Natural Resources Canada
Ressources naturelles Canada

70
2011
Branching Out
from the Canadian Forest Service - Laurentian Forestry Centre

Canadian Forests Exposed to the Winds of Change

With climate change, Canada's forests will be exposed to rapid changes in their environment, including variations in temperature and precipitation. Tree species will have to migrate to find the growing conditions that meet their needs. However, the rate of change in climatic conditions is expected to exceed their ability to migrate by a factor of 5 to 10. This raises the question of whether planning strategies for plantations should be adjusted accordingly.

Compressing several millennia into just 100 years

Some 18,000 years ago, Canada and the northern United States were covered by a thick ice sheet. In Quebec, the temperature was 4°C lower than at present. For most plant and animal species, survival was only possible south of the ice front. As the climate warmed, many species migrated northward, giving rise to the current geographic distribution of populations. This adaptation of natural forests took place over a period of several millennia. With climate change, the global temperature is set to increase by the same magnitude (4°C), but over a period of just 100 years! In this context, if plantations established in intensively managed areas of forest are to provide optimal yields, it will be important to use seed sources that are adapted not only to present-day climatic conditions but also to projected conditions.

Careful selection of seed sources

A team of researchers with the Canadian Wood Fibre Centre and the ministère des Ressources naturelles et de la Faune du Québec are using data from provenance tests established several decades ago to evaluate the potential response of trees to rapid climate change. By comparing the response of seedlings from various geographic and climatic sources, they can predict the impact of climate change on the plantation yields of certain tree species.

The research team found that the best projected yields are not always attained when a plantation is established using seedlings grown from seed collected in a local seed orchard. In the case of white spruce in Quebec, for example, selecting the seed source best adapted to future conditions could result in 3% to 12% faster growth compared with the local source, depending on the location


Photo: R. Gal (CFS)

(see map; for the Témiscouata region, the use of seed from the Duchesnay orchard would result in gains of 12% in 2081–2099). Poor selection of seed sources would cause a decline since the tree species would not be adapted to the new local conditions. In such a case, assisted migration might be required in order to maintain plantation yields.


Photo: R. Gal (CFS)


Photo: CFS

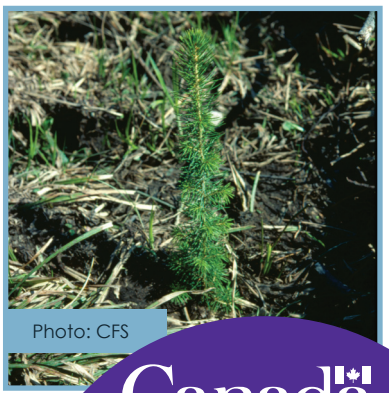
Photo: CFS

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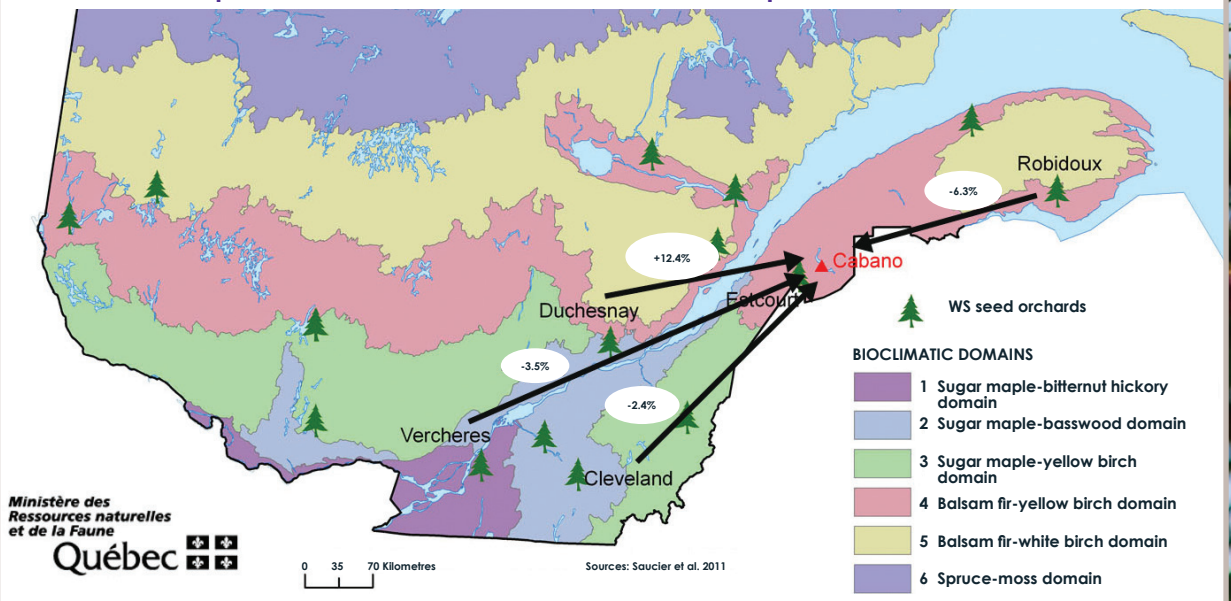
Importance of the seed orchard choice for a plantation in Cabano



Change in productivity (%) during the 2081–2099 period in relation to local seed sources

Map: Marie-Claude Lambert, André Rainville and Maripierre Jalbert (MRNF)

Selection of planting sites

What will happen to the plantation yields in various regions if seedlings from local sources are planted there? Will productivity be the same 70 years from now? These are a few of the questions that the researchers sought to address by studying white spruce and other species. For 2011, they found that yield was 50% higher on average in the sugar maple bioclimatic domain than in the balsam fir and spruce domains. Strangely, the situation is reversed for the 2081–2099 period, with 5% to 19% higher yields in the balsam fir and spruce domains relative to the sugar maple domain. This can be explained by the fact that in southern Quebec, summer temperatures will be too high for white spruce populations. Since this species is not adapted to warm temperatures, productivity will suffer. White spruce populations are also likely to face strong competition from deciduous species. In the north, temperatures will increase but they will not exceed the species' tolerance limit, thus permitting a slight increase in yield.

Transfer models as planning support tools

Forest planning officials can use seed transfer models to select the best seed sources for reforestation. These models, which are based on variables evaluated at the landscape level, are useful for strategic planning. When coupled with a geographic information system, such models allow planners to quickly visualize the most productive zones.

Useful links

Uncovering the postglacial history of conifer populations:
http://cfs.nrcan.gc.ca/pubwarehouse/pdfs/26344.pdf

Optisource:
a tool for optimizing seed transfer:
http://cfs.nrcan.gc.ca/pubwarehouse/pdfs/31544.pdf

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