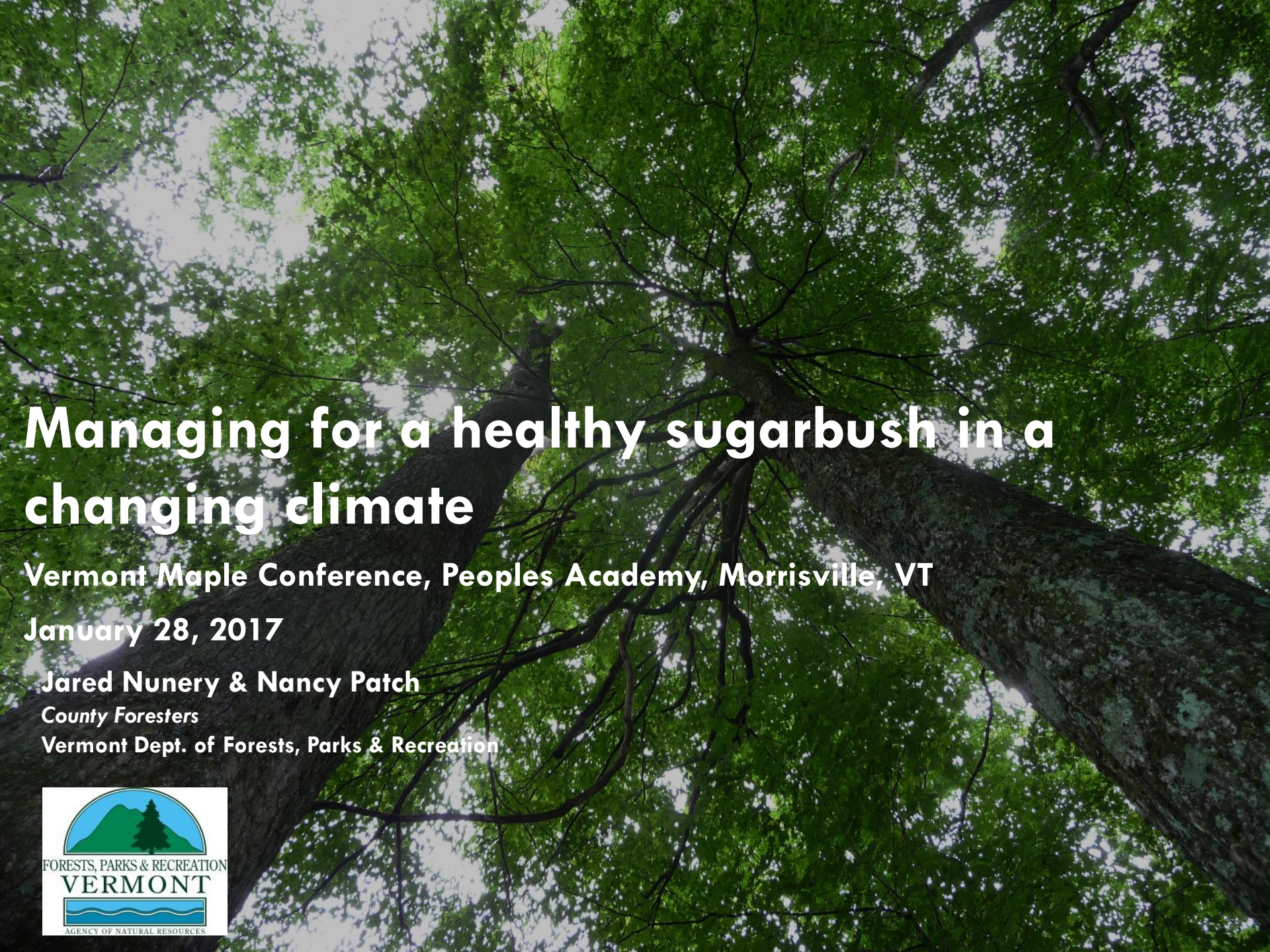

Managing for a healthy sugarbush in a changing climate

Vermont Maple Conference, Peoples Academy, Morrisville, VT

January 28, 2017

Jared Nunery & Nancy Patch
County Foresters
Vermont Dept. of Forests, Parks & Recreation

FORESTS, PARKS & RECREATION
VERMONT
AGENCY OF NATURAL RESOURCES

- What have we seen recently?
- What are we likely to see?
- What can we do about it?

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Climate Change the bad…

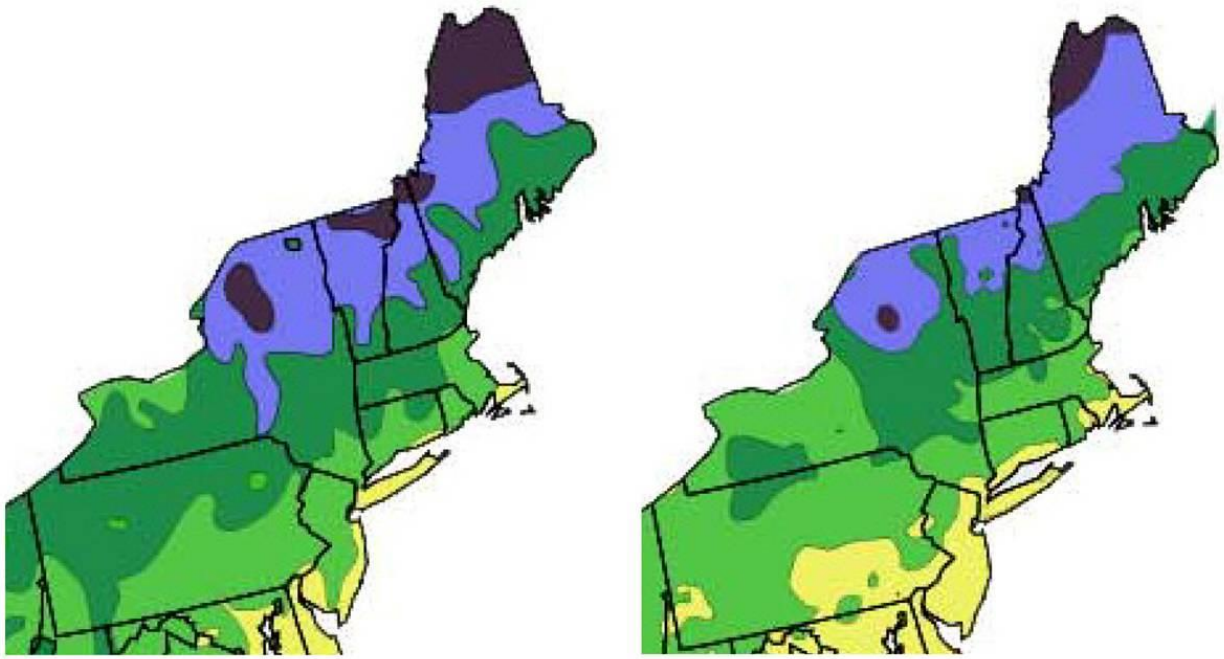
- 85% of people in one US survey reported experiencing extreme weather in the 2012-13
  - 20% of these respondents suffered harm as a result of extreme weather (extreme wind and/or cold weather)
- 54% of Americans think it's likely that extreme weather will cause a natural disaster in their community in the next year.

Photo Credit: Burlington Free Press, Wardsboro, VT during Tropical Storm Irene

Photo Credit: Burlington Free Press, Bolton, VT 2016

Leiserowitz et al, 2013. Yale University and George Mason University

Climate Change the good…



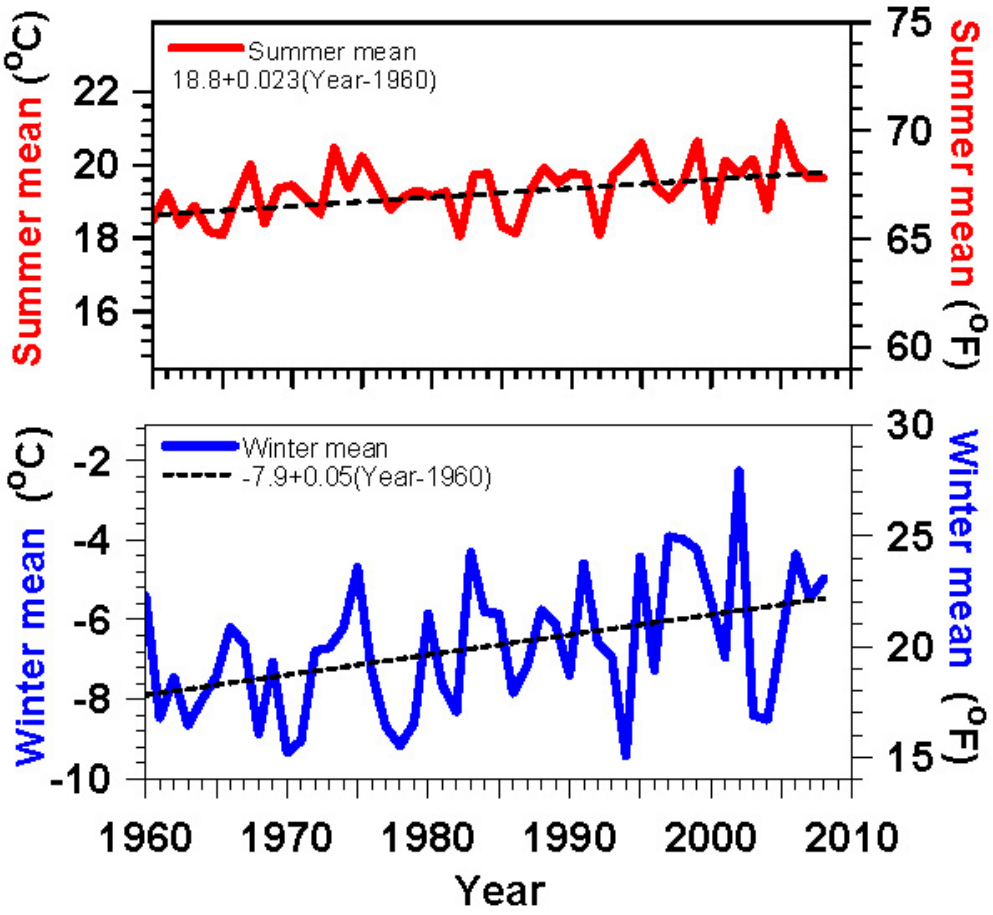
1990 **2006**

Zone

2 3 4 5 6 7 8 9 10

USDA Hardiness Zones

Climate Trends in VT



50 Year Trend

Summer trend is 0.4±0.12 ◦F per decade

2 F Increase

Winter trend is 0.91±028 ◦F per decade

4.5 F increase

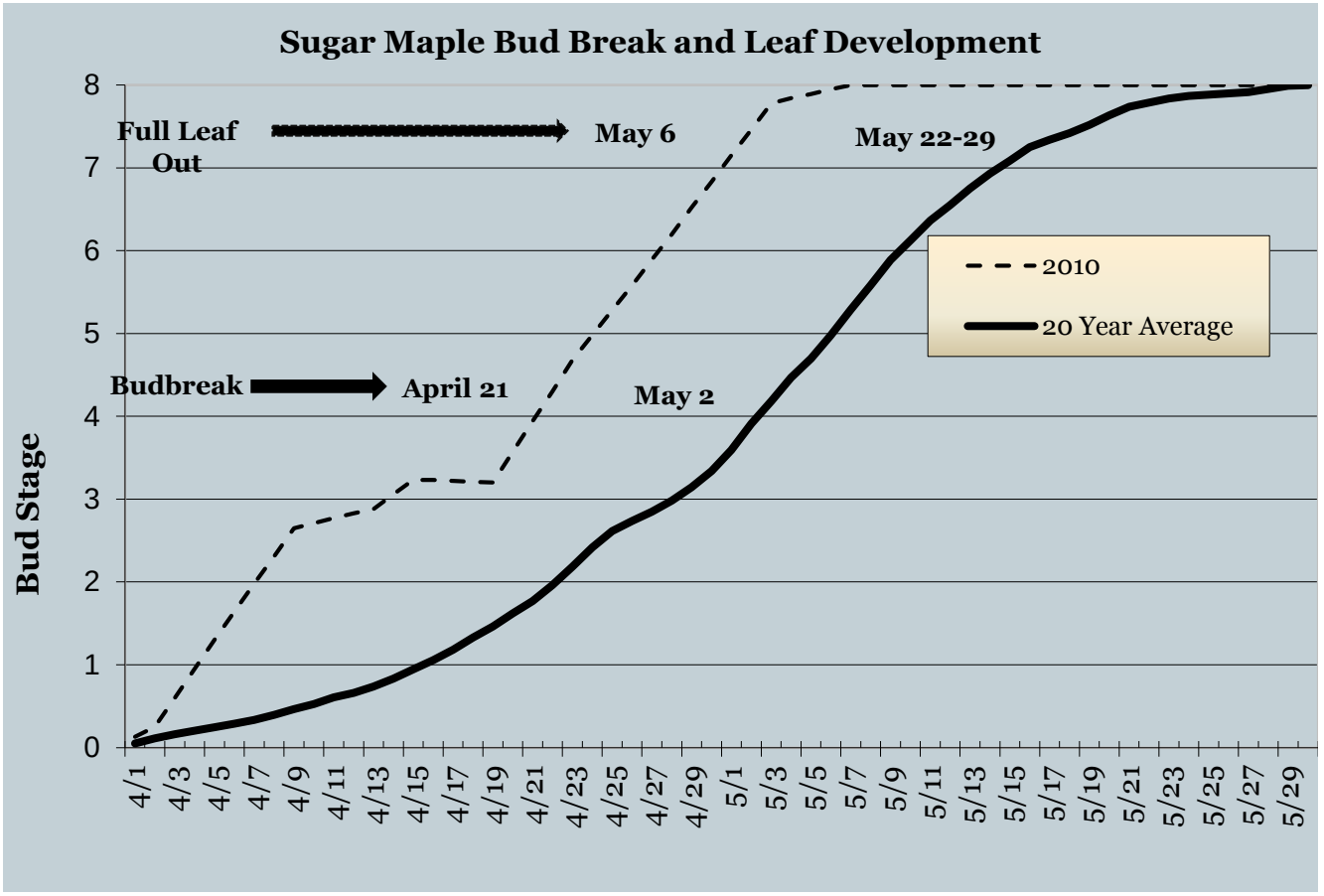
Betts 2010. 4 VT Stations

Dates of sugar maple bud break and leaf out, 2010

Vermont Monitoring Cooperative

Budbreak 11 days earlier

Full leaf out 16 days earlier

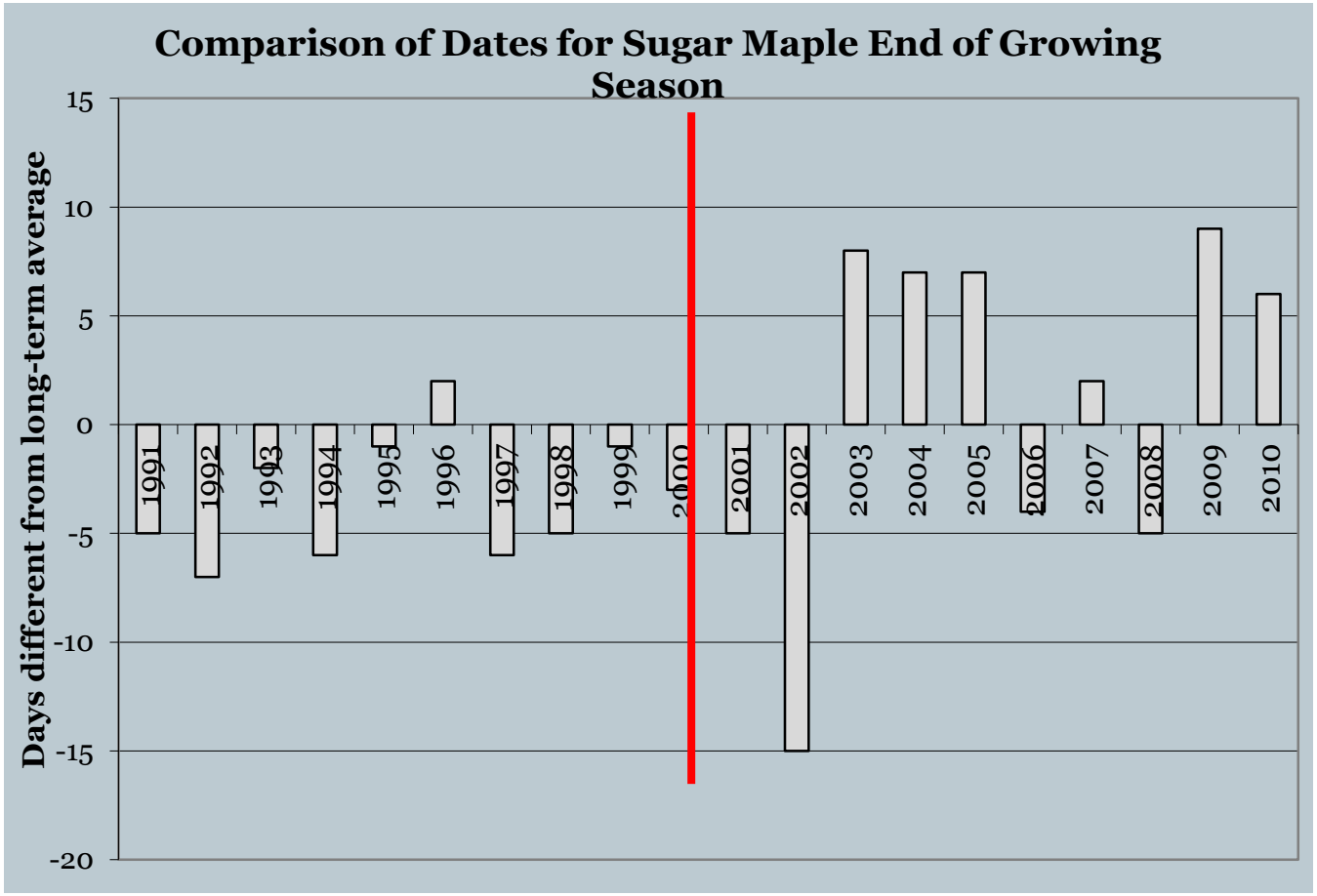


Sugar Maple End of Growing Season

Vermont Monitoring Cooperative

Last Decade: 1 year with later fall

This Decade: 6 years with later fall



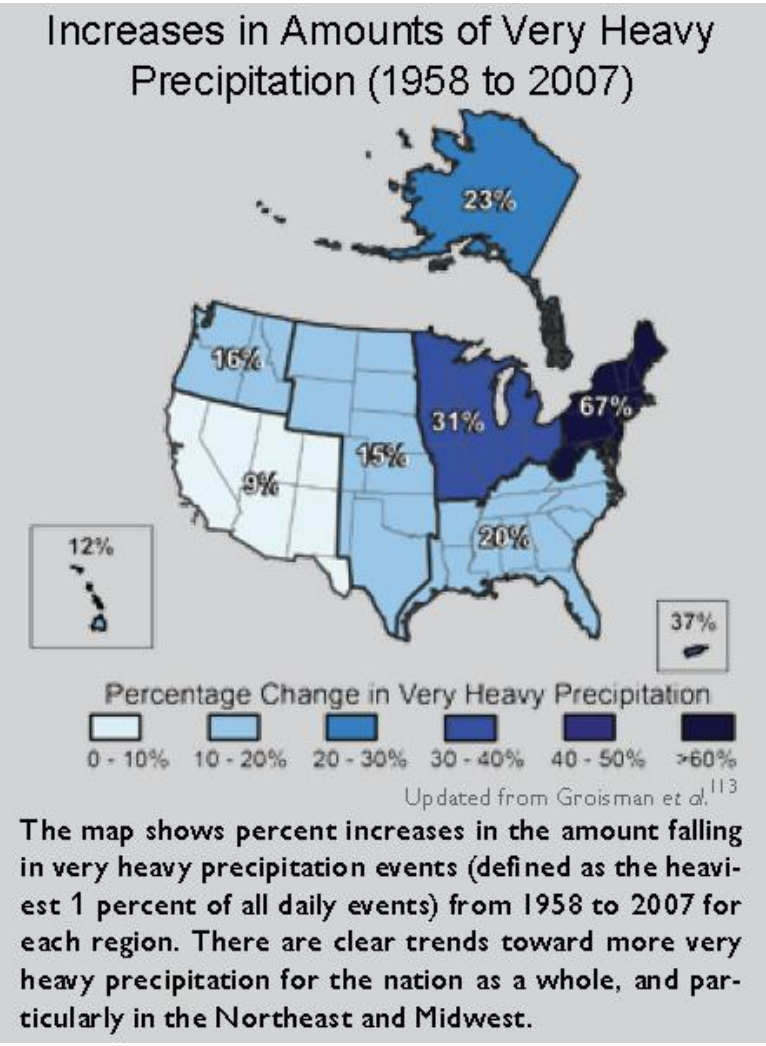
Length of Sugar Maple Growing Season

Vermont Monitoring Cooperative

1991 – 2000	164 days
2001 – 2010	177 days

13 day difference per decade

Precipitation Trends in VT



The map shows percent increases in the amount falling in very heavy precipitation events (defined as the heaviest 1 percent of all daily events) from 1958 to 2007 for each region. There are clear trends toward more very heavy precipitation for the nation as a whole, and particularly in the Northeast and Midwest.

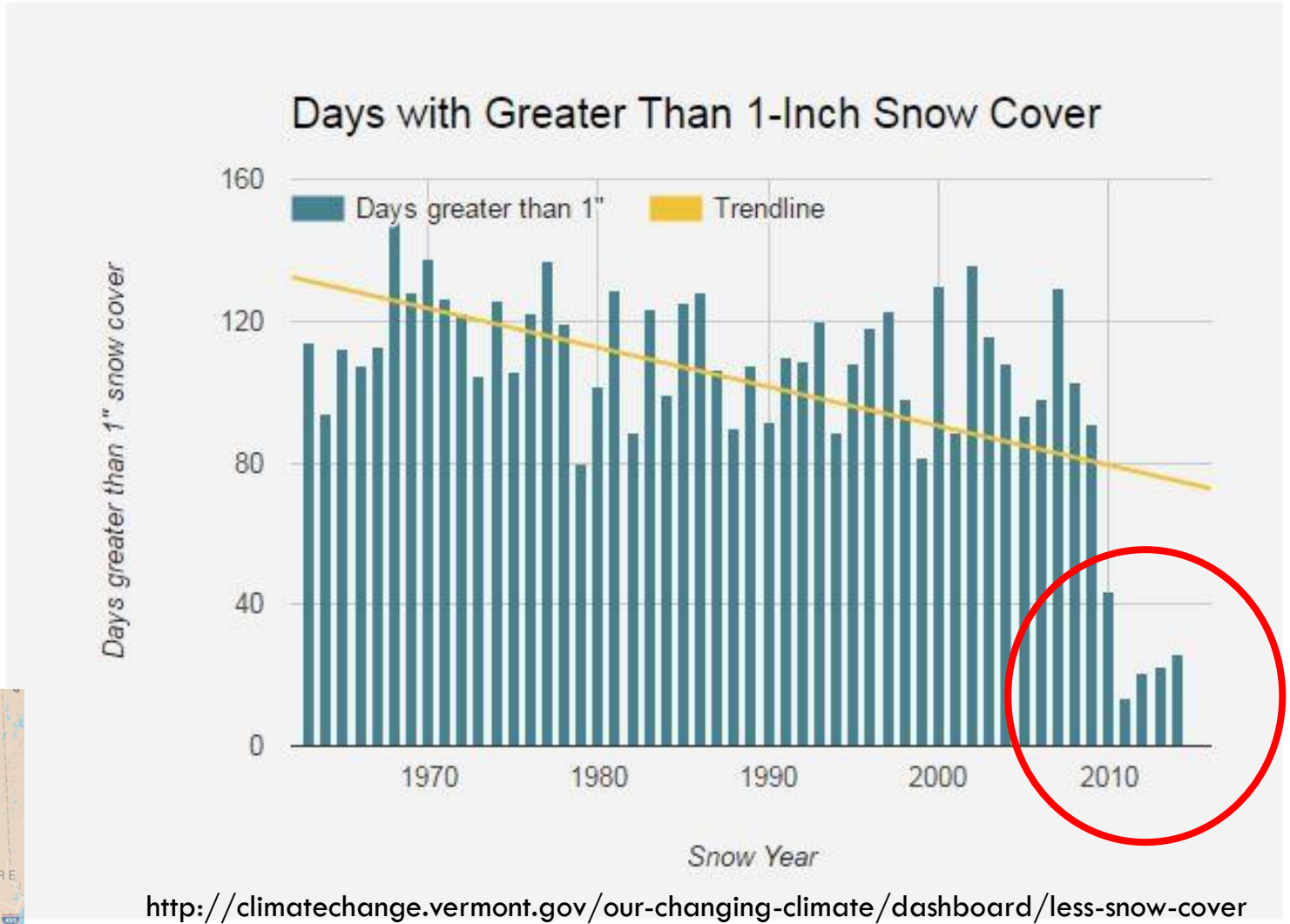
50 Year Trend

15-20% precipitation increase in VT

67% increase in the amount falling as "heavy precipitation"

US Global Change Research Program, 2009

Precipitation in the winter is changing



http://climatechange.vermont.gov/our-changing-climate/dashboard/less-snow-cover

- What have we seen recently?
- What are we likely to see?
- What can we do about it?

The Sugar Maple Decline Complex

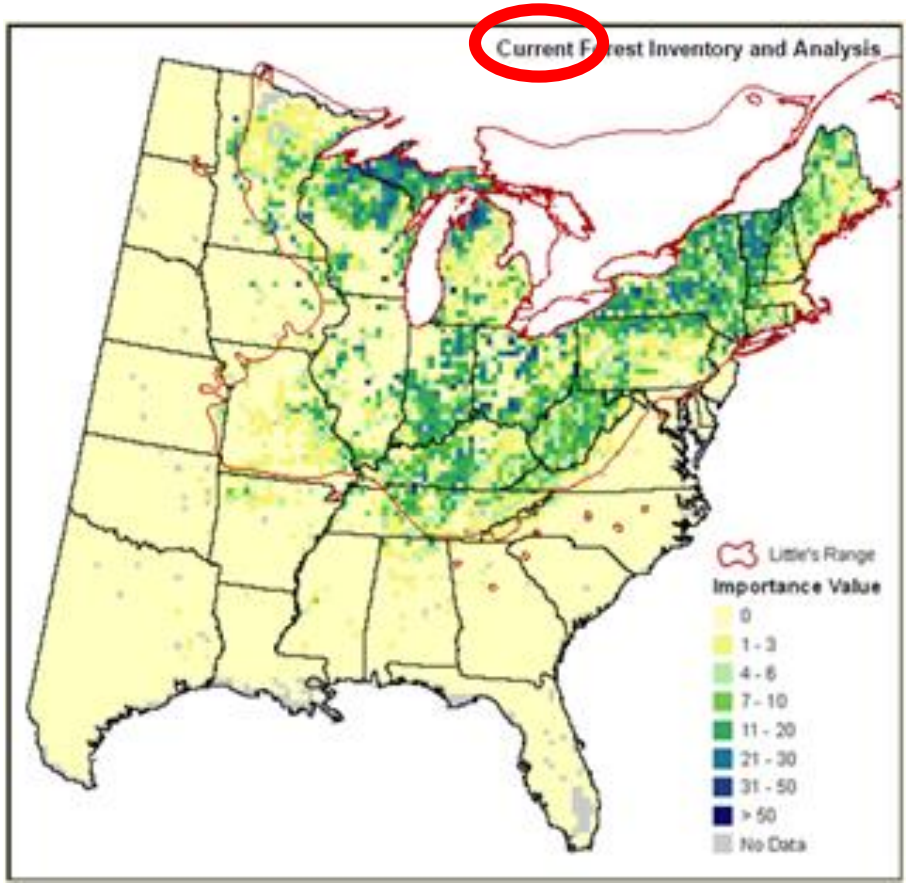
Primary Decline Drivers:

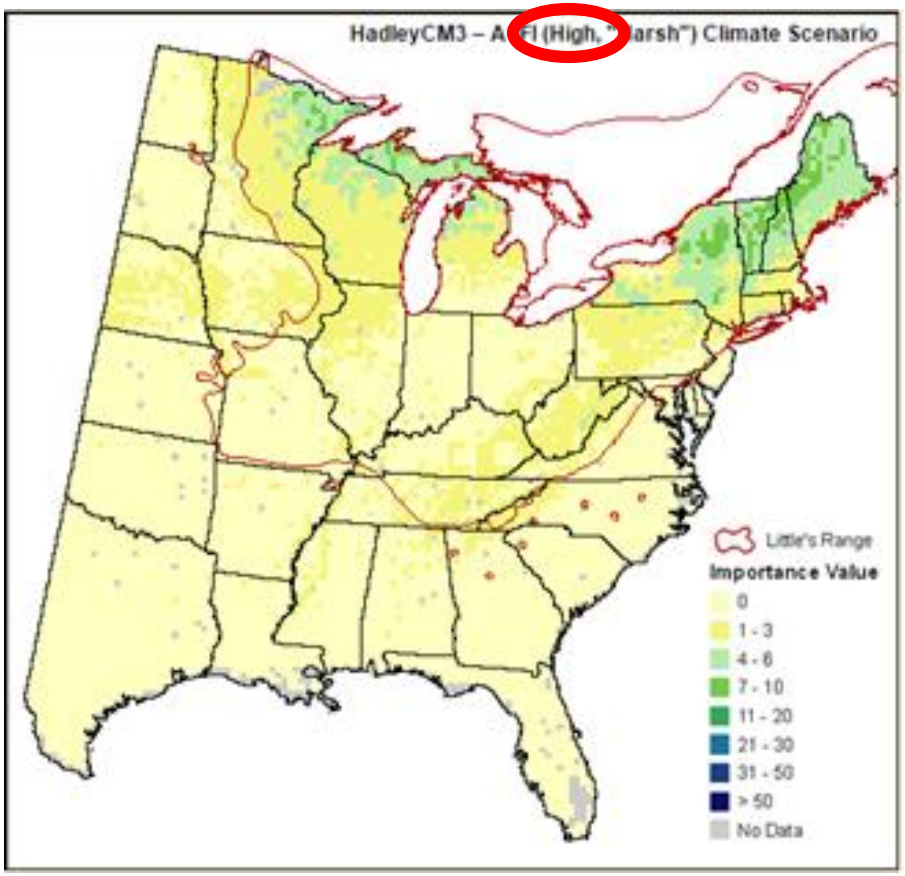
- Soil nutrient status: calcium, aluminum acid deposition (Sugar maple demands calcium)
- Insect Defoliation (higher with monoculture)
- Herbivory (affects seedling and sapling survival)
- *Invasive Species (displaces native plants, changes soil chemistry)*
- **Drought (affects germination, and summer growth)**
- **Winter Injury (root freeze injury, dehardening of tissue, frost on early budbreak)**
- **Natural Disturbance (ice, snow, wind)**

Pontius et al., Vermont Monitoring Cooperative 2015

Isolating the relationship between climate and sugar maple decline

Current vs Future *PREDICTED* SM Range





Pontius et al., Vermont Monitoring Cooperative 2015

Disturbance and climate change

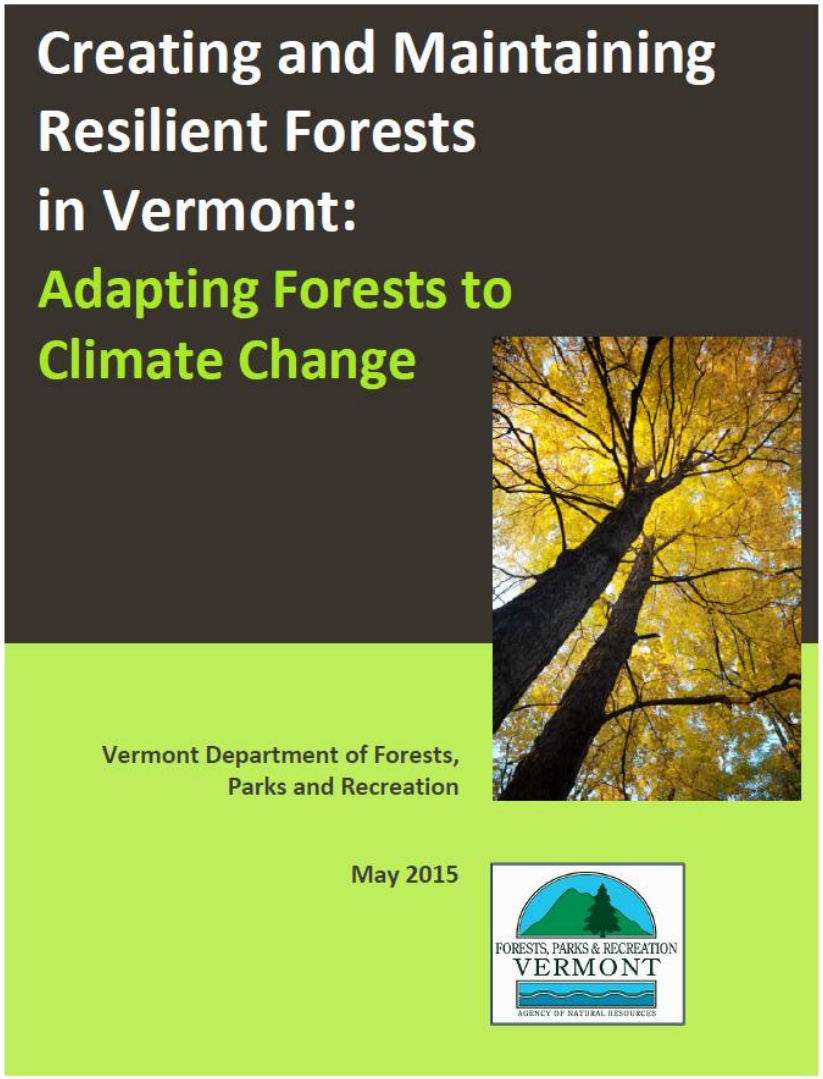
- Research suggests that *disturbance* may have the *strongest single impact* on yearly sugar maple condition, but climate change accounts for a larger portion of the predicted decline in sugar maple condition.
- Disturbance and Climate together accounts for over 30% of the change, *climate change alone accounts for almost 20% of this variation*.


Natural Disturbance

Compounded stressors

- What have we seen recently?
- What are we likely to see?
- What can we do about it?

How does Forest Management fit in?



Available here: http://fpr.vermont.gov/

Forest response-***resilience***

- ***Resilience*** – the capacity of a forest to withstand (absorb) external pressures and return over time, to its pre-disturbance state (Thompson et al. 2009)

- What creates resilience:
  - Diversity
  - Health
  - Structure
  - ~~Landowners~~
  - LAND STEWARDS!

Diversity = Health

Species Diversity

Diversity in all layers
✓Overstory
✓Midstory
✓Shrub
✓Herbaceous.

Having at least **25% non sugar maple species** significantly reduces harmful populations of insect and disease which attack sugar maple. Bird species diversity and abundance are also greater.

Keep the **basswood** and **ash** for fertilizer, the oak, cherry and yellow birch for timber, and the quality red maple to tap.

Structural diversity

Vertical and horizontal structure

Why is this important?

- Nutrient cycling
- Protect from deer
- Provide habitat
- Maintain moisture
- Soil protection

Multiple age classes

Canopy gaps (historical disturbance)

Coarse & fine woody material, snags and cavity trees

Creating a resilient forest

- **Regeneration is a top priority**
  - Establish desired regeneration
  - **<u>Maintain diversity in regeneration</u>**
  - Consider conditions impacting regeneration (soil moisture and temperatures)
  - Consider deer and moose browse pressure
  - Leave tops in the woods and recruit a few large stems per acre for coarse woody material.
  - **<u>Consider non-native invasive species</u>**

Site matters

Transition Forests

These forests are characterized by an early successional red maple, aspen, birch overstory with a sugar maple, yellow birch, beech understory.

Poor overstory is tapped while quality understory is suppressed, causing mortality of sugar maple. Multiple stemmed red maple short-lived, disease prone.

Indicator plants (used to identify ***refugia***)

Wild Leeks

Blue Cohosh

Maidenhair Fern

Wild Ginger

Ginseng

Other indicator plants for optimal sugar maple sites

Abundant

- Hepatcia
- Nettle
- Dutchman's Breeches
- Bulblet fern

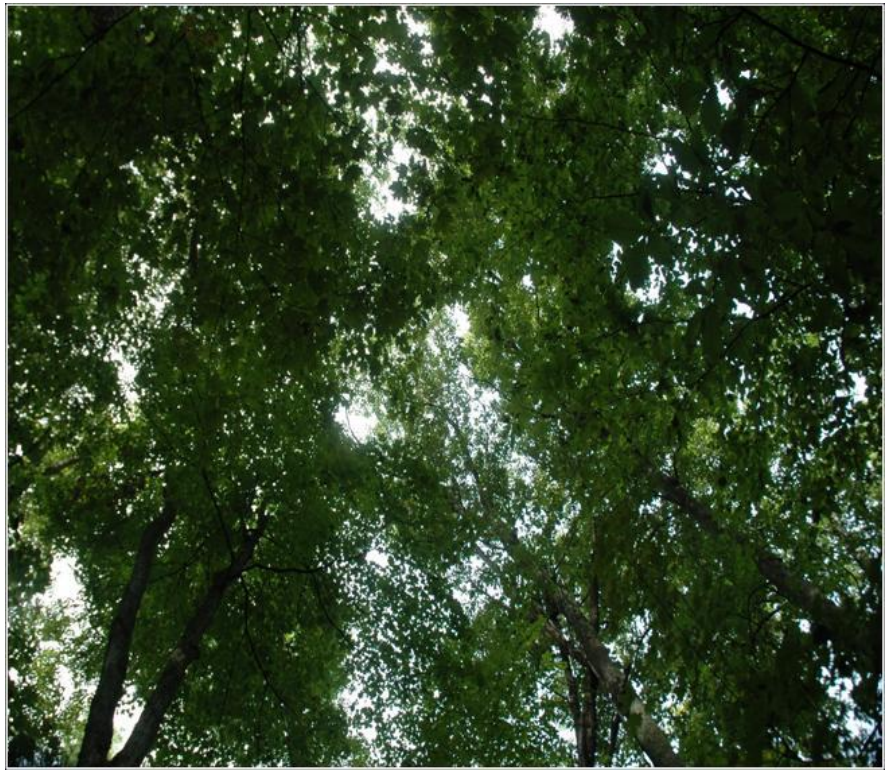
Locally Abundant

- Squirrel Corn
- Baneberry
- Rattlesnake fern
- Virginia waterleaf
- Plaintain leaved sedge

Wildlife as Indicators

- **Songbirds:** healthy songbird populations are present in a diverse forest with both vertical and horizontal structural diversity. Maintaining this structural diversity ensures a healthy sugarbush and a healthy sugarbush will help stabilize the songbird population. **Song birds are important as predators of harmful insects, perhaps more important now with the decline in our bat populations.**
- **Invertebrates:** insects and other arthropods find habitat in snags and coarse woody debris. These animals are both predator and prey. **Many insects are important in keeping other harmful insect populations in check as well as a food source for birds and mammals.**
- **Amphibians:** Coarse woody debris is upland habitat for mole salamanders, while vernal pools and streams provide structural diversity as well as habitat for frogs and salamanders.

Forest Management (*Resilience through health*)



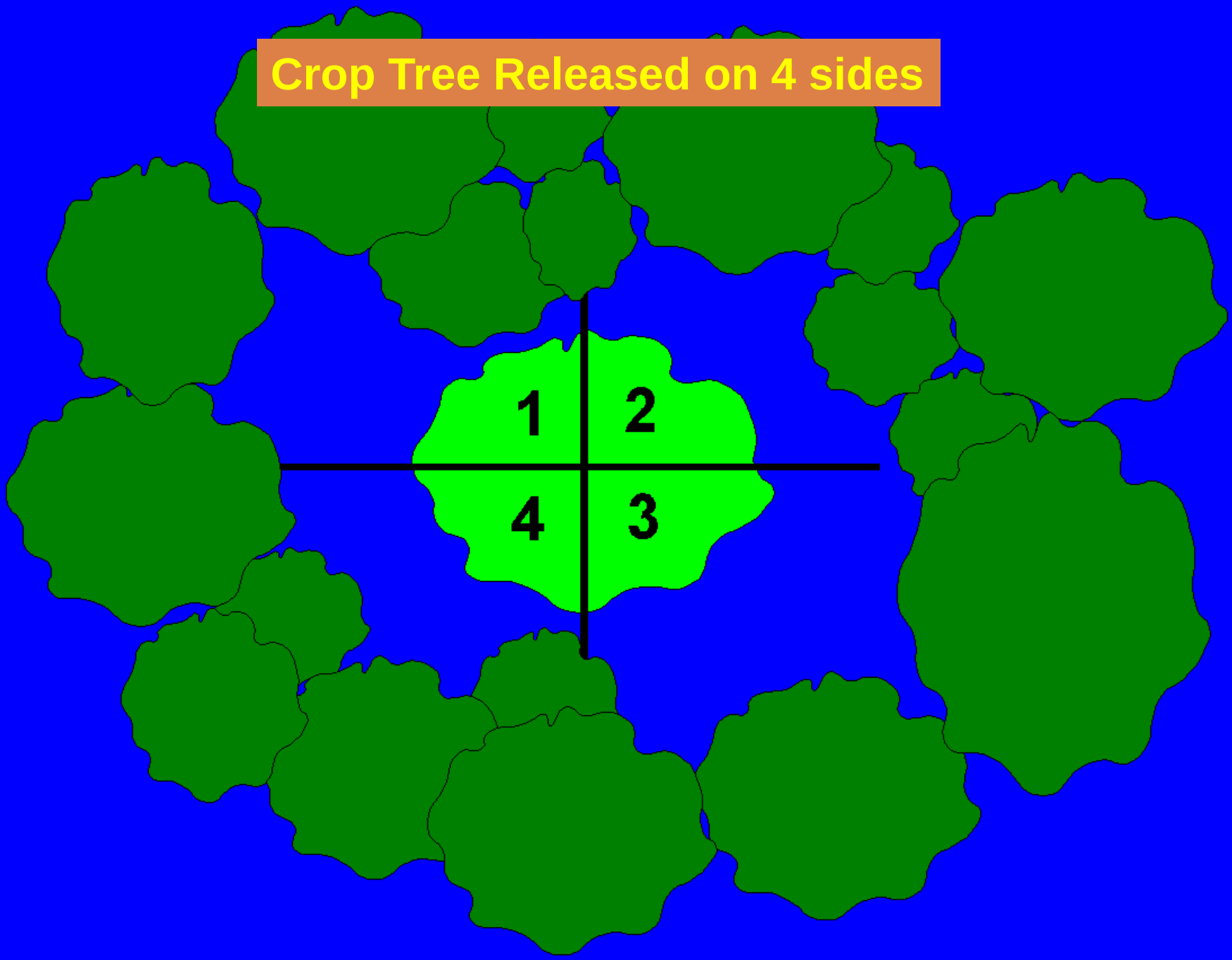
Un-thinned crowns

An example of a monoculture where none of the maple trees are cut

Thinned crowns

Space is provided for crown expansion, regeneration

Crop Tree Released on 4 sides

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Group Selection

Area regulation is easily used to define the harvest design.

Total Gap Area =

$$\text{Stand Area} \frac{\text{Cutting Cycle}}{\text{Rotation Length}}$$

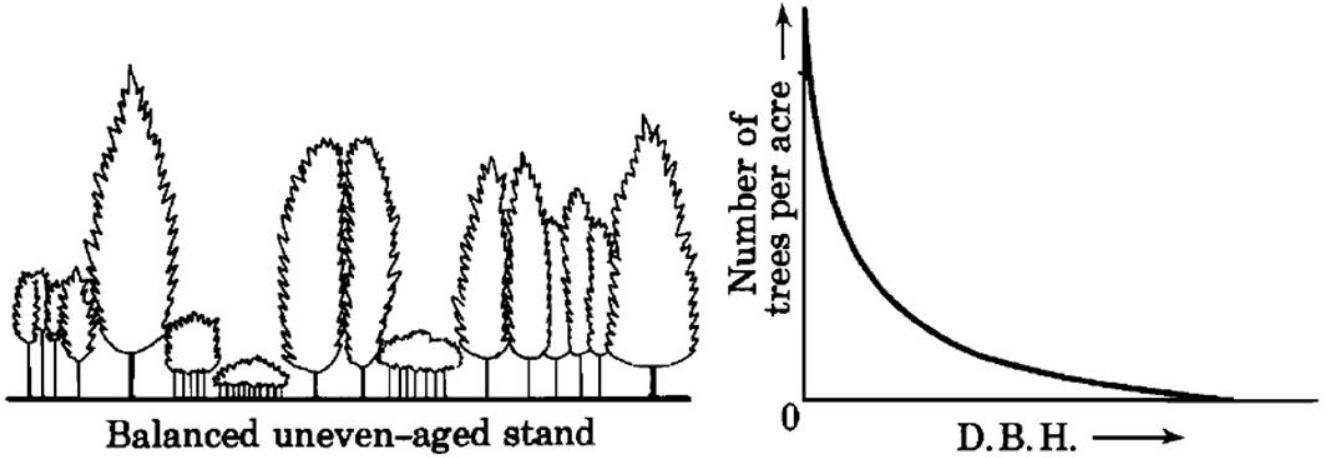
Post harvest

Create Gaps and implement thinning or CTR between groups

Provide: Size (.25 to 2 acres) and Number of openings or percent cover

3 years Post harvest

Balanced vs. Unbalanced Uneven-aged




Diversity allows the forest to self-adapt to climate change

Adapting practices

Adaptation example: Maple syrup production

- Sugaring season **starts 8 days earlier and ends 11 days earlier** than 40 years ago, meaning a 10% reduction in season duration
- If continued normal tapping time and bucket system = **miss early runs** and unusual weather fluctuations
- Sugar makers have **adjusted timing of tapping and increased use of vacuum** to overcome climate change effects on sugaring industry

T. Perkins, 2008

Adapting management practices

- Harvest smart!
  - Use appropriate equipment
  - Minimize residual stand damage
  - Consider drainage on skid trails and plan for the worst
  - Minimize the number of skid trails

Questions?

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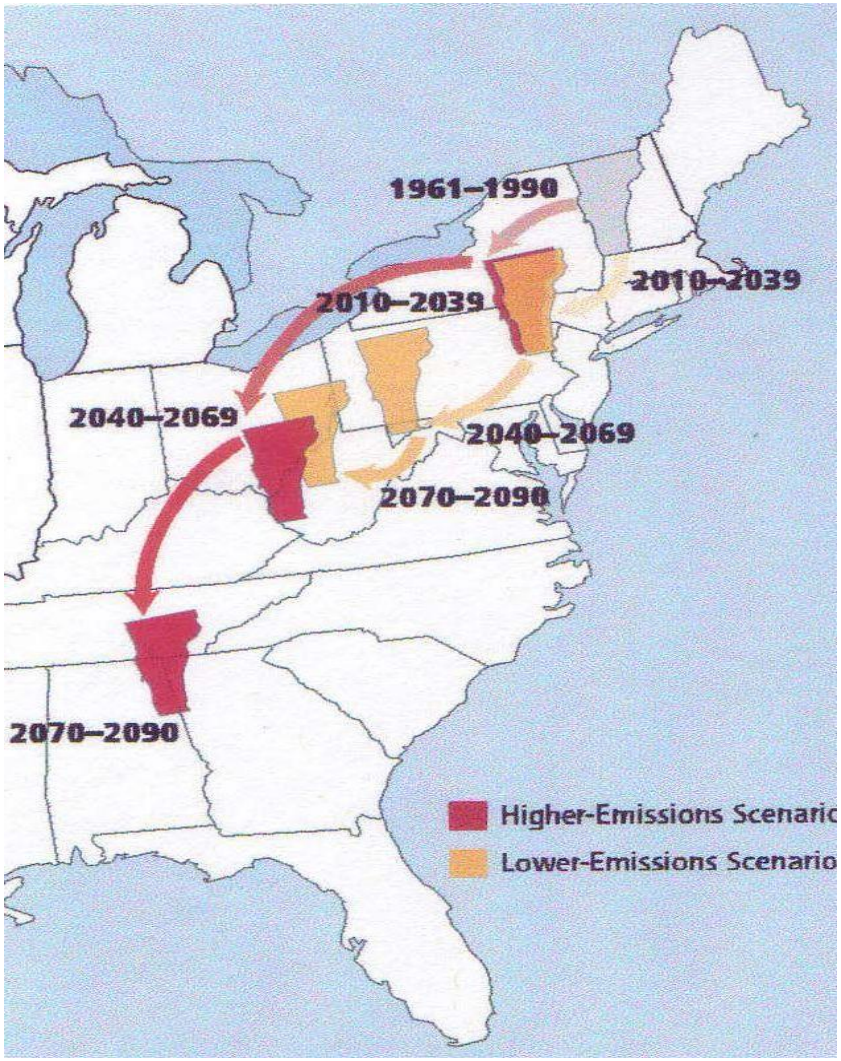
1961–1990
2010–2039
2010–2039
2040–2069
2040–2069
2070–2090
2070–2090
Higher-Emissions Scenario
Lower-Emissions Scenario