the simulation, then every 10 years afterward, to get rid of trees with DBH > 20 cm to see how the results would compare with those from windthrows. Instead of a having a 0.5 probability that large trees would be removed each year, logging would guarantee large tree removal every 10 years. The results were the same, with sugar maples and yellow birches growing more after the removal of most white birches between 2015 and 2025, but with no effect on red maples.

JABOWA model predictions of species found at early, middle, and late successional stages at Hubbard Brook, listed in order of dominance:

Elev. (m)	Species Visible at Elevation	Early (1970-2000; 30 yrs)	Middle (2000-2040; 40 yrs)	Late (2040-2070; 30 yrs)
300	Sugar maple, red maple, beech, pin cherry, choke cherry	Pin cherry, choke cherry (one or the other will be more dominant)	Occasionally beech and red maple; yellow birch grows to short height and quickly dies	Sugar maple, beech, red maple
500	Sugar maple, white birch, red maple, beech, yellow birch, red spruce, balsam fir, pin cherry, choke cherry	Pin cherry, choke cherry	Yellow birch; occasionally pin cherry	Sugar maple, red maple, white birch, beech. When there are many maples, white birch is crowded out. Beech doesn't grow very tall compared to the other trees.
700	White birch, sugar maple, beech, yellow birch, red maple, balsam fir, red spruce, pin cherry, choke cherry	Pin cherry, choke cherry	Yellow birch, red maple	White birch, sugar maple, beech, yellow birch. White birch and yellow birch grow larger than before. Sugar maple and beech smaller.
900	White birch, sugar maple, balsam fir, beech, red spruce, red maple, mountain ash, pin cherry, choke cherry	Pin cherry, choke cherry	Yellow birch, balsam fir	White birch, sugar maple, balsam fir. White birch forms huge canopy and shades out maples, beeches, and yellow birches (if white birch trees die before growing large, these other trees can come in).
1100	White birch, balsam fir, red spruce, beech, yellow birch, pin cherry, choke cherry	Pin cherry, choke cherry	Yellow birch, balsam fir	White birch, balsam fir, red spruce, sugar maple. White birch really dominates; understory of balsam fir and red spruce, with a few scattered small sugar maples.
1300	White birch, balsam fir, red spruce, sugar maple (rare, small), pin cherry, choke cherry (rare, small)	Pin cherry	Balsam fir	White birch, balsam fir, red spruce. More balsam fir than red spruce.
1500	White birch, balsam fir, pin cherry, red spruce (rare, small)	Pin cherry	none	White birch, balsam fir.