



Shooting a Moving Target

Conserving and Restoring Your
Forest in a Changing Climate

Trenton Woodlot Conference

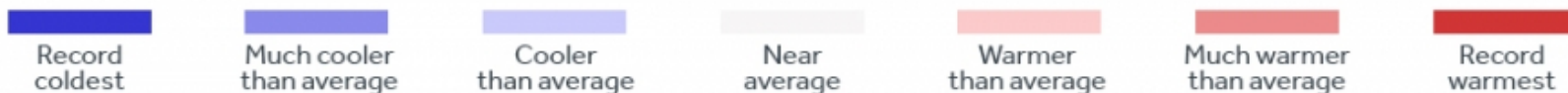
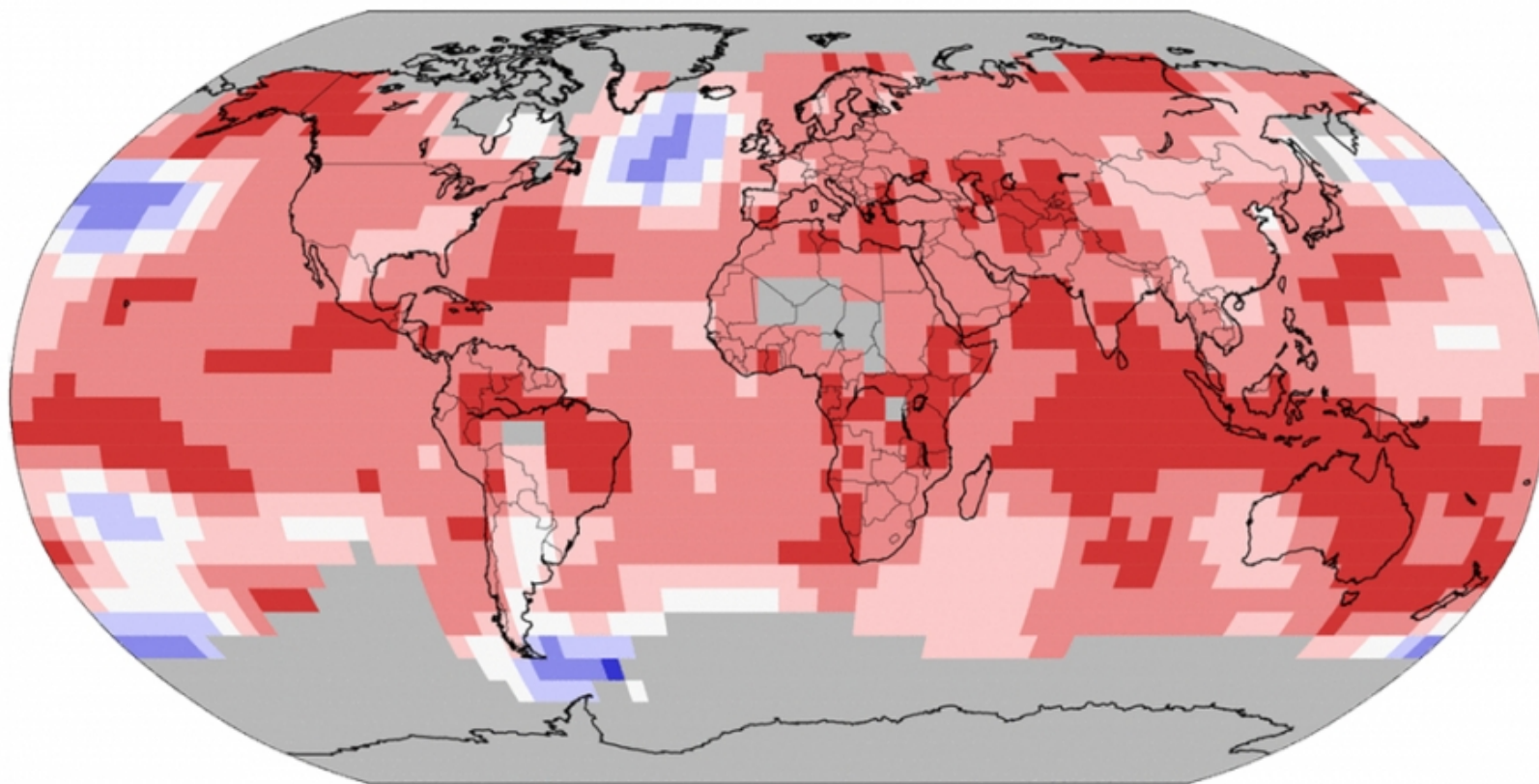
Nov 25, 2016

Local (Seed Zone 34) White Oak and White Pine Planted 2008
Doing well now, but what will the local climate be by 2050?



2016: Hottest Year So Far

Land and ocean temperature percentiles Jan-Jun 2016



Source: NOAA NCEI

CLIMATE  CENTRAL

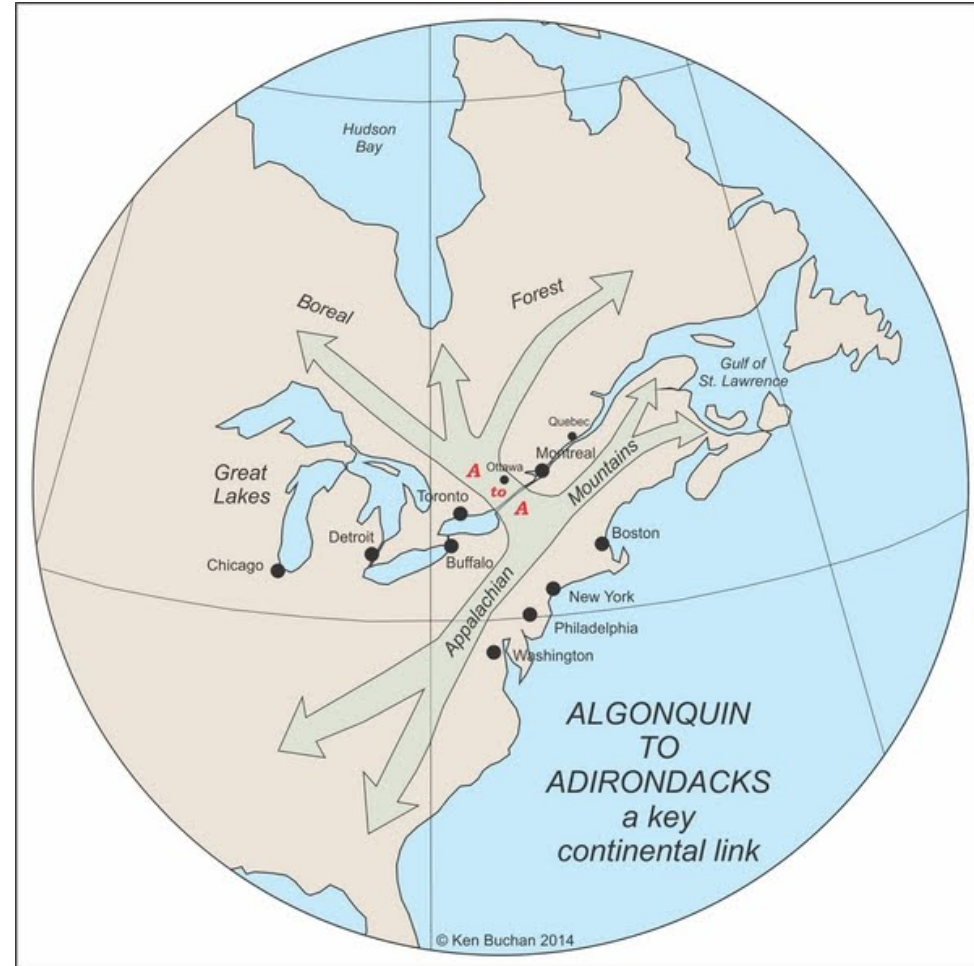
Credits: <https://www.scientificamerican.com/article/first-half-of-2016-blows-away-temperature-records/>

Migration vs Assisted Migration

What is *Migration*?

- A natural process – occurred over millennia pre-ice age, post ice age
- One squirrel hop at a time
- One blue jay flight at a time
- Or a breeze that drops seed onto fertile ground

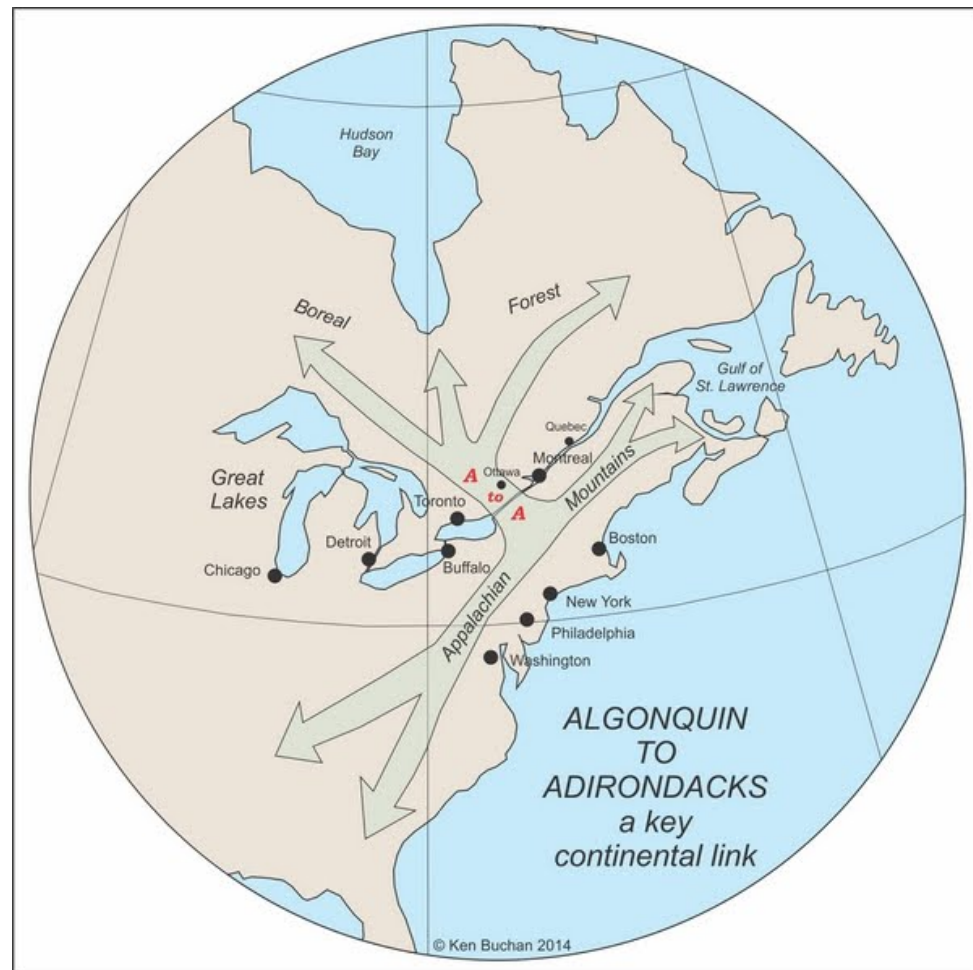
But why must we assist it now?



Migration vs Assisted Migration

Because:

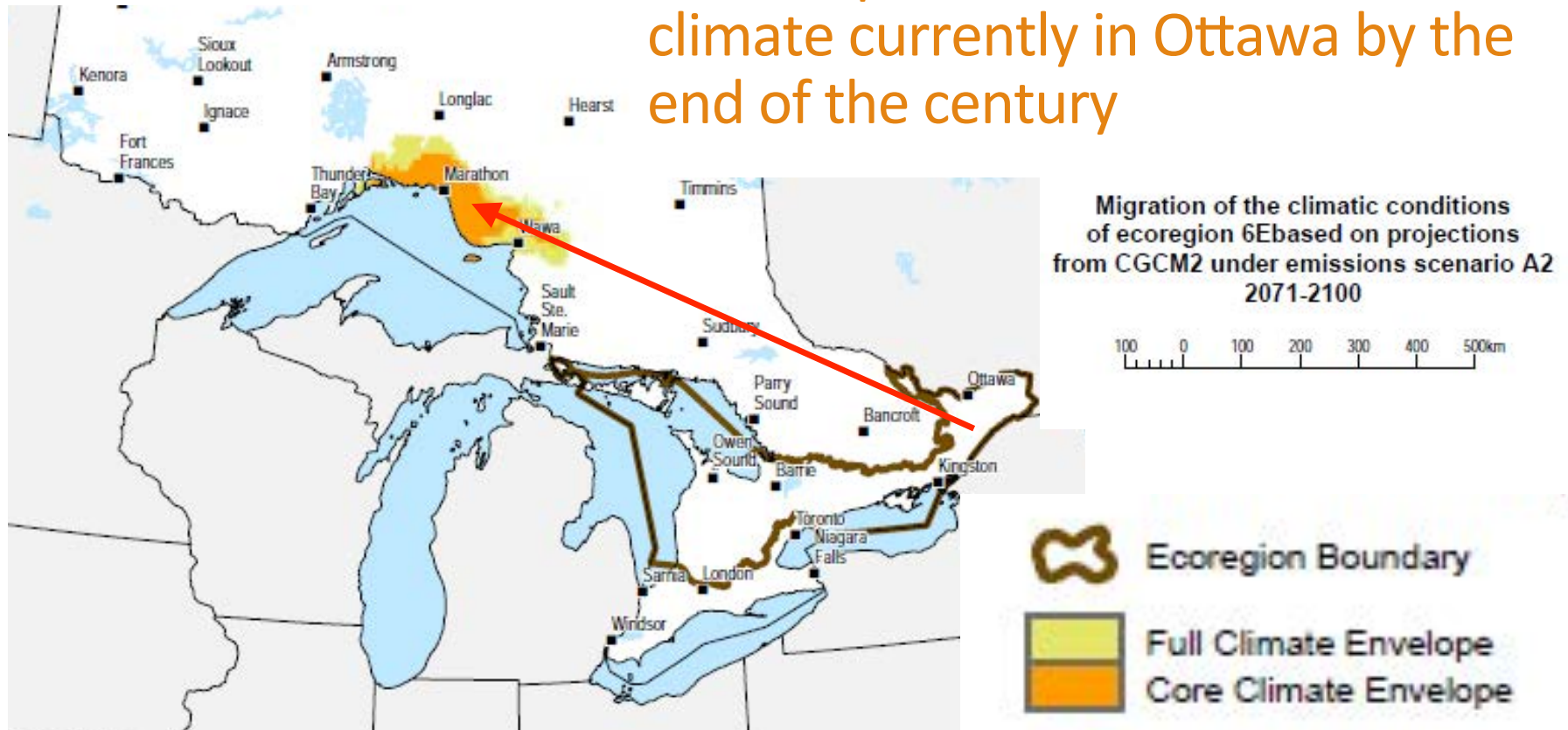
- 1. The climate is changing faster** than our forests' natural capacity to evolve in place or migrate
- 2. If we are going to plant anyway let's be strategic**
- 3. Pieces are disconnected** – our forests, soils, species and gene pools, public awareness, government leadership, etc!



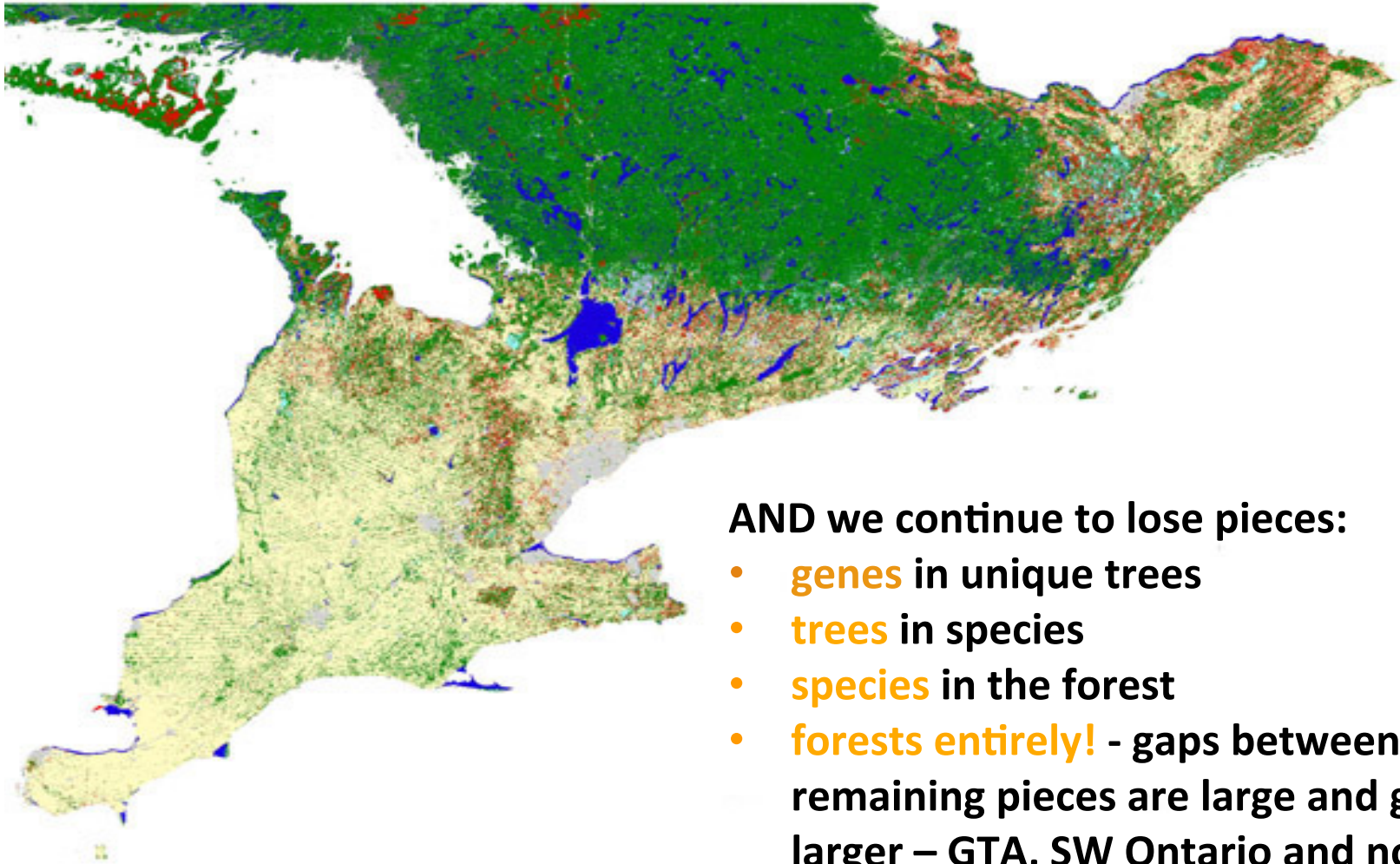
e.g. Climate Envelopes are predicted to shift

- major effects on ecosystem structure and functions

NW ON predicted to have similar climate currently in Ottawa by the end of the century



A landscape in pieces ... even before climate change



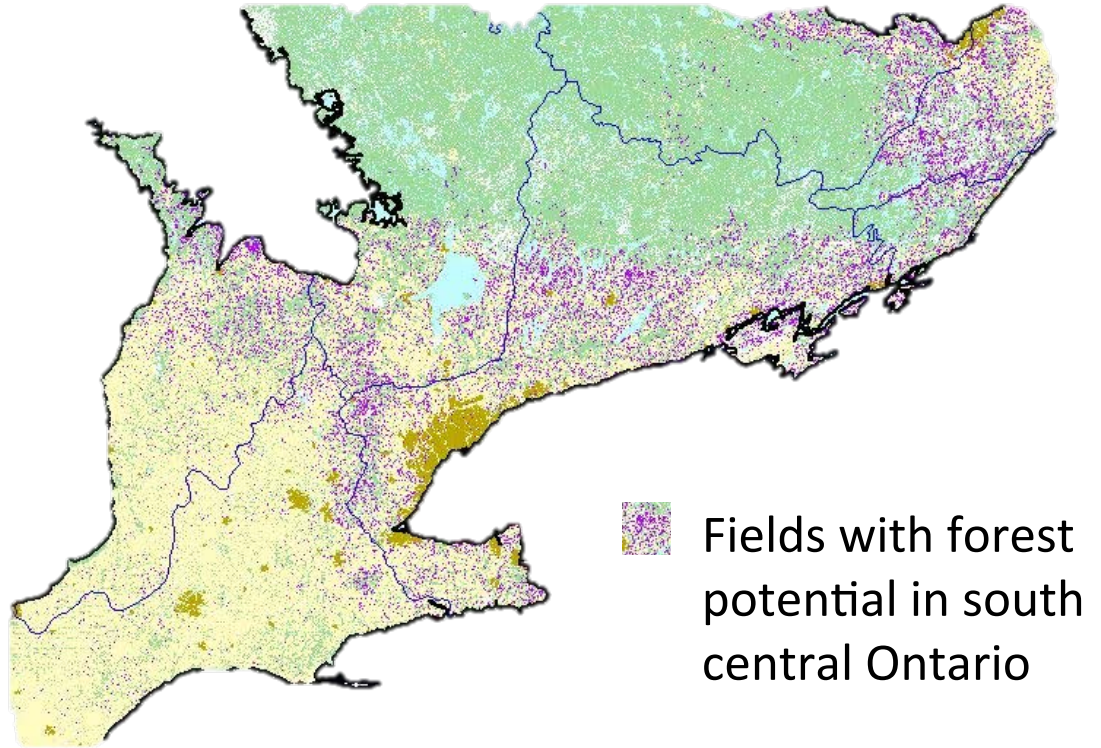
AND we continue to lose pieces:

- **genes** in unique trees
- **trees** in species
- **species** in the forest
- **forests entirely!** - gaps between the remaining pieces are large and getting larger – GTA, SW Ontario and now eastern Ontario

Forests Ontario and FGCA supported by MNRF's 50 Million Tree Program

are building
a system to
strategically reforest
southern Ontario's
landscape,
including

developing approaches and
securing seed and stock **for assisted migration**



A satellite map of a landscape, likely a wetland or forested area, with several irregular polygons outlined in bright green and magenta. These polygons represent different seed zones. The text 'Seed Zone 30' is placed within one of the green-outlined areas. Other green-outlined areas are labeled 'Seed Zone 35' and 'Seed Zone 36'. A magenta-outlined area is also visible. The background is a grayscale satellite image showing terrain features like water bodies and vegetation. The text 'Image Landsat' is at the bottom center, and 'Google ea' is at the bottom right.

Seed Zone 30

FGCA offers “seed source sense” solutions:

- Provide expertise in Assisted Migration and SAR recovery
- SeedWhere Maps to secure and deploy seed strategically
- Our increasingly valuable **SCAN** project,
- Promote better seed source tracking and seed banking
- Certified Seed Collector training and support

Seed Zone 35

Seed Zone 36

Image Landsat

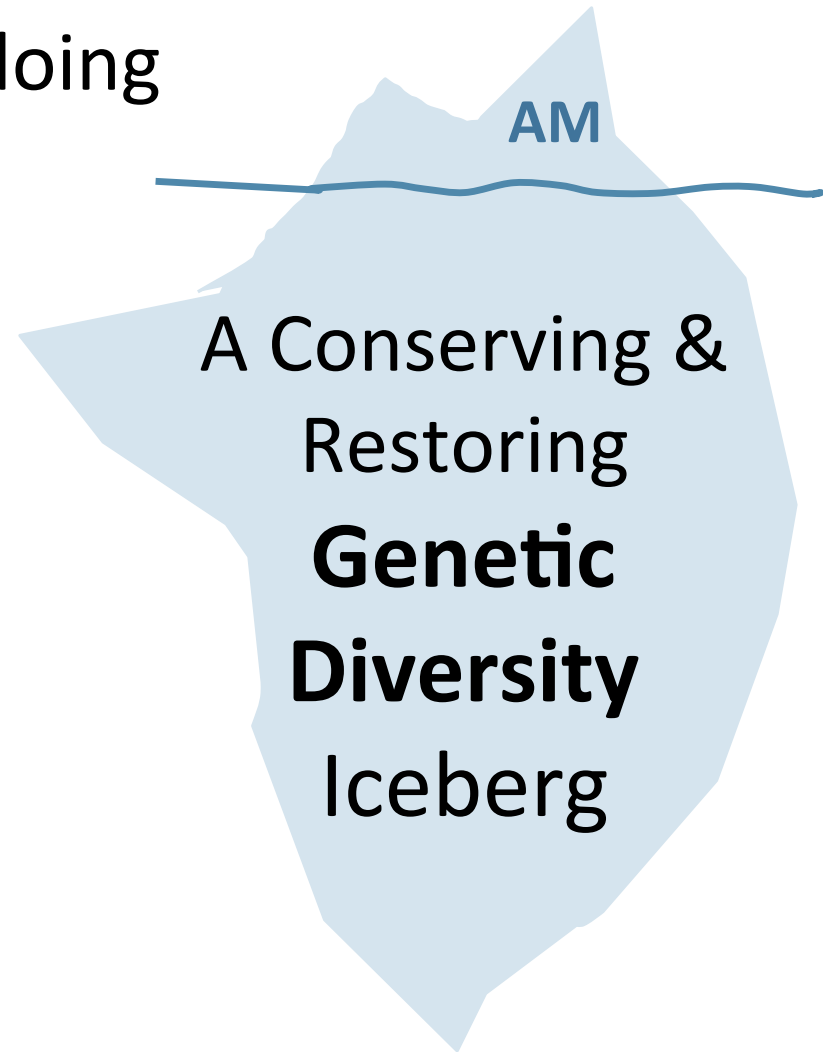
Google ea

FGCA has been talking and doing
Assisted Migration (AM)
for almost 10 years now.



White Pine trial (2009)

But we will fail if you don't
understand that **AM IS JUST** the
tip of a really BIG iceberg.



Bottom of the Genetic Diversity Iceberg =
We all need to understand the threats and
CONSERVE our local DIVERSITY to be able to ADAPT

A message we are taking to:

Private landowners like you

and those who assist them:

Loggers, mills, forest consultants, growers,
seed collectors, tree planters

And especially to Planners and Politicians!

The Message =

**Genetically Diverse
Locally Adapted
Forests**

**Are a huge buffer against
all damaging pressures**

including climate change

**Trees may die
but the species lives on**

**Species may die
but the forest lives on**



All while expecting



■ More frequent & severe disturbances

- droughts, fires, flooding
- wind, ice storms
- native insects/diseases & animals (deer)
- invasive alien species

■ Poor Regeneration

- poorer seed crops
- less regeneration
- higher mortality - drought/flood/frost



= species dominance shifts

= community disruptions

= forest loss?

Gene Conservation = Keeping the pieces when managing existing forests so you are able to assist migration

Conserve **all forest cover** and species

Conserve mature, healthy trees and stands

Remove heavily diseased trees

Conserve older trees until they regenerate

Encourage and manage regeneration needs

- monitor seed crops, prepare sites, thin

Remove invasive alien species

All with enough time/\$\$ to do so...Easy-peasy right?

FGCA, Forests Ontario and local landowners are investigating **Assisted Migration Trials**

Objectives

- Restore forests using adapted sources
- Plant local with 2- 3 'southern' sources
- Monitor growth/health of all sources
- Manage as a seed production area

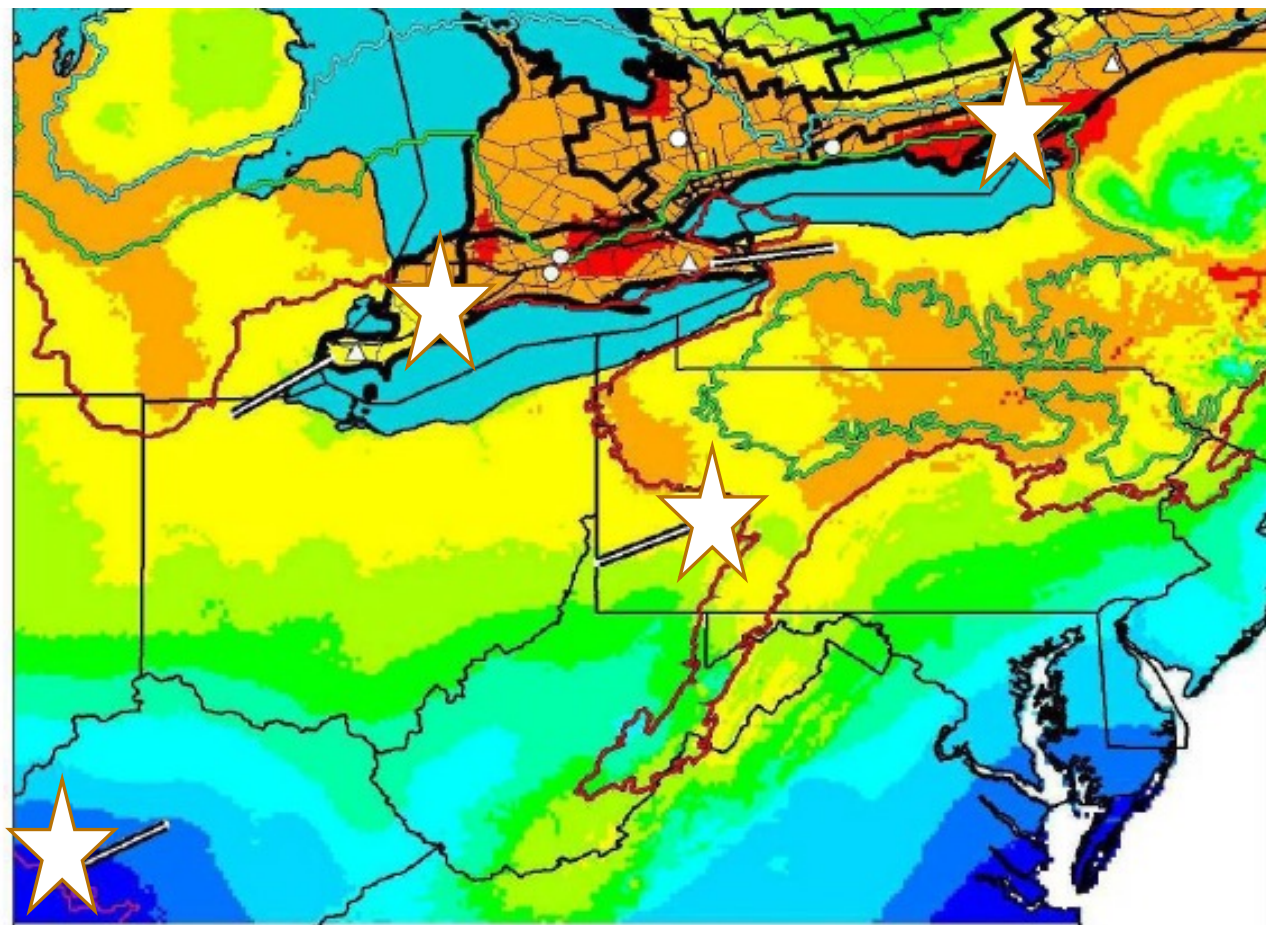
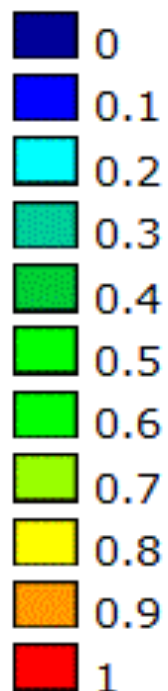
The challenges are many, but **our hope is great** that we can devise approaches that will help sustain our forests and ourselves in this changing climate



Red oak in Oxford County – 6 years old
LO Phil Holst

Kingston Bur Oak Trial

Gower Index



- Local source
- SW Ontario = +10 days Growing Season Length
- Pennsylvania = +20 days
- Tennessee = +40 days (research, not recommended yet)

Monitoring AM trials:

- **Early results are skewed by**
 - Different growers and stock quality, different lift times, storage
- **Variation from the start**, e.g. height
 - southern stock tallest at first but can be set back with winter/frost damage, local doing well so far
- Once seedlings well established (3 to 5 years?) FGCA will work with landowner and partners to watch for **effects on growth from extreme weather:**
 - Drought and storms
 - Spring and fall frosts
 - Long winter, deep cold



Local Or versus Tenn Or
4 years old, Holst Oxford County

Long term Goal – 40 years:

- The surviving/thriving (?) source(s) is thinned to maintain at least 50 trees (100 is better!) for quality seed crop production to continue assisted migration projects in Ontario



Gene Conservation = Keeping the pieces when restoring forests

Watch for good flower and seed crops

Collect & bank volumes of quality seed in good years
= mature seed from large healthy stands

Document the location of the seed source (SCAN!)

- so seed can be used strategically,
- **but maybe not in your area**
- **hope our southern neighbours do the same**

Plant seedlings that are adapted to your site

- the climate = strategically selected **sources**
- the site & forest community = right **species**

Tend your plantings – control competing plants,
animals

**It's still about
buying the right source-identified tree &
putting it in the right place**



The
question is
where is
the right
place?

↑
↑
Niagara source planted in **Brockville**?

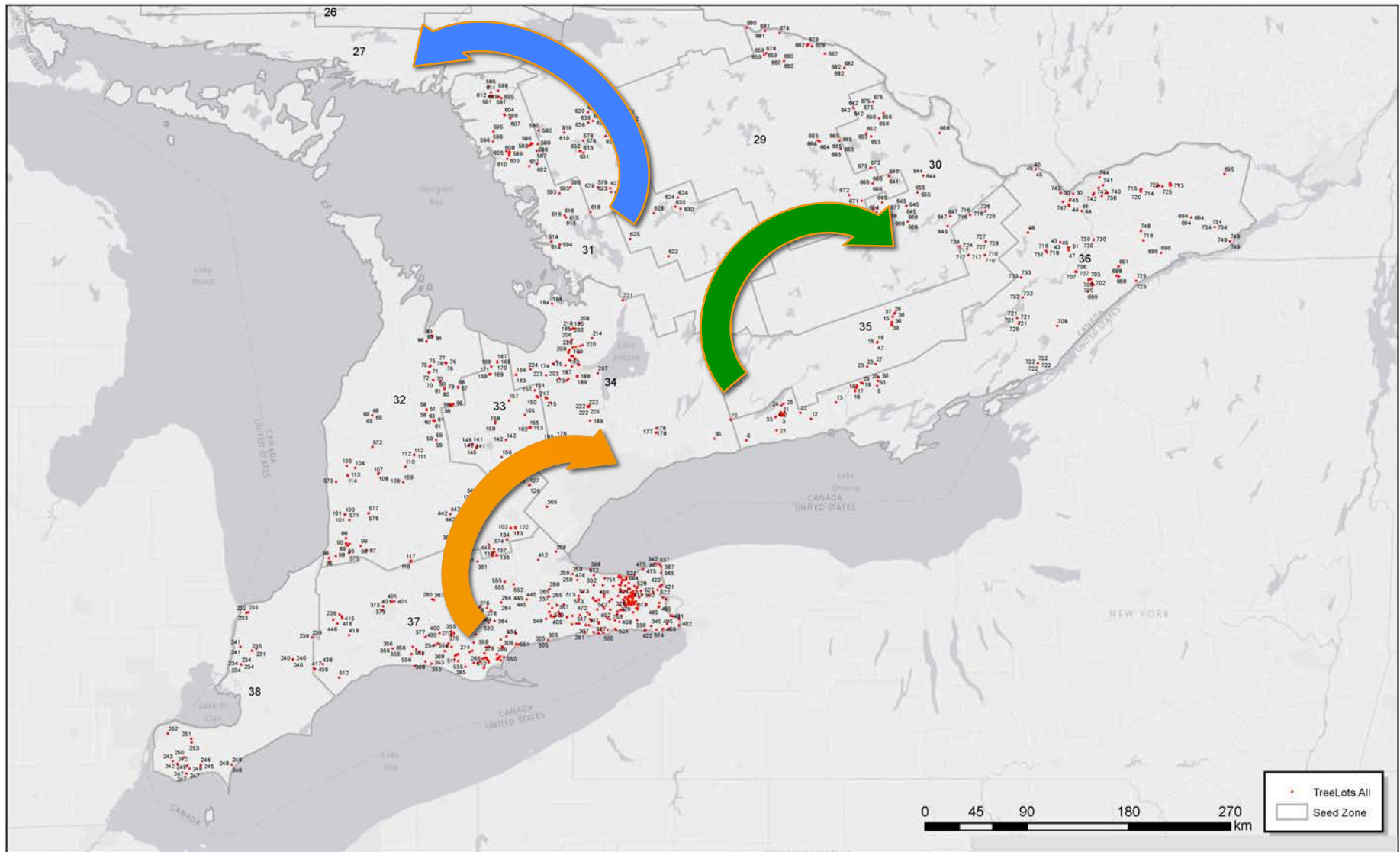
↑
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Toronto source planted in **Ottawa**?

↑
↑
Ottawa source planted in **Algonquin Park** ?

SCAN Overview

Total: 751

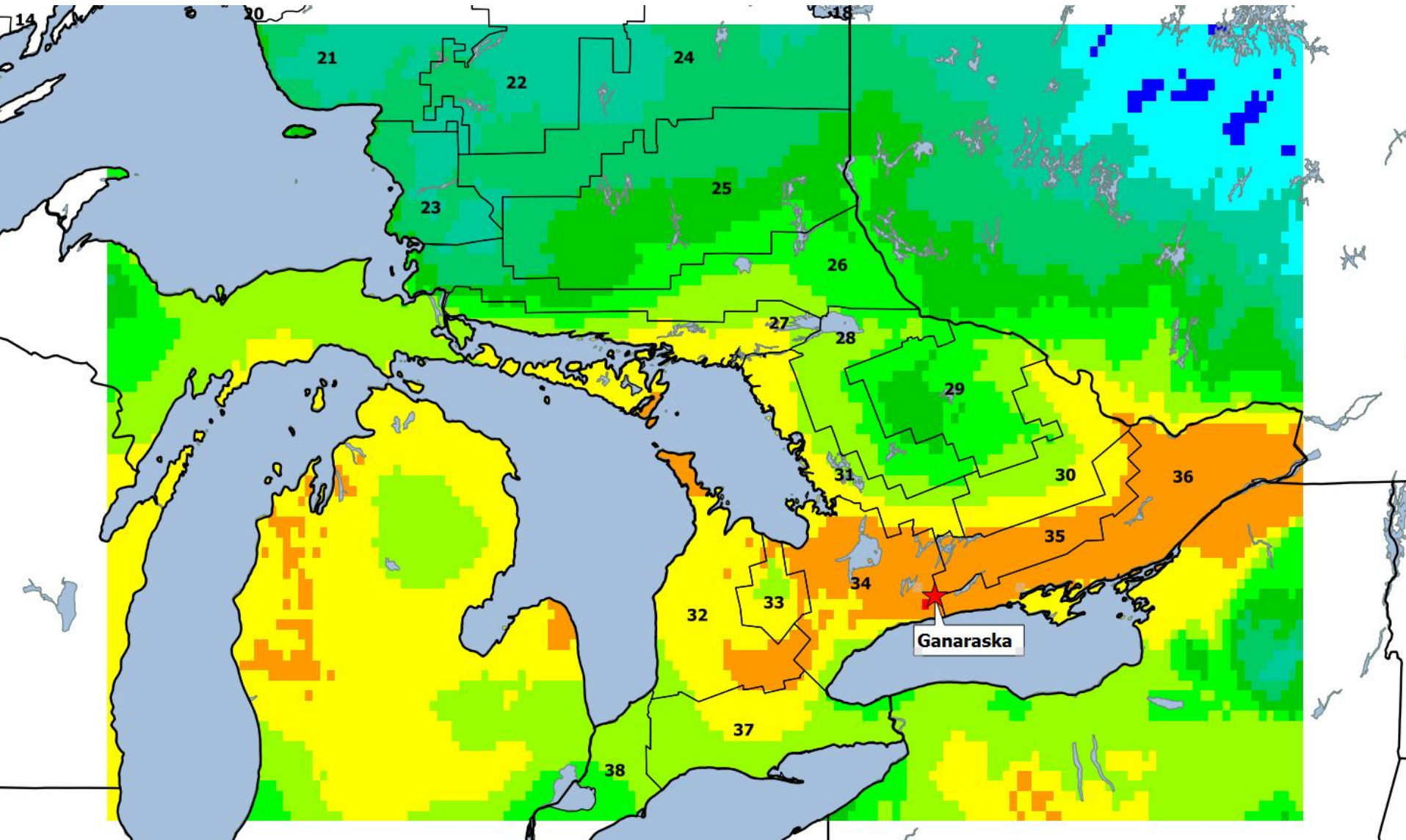
Ministry of Natural Resources and Forestry 



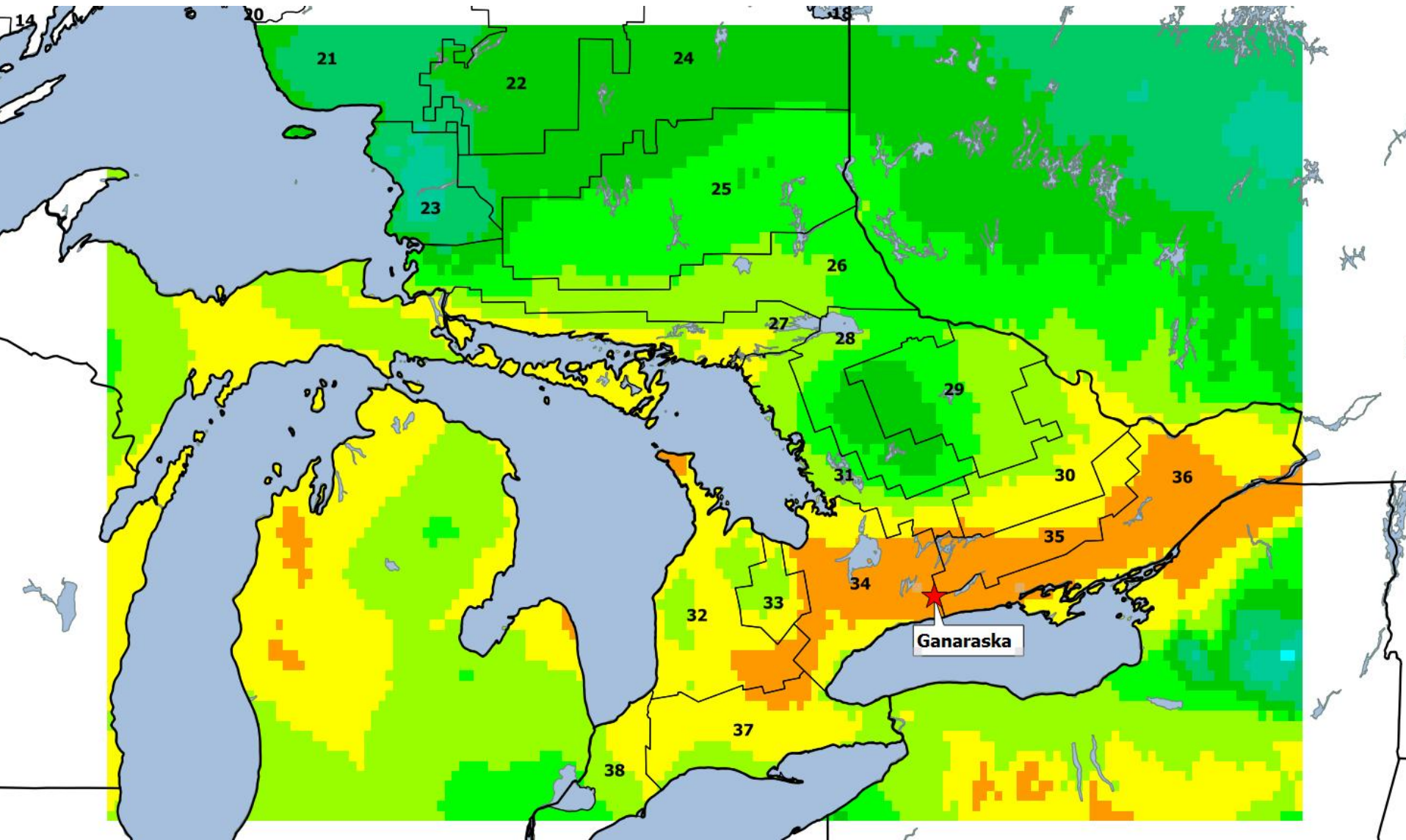
More Sites: Ganaraska Pr Seed Potential



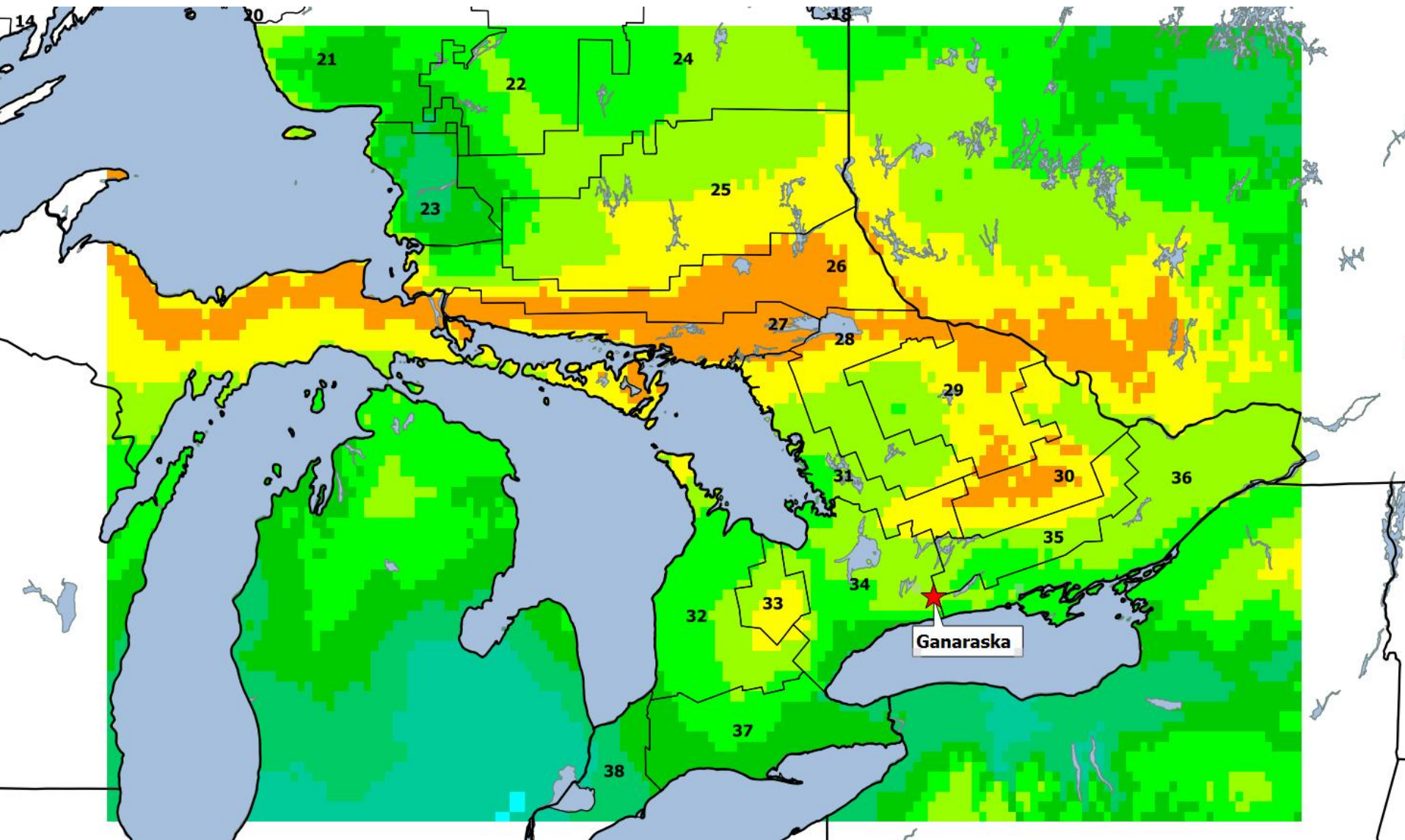
Ganaraska Climate 1941-1970



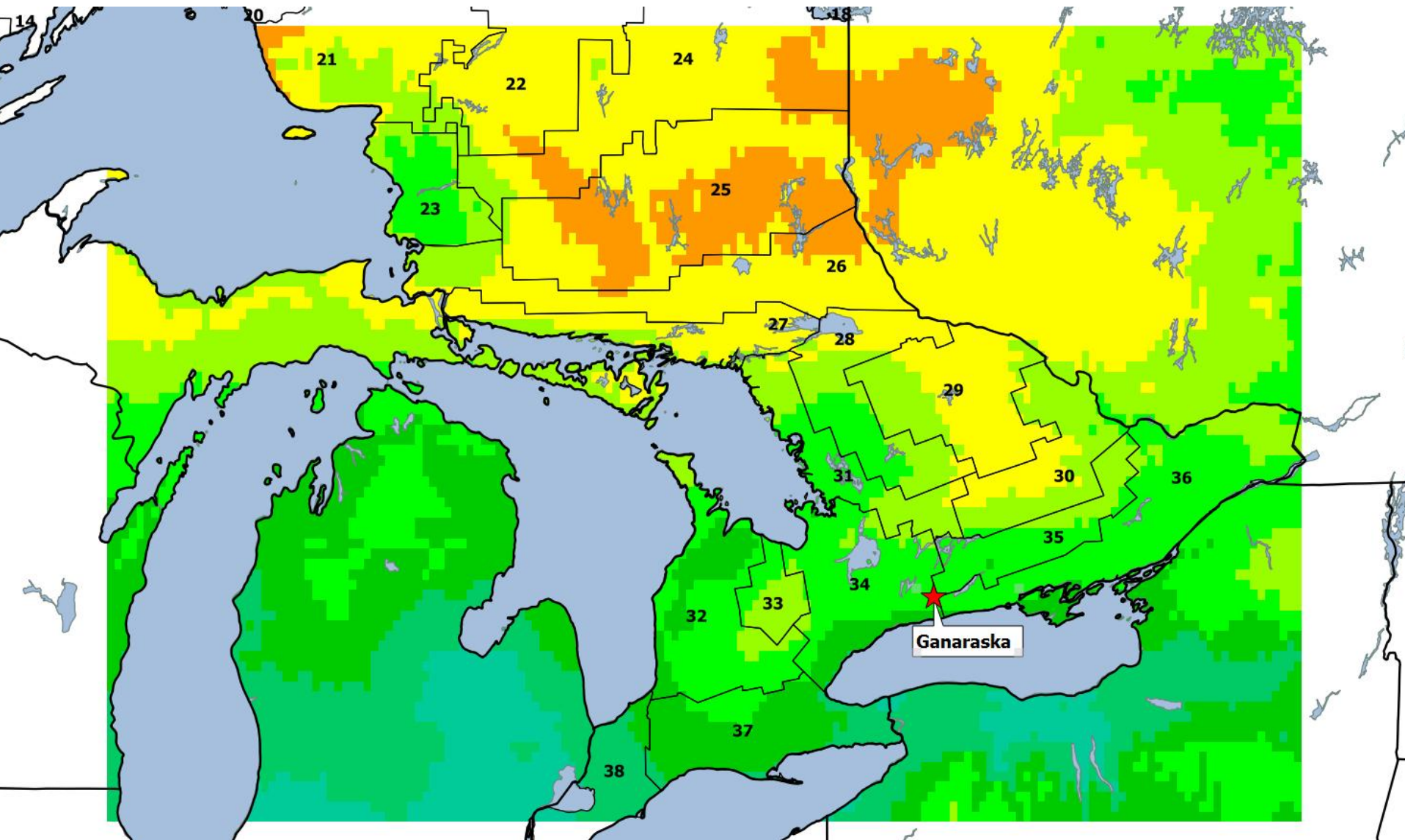
Ganaraska Climate 1971-2000



Ganaraska Climate 2011-2040



Ganaraska Climate 2041-2070



Species **winners** vs losers – depends on region/sites

Winners?

- Speculation based on “imperfect knowledge of most species **and uncertain and complex changes**”
- **pin**es, **o**aks, **h**ickories, **ch**erry, **w**alnuts, **ASH?**
 - Adapted to open, drier conditions
 - Growth patterns less susceptible to frosts
- **ASH?** – regenerates well; may not live long until EAB balance is reached (?),
 - But a cost-effective nurse crop to restore sites

Losers?

- **spruce, balsam fir, sugar maple, hemlock?**
- Require moisture, cooler conditions – losing suitable sites?
- Range may shrink northward as climate warms
- **Conserve the trees but spend planting \$ on other species?**

Immediate Solutions:

1. **Conserve ALL** remaining trees and forests
2. Report/collect good seed crops for seed banking
3. **Assist migration in your next planting project with a Seedling Mix of “Best Bets, No Regrets”:**

Incorporate more southern sources of local species:

example: $\frac{1}{2}$ local + $\frac{1}{4}$ 1-zone south + $\frac{1}{4}$ 2-zones south

And/or try new Southern species

- species that are adaptable to local sites & ecosystems
 - black walnut, tulip tree, oaks, hickories, etc
- using suitable seed sources from SeedWhere analysis

In 20 years – 2036!

- generally warmer yet still cold extremes, more storms

= dry sites dryer; low sites more often seasonally wet?

= more disturbance in forest, invasive species competition

= local species - some thriving, some failing – monitor/observe

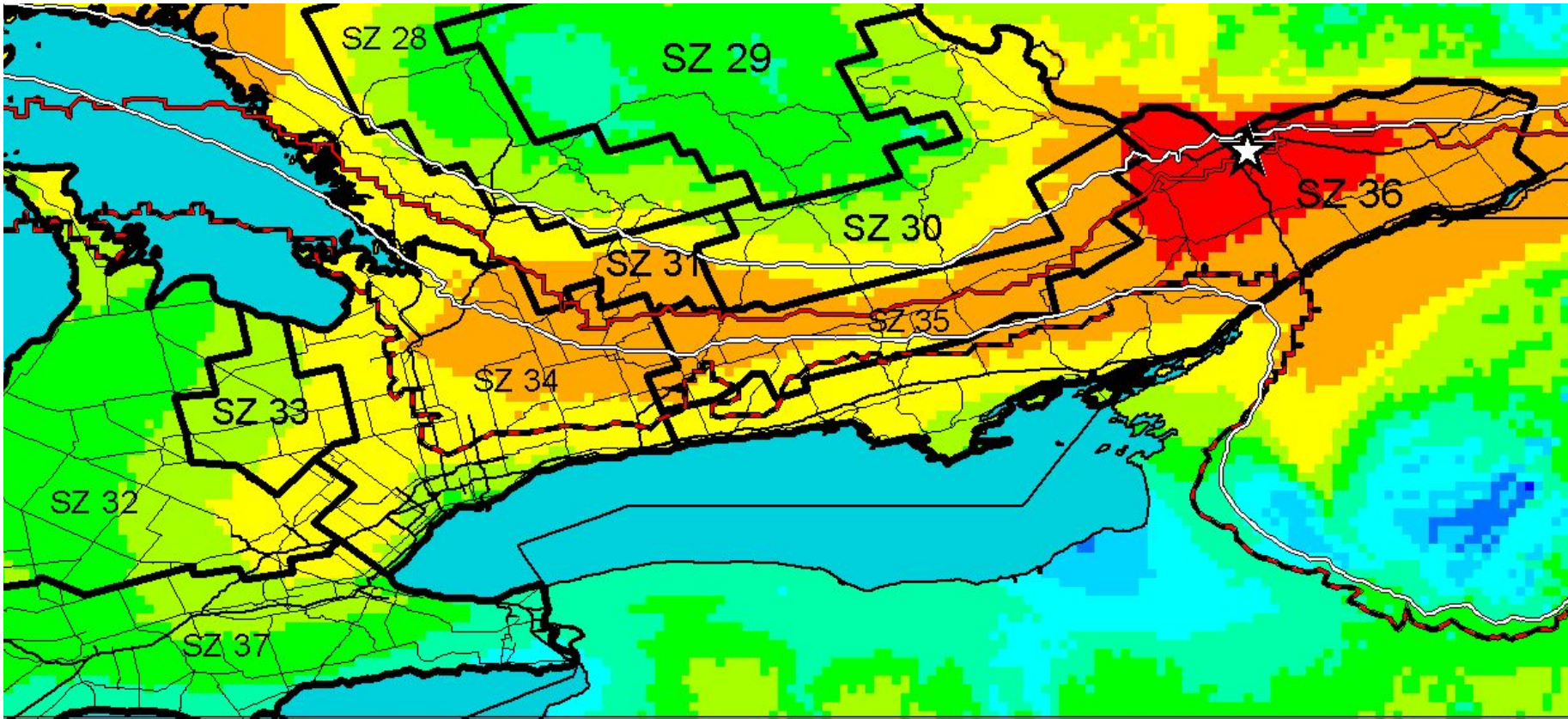
= flower and seed crop failures more common

– bank high quality seed to support annual planting efforts

= Southern species & sources surviving, maybe thriving?

→ Continue Assisted Migration

- more-southern sources of species suited to local sites
- Some southern species adapted to local forest community
- $\frac{1}{4}$ local + $\frac{1}{2}$ 1-zone 'south' + $\frac{1}{4}$ 2-zones 'south'



e.g. Ottawa - a specific site allows comparison within/between zones

Local	= red & orange	= northern 36, 35 & northern 34
1-Zone south	= southern yellow	= southwest 36, southwest 34
2-Zones south	= southern green	= 32 & 37

Source = SeedWhere, NRCAN

For 40 years – 2056! (that's less than 1/2 a tree's life span)

- warmer climate, longer season, **unpredictable cold extremes**
- **Uncertain moisture** regimes – snow vs rain, timing/amount

= some open sites now too dry for forests = to scrub, grasslands?
= local species – winner vs losers, species dominance changes

☒ pine/oak? vs ☐ maple/hemlock?

= Early flowering species with crop failures – soft maples/elms
= More frequent droughts and **seed crop losses** (think 2016!)
= Southern sources growing better than local? producing seed?

→ **Continue Assisted Migration - IF SEED is AVAILABLE?**

- Plant increasing mix of southern sources and species
 - $\frac{1}{4}$ local + $\frac{1}{4}$ 1-zone 'south' + $\frac{1}{2}$ 2-zones 'south'



We will always need seed!

UGA0008249



Assisted Migration = Moving Seed and Stock

Caution!

A forest community = many organisms in balance
plants, birds, mammals, insects, diseases, soil organisms!

Organisms can hitch a ride on imported seedlings

= can disrupt the balance, sometimes catastrophically

- Minimize risks e.g. phytosanitary inspections and monitoring
- Import seed instead of seedlings from trusted sources

Logistical issues - need strategic planning

- Southern Ontario will need American sources = customs
- Importing/shipping can be hard on perishable seed & trees
- Southern sources availability may not match our planting times

Assisted Migration alone isn't the answer

- **Firstly** and very importantly, we **NEED existing forests**
 - to help mitigate climate change
 - to be the **source of high-quality seed** to grow seedlings adapted to current and future climates
 - **which may in part adapt and thrive in situ?**
- **Secondly**, we don't have the \$ or open land to affect all of southern Ontario

Conservation of all existing forests is necessary
to give us **high quality ammunition**
to shoot at climate change,
a challenging **moving** target

So as you fight to conserve forests,
plan harvests, plant trees, tend trees
collect seeds, or just learn more
about your own forest

Communicate

- with your peers,
- your local community
- your governments

All our voices are needed
to conserve and restore our forests



***If not you
Whooo?***

Thank you!