Trees on the Move

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Origin Story: Trees Migrate?

Trees are important, both environmentally, creating oxygen, shelter, and food for the creatures in their environment, and economically, providing lumber for industry and construction. Scientists have been looking at tree rings (circular rings in the cross-section of a tree trunk, representing a single year's growth) to learn about the risks associated with climate change and assisted migration. Assisted migration is when humans move plants or animals to a new habitat. The goal of assisted migration is to remove the species from a hazardous environment and give them a chance to survive and reproduce in an environment other than the one threatening them. For some trees, these hazardous environments are being caused by climate change.

Environmental conditions are changing faster than plant populations can adapt. Climate change is causing longer growing seasons with an increase in temperature swings. These swings in temperature can cause later frosts in the spring and earlier frosts in the fall. Frost damage remains a risk to all trees.

Assisted migration is being considered to help conserve some trees that are not able to spread their seeds fast or far enough to move to new environments as their old ones become uninhabitable for them due to climate change. Scientists have been researching cold adjustment in tree rings of migration-assisted trees to see how far we can move trees to other areas and have them thrive.

One Ring, Two Tings. Red Rings, Blue Rings!

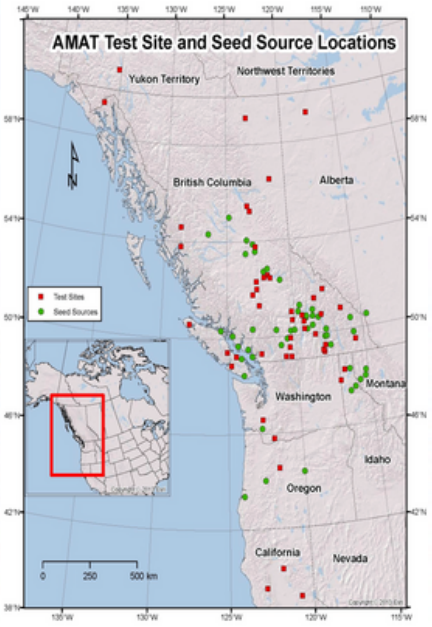
Researchers looked at 2,999 tree rings from 117 trees from twenty different types of lodgepole pines. They looked at two features in tree rings linked to cold and frost: frost rings and light, or blue, rings. Frost rings are layers of deformed, collapsed cells. They are generally caused by colder years, in which temperatures drop below freezing during the tree's growing season, disrupting its growth. Light rings are formed from layers of cells that are unable to thicken and become wood or woody material. This is caused by frost events that cause these cells to die off before they can become strong and rigid. Light rings are also called blue rings because they do not fully absorb the red dye used to observe them in scientific procedures, making them appear blue in the lab instead. Both of these types of tree rings are long-term signs of cold damage.

Southern trees and northern trees were planted in a central location between their native habitats to see what would happen and if they could survive in a different climate. In this central location, the northern trees were further south than their native range, and the southern trees were further north than normal. The scientists then used the evidence from the tree rings to inform them how trees from different environments may adapt to other environments with different temperatures. This can tell the scientists how far out of their original environment tree seeds can be transferred through assisted migration to combat climate change.

For the trees native to the north, scientists interestingly found that these trees would be sensitive to frosts late in the spring. You may be thinking this sounds a little questionable, given that the northern trees would already be adapted to shorter growing seasons from their original environment. But this is because of the colder climate the northern trees are adapted to. The northern trees are adapted to a shorter growing season, so begin to grow and produce leaves and needles earlier than those found in more southern climates. So, a late spring frost will have more of an impact on these trees since they need to start growing earlier than trees in other environments. The resulting frost damage from late spring frost events could reduce growth and survival of northern trees in southern areas and reduce wood quality and value by creating weaknesses and defects in the wood.

On the other hand, the southern trees planted further north were sensitive to fall frosts. This may be because, unlike the northern trees, the southern trees are used to a longer growing season, so they are in less of a rush to grow and produce new shoots in the spring. However, their exposure to fall frosts would be because of the shorter growing season they were now experiencing being further north than normal. The fall frosts in the north arrived earlier than the tree's usual climate, causing damage to them since they were still trying to grow. Southern trees had a sizeable loss of growth and permanent changes shown in the tree rings.

This research shows that trees' ability to adapt to cold should remain a very important point when making assisted migrations designed to conserve trees while reducing the harmful effects of climate change. We must carefully consider the new environments we move trees to, even if they are the same species as they were in this study. By taking these considerations into account, we can move the trees to the right environment for them in the face of climate change.



When trees are planted, it takes approximately sixty to eighty years for them to be harvested. With changing climates, the temperatures could be anywhere from three or more degrees warmer when they are harvested compared to when they were planted. To combat this, the Assisted Migration Adaptation Trial (AMAT) was started. This will hopefully help forest managers to understand the climate tolerances of different species, and to select, and plant seeds that are best suited to future climates.

TIME FOR GENACTION!

Grow a Lodgepole Pine

Growing at a moderate rate, approximately two feet per year, the lodgepole pine requires little attention once established. Locate these cone-bearing trees, or conifers, in full sun to partial shade. Lodgepole pines are not fussy about soil type, preferring moist conditions. They are tolerant of either drier or water-logged soils.

Planting Lodgepole Pine

While you can grow pine trees from seeds and cuttings, we recommend planting saplings to grow lodgepole pine trees successfully. Plant saplings during late summer to early fall (end of August to mid-October) so that young trees can take root prior to the winter season.

Step-by-Step: Planting a Sapling

1. Dig a hole at least twice as wide as the sapling's roots, but not any deeper than the roots are long.
2. Gently place the sapling into the hole by lifting from the roots and leave any burlap intact if the roots are wrapped.
3. Fill in the hole with permeable soil to cover the roots; gently compact. Water the roots deeply.
4. After planting the sapling, water the young lodgepole pine daily for six to twelve weeks while the tree acclimates to the location. You might want to protect the tree with a tree shield or a grow tube. If your sapling needs extra support, stake the tree to help the trunk stay strong.
5. Once the tree is established, don't worry about maintenance for this hardy conifer.

Lodgepole pines are excellent candidates for bonsai because they can be compressed and sculpted into a healthy, lively work of art!

For more details, check out planting instructions from gardentabs.com.

"Assisted Migration Adaptation Trial." Government of British Columbia. Accessed January 13, 2023. https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/tree-seed/forest-genetics/seed-transfer-climate-change/assisted-migration-adaptation-trial.
This Science Spotlight was written based on Montwé, David, Miriam Isaac-Renton, Andreas Hamann, Heinrich Spiecker. 2018. "Cold adaptation recorded in tree rings highlights risks associated with climate change and assisted migration." Nature Communications, 9: 1574. https://doi.org/10.1038/s41467-018-04039-5

Climate Change
Past, Present, and Future

Earth is the only planet in the solar system known to support life. What makes our home so special? Earth has an atmosphere, a layer of gases between our planet and space. Some of these gases, like carbon dioxide, are called **greenhouse gases**. They are crucial parts of our atmosphere; they trap in the heat of the sun, similar to how heat is trapped in a greenhouse, or in a car on a hot day. This process, called the **greenhouse effect**, keeps Earth's temperature warm enough for living things to thrive.

The sun's rays hit our round, tilted planet unevenly. This uneven heating of Earth's surface leads to differences in temperature, which drives weather patterns. We call the patterns in temperature and weather over long periods of time **climate**. Different parts of the world have vastly different climates; it depends on how much heat they receive, as well as what landscape features are nearby. Water, mountains, ocean currents, and forests all impact our climate. In turn, living things around the world have adapted to the climate they live in.

Something, though, is changing. Over the past two hundred years, humans have been burning fossil fuels, such as coal and oil, to make energy to power our daily lives. Fossil fuels are made from decomposed plant matter and microscopic life millions of years old. This matter is full of carbon, and, burning it releases, or emits, billions of tonnes of **carbon dioxide** gas into the atmosphere every year. When too much carbon dioxide is emitted, the delicate balance of greenhouse gases maintaining

Earth's climate is upset. More and more heat is trapped, causing the planet to warm. Weather patterns change, water levels rise, storms get worse.

Climate has changed many times throughout Earth's history, from ice ages to periods much hotter than today. So why is this time any different? Scientists agree on two things. One, temperatures are rising faster than they ever have in documented climate history. Two, this climate change is driven by human activities, due primarily to greenhouse gas emissions.
Climate change is already impacting people's ways of life all over the world. Powerful storms, droughts, forest fires, and floods are threatening people's access to food, water, and safe homes.

The most important step we can take to prevent serious climate change is to reduce greenhouse gas emissions. Incredibly brave and caring people around the world are finding new ways to reduce emissions and make our communities climate resilient every single day. And you can join them! These Science Spotlights are here to help us learn more about climate change and how you can take action.

Our Commitment to the Decolonization of Science

Institutions of GenAction initiative respect and affirm the inherent and Treaty Rights of all Indigenous Peoples across what we now know as Canada. We give thanks to the Indigenous Peoples who care for this land since time immemorial and pay respect to their traditions and ways of knowing. We acknowledge their many contributions to innovations in Science, Technology, Engineering, and Mathematics, past and present, and are committed to deepening engagement and collaborating with Indigenous Peoples as partners in order to advance truth and reconciliation and the decolonization of science.

Climate Change: Past, Present, and Future is based on...Delmotte, Masson, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, et al. 2021. "Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change." Intergovernmental Panel on Climate Change. Cambridge University Press. In Press.