Branching out

from the Canadian Forest Service ▪ Laurentian Forestry Centre

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Climate change and forest productivity: questions abound

Take 2

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Researchers at the Canadian Forest Service are working on methods to estimate forest productivity at different spatial scales. Variations in forest productivity can best be estimated at the tree and stand levels.

According to the simplest growth scenario, tree productivity depends on site fertility as well as on temperature and precipitation regimes. An increase in temperature would result in accelerated tree growth because it would lengthen the growing season and reduce the frequency of summer frost in northern regions. Summer drought, however, could cancel out the positive impact of increased temperature on tree growth.

Root growth measurement.
Photo: Pierre Bernier (CFS)

Tree growth: not so easy to predict

Several factors contribute to the uncertainty associated with predictions of accelerated tree growth. The capacity of trees to adapt to new climatic conditions depends on their genetic characteristics. For example, trees from local seed sources subjected to more favourable climatic conditions do not grow as fast as trees that are genetically adapted to these enhanced conditions. Increased atmospheric CO_2 could have a fertilizing effect on forests, but this effect, which has been observed under controlled conditions, has not yet been clearly demonstrated in the natural environment. Soil fertility, and the availability of nitrogen in particular, could limit the magnitude of the effect.

Is there compelling evidence of enhanced productivity here and elsewhere in the world?

Currently, Canadian forests show mixed signs of increased productivity. In comparison, in Europe, growth rates seem to have improved significantly during the 1970s and 1980s. This increase is attributed to both global warming and the fertilizing effect of nitrogen pollution. In the United States, analyses conducted using traditional inventory systems have not revealed a similar change.

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Here in Canada, recent growth analyses conducted on samples from sites located across the boreal forest suggest a great deal of variability in response to on-going climate change, both from one species to another and from one region to another with respect to a given species. This type of variability could explain, in part, the absence of any clear tendency in the analyses based on forest inventory data.

In all likelihood, the northern limits of forest ecosystems will shift very slowly while their southern limits will be subjected to increasing environmental constraints. These constraints could result from significant disturbances, increased competition from herbaceous species during the regeneration stage or other mechanisms whose impact is currently marginal.

Fine litterfall measurement.
Photo: Pierre Bernier (CFS)

Fir photosynthesis measurement.
Photo: Pierre Bernier (CFS)

What is the expected impact on the northern and southern limits of ecosystems?

With global warming, the forest picture projected by models for Canada is quite different from that of today. A 2 °C increase in average annual temperature up until 2100 is equivalent to a northward shift in climatic zones of approximately 300 km. However, analyses of pollen accumulated in lake sediments since the end of the last glacial period suggest that vegetation has been advancing by about 50 km per century.

Room for optimism

Trees live a long time and therefore our forests will change slowly despite accelerated changes in their environment. In regions where water availability does not limit growth, most of these changes should result in a general improvement in growth conditions. The main questions that remain to be answered concern the effects that climate change will have on natural disturbance regimes and the threats posed by exotic insect pests and diseases.

USEFUL LINK:

Forest ecosystems of Canada – Issues: Climate change
http://ecosys.cfl.scf.rncan.gc.ca/enjeux-issues/climat-climate-eng.asp

FOR MORE INFORMATION, PLEASE CONTACT:

Pierre Bernier
Natural Resources Canada
Canadian Forest Service
Laurentian Forestry Centre
1055 du P.E.P.S.
P.O. Box 10380, Stn. Sainte-Foy
Quebec City, Quebec G1V 4C7
Phone: 418-648-4524
Fax: 418-648-5849
E-mail: pierre.bernier@nrcan-rncan.gc.ca
Website: cfs.nrcan.gc.ca

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