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Climate change: predicting white spruce yield

The ability of species to disperse, migrate and adapt is a crucial determinant of their survival in a context of climate change. Trees' capacity to adapt to changing environmental conditions depends mainly on the genetic diversity that exists within their population since they cannot "flee" when problems arise in their environment. In forest tree species, adaptation is a process that typically spans several generations.

Key information for estimating the response of trees to rapid climate change is obtained by geneticists from provenance tests, which are conducted using seedlings of various geographic and climatic origins. Using this type of data, Canadian Forest Service researchers have developed a model for predicting the effect of climate change on the timber yield from white spruce plantations in Quebec.

Under a scenario of climatic warming, the overall yield from white spruce plantations in Quebec is expected to increase slightly. However, it is predicted that, in the second half of this century, the yield from a given area that has undergone rapid warming will still be lower than that from a region that currently enjoys those warmer climatic conditions, because of the time required for adaptation.

White spruce plantation.
Photo: Jean Beaulieu

For example, if the area of the Mastigouche wildlife reserve were to experience a 2°C rise in temperature between now and 2070, its climate would be similar to that currently characterizing the Mirabel region, where white spruce plantations have a yield of 400 to 450 m^3 per hectare at age 50. Under these new conditions, the Mastigouche plantation

yield would be 350 to 400 m^3 per hectare, or 50 m^3 per hectare less than in the Mirabel area, because of the genetic adaptation of the Mastigouche provenance to its present-day climate. Although timber yield increases with higher average temperatures, provenances that are derived from and adapted to warmer climatic conditions will retain their yield advantage over cooler-climate provenances that undergo rapid climate change.

Over the short term, the establishment of a vast network of plantations designed to validate yield predictions would be a major asset for developing increasingly precise models that can guide the efforts of forest managers.

Since it is unlikely that white spruce populations will be able to migrate at a rate matching the accelerated pace of climate change, plantation establishment could be favoured by using seed sources already adapted to the new climatic conditions of regions affected by rapid warming.

FOR MORE INFORMATION, PLEASE CONTACT:

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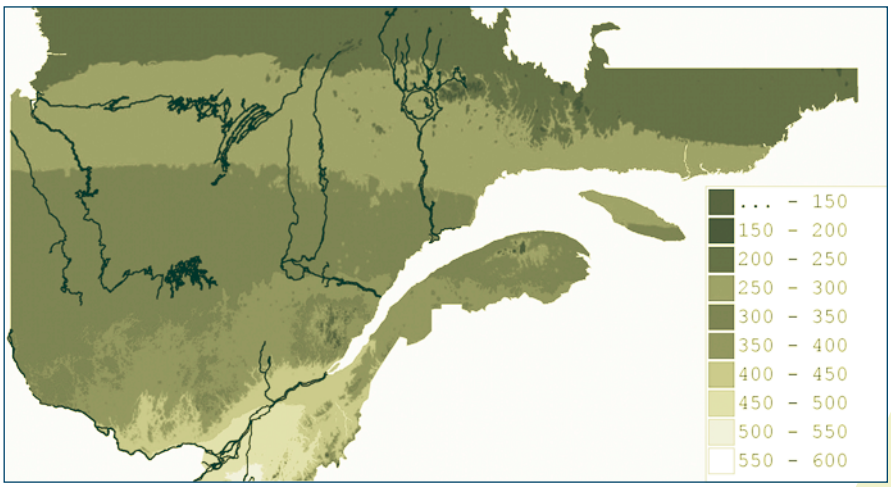
White spruce is a sought-after species because of its high plantation survival rate, its very good yield, its size, the straightness of its trunk, its considerable plasticity and the quality of its wood. It is the second most popular species, after black spruce, for reforestation use in Quebec.

2005		2005		2070	
MIRABEL		MASTIGOUCHE		MASTIGOUCHE	
Temperature	Yield	Temperature	Yield	Temperature	Yield
+2	400-450 m^3/ha	0	250-300 m^3/ha	+2	350-400 m^3/ha

Yield expected in 2005 (m^3/ha) from 50-year-old white spruce plantations with a spacing of 2.24 m.



Yield expected in 2070 (m^3/ha) from 50-year-old white spruce plantations with a spacing of 2.24 m.

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