SEED SOURCING FOR RESILIENT FORESTS

Kristen Sandvall – Seed and Climate Change Coordinator
Meghan Clay – Seed and Climate Change Technician

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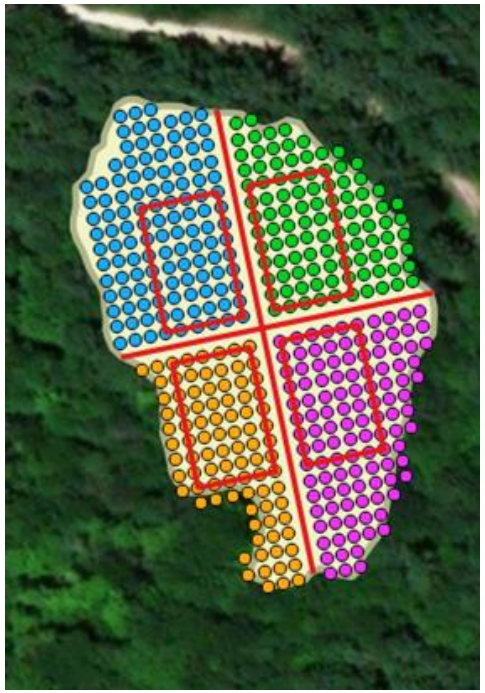


CREATING RESILIENT FORESTS IN ONTARIO

A Climate Change Analysis for Forests Ontario's Tree Planting Programs

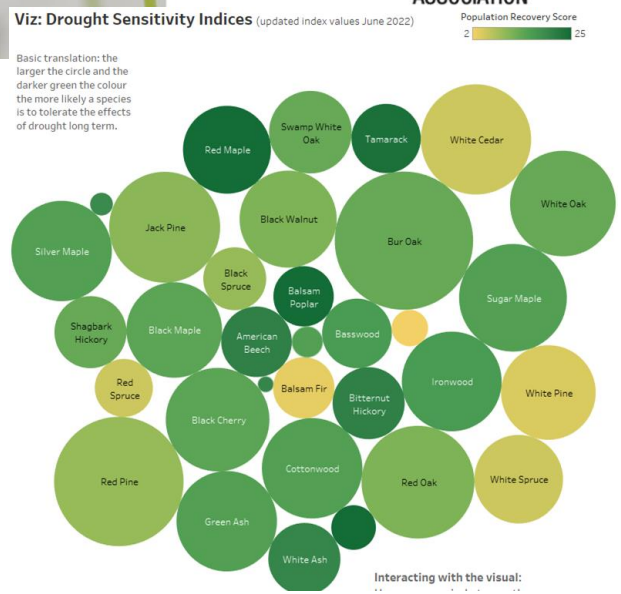
JULY 2021

French Severn Forest Vulnerability Assessment
Completed by the Forest Gene Conservation Association for Westwind Forest Stewardship Inc.

The Forest Gene Conservation Association has partnered with Westwind Forest Stewardship Inc. to complete a forest vulnerability assessment for the French Severn Forest (FSF). This project was supported by the Forestry Futures Trust- Forest Genetic Resource Management Program. This interactive decision management tool, based in Tableau, has been developed to complement the 2017 *Adapting to a Changing Climate: A Report for Southern Region Sustainable Forest License Holders*.

This tool, and the discussions to follow during a 2022 site tour, are intended to provide Westwind Forest Stewardship staff with information to aid in decision making given the uncertainty of climate change.

The analysis was completed through a species based and Forest Unit based approach to identify species vulnerabilites as well as opportunities and how climate change may affect the primary Forest Units managed in the FSF. The SeedWhere maps included where sourced from previous work used to identify target areas for seed procurement for the Harris Lake White Pine assisted migration Seed Production Area (SPA) trial site, (planted 2021-2023).



THE CLIMATE IS CHANGING

What can we do about it?

FGCA Context

What We Strived to Accomplish

- Current science presented for the practitioner context
- Guide changes to practitioners' programs in the face of climate change
- To be used in conjunction with practitioners' knowledge of their local areas

What We Don't do/provide

- Provide one size fits all recommendations
- On the ground local knowledge
- Government policy
- Guaranteed prediction of the future
  - Climate
  - Species

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Considerations

CLIMATIC CHANGES

SPECIES SUITABILITY

PLANTING SITE/FOREST CONDITIONS

GENETICS & ASSISTED MIGRATION

SEED

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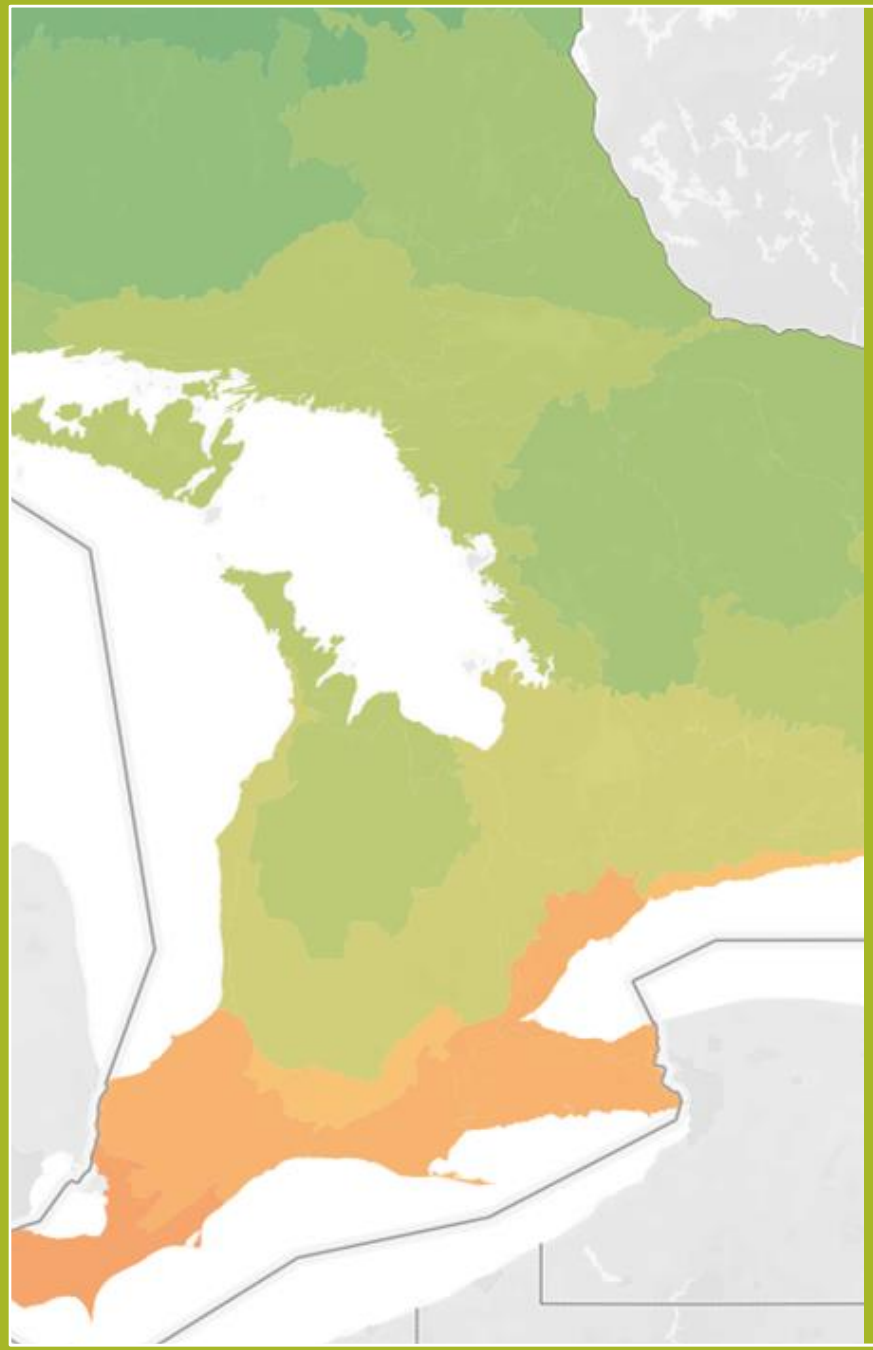

Why is Climate Change so Important?

One Century of Movement

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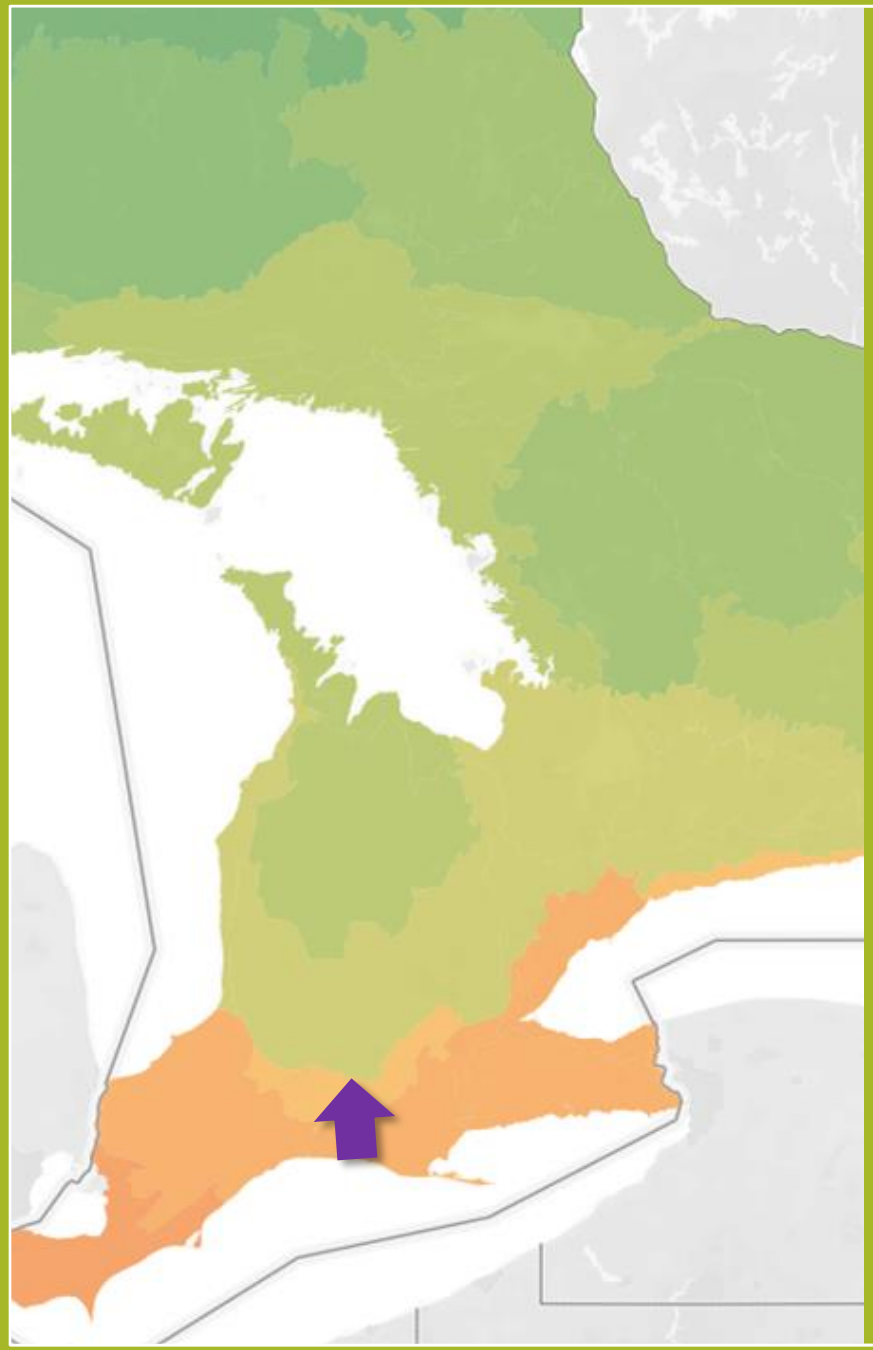

Why is Climate Change so Important?

One Century of Movement

Natural migration rates = 10-50KM

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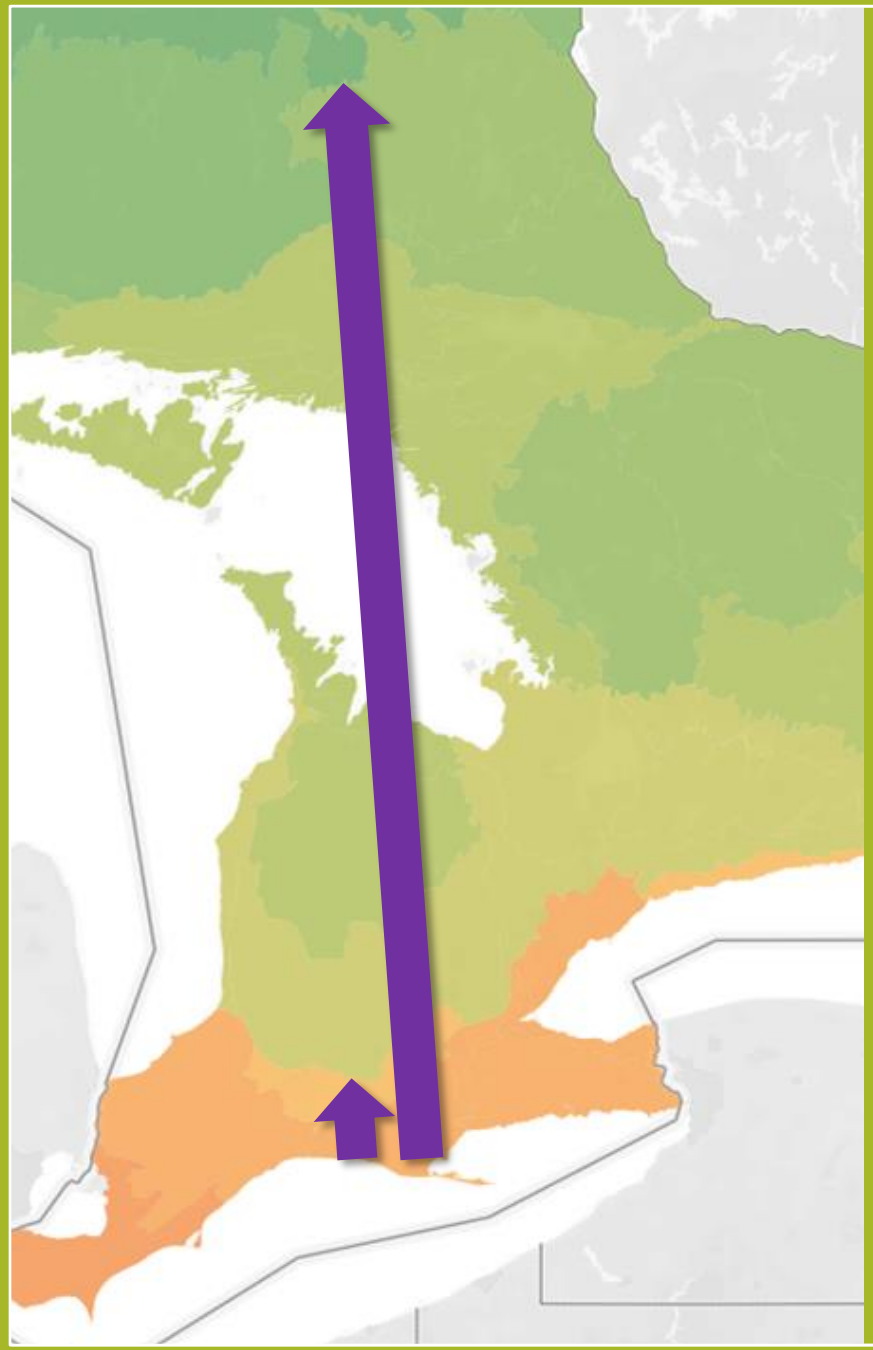

Why is Climate Change so Important?

One Century of Movement

Natural migration rates = 10-50KM

Potential shift of climate = up to 700km this century

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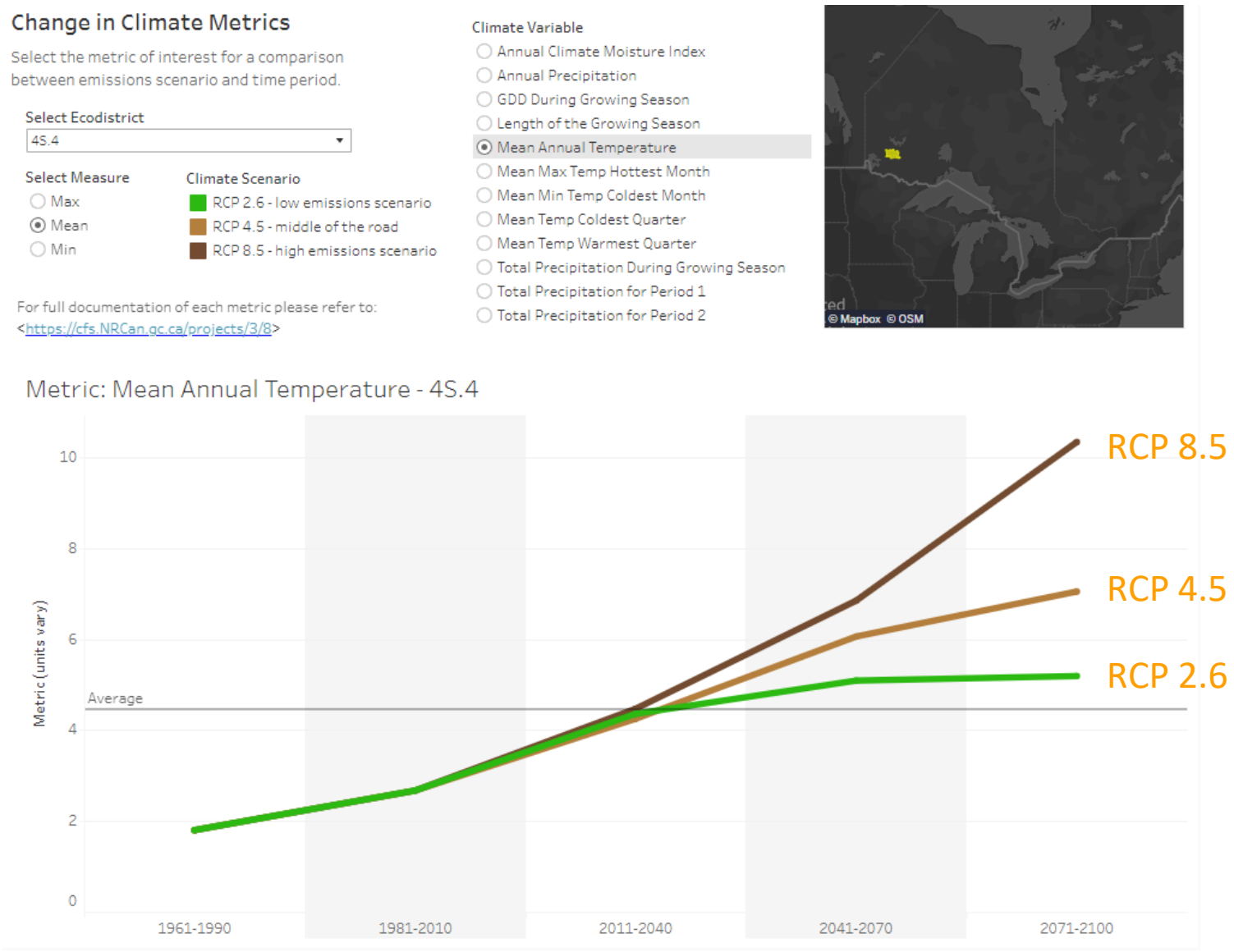

https://public.tableau.com/app/profile/larlo/viz/SeedSourceOntario/Intro

Climate Models

Representative Concentration Pathways (RCP)

- RCP 2.6 – Low emissions scenario
- **RCP 4.5** – Middle of the road
- **RCP 8.5** – High emissions scenario
  *aka business as usual

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TEMPERATURES ARE INCREASING

PRECIPITATION IS INCREASING

WEATHER IS BECOMING MORE VARIABLE

A Few Things We Know

Climate Moisture Index (CMI)

AKA Drought Index

All Ecodistricts show a downward trend
≈decrease in available moisture for trees

- Some ecodistricts have values that go below a CMI of 0
- Drought to increase difficultly of establishment & long-term survival

Can we find more adaptive sources?

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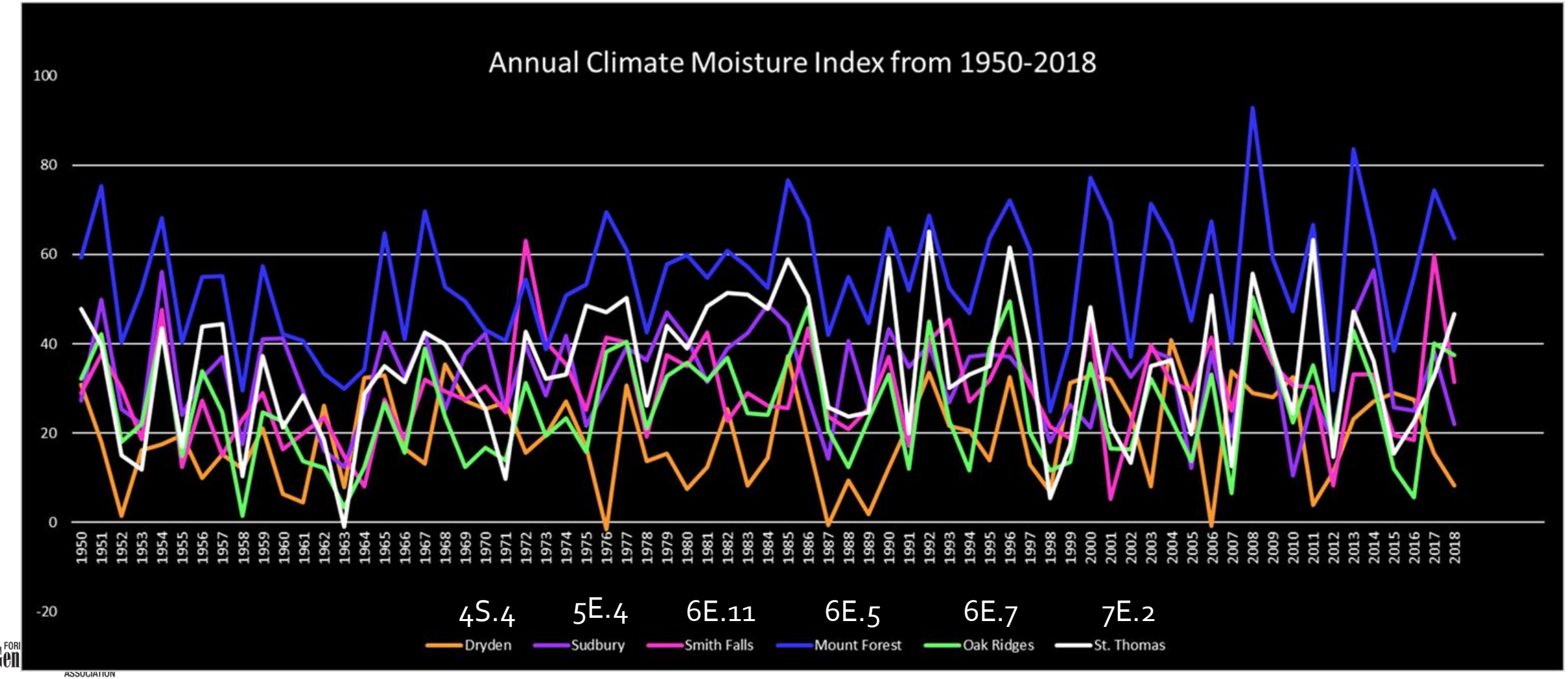
CMI Variability

Source: NRCan



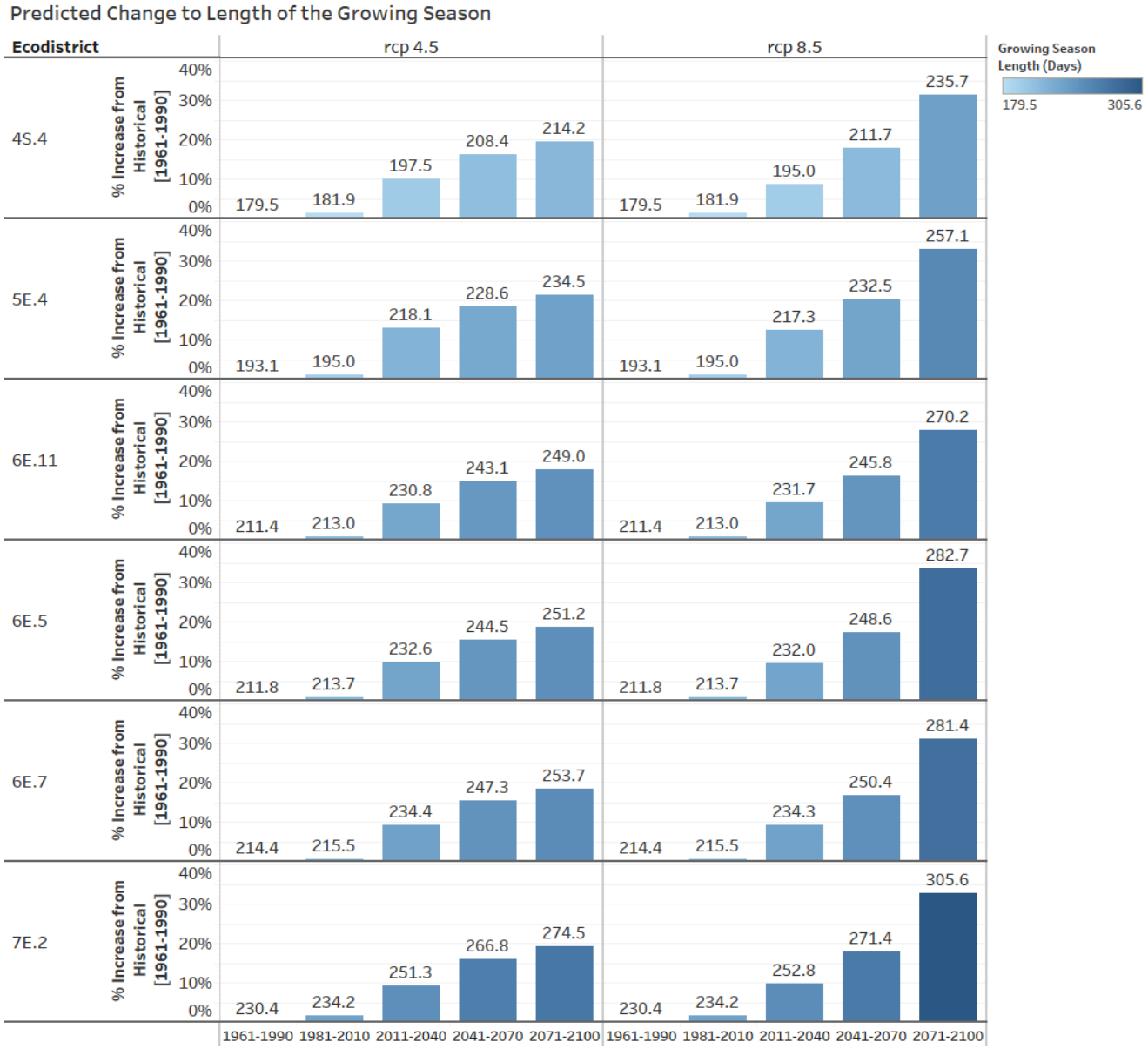
Prepare for Reduction in Winter Harvest

- Increase in temperatures and growing season
- Variable weather patterns – Drought to Flood
- Potential for more snow fall but also more potential for freeze thaw events and reduction in frozen ground time

Growing Season Length (GSL)

- GSL is a critical variable in bud set, bud break and can have a significant influence on growth potential each year
- Increasing in length by as much as 60 days by end of century

Change like nothing they've ever seen historically!



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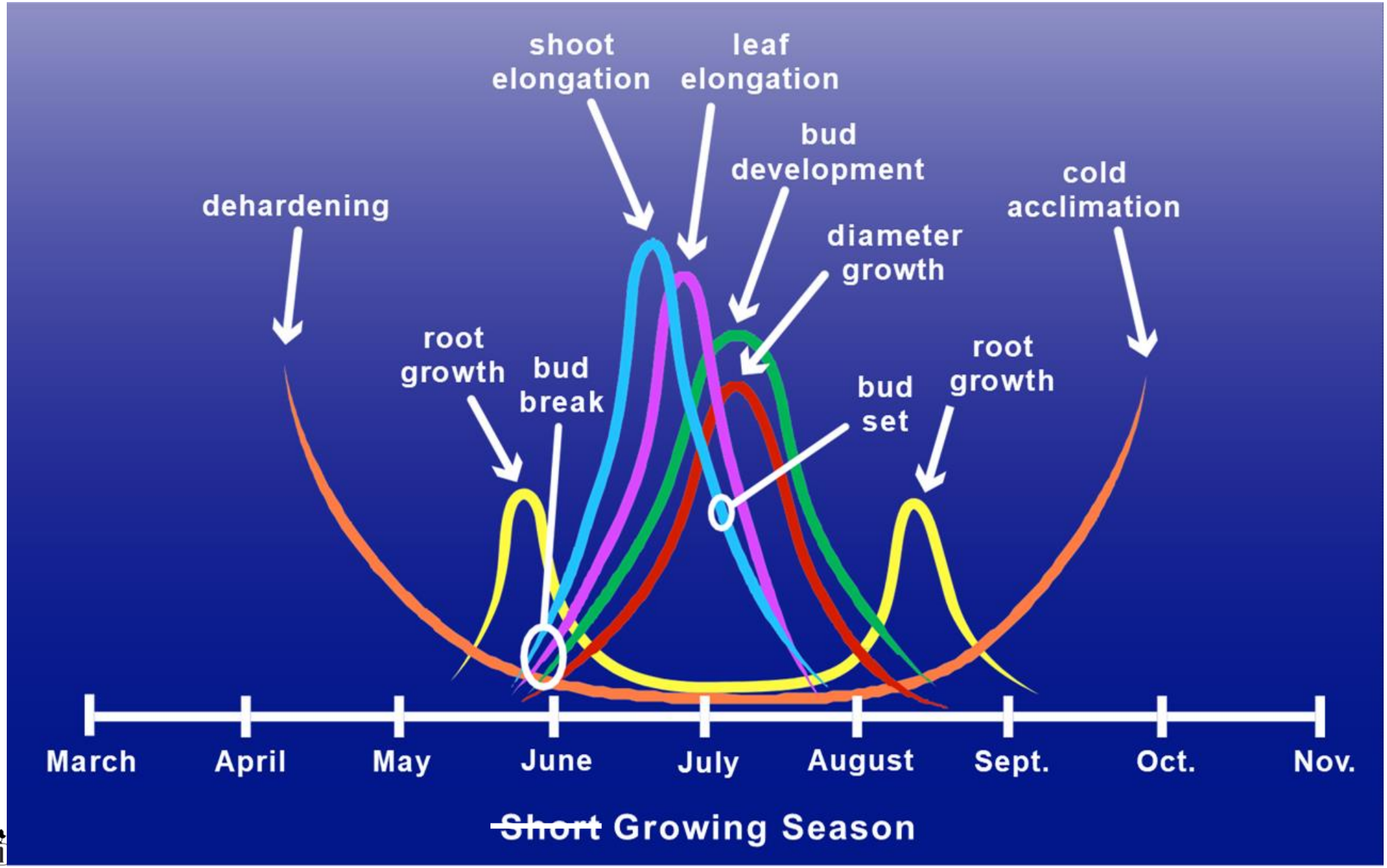

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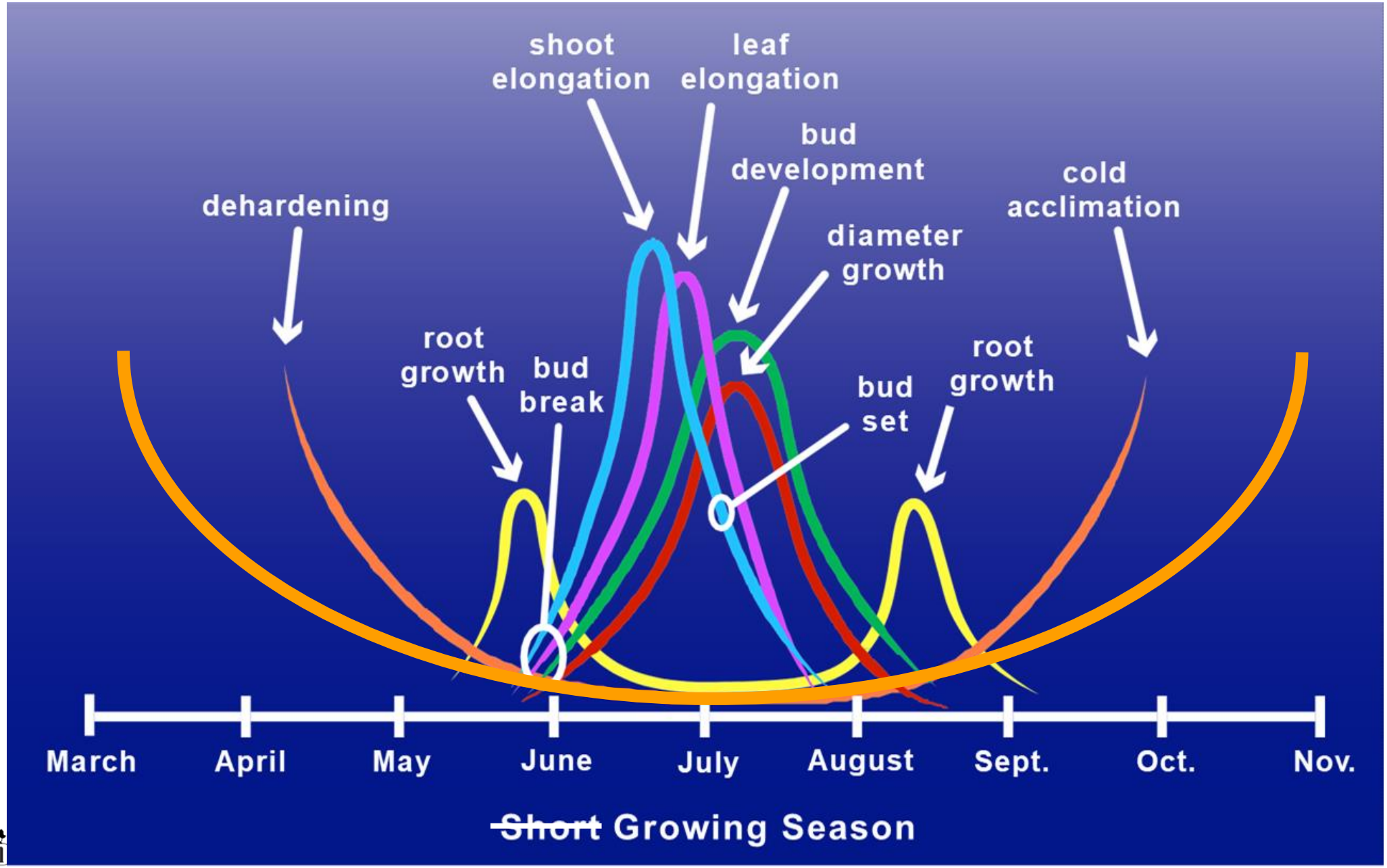

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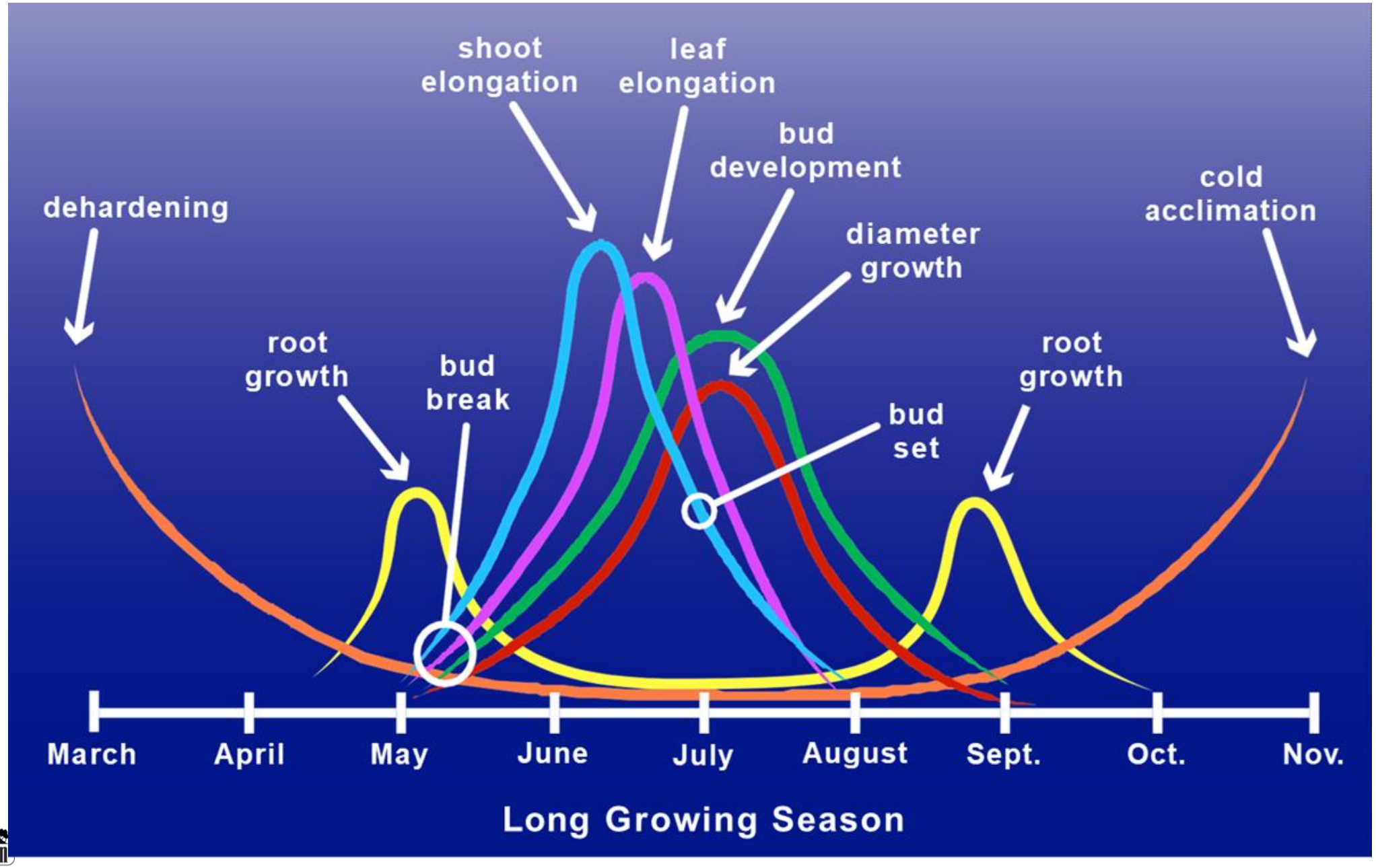

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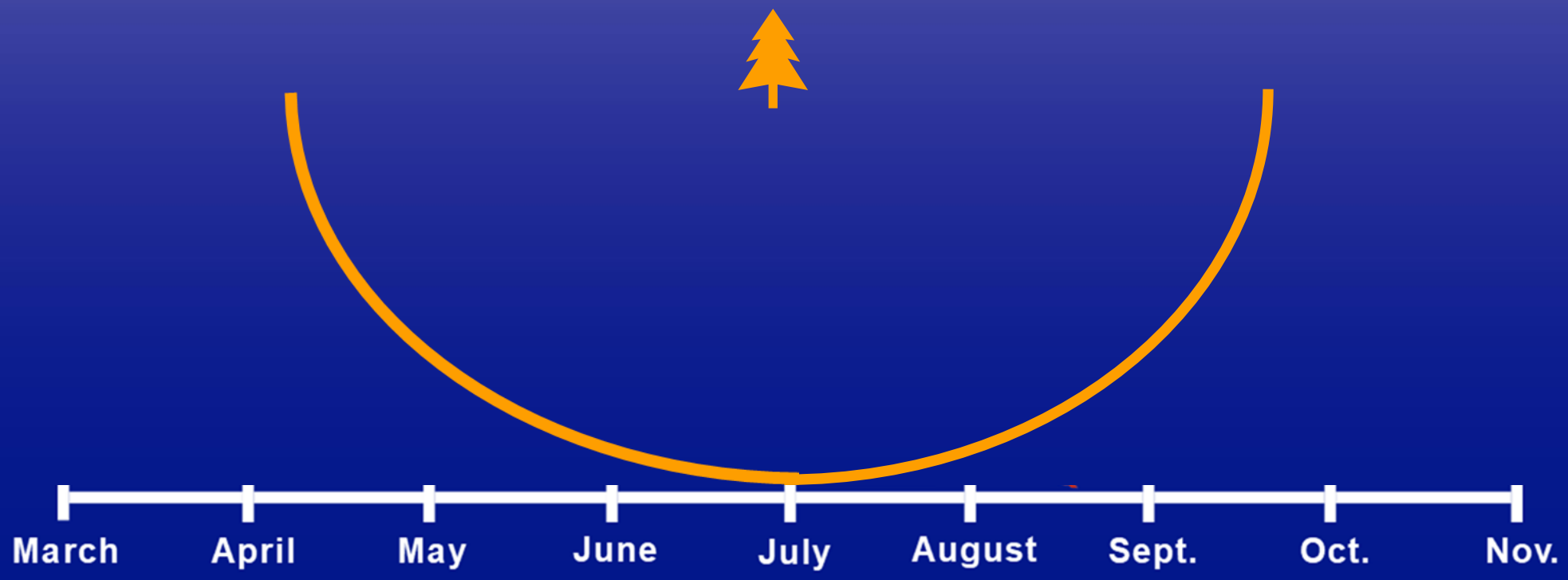
How Can We Assist the Change?



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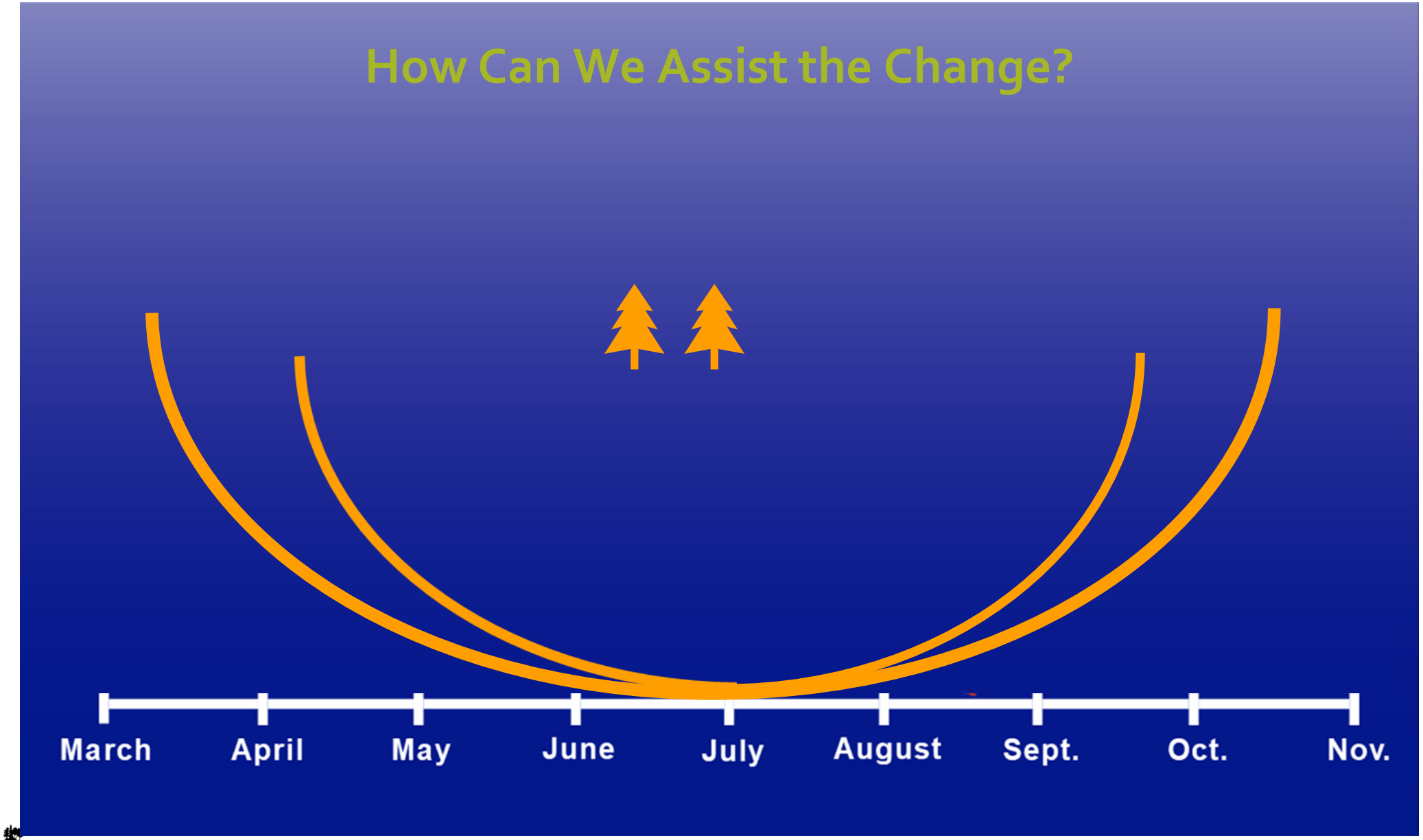

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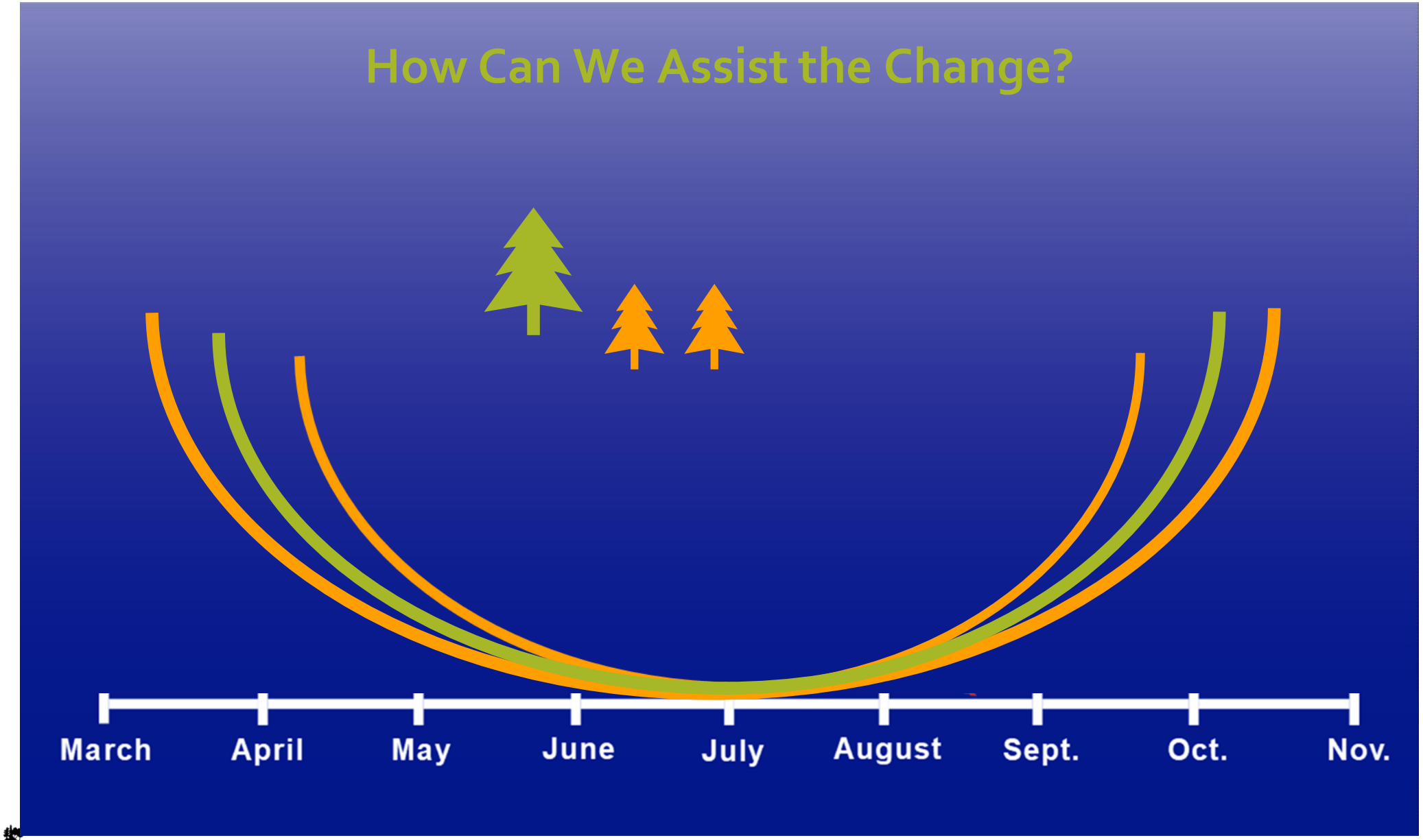

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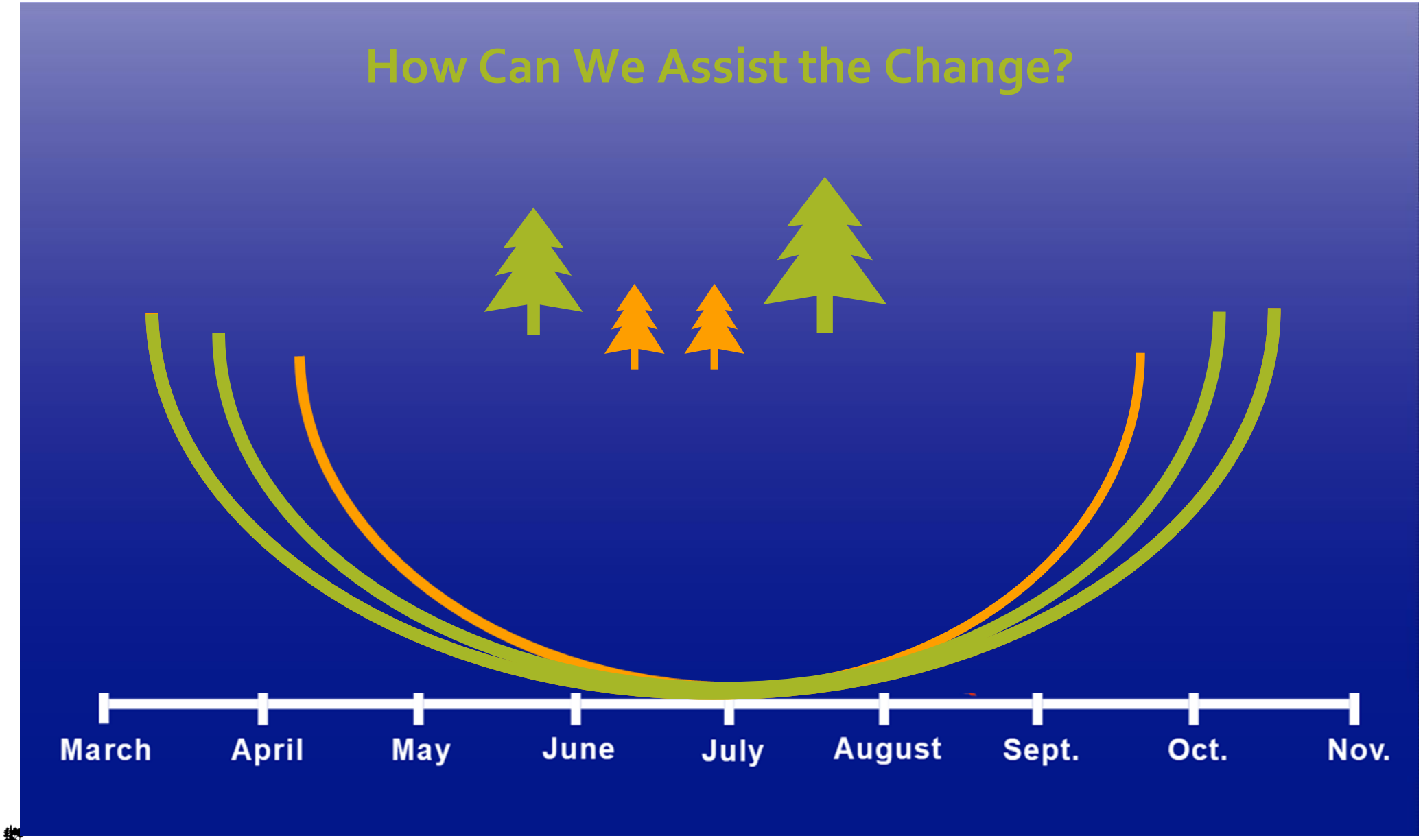

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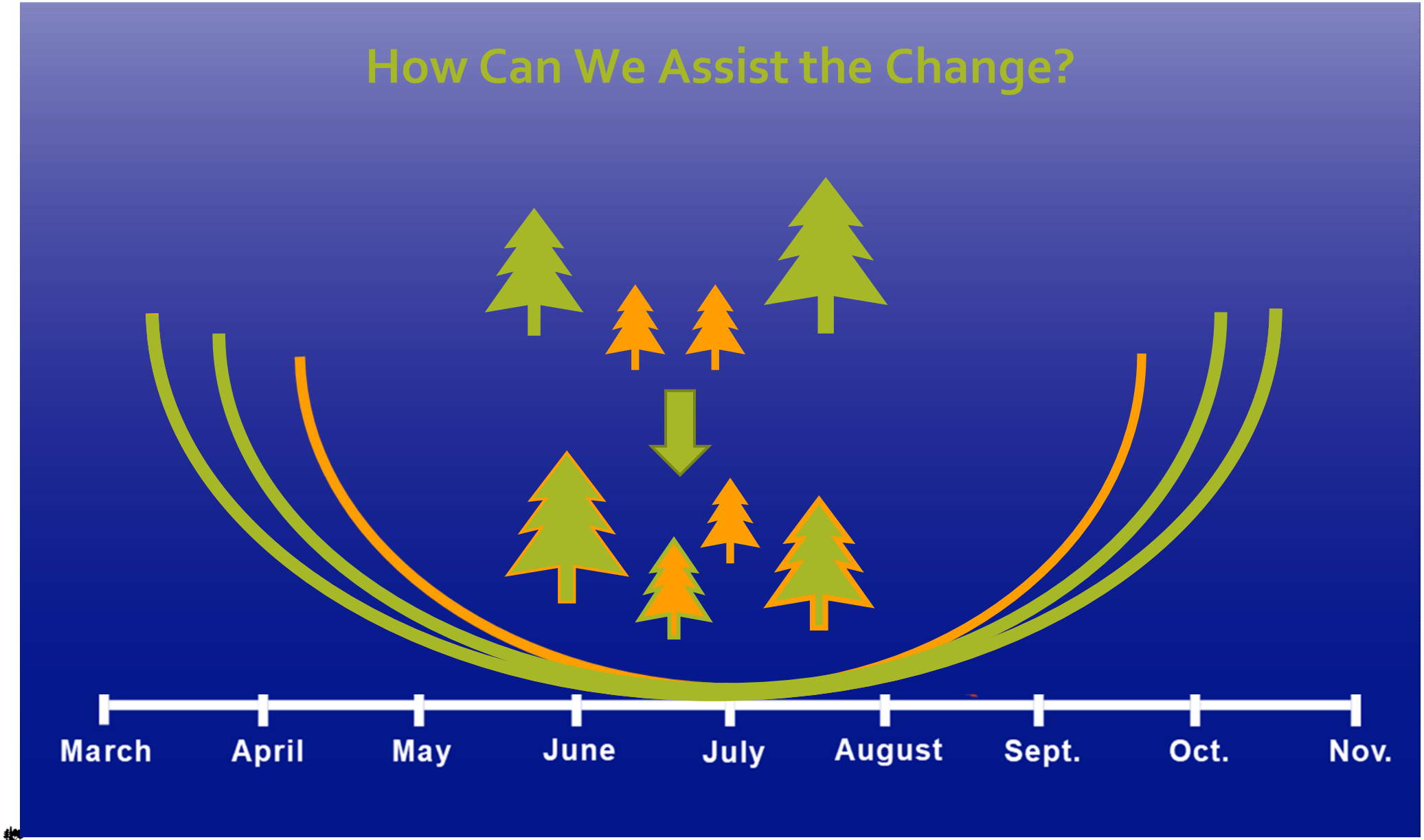

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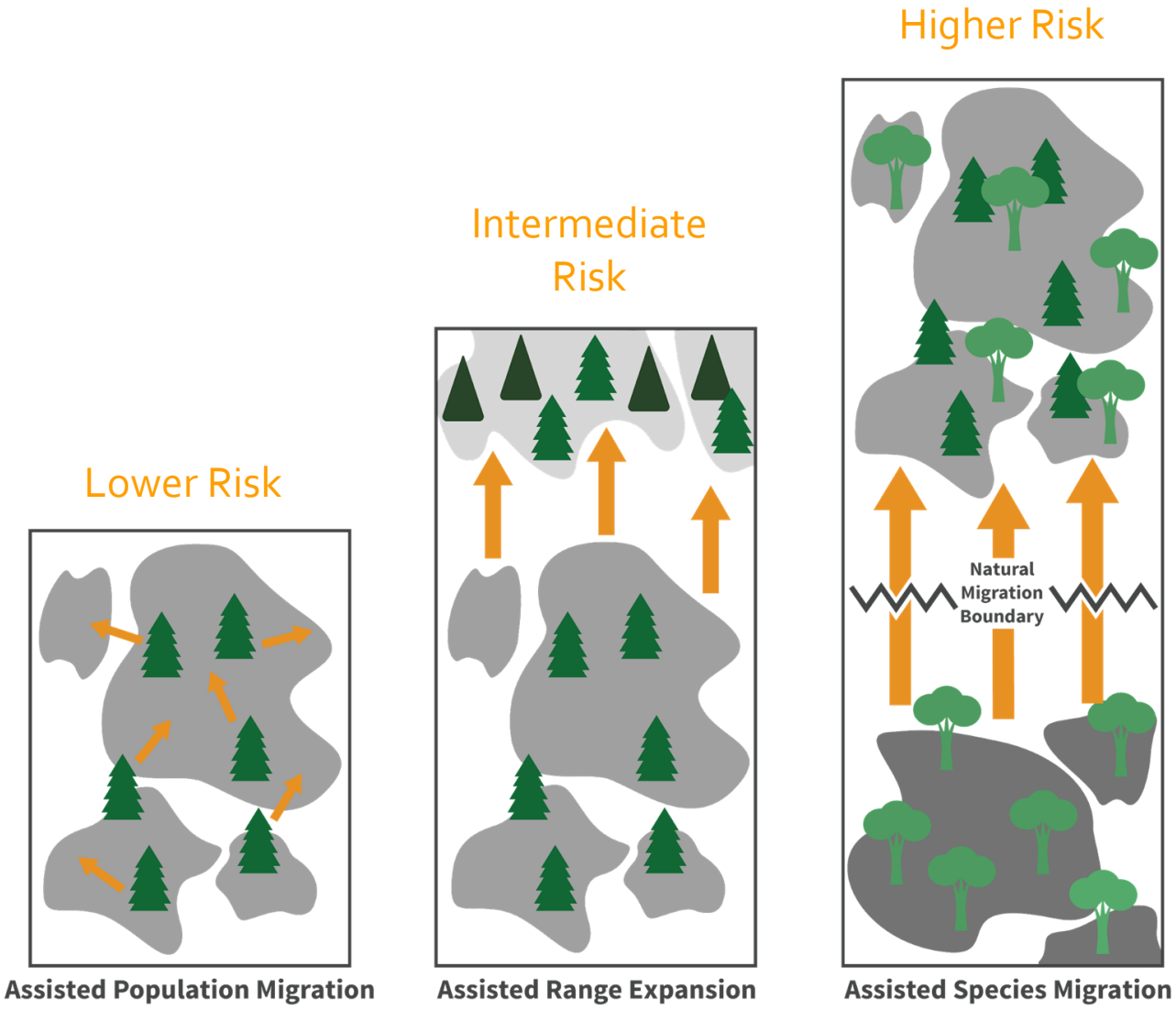
Assisted Migration (AM)

Assisted population migration — movement of populations within a species' established range

Assisted range expansion — movement of species to areas just outside their established range, facilitating or mimicking natural range expansion

Assisted long-distance migration (species) — movement of species to areas far outside their established range

*Beware of variable weather patterns



https://www.fs.usda.gov/ccrc/topics/assisted-migration

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Understanding the Risks

- Species ID Issues
- Pest & Disease
- Frost Damage
- Phenology differences – Misaligned pollination windows
- Maladaptation to local conditions in species or populations that have strong adaptative links to their native conditions

When is Assisted Migration right for you.. and your forests.

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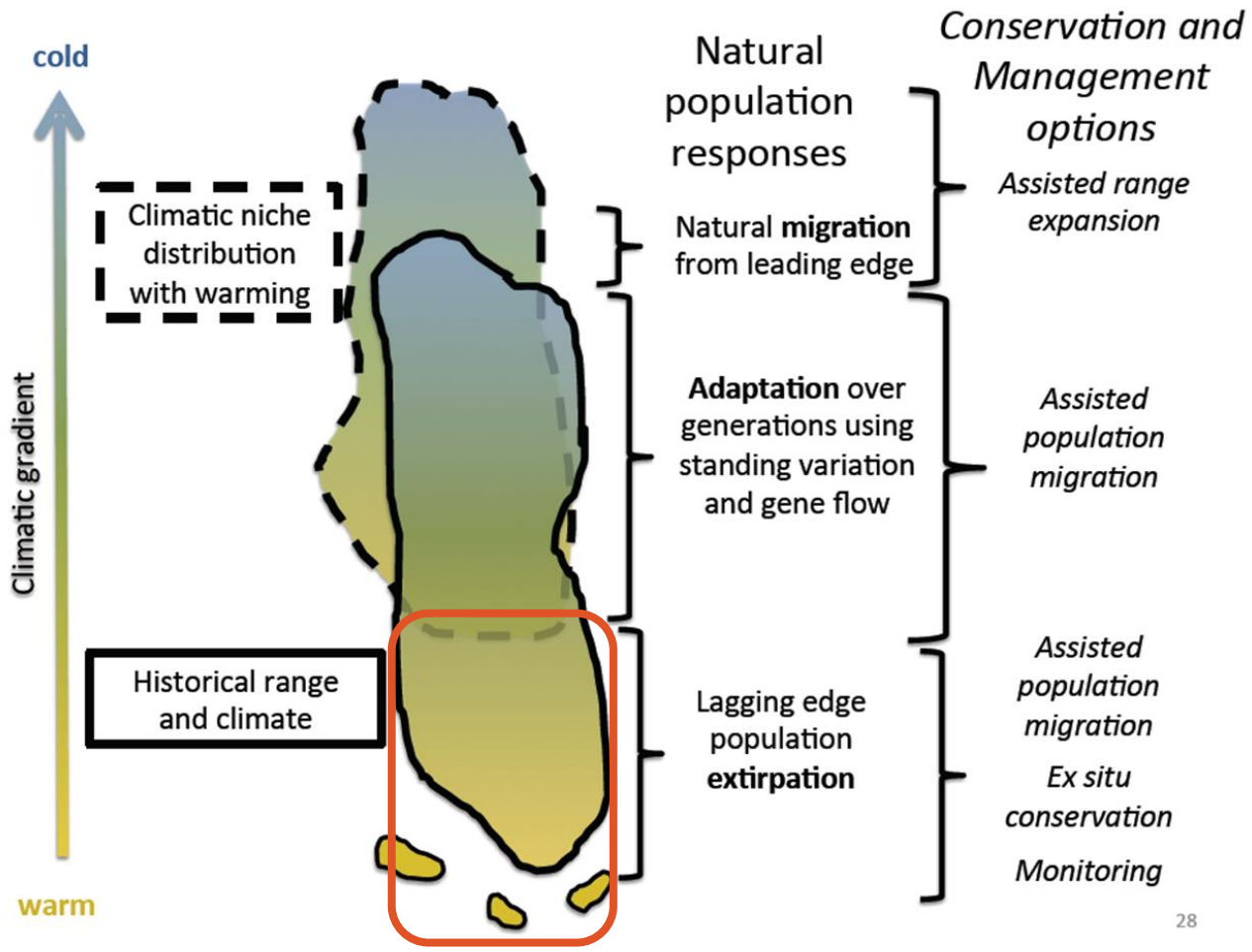
Conservation and Management Options

Southern/Lagging Edge

- Extirpation
- AM, Ex and In-situ Conservation



Source: Aitken. 2012. Centre for Forest Conservation Genetics/CONFORGEN Presentation.

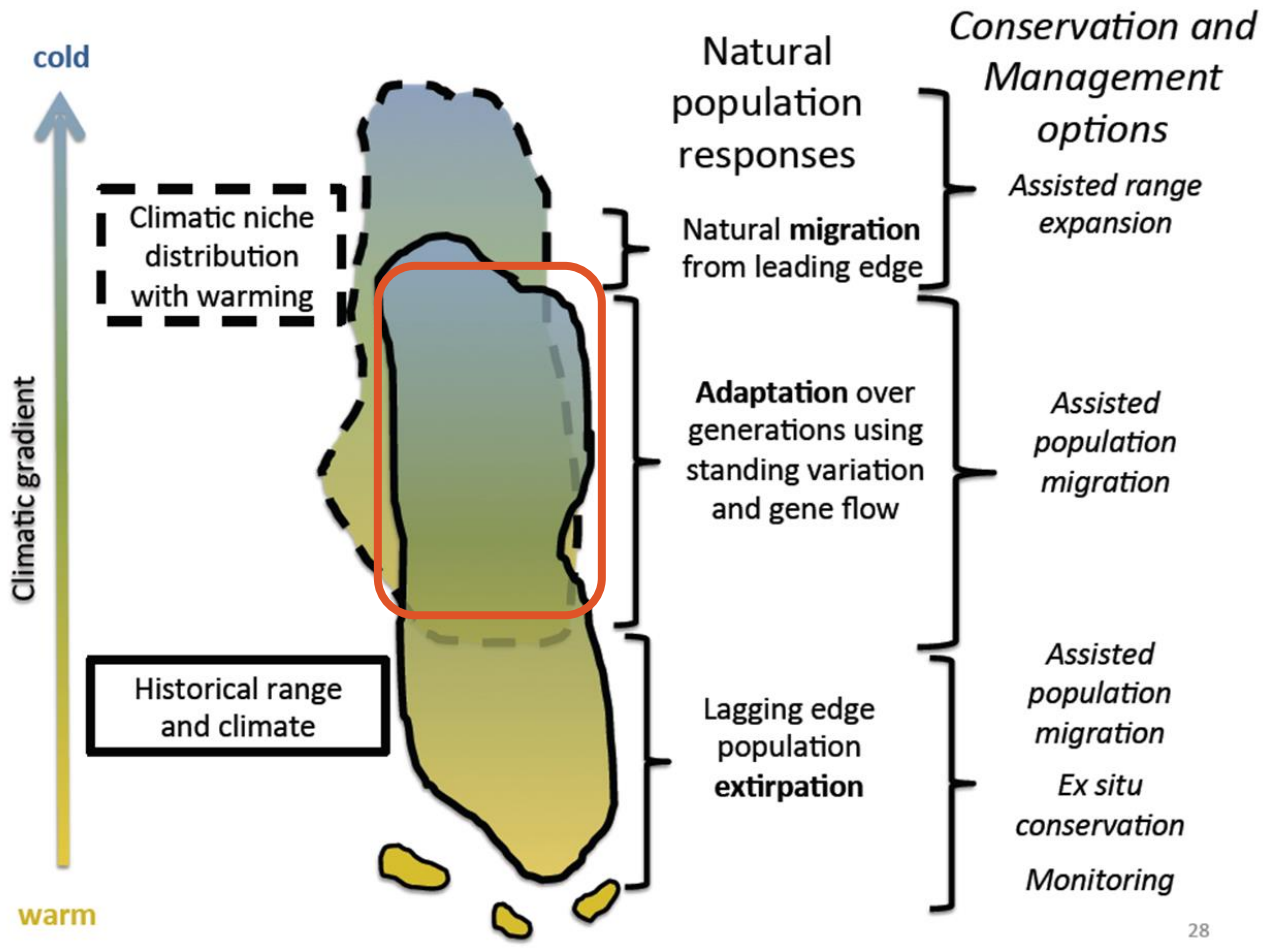
Conservation and Management Options

Southern/Lagging Edge

- Extirpation
- AM, Ex and In-situ Conservation

Current and Future Climatic Overlap

- Adaptation, Genetic Diversity, Gene Flow
- Assisted Population Migration



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Conservation and Management Options

Southern/Lagging Edge

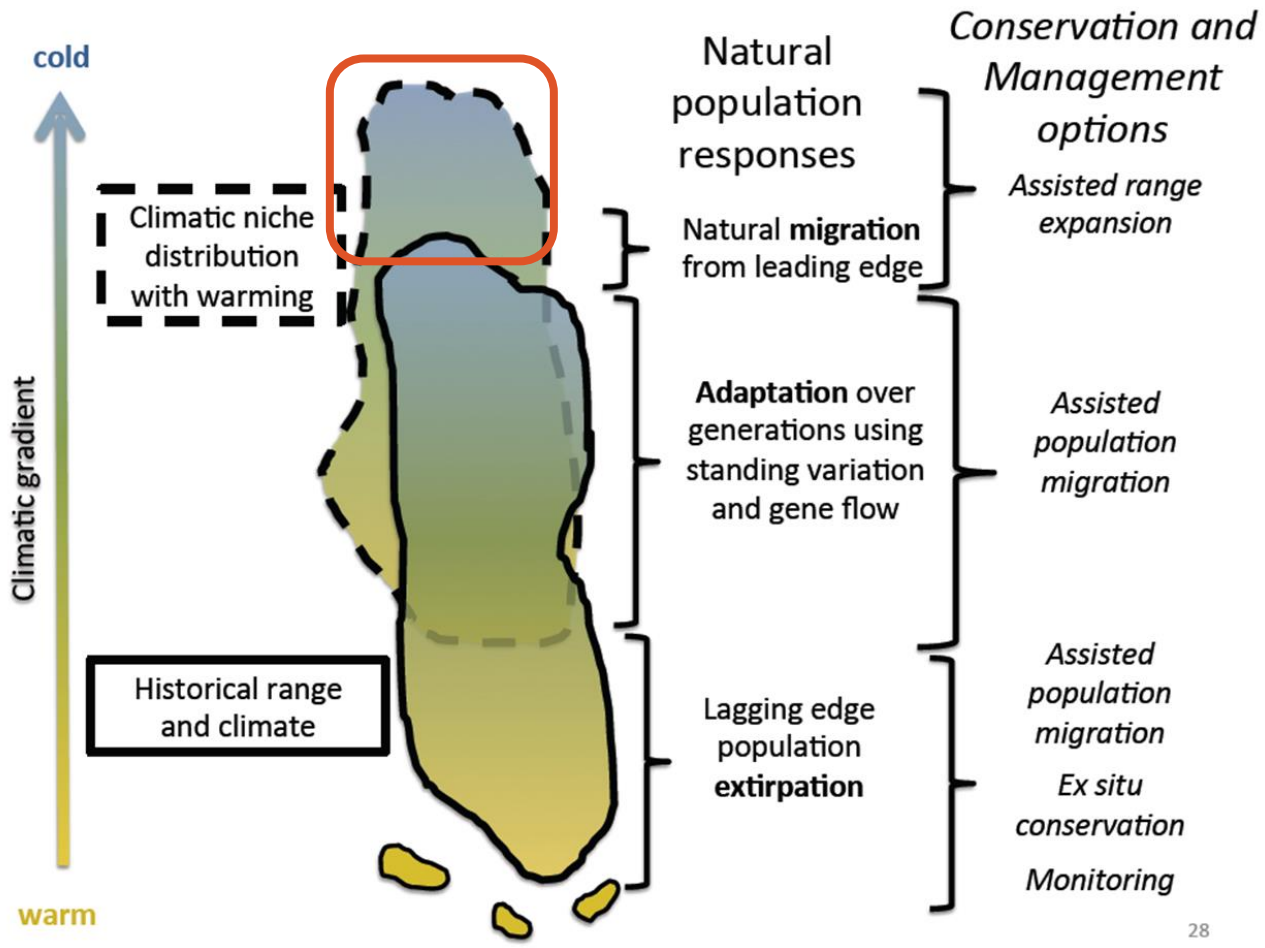
- Extirpation
- AM, Ex and In-situ Conservation

Current and Future Climatic Overlap

- Adaptation, Genetic Diversity, Gene Flow
- Assisted Population Migration

Future Climatic Niche

- Natural Migration
- Assisted Range Expansion



Source: Aitken. 2012. Centre for Forest Conservation Genetics/CONFORGEN Presentation.

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Bioclimatic Species Profiles (BSP)

Based on data from NRCAN which identifies climate values where species are known to occur

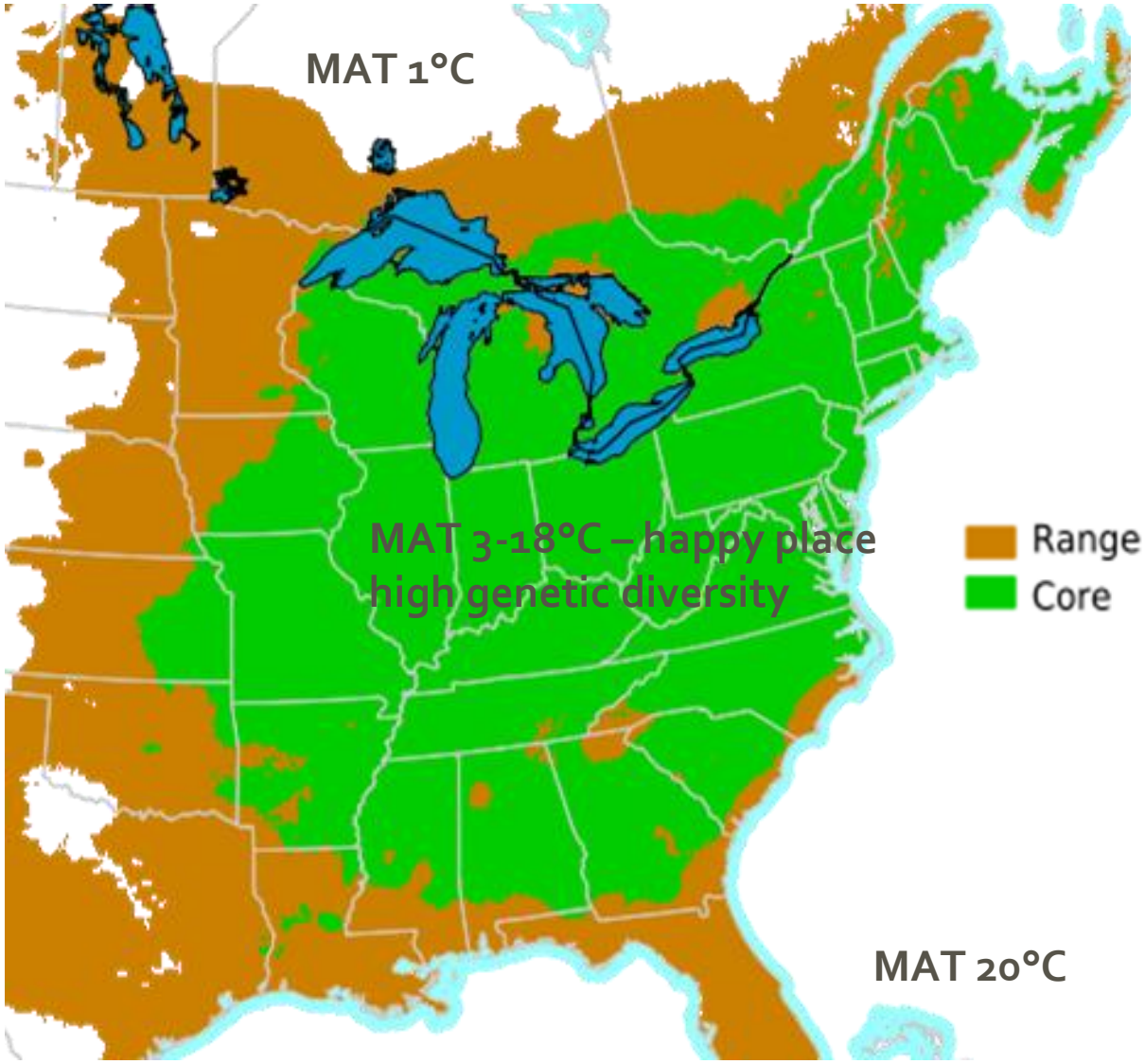
Full Ranges use climate values from the MIN and MAX of the distribution data.

Core ranges use climate values that fall between the 5th and 95th percentiles

Mean Annual Temperature (MAT) is linked to

- Species local adaptation
- Species occurrence

Acer rubrum (Red Maple) – Current Climatic Range



http://www.planthardiness.gc.ca/index.pl?lang=en&m=24m&s=b&speciesid=1000050&phz=p10000501971-2000

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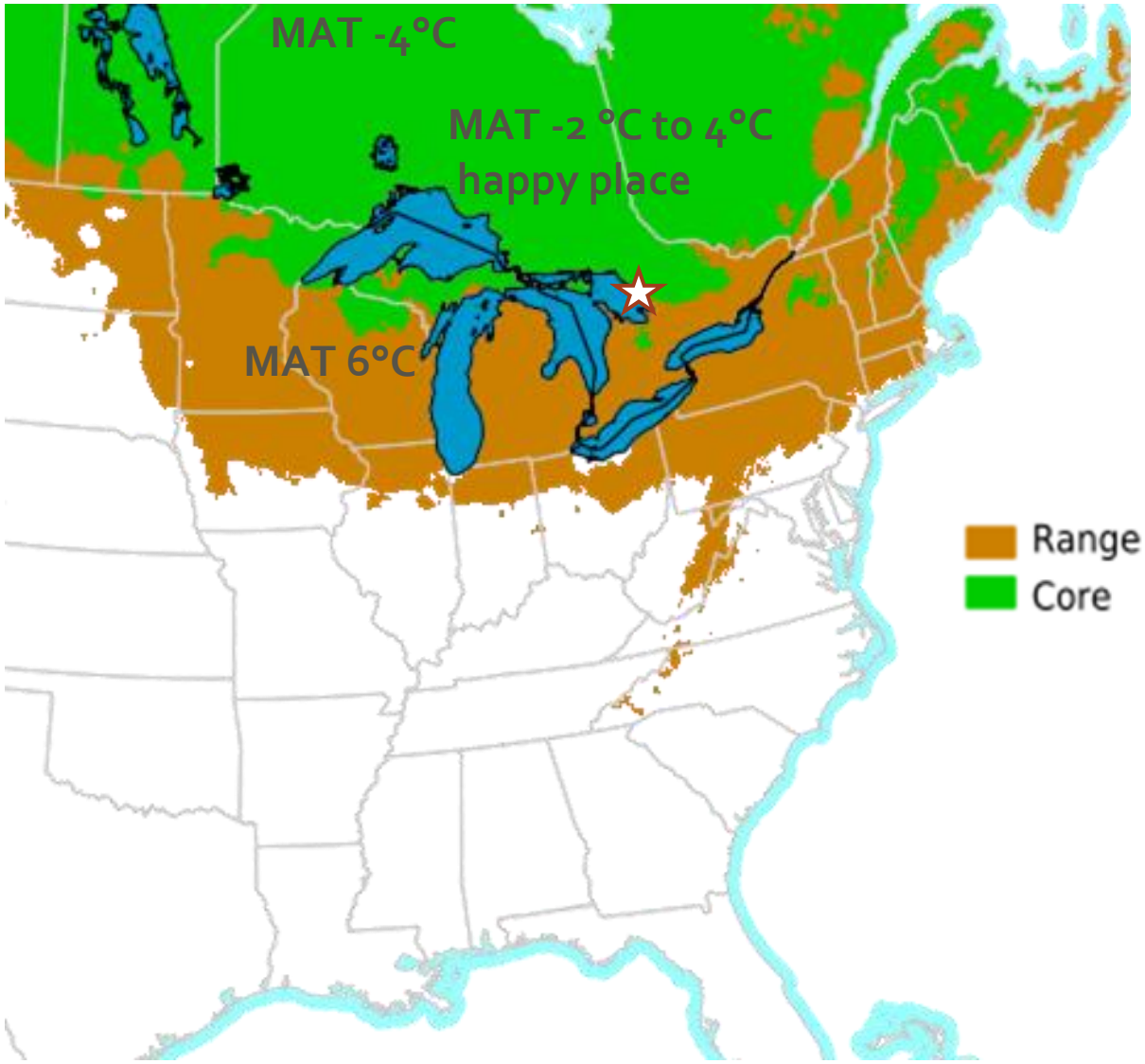
Bioclimatic Species Profiles (BSP)

See Black Spruce - Smaller ideal climatic range and limited to a more northern geography

The star indicated the general location of Ecodistrict 5E.7

Let's see what happens when we add climate change as a factor

Picea mariana (Black Spruce) – Current Climatic Range



http://www.planthardiness.gc.ca/index.pl?lang=en&m=24m&s=b&speciesid=1000796&phz=p10007961971-2000

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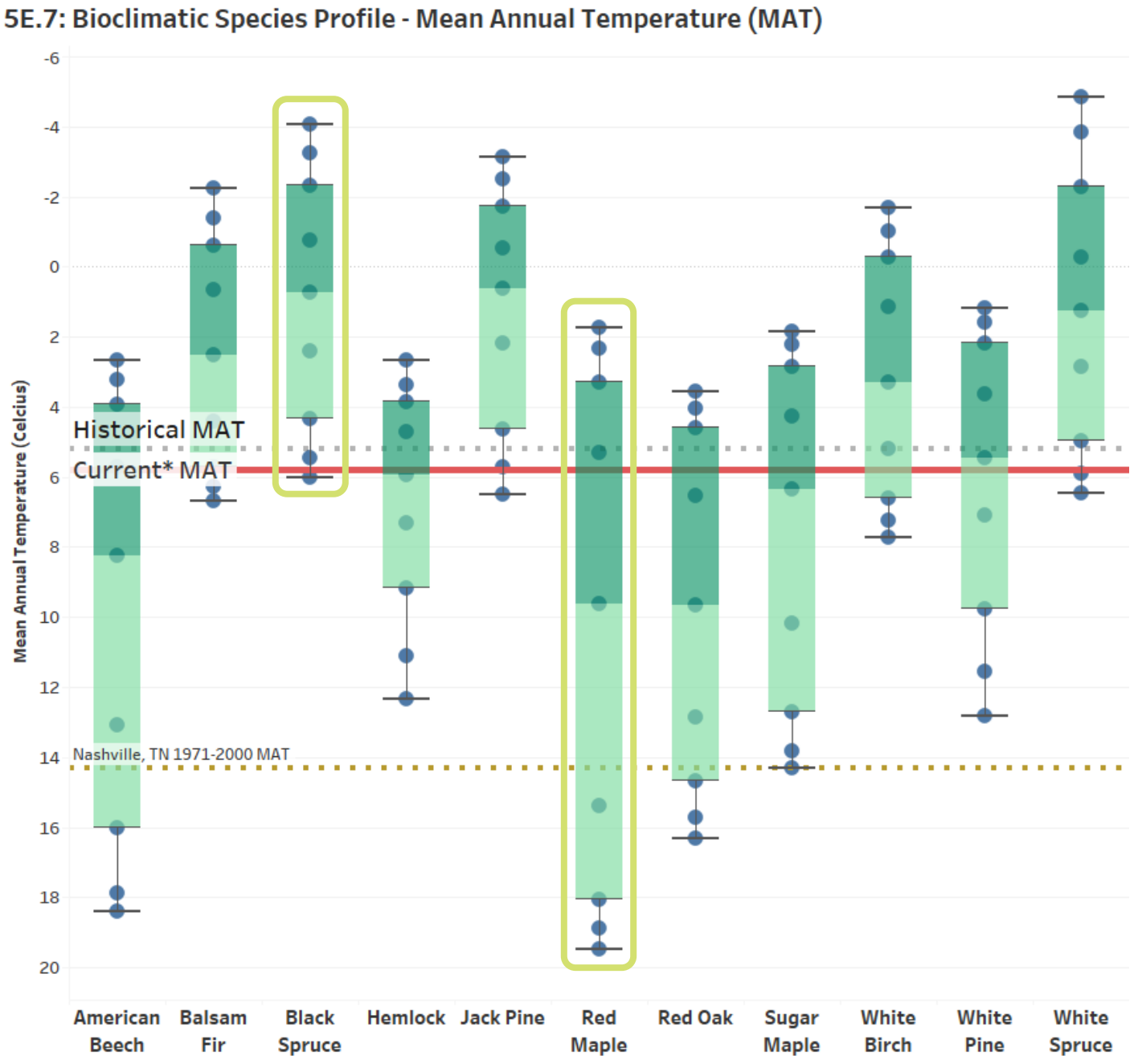
BSP
ED 5E.7

Red line here representing the current MAT value

All species climatic MAT ranges currently overlap

See the difference in Red maple & Black maple here



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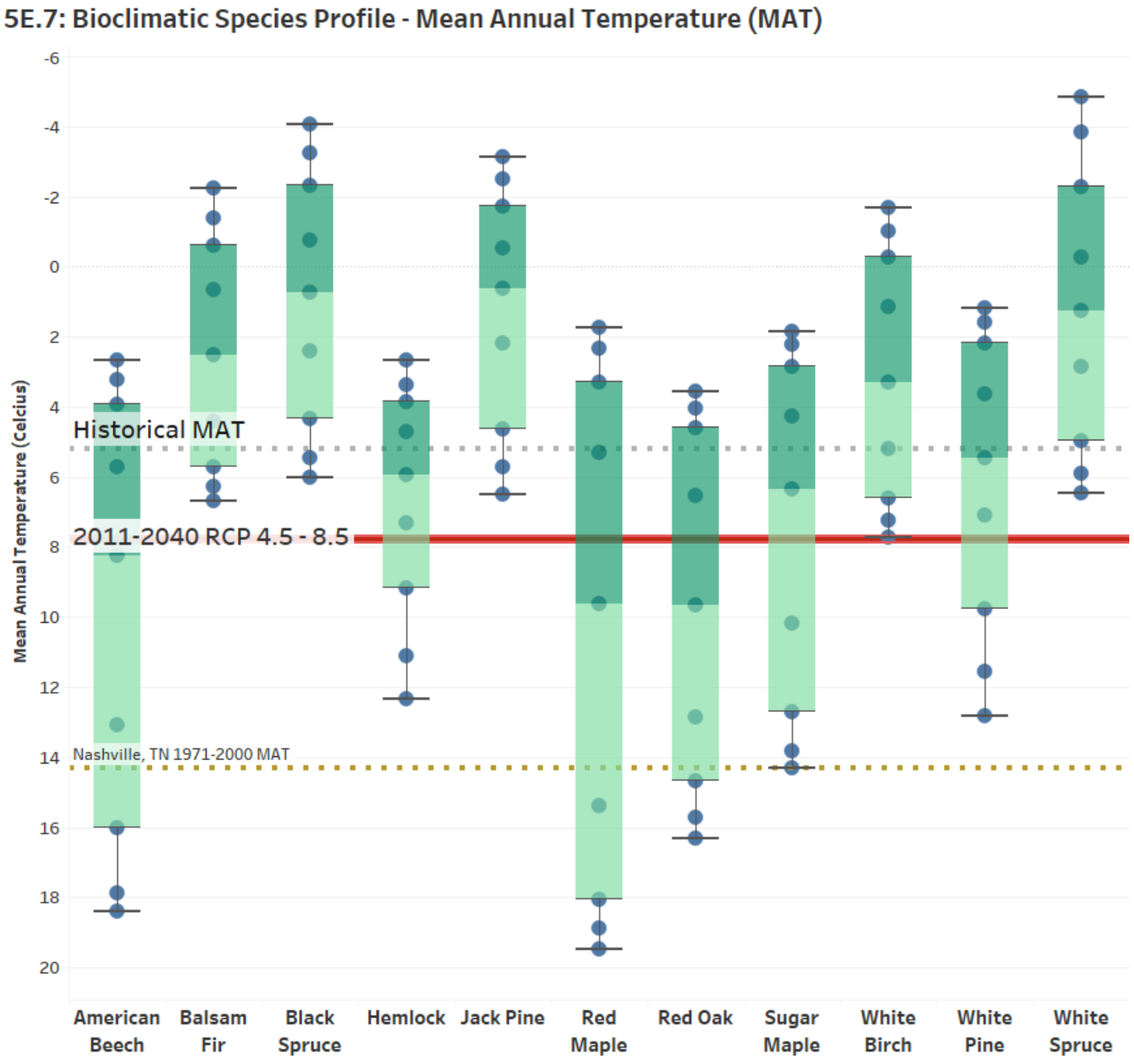
BSP
ED 5E.7

Follow the Red line

By 2040 the climate has the potential to shift several degrees

The climate is getting warmer, but species ideal climatic ranges remain the same



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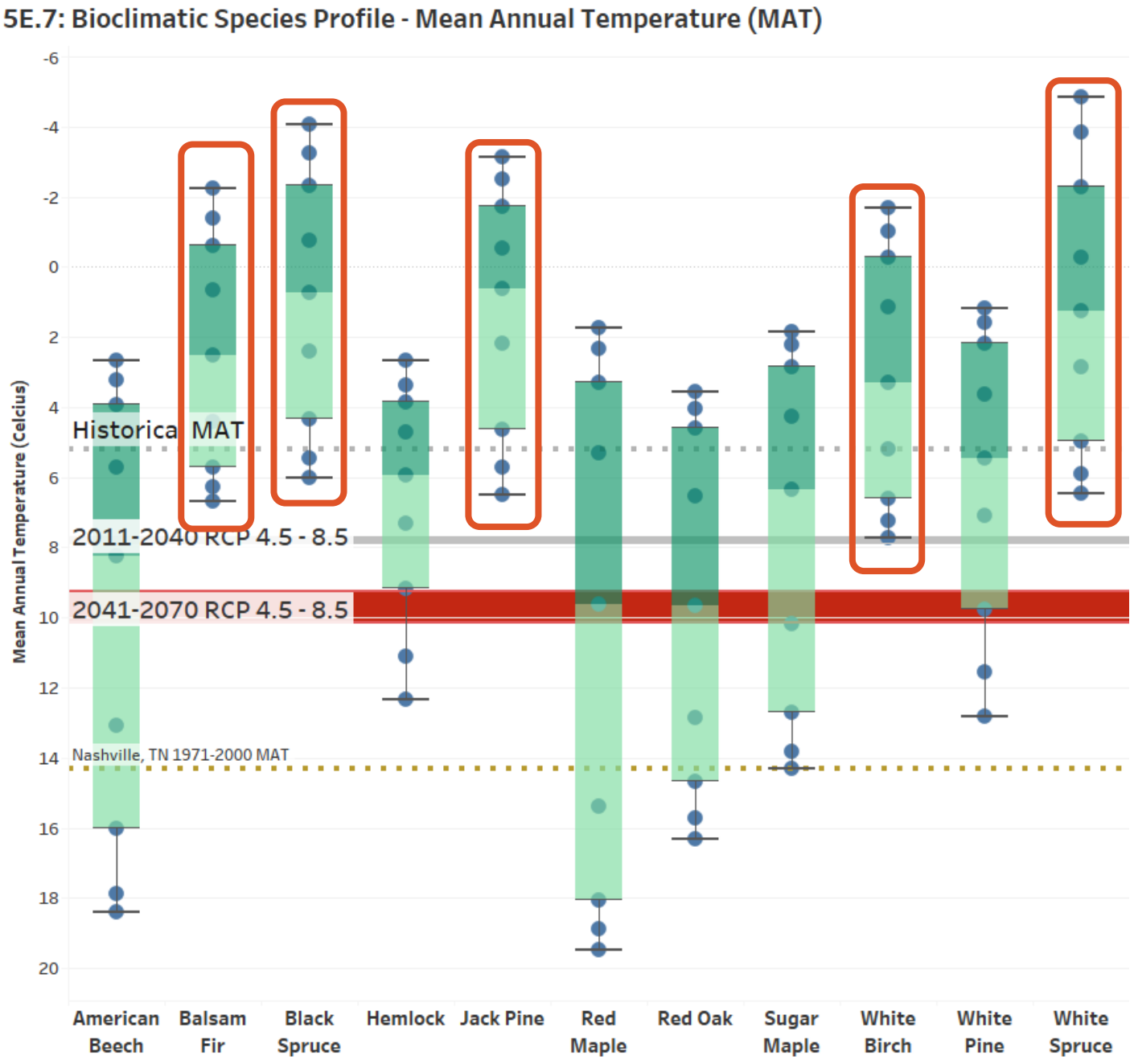
BSP
ED 5E.7

By the 2041-2070 time period the climate has potentially shifted even further

Beyond the range of several species' historical climatic ranges



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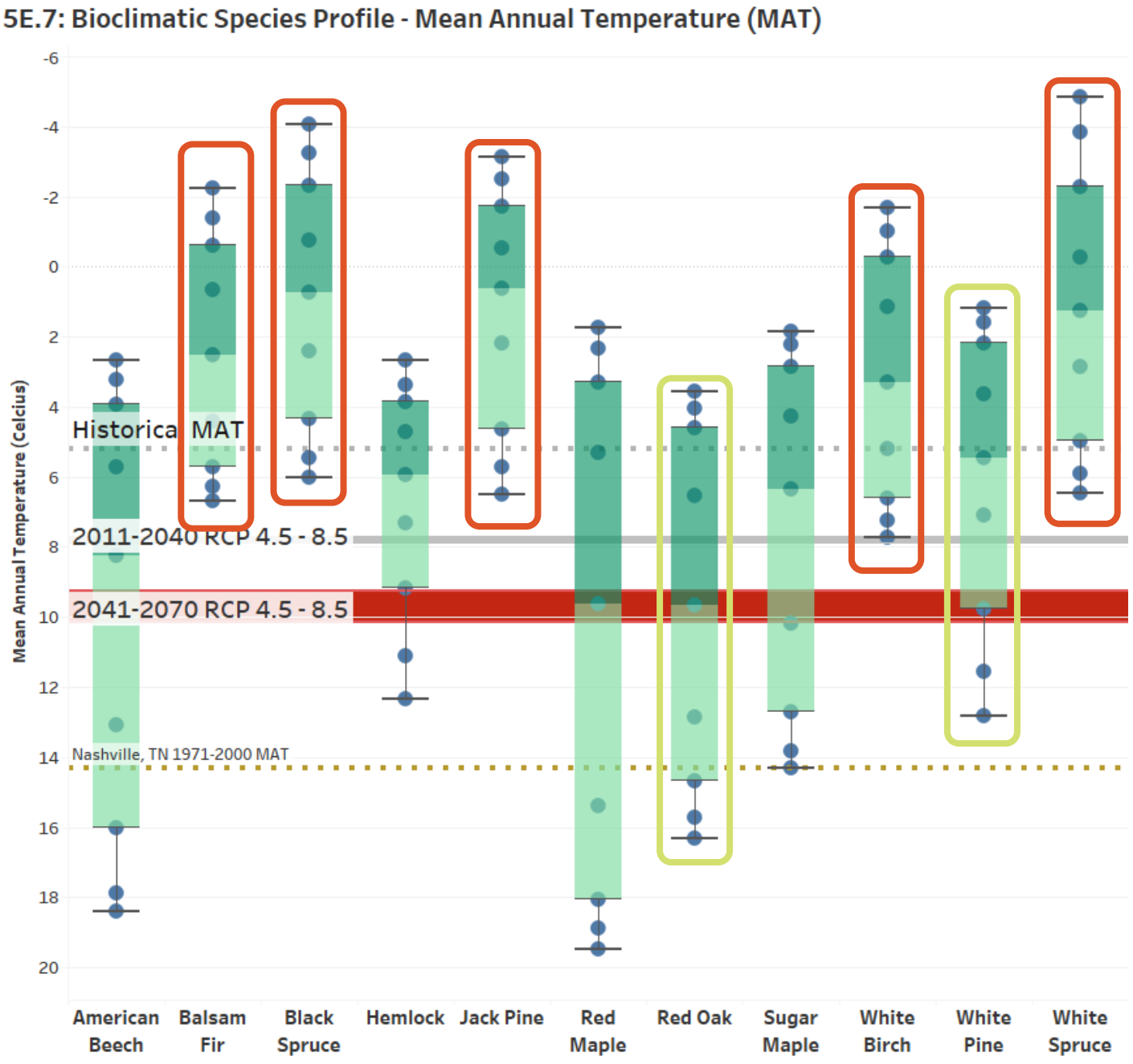
BSP
ED 5E.7

By the 2041-2070 time period the climate has potentially shifted even further

Beyond the range of several species' historical climatic ranges

Some future potential winners emerge



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Seed Procurement

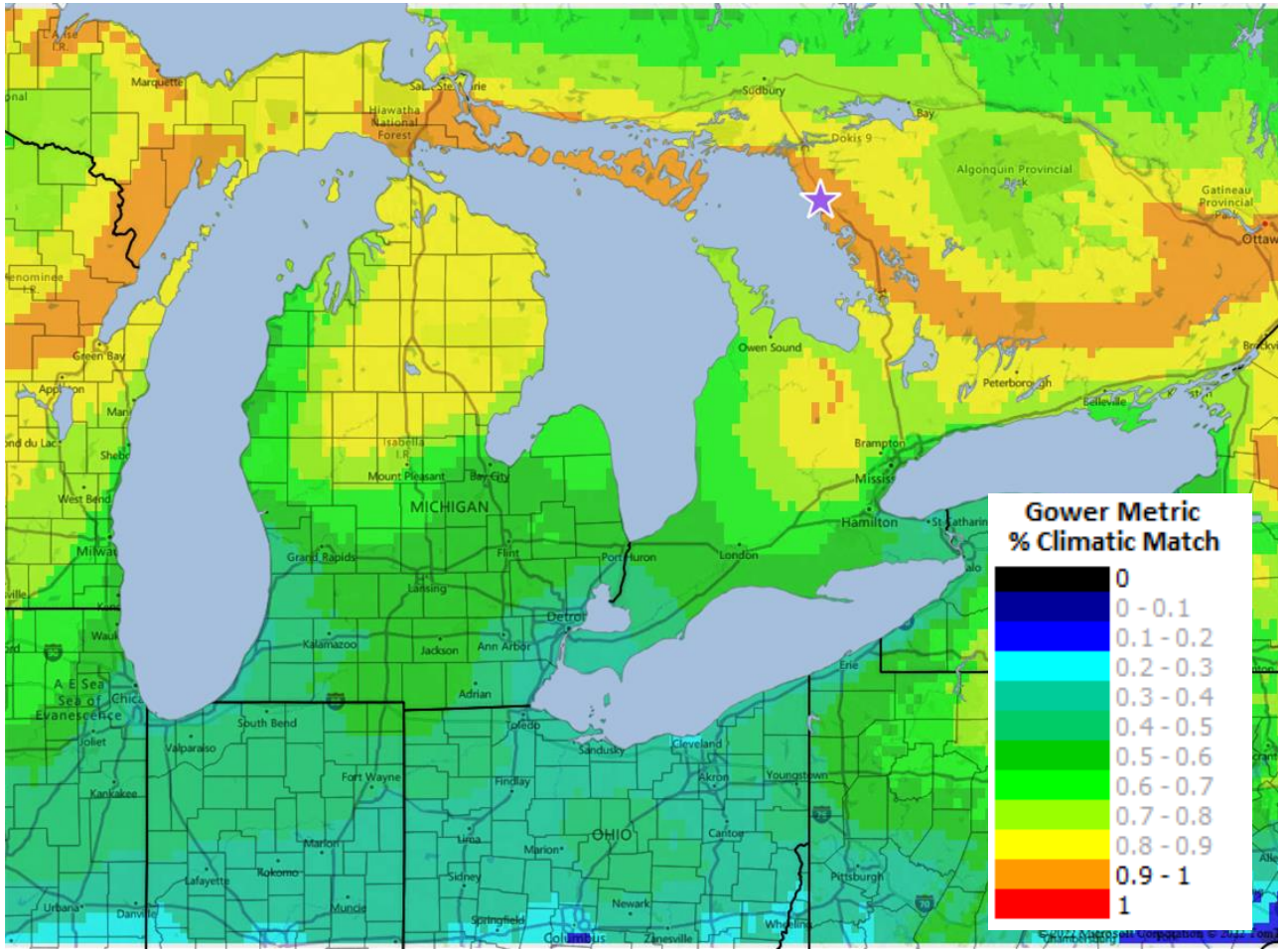
Current*

SeedWhere is a tool that identifies areas based on climate similarity

Typically for seed procurement, targeting areas in orange with a 90% or greater similarity

*1971-2000 used as reference period

5E.7 Current Matching Climate in Orange



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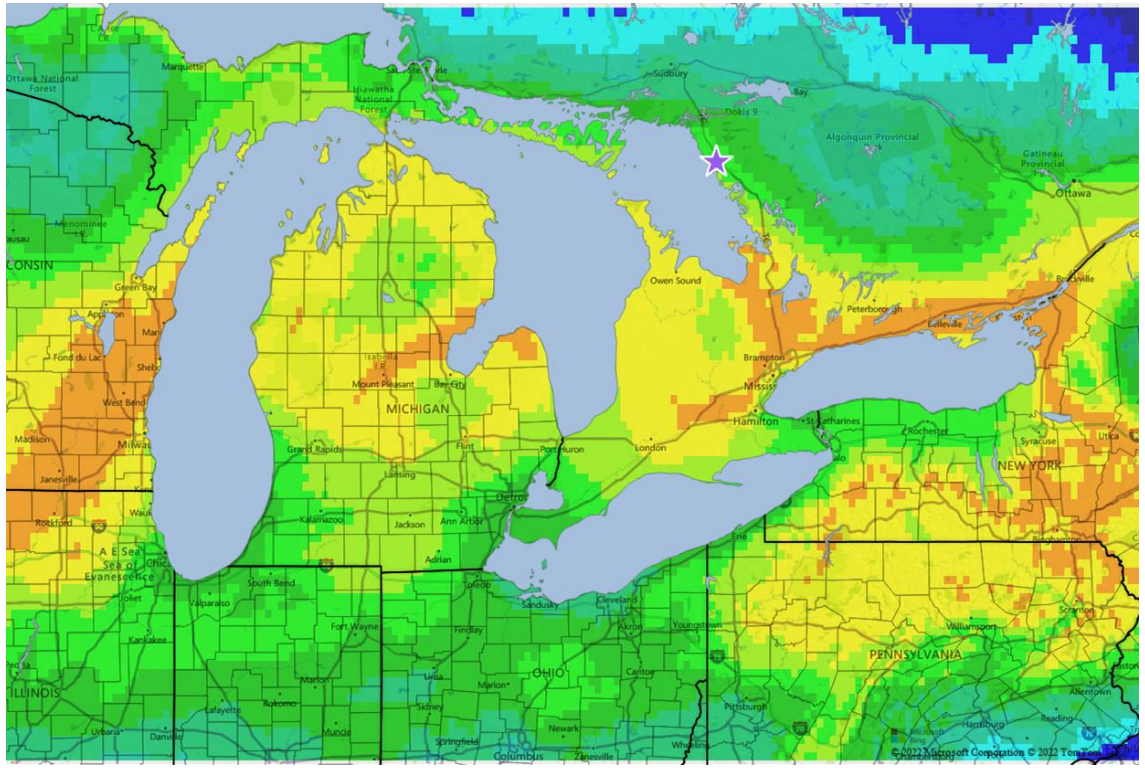
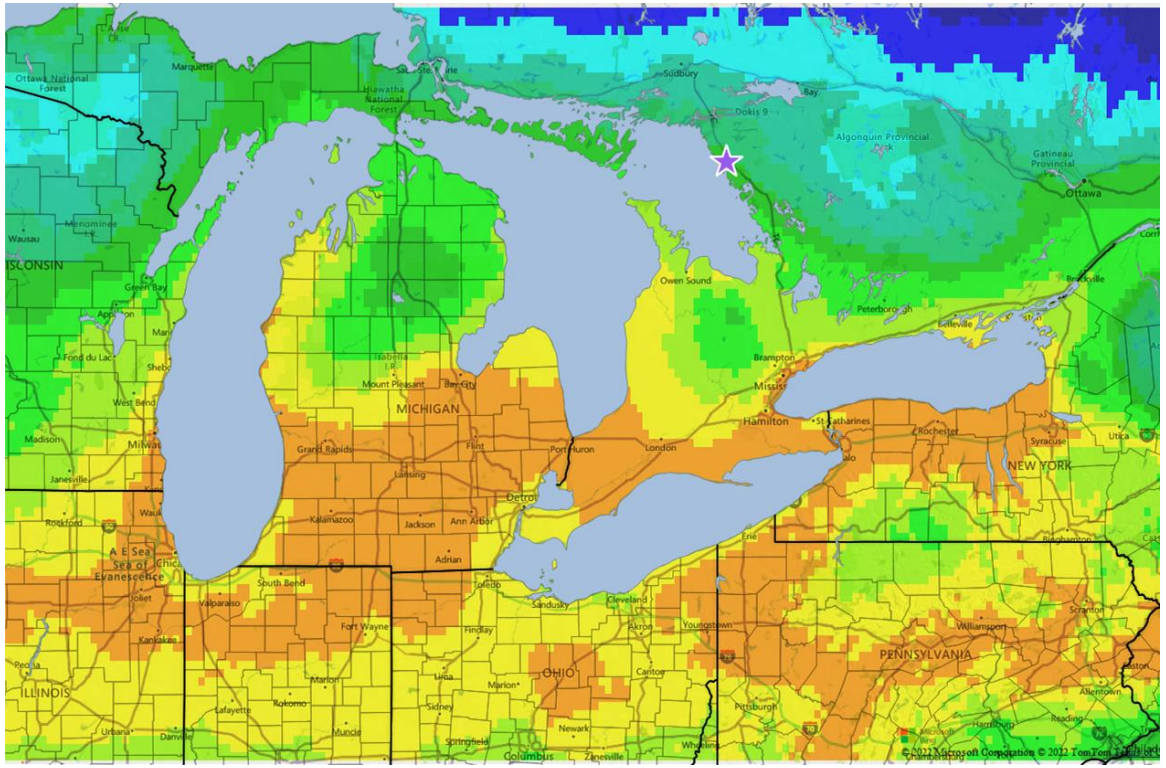
Seed Procurement

Target Procurement area based of 2011-2040 Matching Climate RCP 4.5



Target Procurement area based of 2041-2070 Matching Climate RCP 4.5



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Sourcing seed in Ontario and the United States

Genetic Diversity & Seed Quality

Genetic diversity is a measure of variability within a single species

- Populations
- Individuals
- Genes

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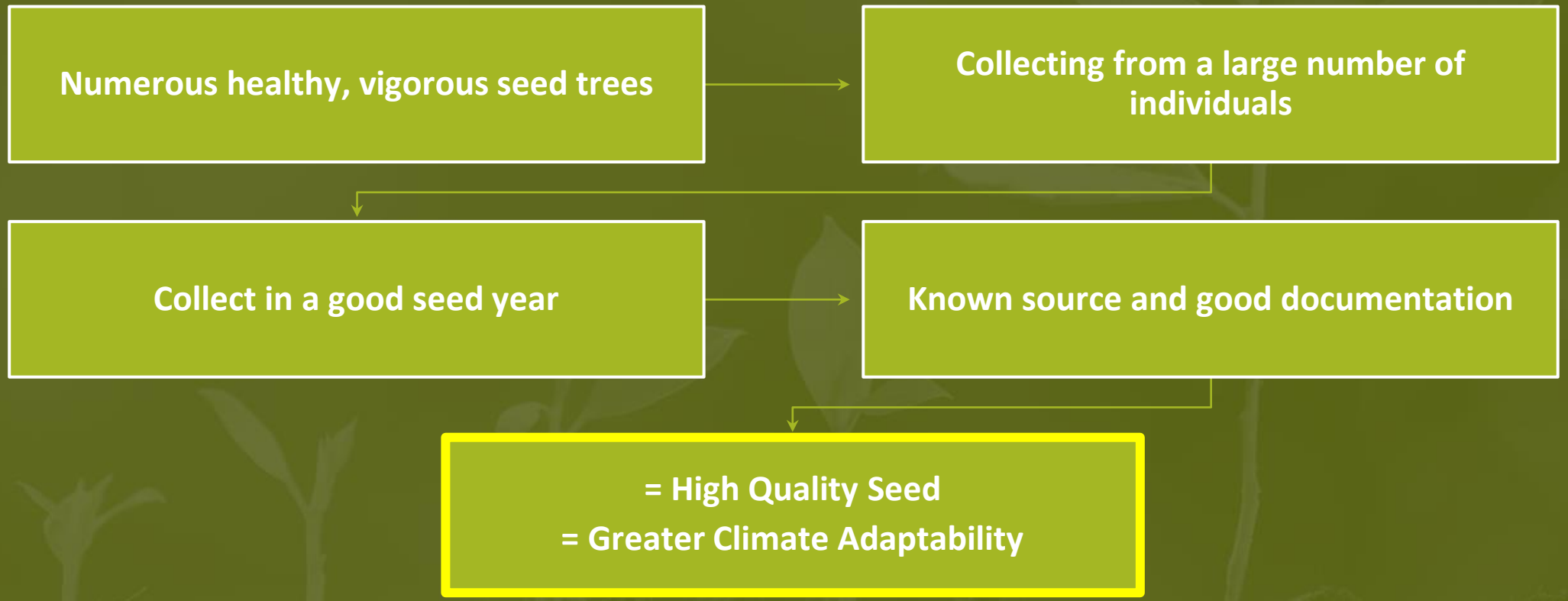
Genetic Diversity & Seed Quality

Best practices for high quality seed



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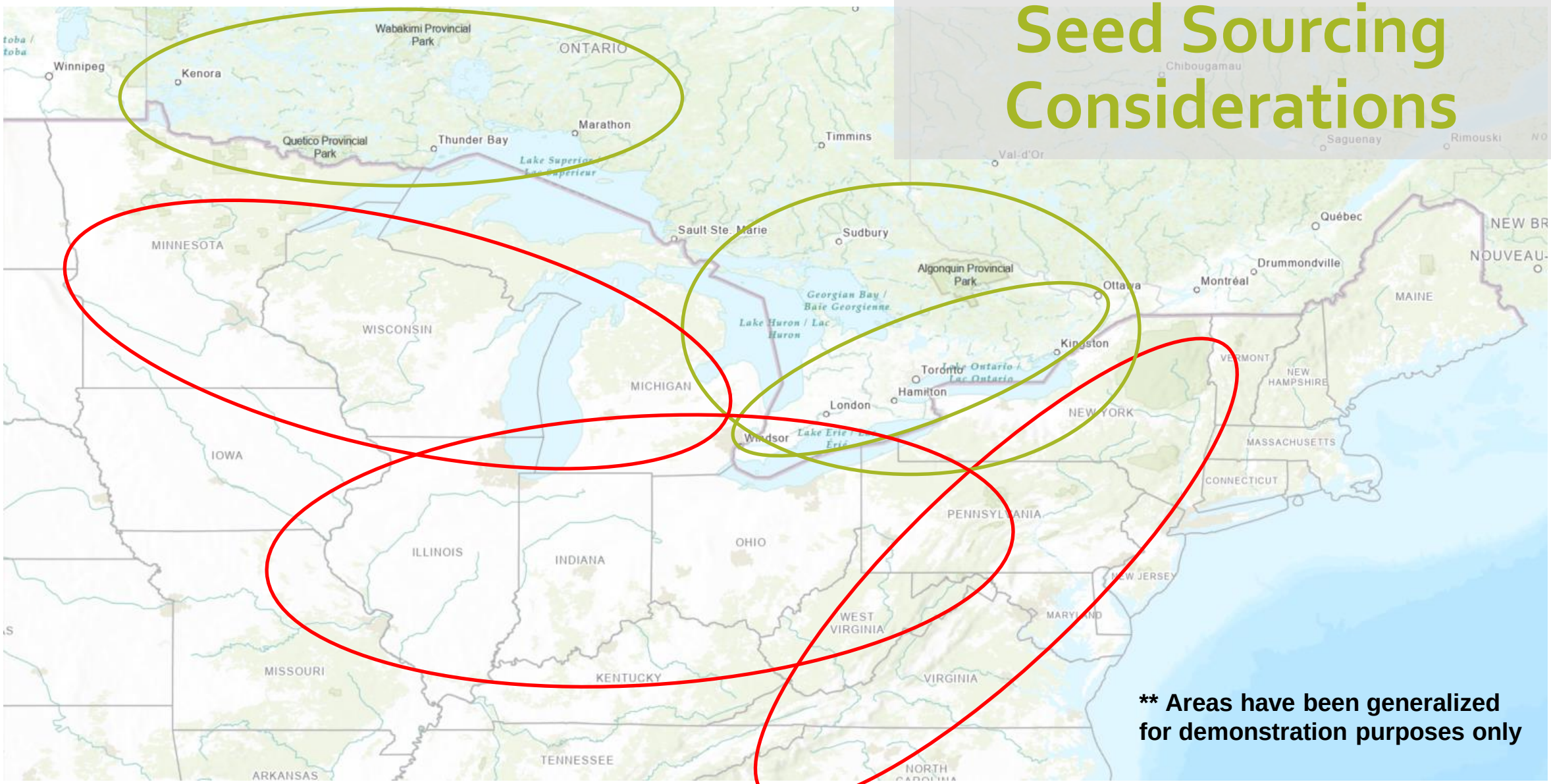
Seed Sourcing Considerations



** Areas have been generalized for demonstration purposes only

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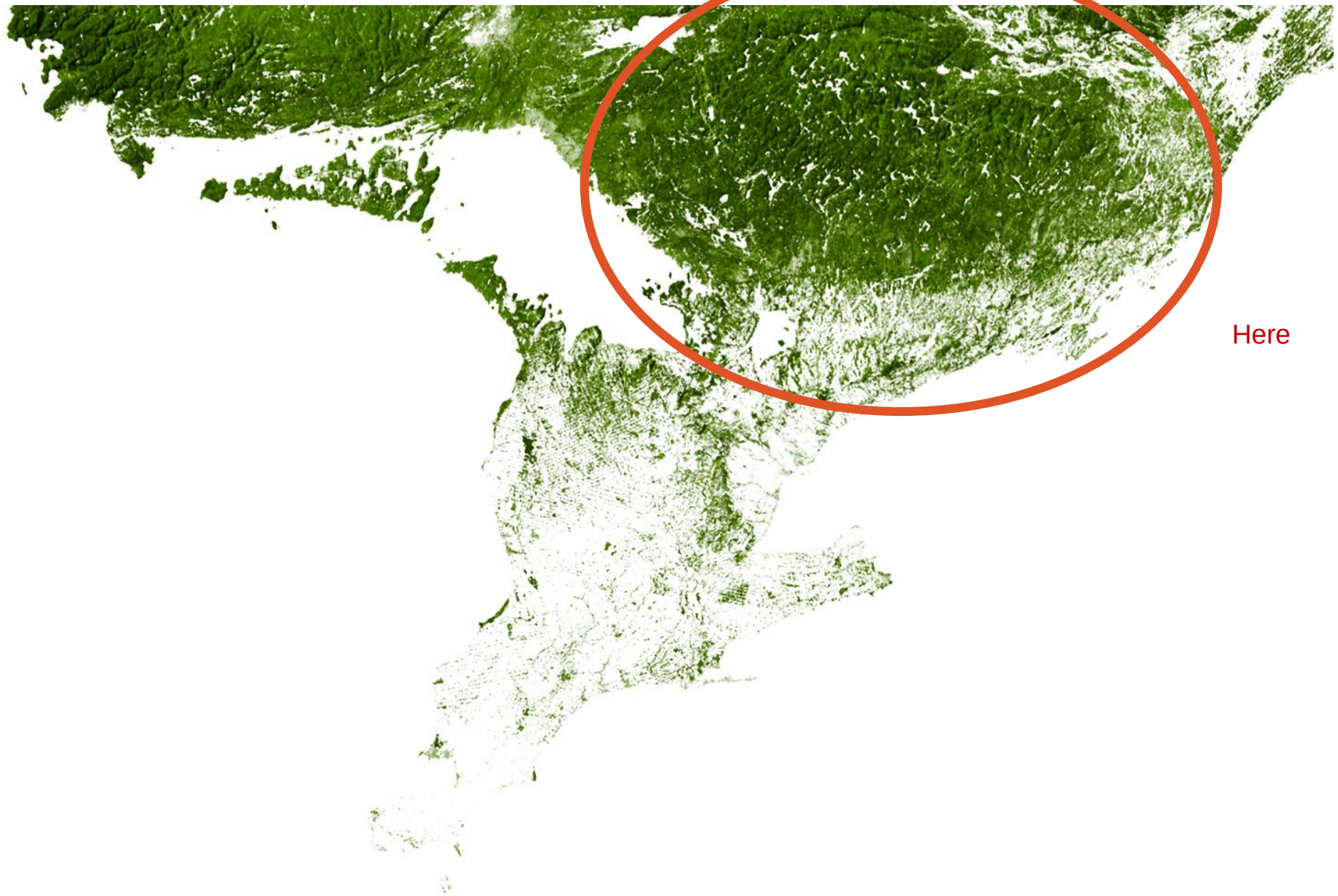

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>94% original forest cover lost

=

genetic bottlenecks in many species and **limited healthy sources**

Here

Sourcing Here

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The Challenges with Seed Sourcing

- Poor seed production
- Limited quantities available in seed banks
- Lack of collectors
- Seed is undervalued
- Source information is not always available
- International shipping
  - Phytosanitary considerations
  - Seed viability throughout transportation
  - Shipping costs

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Opportunities with Seed Sourcing

Deciduous Species

- Abundance of oak, hickory and other Carolinian species
- Actively collected and propagated in the US
- More opportunities to obtain high quality seed

Partnerships & Connections

- Connections with forest industry and government agencies
  - **Still have work to do!**
- Explore connections outside of forestry

Knowledge Transfer

- Spreading awareness of the importance of genetic quality and source identification
- Lessons learned
- Climate adapted seed will be more in demand

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Creating Seed Sources

Seed Orchards (SO)

- A plantation of superior selected trees
- Generally clonal
- Used and intensively managed for seed production
- VERY High inputs

Seed Production Areas (SPA)

- Phenotypically superior natural stand or plantation
- Used and intensively managed for seed production (thinning, upgrading, crown release)
- Moderate inputs

Seed Collection Areas (SCA)

- Phenotypically superior natural stand or plantation
- Used for seed but not intensively managed as such
- Low inputs

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Lessons Learned

- Seed VS stock
  - Confirming ID (avoiding hybridization and related species)
- Trusting your source
- Multi-year effort
- Assisted Migration Trial successes

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Seed Sourcing Considerations

Source high quality, genetically diverse seed – source documentation

Seed Availability – Periodicity, effects of climate change and genetic bottlenecks

International barriers – Navigating international shipping

Partnerships – Create and maintain partnerships

Create a local seed source – Based on informed decisions for climate adapted seed

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Want More Info or Become a Member at www.fgca.net

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