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TAY WATERSHED

We All Live Downstream...

Friends of the Tay Watershed

Educational Program
Trees and Climate Change



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- Welcome to all participants
- Educational Programs- Fall/ Winter 2020-2021
 - Jan 20th – Conservation Areas and Land Donations
 - March 24th – Shoreline Planting

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Agenda

1. Introductions
2. Summary of Current State of Forestry in Canada
3. Trees and Climate Change Presentation
4. Question
5. Wrap up

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State of Forestry in Canada

- Canada's Forest cover 347 million hectares
- Canada is the third most forested country (9% of the world's forest)
- The forest industry contributes some 24.6 billion dollars to Canada's GDP and employs 210,000 people
- Some 600 million trees planted annually (225,000 by the RVCA)
- The Government of Canada intends to plant 2 billion trees to offset our carbon emissions

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Trees and Climate Change

- Climate change has increased the importance of our forests as a means to reduce greenhouse gases
- The presentation today will focus on what changes are occurring in trees and what measures Foresters are taking to reduce the impacts of climate change

Trees and Climate Change

Ian Cochrane (RPF in Training)
Forestry Program Manager
Rideau Valley Conservation Authority (RVCA)



House keeping

- Please keep your microphone on mute during the presentation
- You can ask questions about the powerpoint by:
 1. “Raising your hand” on Teams
 2. Typing in your questions in the chatbox
- Disclaimer: Climate Change and its impact is a complicated subject. Its impact on Forest and Trees is not completely understood. This presentation serves as only an introduction to the topic.

Agenda

1. Introductions
2. Recent History of Ontario's Forest
3. Climate Change
4. Climate Impacts on Trees and Forests
5. Predicted Changes in the Forest
5. What measures are we taking to create resilient forests for the future
6. Tree Planting Programs
7. How can you help?



Rideau Valley Conservation Authority

- One of 36 Conservation Authorities within Ontario
- Established more than 50 years ago
- 10 Conservation Areas that are open to the public
- Managing over 2000 hectares of protected forested land
- Covers over 4200 square kilometers

Our Vision

Our vision is for a thriving watershed with:

- clean, abundant water
- natural shorelines
- rich forests and wetlands
- diverse habitat and
- sustainable land use that is valued and protected by all



Our Mission

Our mission is to understand, manage, protect, restore and enhance the Rideau watershed through science, stewardship, education, policy and leadership.

The Recent History of Our Forest



Our forests are not a static environment; Mortality, growth, reproduction, decay occur year after year. The forest we see today wasn't always here and 1000 years from now it will be different based on our climate

Recent History of Eastern Ontario Forests

- **20,000 years ago-** Southern Ontario is under the Laurentide Glacier, 2 km thick glacier!
- **13,000 years ago-** The earth begins to warm and glacier begins to recede: Eastern Ontario covered by the ancient Champlain Sea
- **10,000 years ago-** Lichens, mosses and ferns are first to colonize exposed soils increasing soil depth to support shrubs and grasslands. Likely the first tree species would have been tundra species including willows, birch and junipers as the water receded
- **9000 years ago -** Temperatures are still cool with grasslands dominant, pockets of boreal forest with birch, spruce, pines and tamarack

(Forest History, 1997)

Recent History of Eastern Ontario Forests

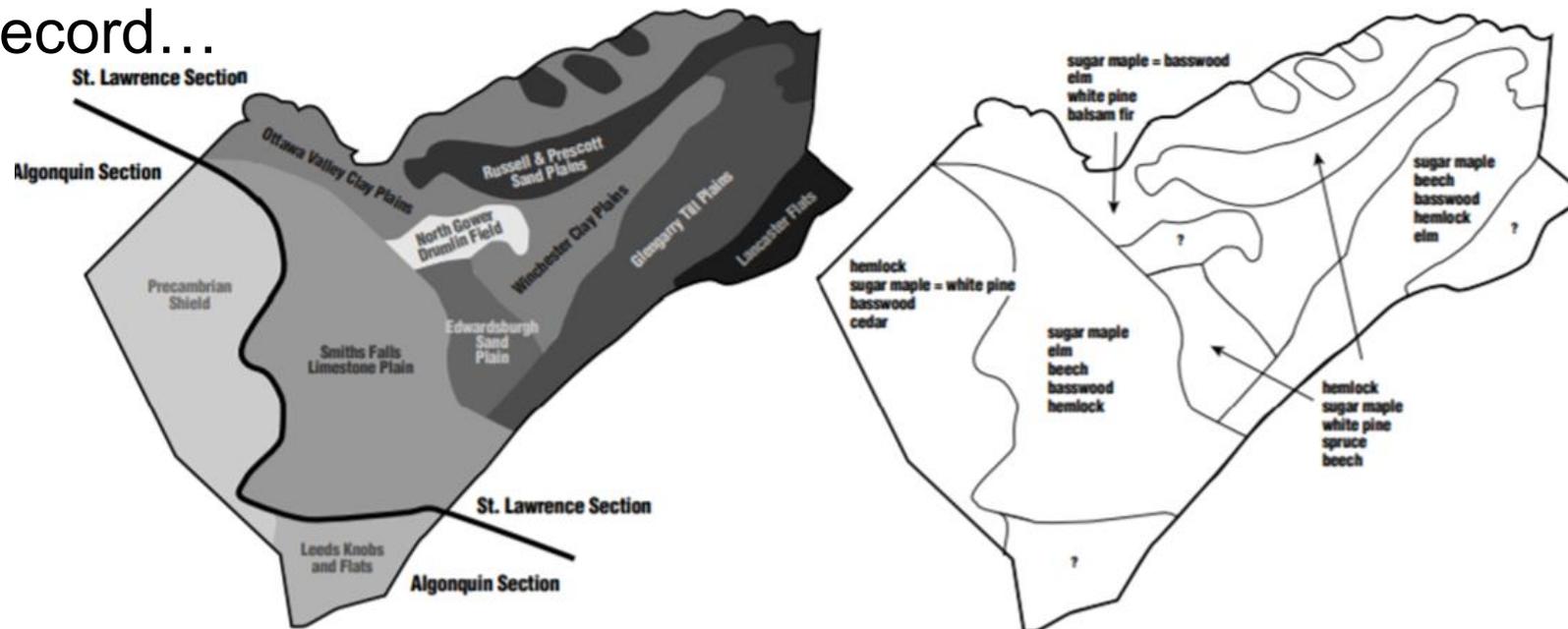


- **8,000 years ago-** Temperatures and moisture increase; Pine and Hemlock begin to increase in abundance throughout in Eastern Ontario, Champlain Sea is dry. Spruces and Firs begin to decrease in abundance.
- **5,000 years ago-** Significant decline of Hemlock across entire range (likely a disease or pest), causing an increase in hardwood species (ash, elm, oak, maple, poplar and basswood).
- **3,000 years ago-** Temperatures drop to weather conditions like what we have today, Spruces and Fir begins increase in abundance. Hemlock begins to recover. Oak begins to decline. Gradual warming begins..

(Forest History, 1997)

Ontario's Forests before Europeans?

Climate and soil type has influenced what tree species will grow where. What was the forest like before European's arrived? Based on fossil and pollen record...



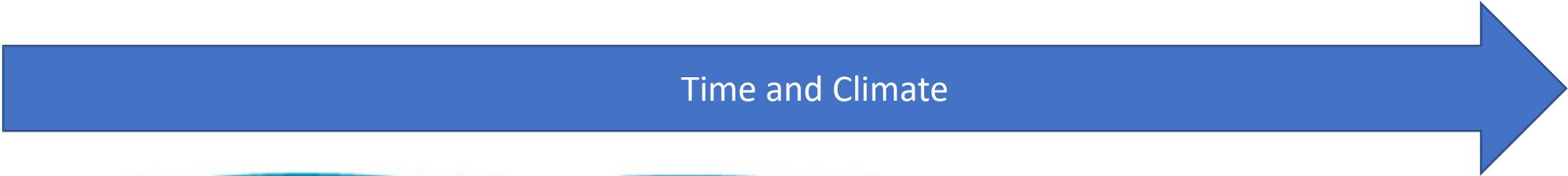
Physiographic regions of the Eastern Ontario Model Forest Region (from Eastern Ontario Forest Resources Stewardship Council 1992).

Tree species in upland forests prior to European settlement. For each region, the five species most frequently mentioned in surveyors' notebooks are listed in order of abundance.

So this is where we came from?



Time and Climate



Where do we stand today?



Human Effects on Ontario's Forests

Since European Settlement we have seen:

- Introduced pests and diseases (Dutch Elm Disease, Emerald Ash Borer & Gypsy Moth...) that have changed species compositions
- Introduced invasive species (Buckthorn & Scot Pine)
- High grading of timber stands, selecting the best trees and leaving the worst resulting in less resilient forests
- Land clearing for development and agriculture causing fragmentation
- Suppression of natural fire cycles, favoring fire intolerant species
- And last but certainly not least, we have human induced climate change!

(Thompson *et al*,2009)

Climate Change

What is it?

Climate change is a long-term shift in weather conditions identified by changes in temperature, precipitation, winds, and other indicators using averages taken over time.

What is causing it?

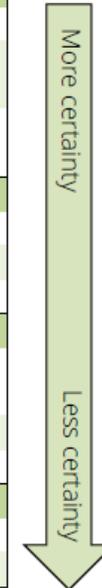
Human activity is the major cause of climate change by burning fossil fuels (gasoline, coal and natural gas etc.) and/or converting forested areas to farmland causing the earth's climate to change (Environment Canada, 2020)

Climate Change and the Capital Region

Where do we go from here?

Summary of Future Climate in Canada's Capital Region

What to expect*	2030s	2050s	2080s
Temperature			
Average temperature	↑ 1.8°C	↑ 3.2°C	↑ 5.3°C
Very hot days (above 30°C)	2.5 times more	4 times more	6.5 times more
Very cold days (below -10°C)	20% less	35% less	65% less
Seasons			
Winters shorter by	4 weeks	5 weeks	8 weeks
Springs earlier by	2 weeks	2 weeks	4 weeks
Winter freeze-thaw	↑ 15%	↑ 35%	↑ 55%
Precipitation			
Fall-winter-spring precipitation	↑ 5%	↑ 8%	↑ 12%
Intense precipitation	↑ 5%	↑ 15%	↑ 20%
Snowfall	↓ 10%	↓ 20%	↓ 45%
Extreme Events			
Possible increases in freezing rain			
Warming favours conditions conducive to storms, wildfires			

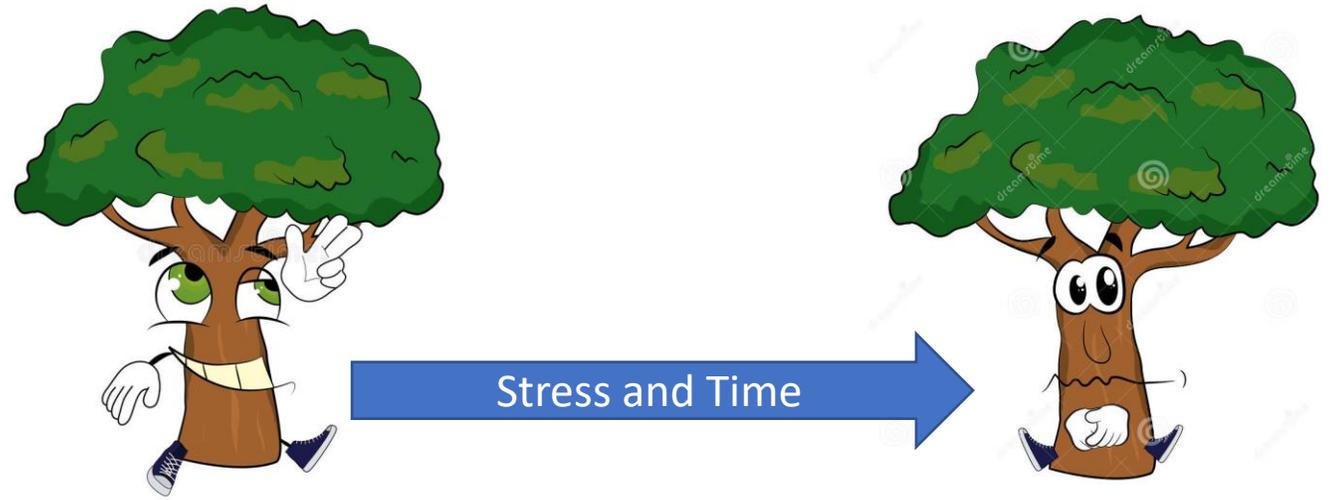


* For high emission scenario RCP 8.5



Climate Projections for the National Capital Region (2020)

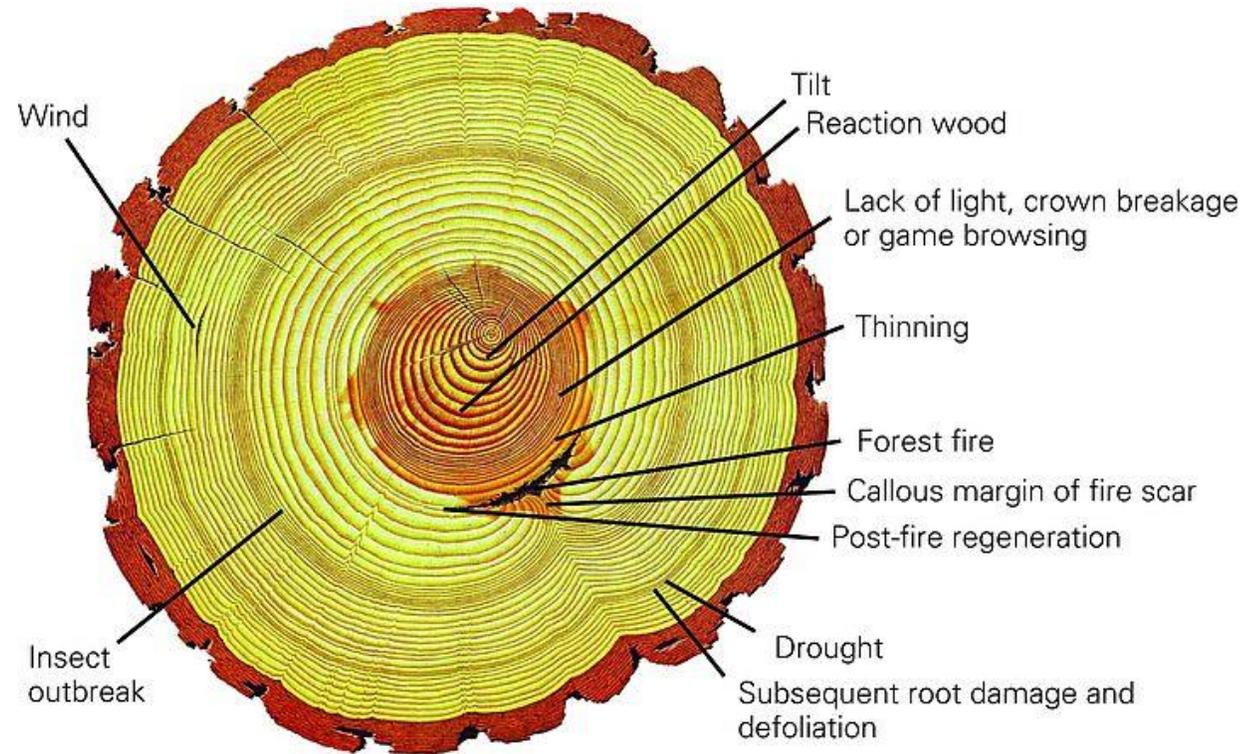
Effects on Trees



- Most tree species are resistant and adaptable to changes in growing conditions over the short term (ie. seasonal droughts or heatwaves)
- Trees have annual energy budgets and they can allocation resources to different tasks based on environment or life stage (reproduction, growth, storage and defence)
- Trees can allocate more resources towards defense and less towards growth in times of stress for example

(Lily,2010)

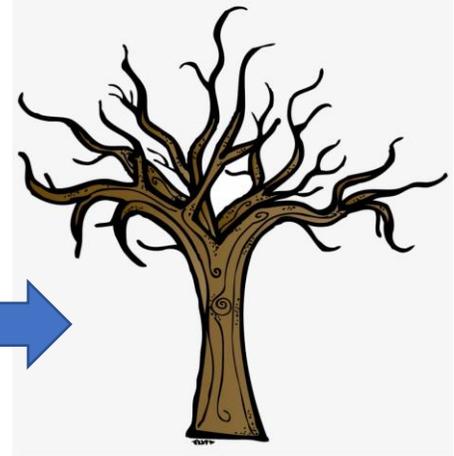
Effects on Trees



Effects on Trees



Increased stress



- If the short term stress becomes more long term, the reduced resource allocation towards growth and defence can make it more susceptible to pests and diseases.
- Long term stress caused by climate change can increase the susceptibility to pests outbreaks and diseases causing mortality (called “disturbances”)
- Disturbances provide canopy openings in the forest and new opportunities for younger trees to grow

(Lily,2010)



Tree & Climate Interactions



- The forest recovers from disturbances through a progression of shade tolerant species
- How do trees recover from disturbances? They use unique life strategies to help recover from disturbances called “niches”

OMNR. 2004

Tree & Climate Interactions

These niches include:

- Some species rely on fires that create regenerate (Jack Pine, Red Pine and Oak)
- Some species require large openings in the forest canopy to regeneration (White Birch, Poplar and Soft Maple)
- Some species are adapted to grow after wind events (Yellow Birch)
- Some species are not adapted to well adapted large disturbances and require a long time to become dominant in the forest (Balsam Fir)
- Some species show little to no response after disturbances (Black Cherry)

Effects on Forest Ecosystems



Precipitation			
Fall-winter-spring precipitation	↑ 5%	↑ 8%	↑ 12%
Intense precipitation	↑ 5%	↑ 15%	↑ 20%
Snowfall	↓ 10%	↓ 20%	↓ 45%
Extreme Events			
Possible increases in freezing rain			
Warming favours conditions conducive to storms, wildfires			

* For high emission scenario RCP 8.5

More certainty → Less certainty

Less certainty ↓

The changing climate will likely cause more disturbances (severe thunderstorm, ice storms, droughts) to the forest which will benefit some species while causing other species to decline.

Effects on Forests Conditions?

- Very complicated, a lot of unknowns
- Warmer winters and a longer growing season may increase evaporation and water use by forests, reducing summertime soil moisture and increasing length of droughts
- Longer growing seasons and higher atmospheric CO₂ concentrations may increase productivity and growth
- Increased summer drought combined with changes in suitable habitat, increases in pests and disease, and continued problems with air pollution may lead to decrease productivity
- Increased freezing and thaw cycles could cause significant decline to colder adapted species

(Rustad et al, 2012)

	Seasons		
Winters shorter by	4 weeks	5 weeks	8 weeks
Springs earlier by	2 weeks	2 weeks	4 weeks
Winter freeze-thaw	↑ 15%	↑ 35%	↑ 55%

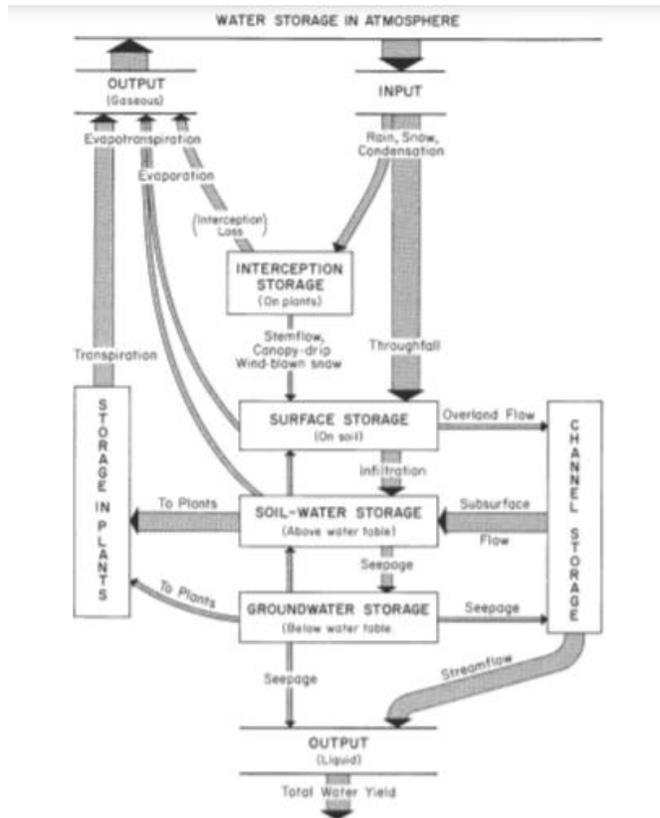
Effects on Watercourses?

- Changes to forest conditions will have spin off effects on the forest communities and wildlife that rely on them for habitat.
- Eg. A Hemlock tree that produces very dense shade all year round. The shade slows of the snow runoff in spring as well as creates higher soil moisture content during other months when compared to hardwoods. If the hemlocks disappeared, small creeks could run dry earlier which could cause a decline in fish habitat.



(Rustad et al, 2012)

Effects on Watercourses?



Forests help control flooding by:

- Intercepting rain and snow before it hits the ground (leaves and branches)
- Rainwater and snowmelt are absorbed by trees through the roots.
- Conifers provide shade in the spring to slow the melt of the snow pack reducing spring flooding
- Soils have a limited capacity to hold moisture during severe rain and spring melts

Effects on Watercourses?

Precipitation			
Fall-winter-spring precipitation	↑ 5%	↑ 8%	↑ 12%
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More certainty
Less certainty



Decline in forest cover (especially conifer cover) could cause an increase surface and subsurface runoff resulting in more flooding during the spring melt.

What can we expect the future forest to look like?

- Very difficult to predict what our forests will look like as there are many variables at play.
- More cold adapted species will be pushed further north as the climate warms and suitable habitat becomes sparser and more competitive
- More hardwood species will increase in abundance
- More pest and disease disturbances within the forest, increasing abundance of shade intolerant species

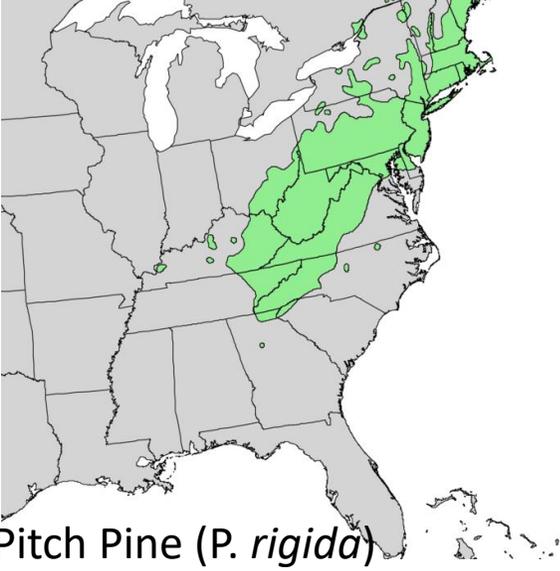
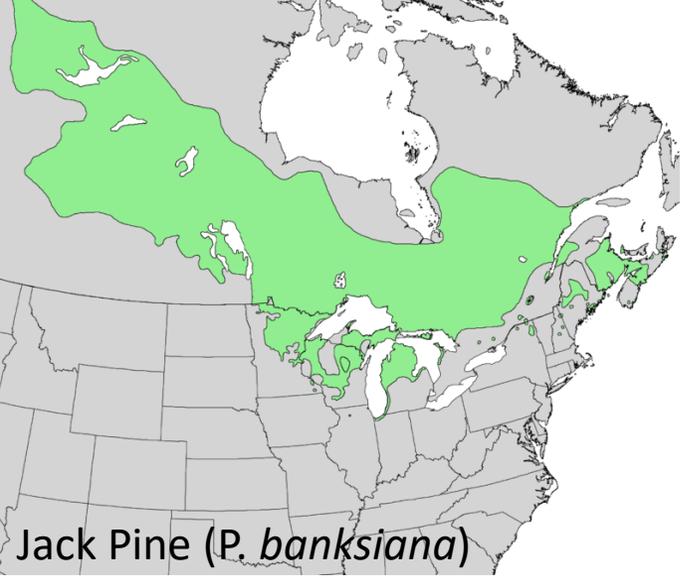
(USDA,2010)

What are Foresters doing to help?



From a Silvicultural perspective we are looking into...

Species Substitution?



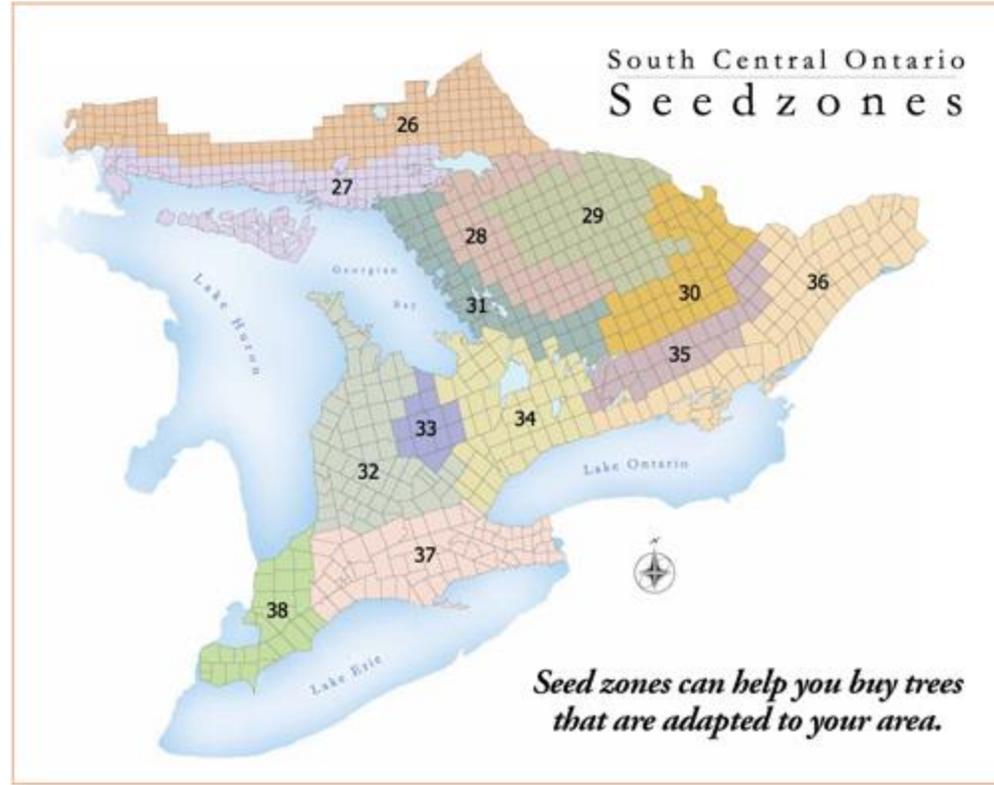
Elbert L. Little, Jr., USGS

Seed Source Areas?

- Most tree species grow across large geographic areas
- Local populations of trees have evolved to be specially adapted to local climatic conditions over many generations
- Seedlings need to be planted in the area from which their seed came
- Can we experiment with planting the same species with using a different tree seeds zones from another area of Ontario? Perhaps!

(EOMF, 2010)

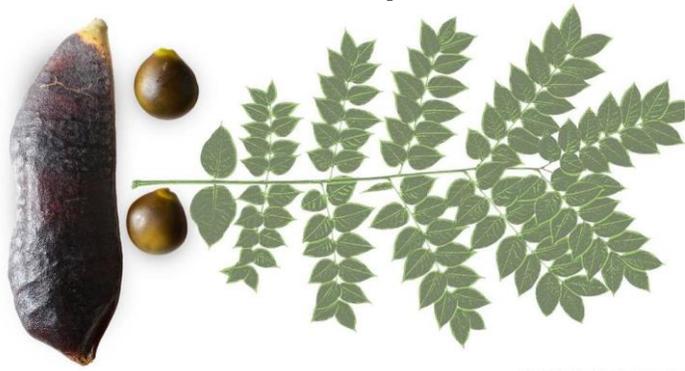
Seed Source Areas of Ontario



1-YR OLD RED OAK GROWN FROM VARIOUS ONTARIO SEED SOURCES UNDER THE SAME GREENHOUSE CONDITIONS; FROM AN OMNR SEED SOURCE STUDY (UNPUBLISHED, OMNR 1996).

Assisted Tree Migration?

- Taking a tree from with a similar “niche” from a warmer climate and introduce it to the Capital Region based on the predicted changes in climate
- Several examples of success of introducing street trees in the City of Ottawa that are native to the Windsor area.
- Scientist suspect that First Nations peoples would have transplanted useful tree species for resources (ie. Petrie Island or Carleton Place)



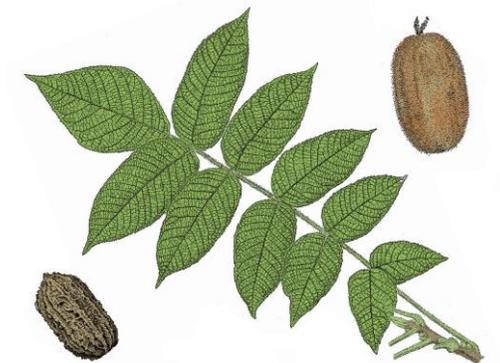
Kentucky Coffee Tree



Common Hackberry

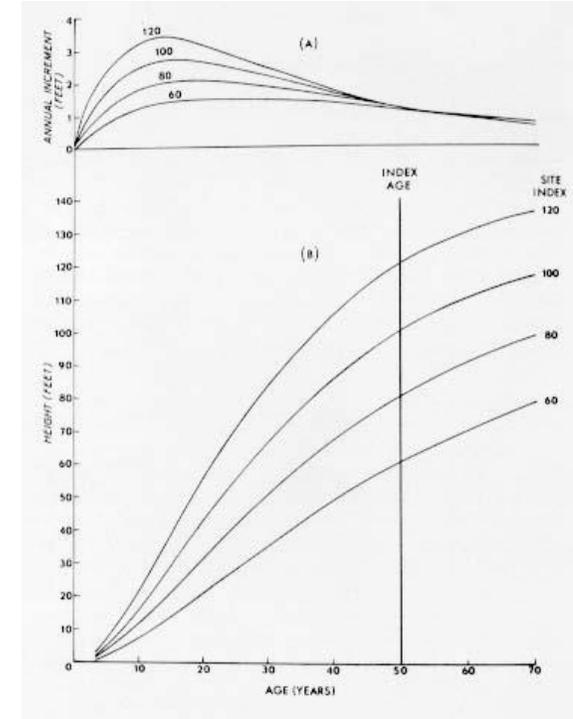


Honey locust



Butternut

Tree Planting: Selecting the best tree for your site



Southern Research Forest USDA

Planting trees species that are best adapted to the site conditions (drainage, soil type, soil depth and exposure) will reduce stress, increase growth and increases survivability for trees. (EOMF, 2010)

How do Trees Help?

Trees provide many benefits that include:

- absorbing carbon dioxide and releasing oxygen
- providing shade (reducing energy consumption for cooling)
- improving soil stability/health
- providing for wildlife habitat and protection
- reduce surface runoff and flooding



Interested in Planting Trees?

Programs offered by the Rideau Valley Conservation Authority:

Green Acres Reforestation Program:

Funded by the City of Ottawa for properties within the City of Ottawa through Forest Ontario

Trees for Tomorrow Reforestation Programs:

Properties outside of the City of Ottawa within the Rideau Valley and the Mississippi Valley watersheds funded through Forest Ontario

Program Services Provided

- Significant subsidies for all reforestation projects (\$0.15/tree)
- Customized tree planting plans to suit your needs
- On site technical advice from qualified field staff
- Tree planting and tending services
- Ordering and handling of trees
- Site preparation
- Survival assessments



Requirements: Minimum of 1.25 acre of open land (1000 trees)

What can you do?

As landowners, you have the best opportunity to show good stewardship!

- Plant trees that are best suited to the site conditions
- Do some research on tree species and the effects climate change. Plant trees that will grow well today and for generations. US Department of Agriculture (USDA) has a lot of good info!
- Reach out for resources and information from your local forester or organizations like Eastern Ontario Model Forest, Ontario Woodlot Association, Forest Gene Conservation Association, the Landowner Resource Center and your local Conservation Authority
- If you are harvesting timber on private land, get a qualified tree marker to mark the trees before harvesting
- Create a forest management plan through the Managed Forest Tax Incentive Program (if applicable)

Questions?

We will now take your questions!

If we don't have time for your question or if you would like to give us feedback please email us:

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Friends@taywatershed.ca

The powerpoint is available upon request

References

- Colombo, S.J. Ontario's Forests and Forestry in a Changing Climate 2008 Queens Printing Press. Ministry of Natural Resources and Forestry.
- OMNR. 2004. Ontario Tree Marking Guide, Version 1.1. Ont. Min. Nat. Resour. Queen's Printer for Ontario. Toronto. 252 p.
- Forest History, 1997. Forest History of Eastern Ontario Extension Note: 1997 Queens Printing Press. Landowner Resource Centre
- Climate Projections for the Capital Region, 2020, City of Ottawa and the National Capital Commission
https://documents.ottawa.ca/sites/documents/files/climateprojects_execsummary_en.pdf
- Choosing the right tree, 2010 Eastern Ontario Model Forest
- Etterson, J. R., Cornett, M. W., White, M. A., & Kavajecz, L. C. (2020). Assisted migration across fixed seed zones detects adaptation lags in two major North American tree species. *Ecological Applications*, 30(5)
- FGCA, 2016 Seed Source matter, Forest Gene Conservation Association.
<https://fgca.net/2016/12/seed-source-matters/>

References

- Rustad, L., Campbell, J., Dukes, J. S., Huntington, T., Lambert, K. F., Mohan, J., & Rodenhouse, N. (2012). Changing climate, changing forests: The impacts of climate change on forests of the northeastern United States and eastern Canada. doi:10.2737/nrs-gtr-99
- Lily, 2010, International Society of Arboriculture Arborist Certification Study Guide
- <https://www.esd.ornl.gov/projects/gen/nercNORTHAMERICA.html>
- Anderson, Hover, and Reinhart (1976) Forest and Water Effects of Forest Management on flood, sedimentation and water supplies. USA Department of Agriculture
- Thompson, I., Mackey, B., McNulty, S., Mosseler, A. (2009). Forest Resilience, Biodiversity, and Climate Change. A synthesis of the biodiversity/resilience/stability relationship in forest ecosystems. Secretariat of the Convention on Biological Diversity, Montreal. Technical Series no. 43, 67 pages

Useful links

- United States Forest Service Climate Change Models

<https://www.fs.fed.us/nrs/atlas/>

Shows predicted changes in species abundance by state and by forest type (Vermont & New York has a very similar climate and species composition to Eastern Ontario)

- Natural Resource Canada Climate Change (General Information)

<https://www.nrcan.gc.ca/climate-change/impacts-adaptations/climate-change-impacts-forests/13083>

- Natural Resource Canada Climate Change Models

<https://www.nrcan.gc.ca/climate-change/impacts-adaptations/climate-change-impacts-forests/forest-change-adaptation-tools/17770>

- Managed Forest Tax Incentive Program

<https://www.ontario.ca/page/managed-forest-tax-incentive-program>

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Thank you for attending and look forward to seeing you again soon!