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« Influence of long-term climatic variability on the growth of trees in the boreal mixedwood forests of Quebec in eastern Canada »

Forests in northern latitudes store nearly half of the global forest carbon. Hence, their continuous role in the global carbon cycle is critical for climate change mitigation. The growth of trees in these forests is limited by a short growing season and lower temperatures. Nevertheless, the climate warming trend since the nineteenth century has been modifying the growing conditions of trees which can impact growth. The objective of this research is to enhance the understanding of the growth response of dominant tree species in the boreal mixedwoods of Quebec in eastern Canada to the changes in climate.

The research was structured around three individual and interconnected studies. In the first study, a large inventory dataset of two shade-intolerant species, trembling aspen (Populus tremuloides Michx.) and jack pine (Pinus banksiana Lambert) sampled across the boreal mixedwood forests of Quebec was used to evaluate the growth response to climate warming. The results showed a contrasting growth response of jack pine and trembling aspen to climate warming. A significant increase in the growth of trembling aspen was observed whereas that of jack pine decline was not significant. Over the whole study region, the trees growing in sites with lower competition, and those at the lower sections of the terrain slope experienced more of the positive effects of temperature on growth. The study suggests that the tree growth response to climate warming may be species-specific and will vary across the boreal mixedwoods.

In the second study, tree inventory dataset of three conifers, balsam fir (Abies balsamea (L.) Mill.), white spruce (Picea glauca (Moench) Voss) and white cedar (Thuja occidentalis L.), and two deciduous hardwoods, trembling aspen and white birch (Betula papyrifera Marsh) which co-occur in the mixedwoods of the lake Duparquet Teaching and Research Forest (LDTRF) in Western Quebec was used to assess the response of the species to climate and insect outbreaks. The results showed a decreased growth rate of the spruce budworm host species, balsam fir and white spruce, and an increased growth rate of the non-hosts, white cedar, trembling aspen, and white birch. The results warrant the inclusion of spruce budworm defoliation into models predicting forest productivity.

In the final study, the spatially-explicit stand dynamic model, SORTIE-ND was used to simulate how species-specific growth response to climate and insect outbreak will influence the future succession trajectory of the boreal mixedwood forests of LDTRF. The results of the simulation showed that the differences in the growth response of deciduous hardwoods and coniferous trees to climate and insect outbreaks may not alter the future succession trajectory of the boreal mixedwood forest.

Overall, the different growth responses of the tree species to climate warming suggest that managers should be cautious in generalizing forest management prescriptions. Instead, they should take into consideration species-specific growth response to climate in the long-term forest planning. Local environment interactions and disturbance factors also have the potential to modify the species-specific growth responses to the warming climate. Therefore, it is important that as managers develop the tools for forest management, they also consider the local site modulating factors.