Effects of Climate Change on Vermont’s Forests

Ali Kosiba, PhD
Extension Assistant Professor &
State Extension Forester
University of Vermont

House Committee on Environment
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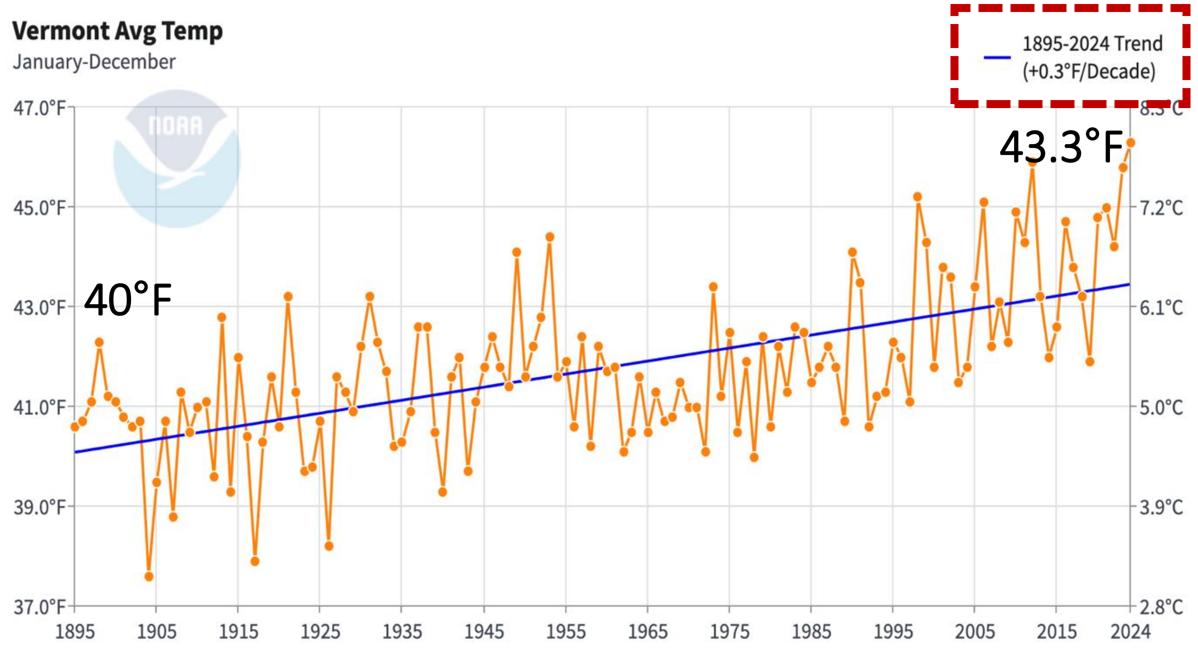
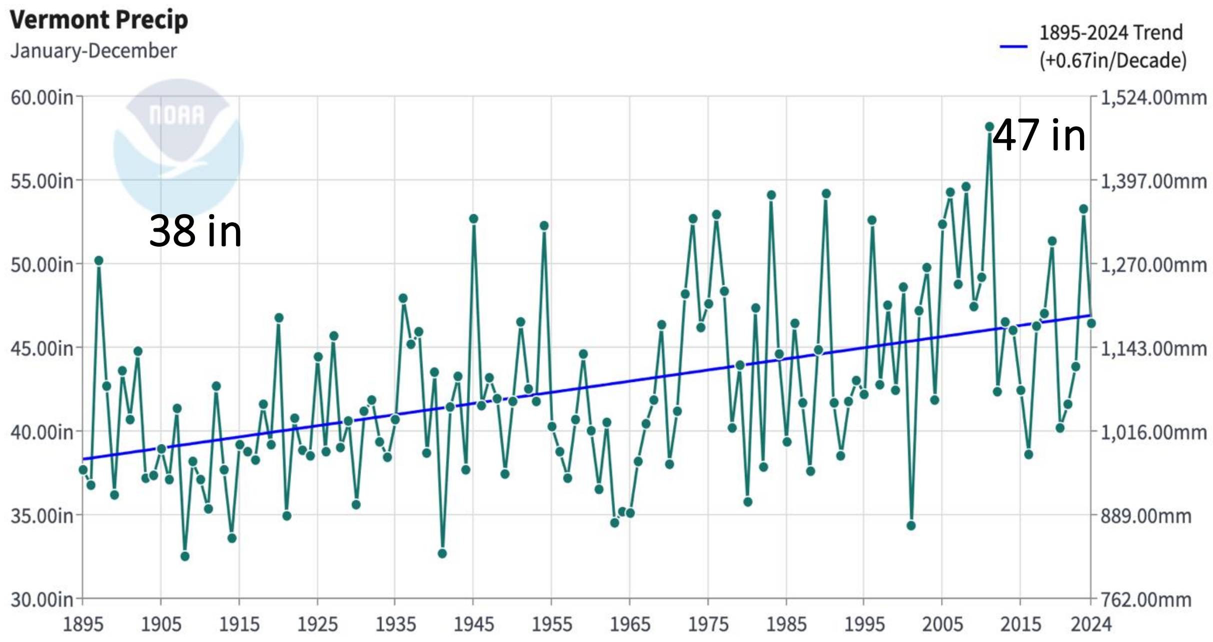
Vermont's Climate is Changing

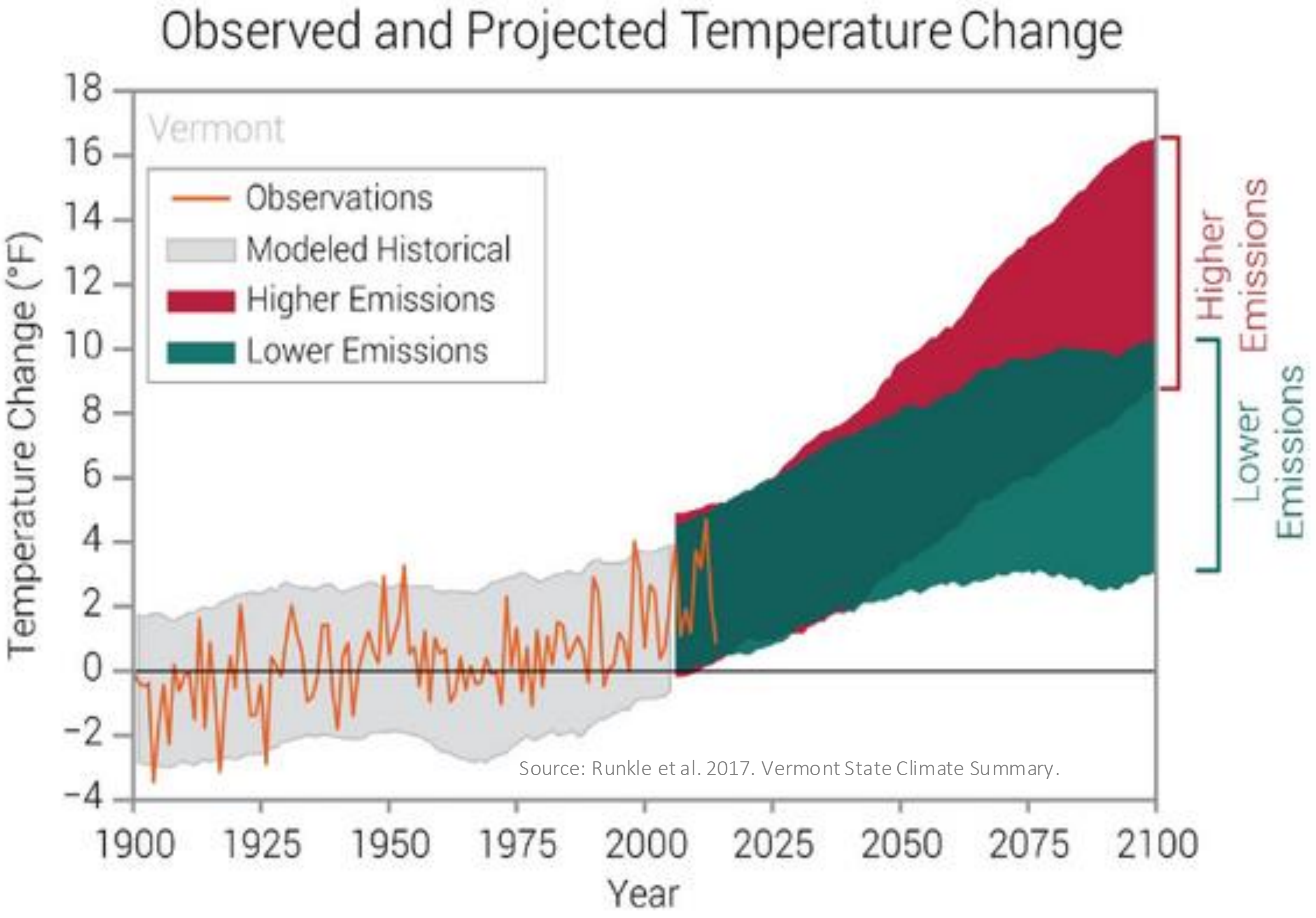
Annual temperature has increased
3.3°F

Annual precipitation has increased
20% (9 in)

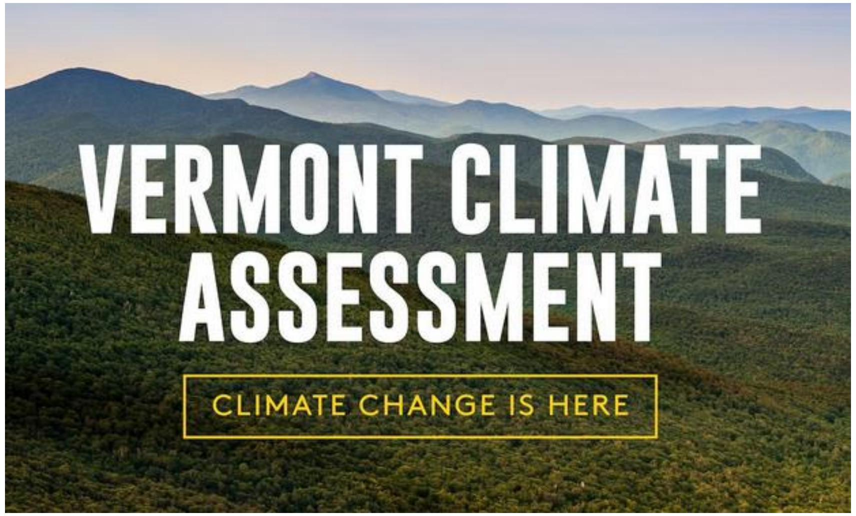




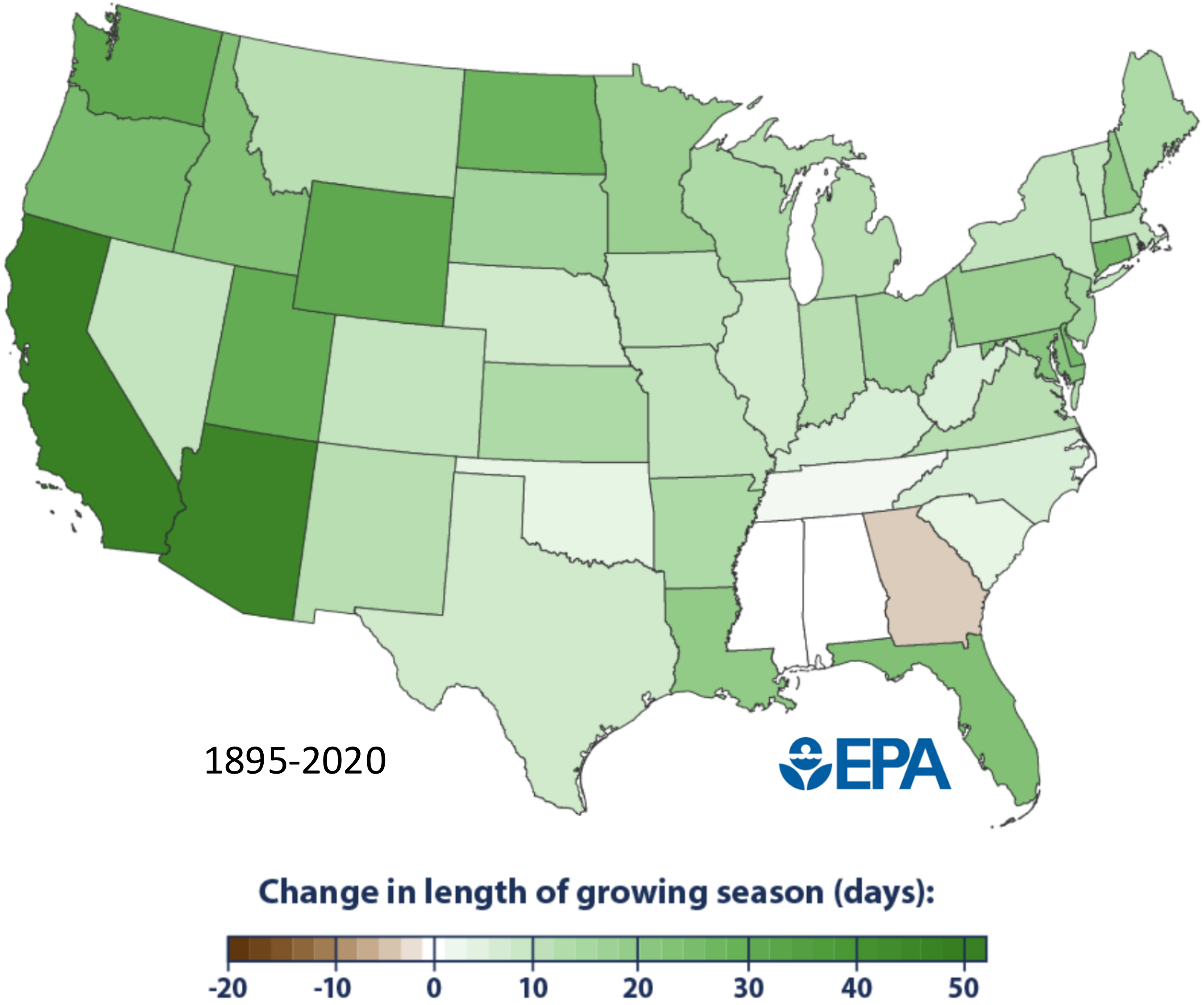
More change is projected



Source: Runkle et al. 2017. Vermont State Climate Summary.



Longer Growing Season



Impacts of a Longer Growing Season

- Trees and plants can grow more, store extra reserves

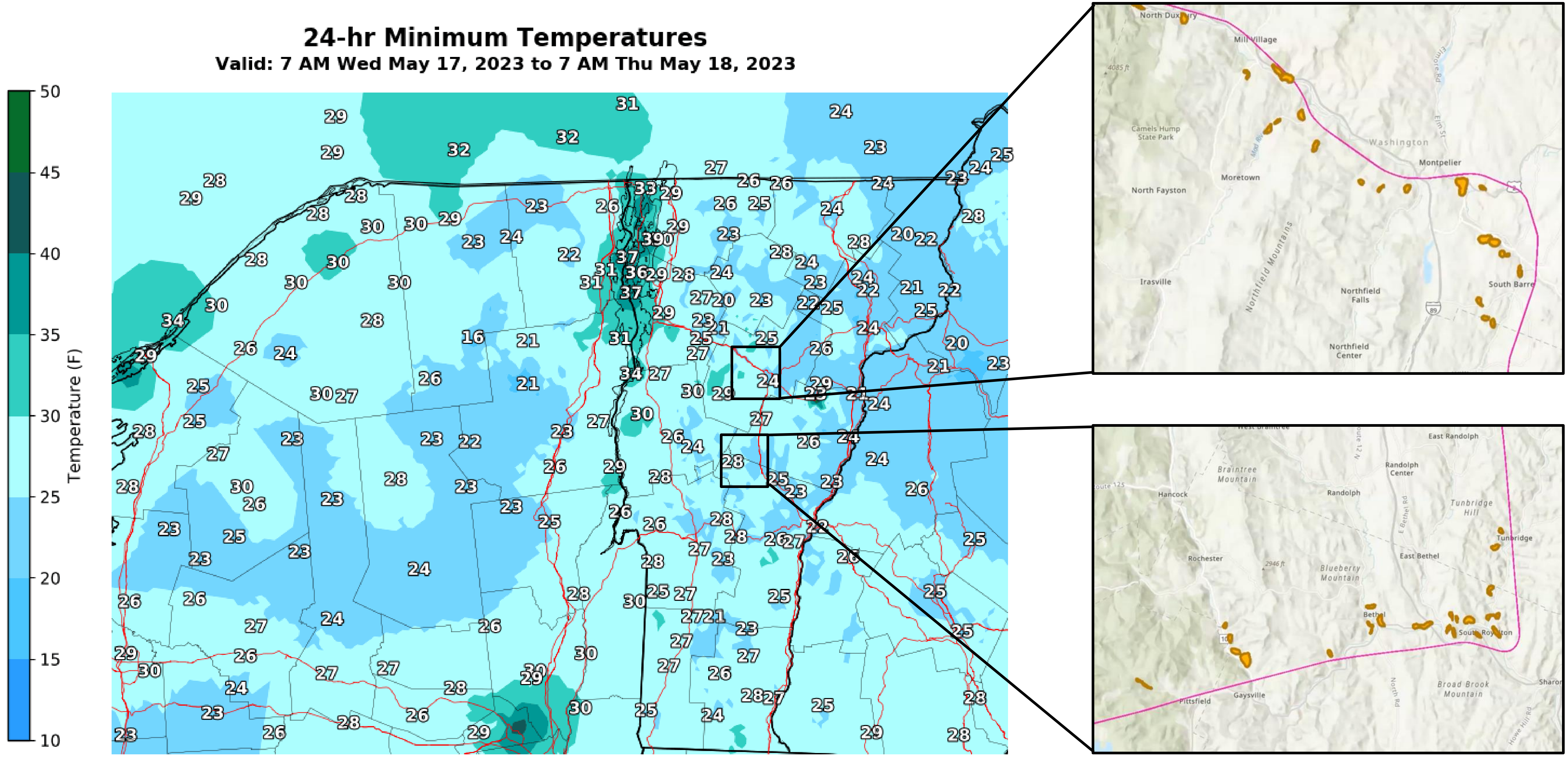
- Insects can have more generations
- Rapid changes may lead to phenological mismatches





Earlier budbreak may increase chance of spring frost damage

May 18th, 2023 freeze event



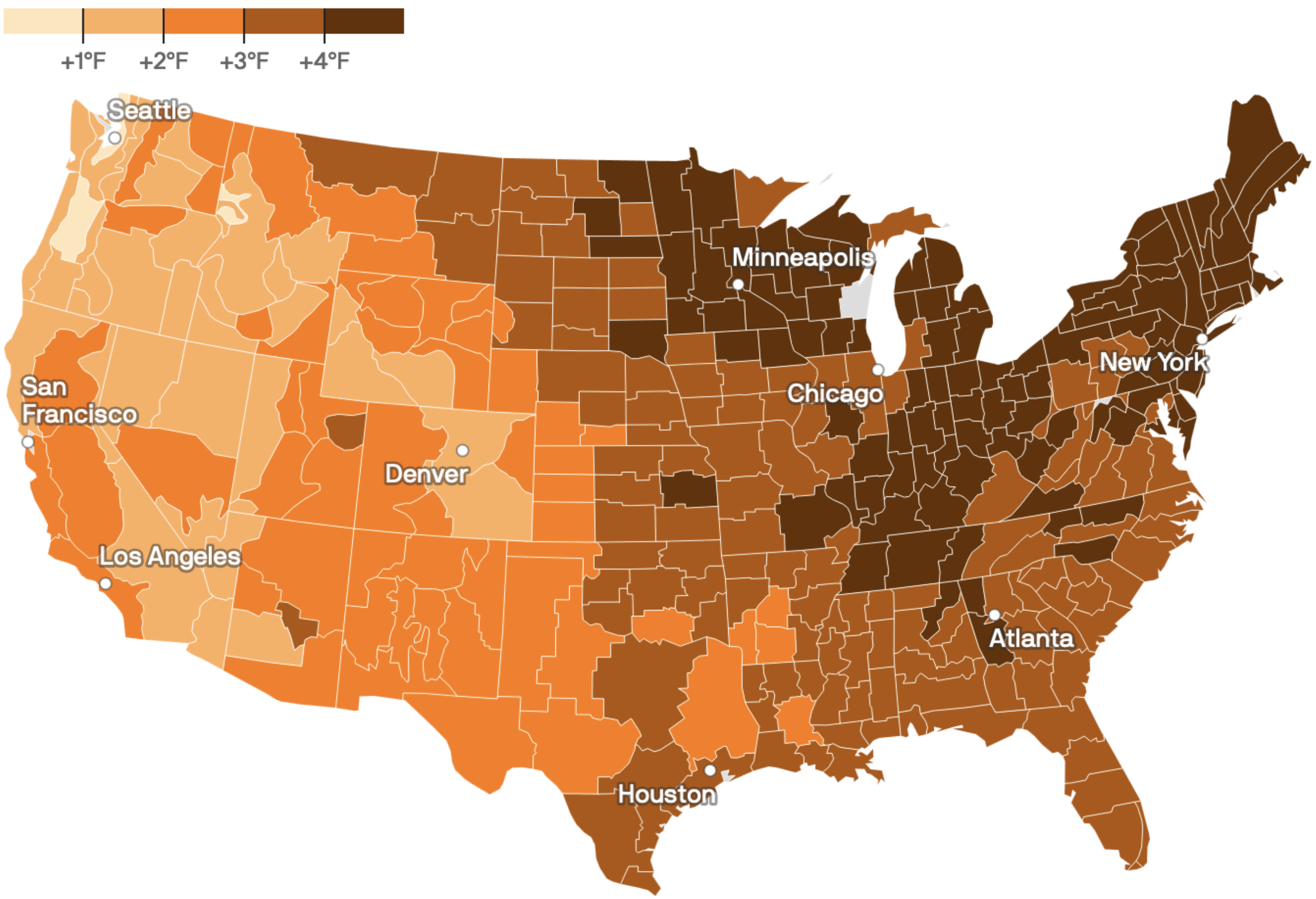
Source: NOAA Burlington

Source: Josh Halman (VT FPR)

Milder Winters

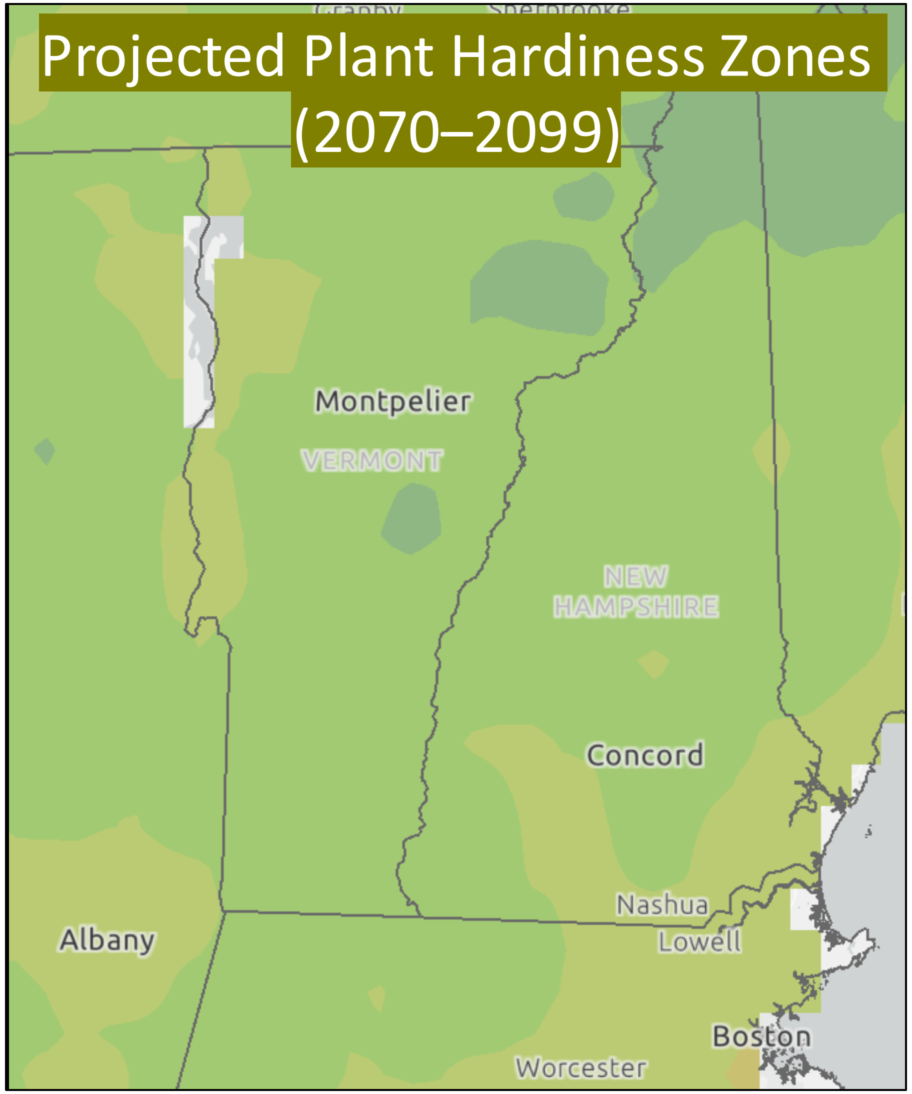
Change in average winter temperature from 1970 to 2023

By USGS climate division; Average temperature from Dec. 1 to the last day of February each season



Reproduced from Climate Central. Map: Axios Visuals

Impacts of Milder Winters

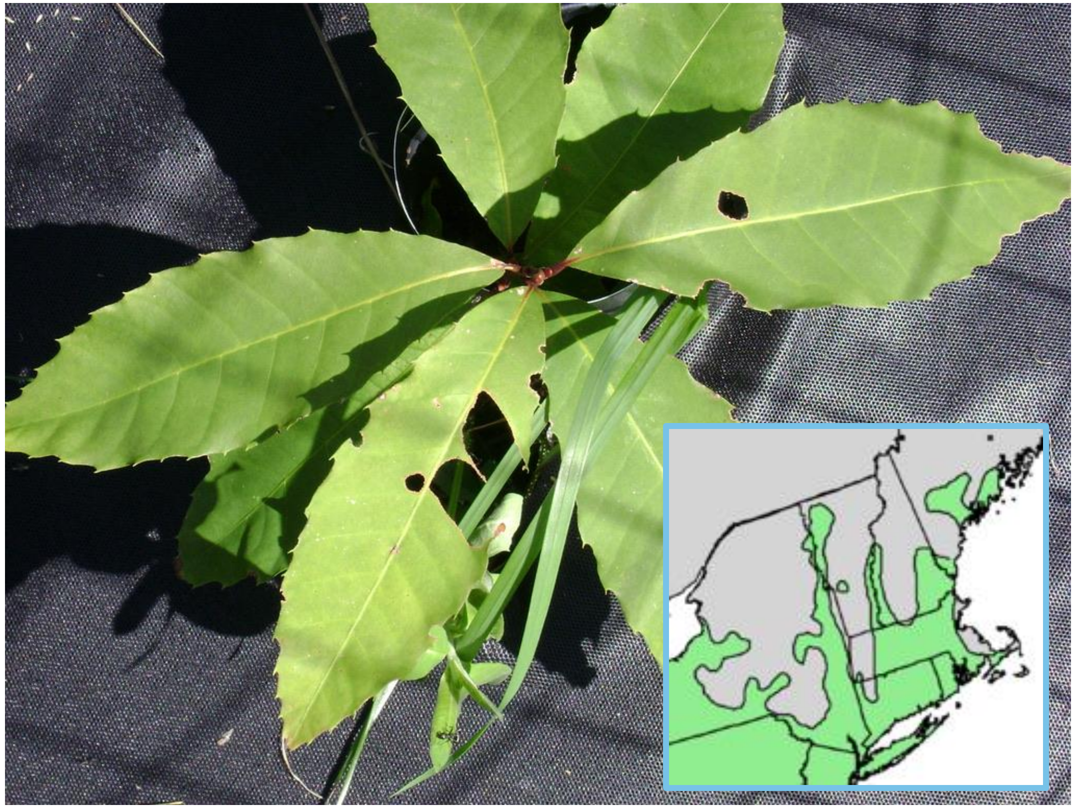


Plant Hardiness Zones: Minimum Temperature (°F)

- 1-2: -70 to -40
- 3: -40 to -30
- 4: -30 to -20
- 5: -20 to -10
- 6: -10 to 0
- 7: 0 to 10
- 8: 10 to 20
- 9: 20 to 30
- 10: 30 to 40
- 11-13: 40 to 70

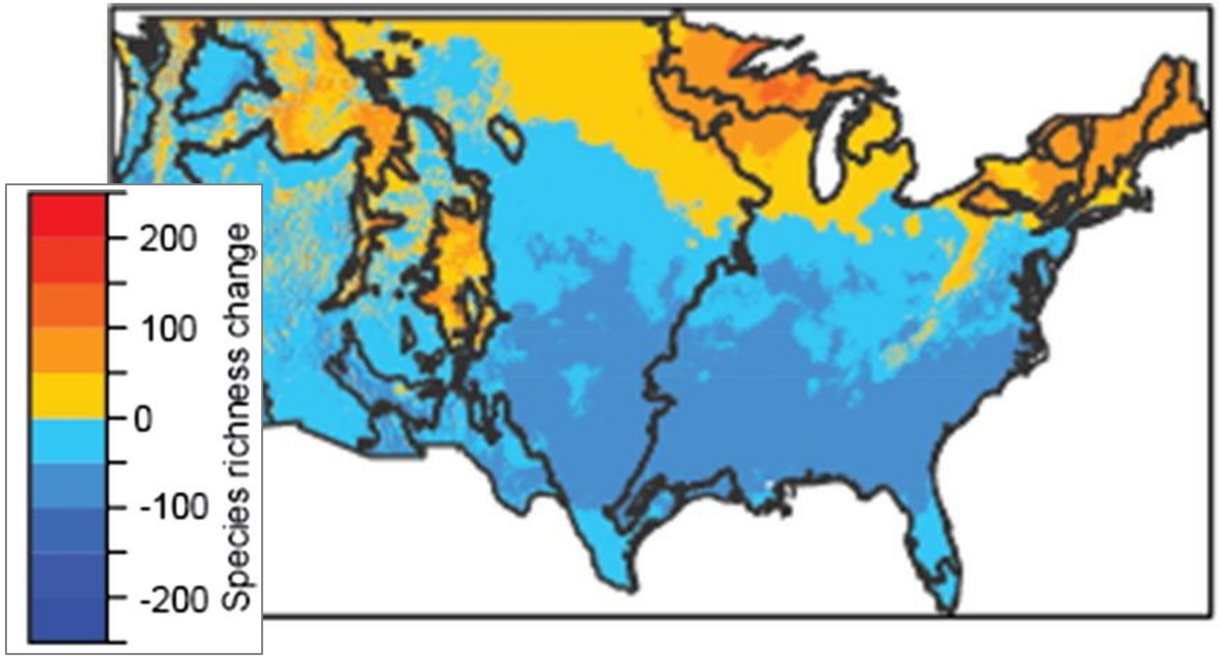
Impacts of Milder Winters

- Trees and plants historically limited by cold winters will be able to survive, thrive



- Invasive plants will be able to spread to new locations

Increase in number of invasive plants in northern US projected with climate change



Source: Allen and Bradley (2016)

Impacts of Milder Winters

- Pests that have been historically limited by cold will be able to spread to novel locations
- More rain in the winter, shorter duration of snow period, less snow

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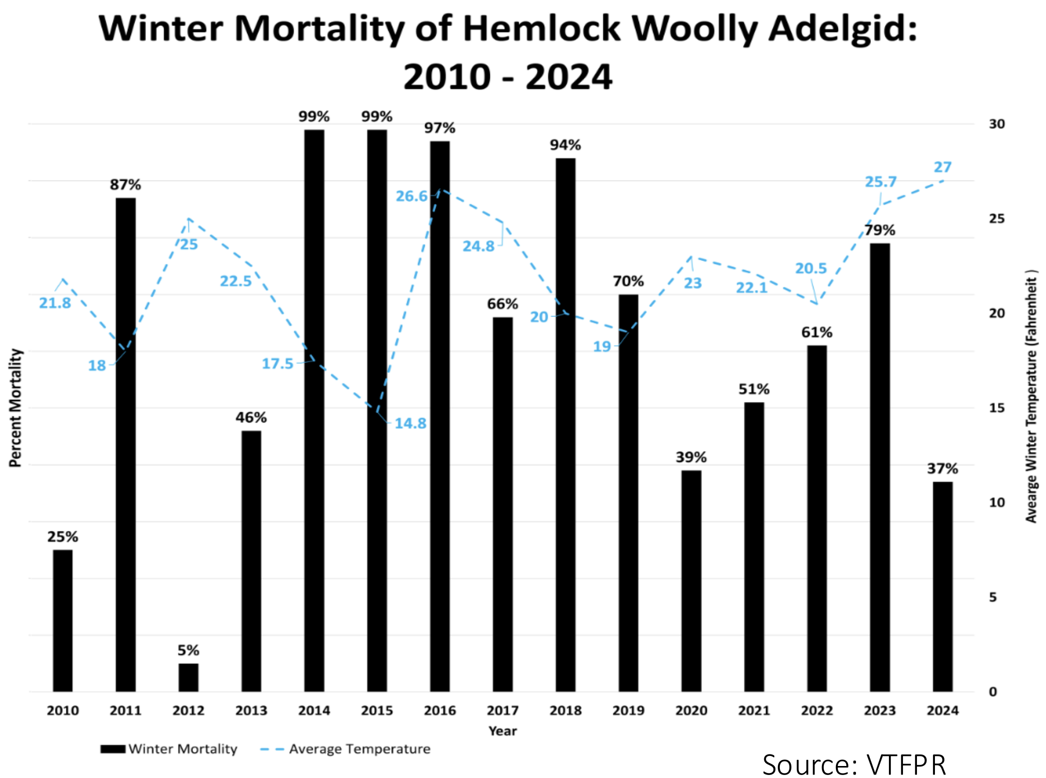
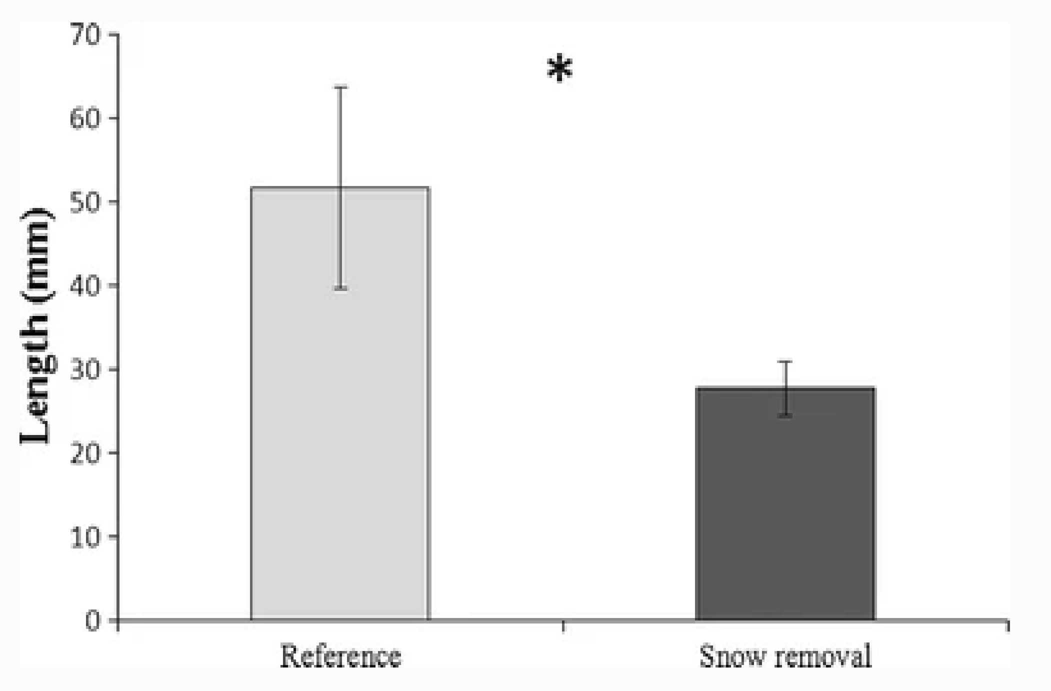


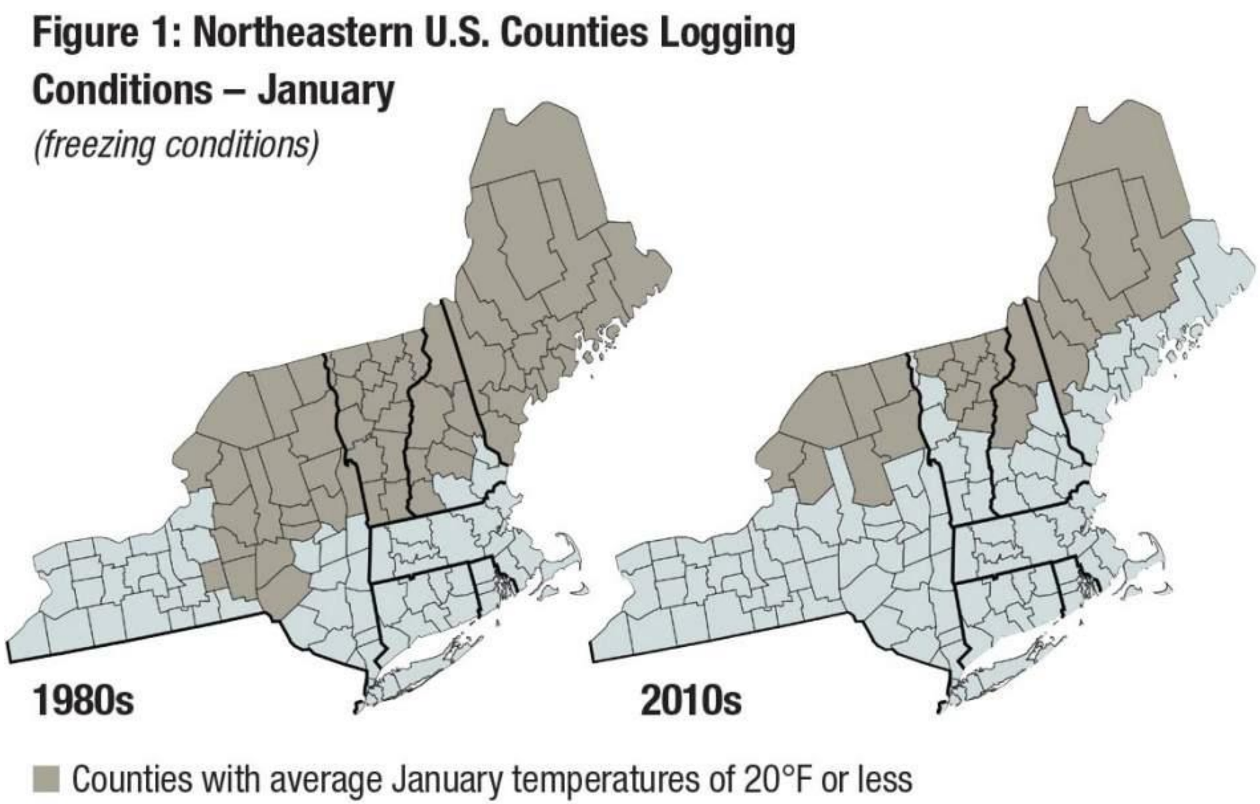
Source: VTFPR



Source: Comerford et al. 2013

Impacts of Milder Winters

- Unpredictable, shorter winter timber harvesting conditions



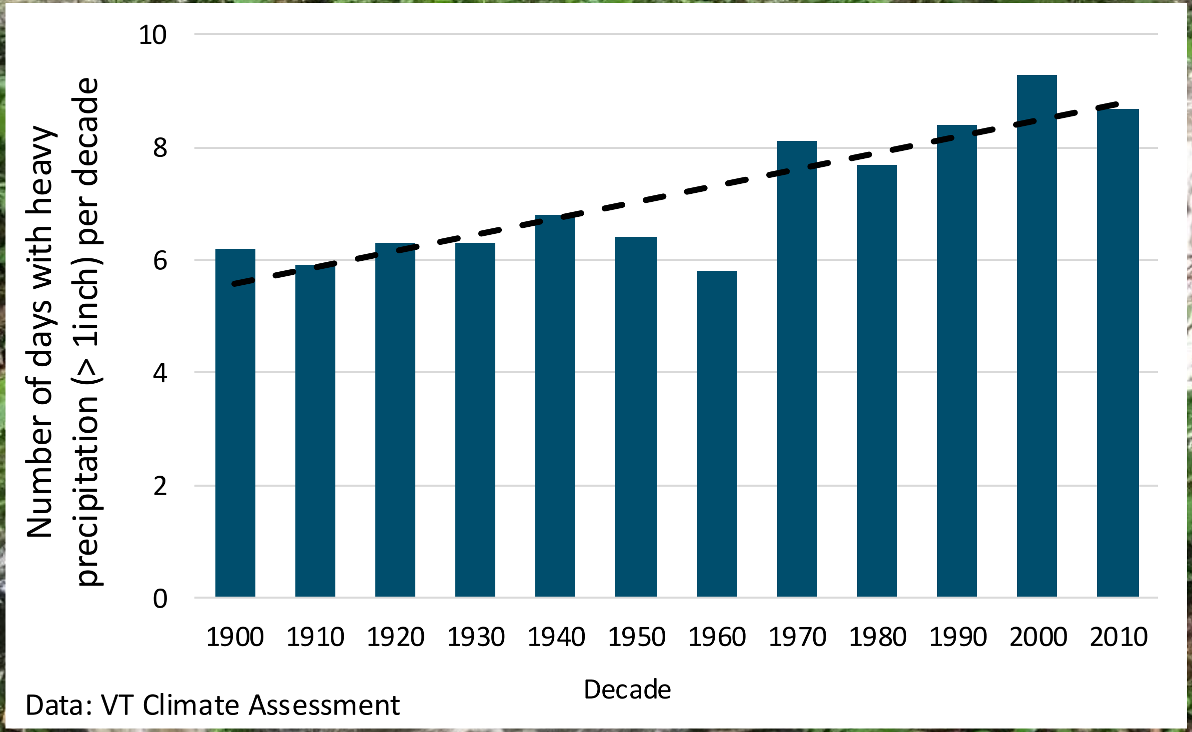
Source: Bick et al. 2019

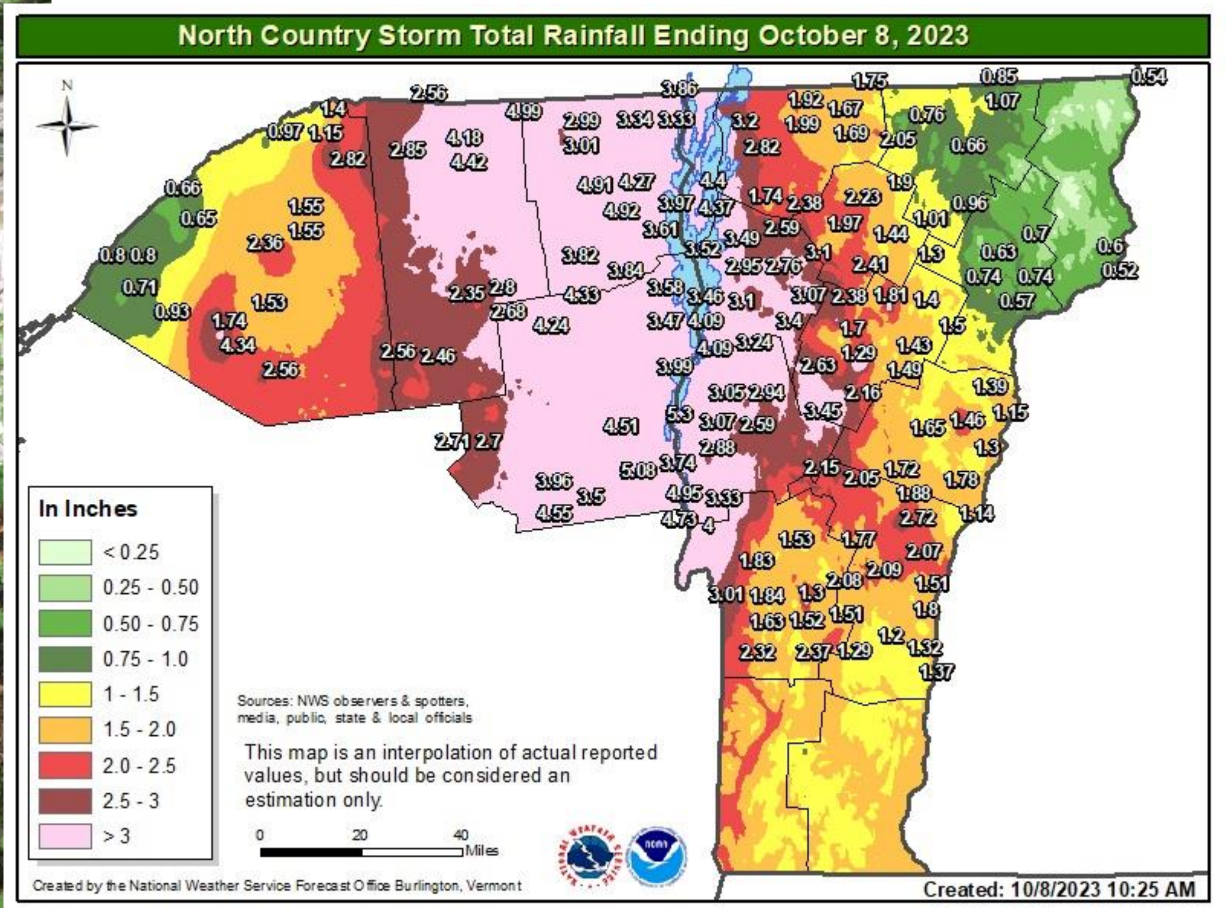
More disturbance events

Impacts of More Precipitation

- Increases in foliar diseases
- Prolonged wet soils challenge forest management activities

Heavy Rainfall Events





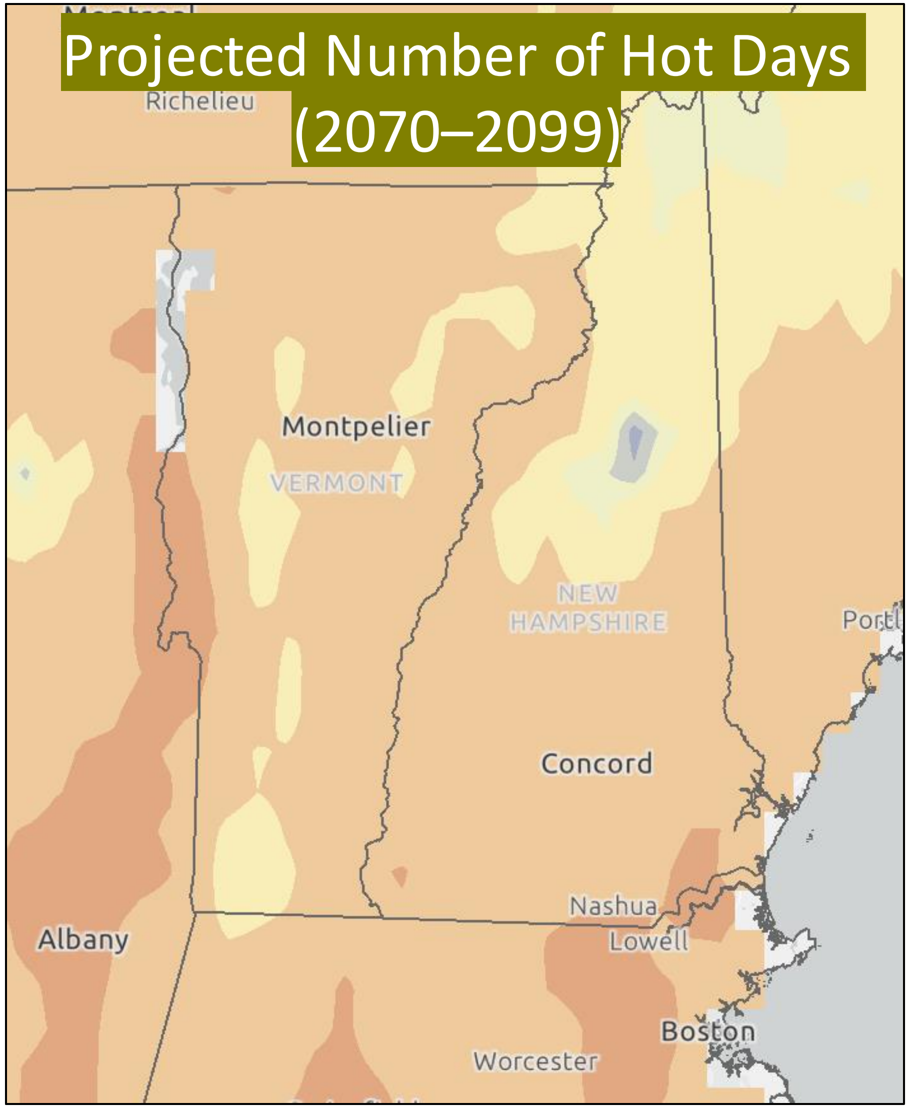





Impacts of Heavy Rainfall Events

- Erode soils
- Wash away leaf litter and expose fine roots
- Wash away and deplete soil nutrients
- Effect water quality
- Damage roads, culverts, bridges, etc.

Hotter Summers

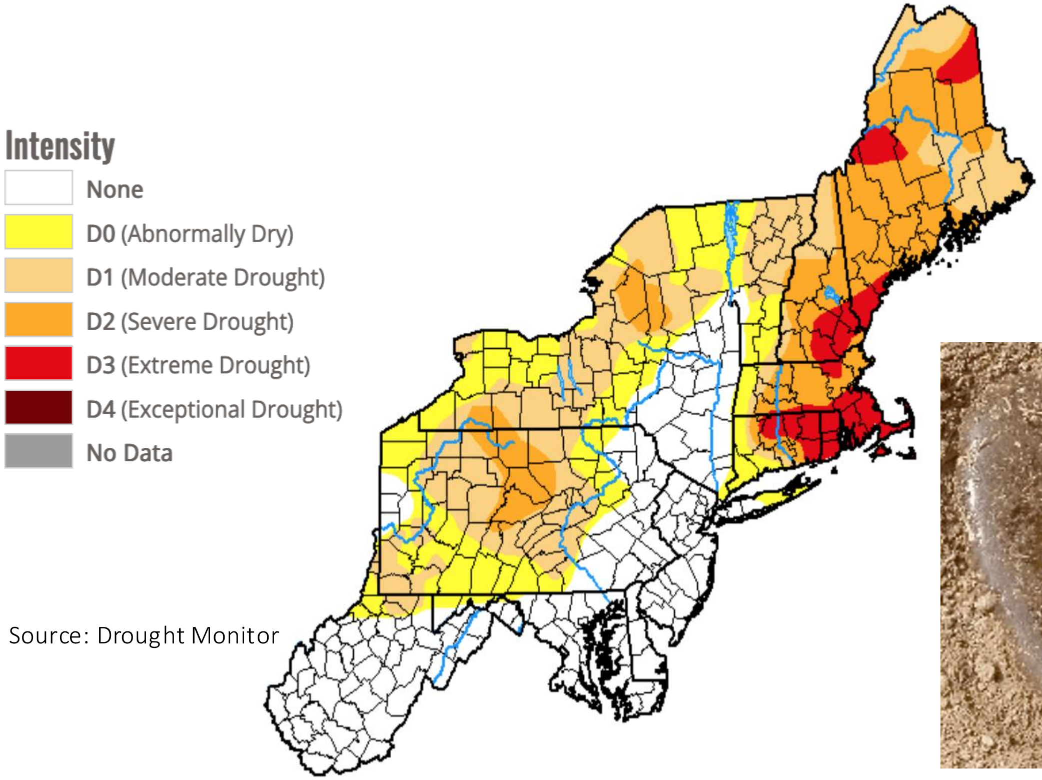


Mean Number of Days ≥30 °C (86 °F)

- <1
- 1 - 7
- 8 - 14
- 15 - 30
- 31 - 45
- 46 - 60
- 61 - 90
- 91 - 120
- 121 - 150
- 151 - 180
- 181 - 210
- >210

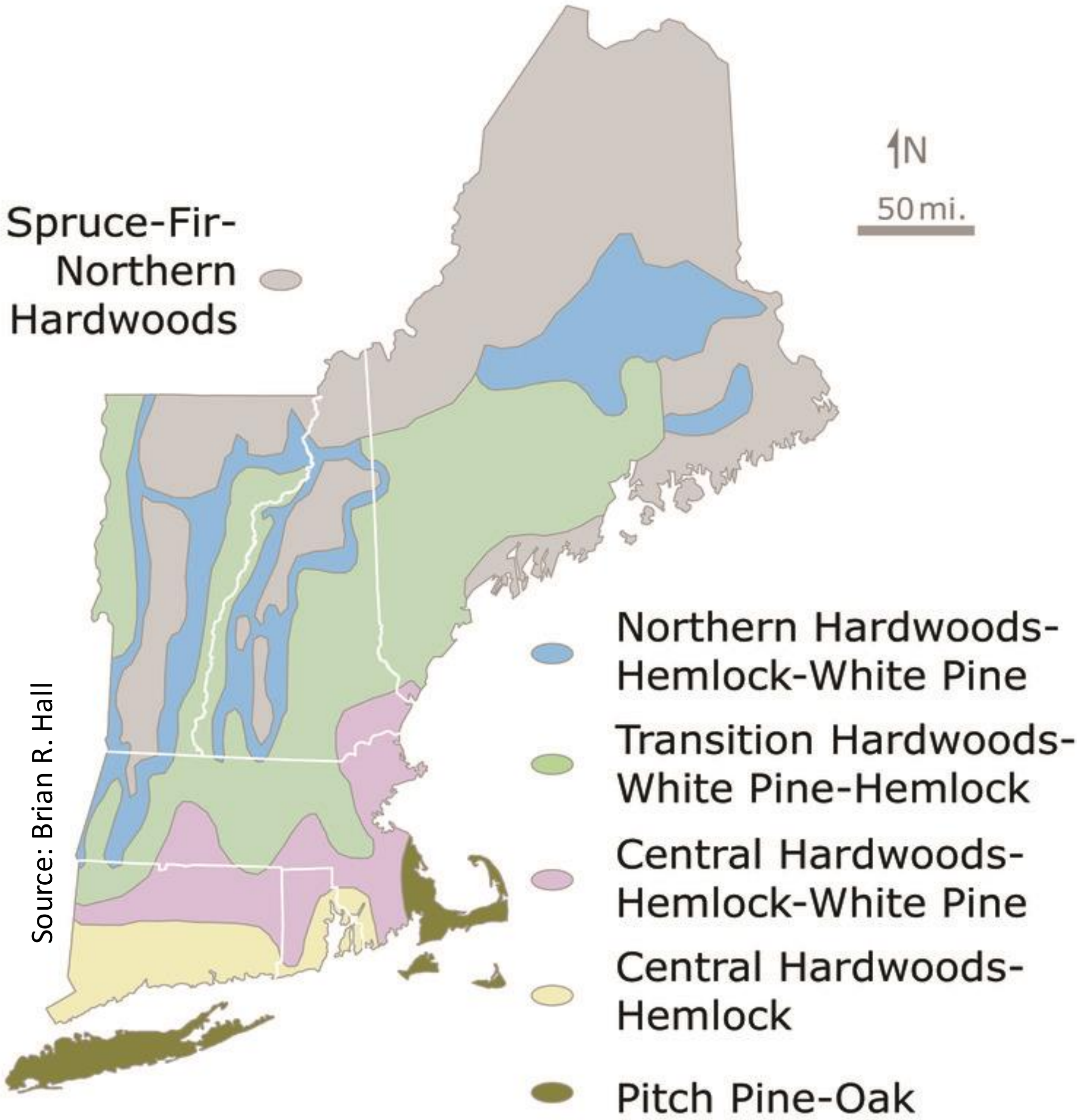
Impacts of Hotter Summers

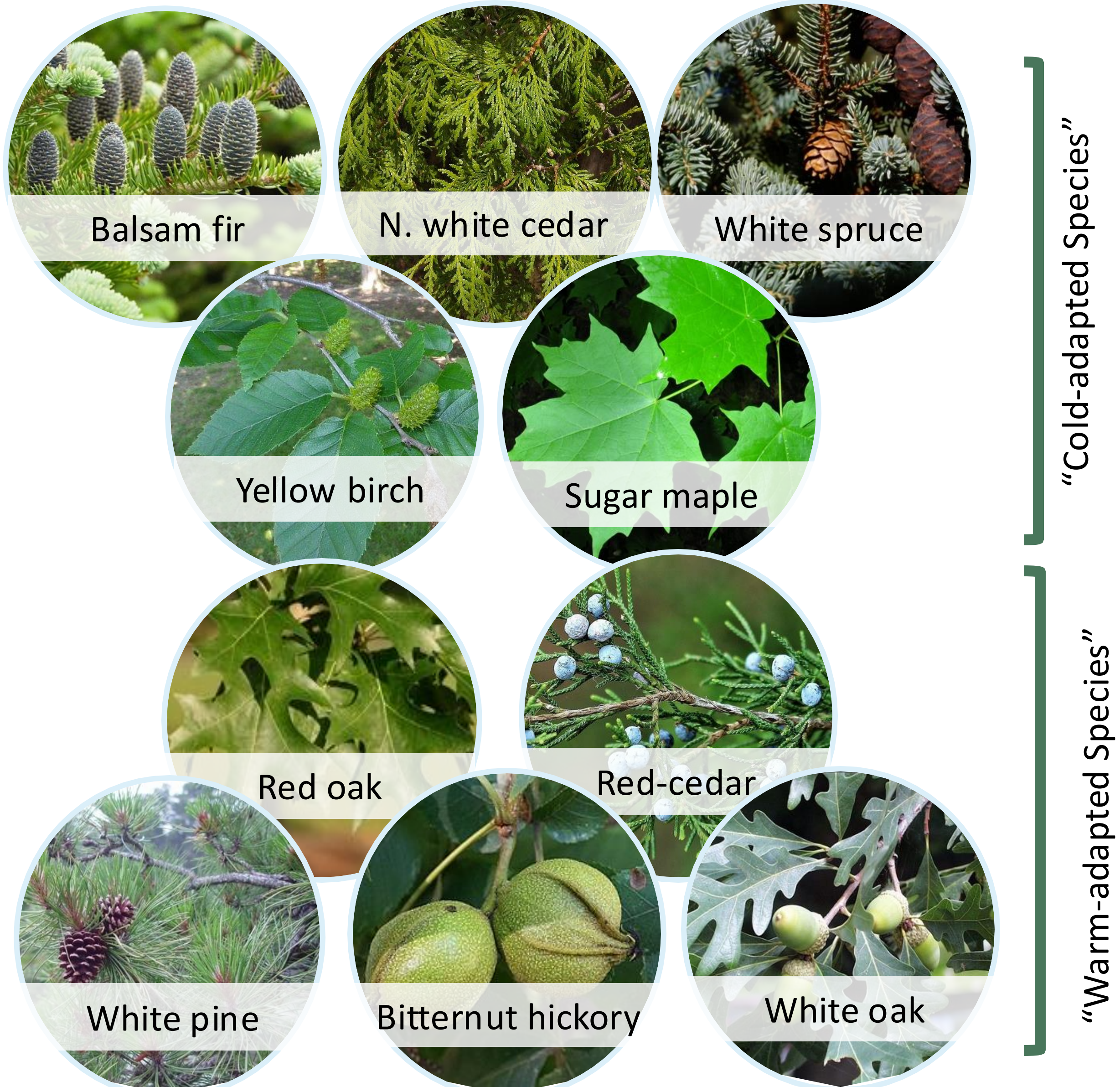
- Increases water loss from soil and leaves
- Can cause dry soils and drought stress
- Can be stressful to many of our cold-adapted species
- May lead to forest fires



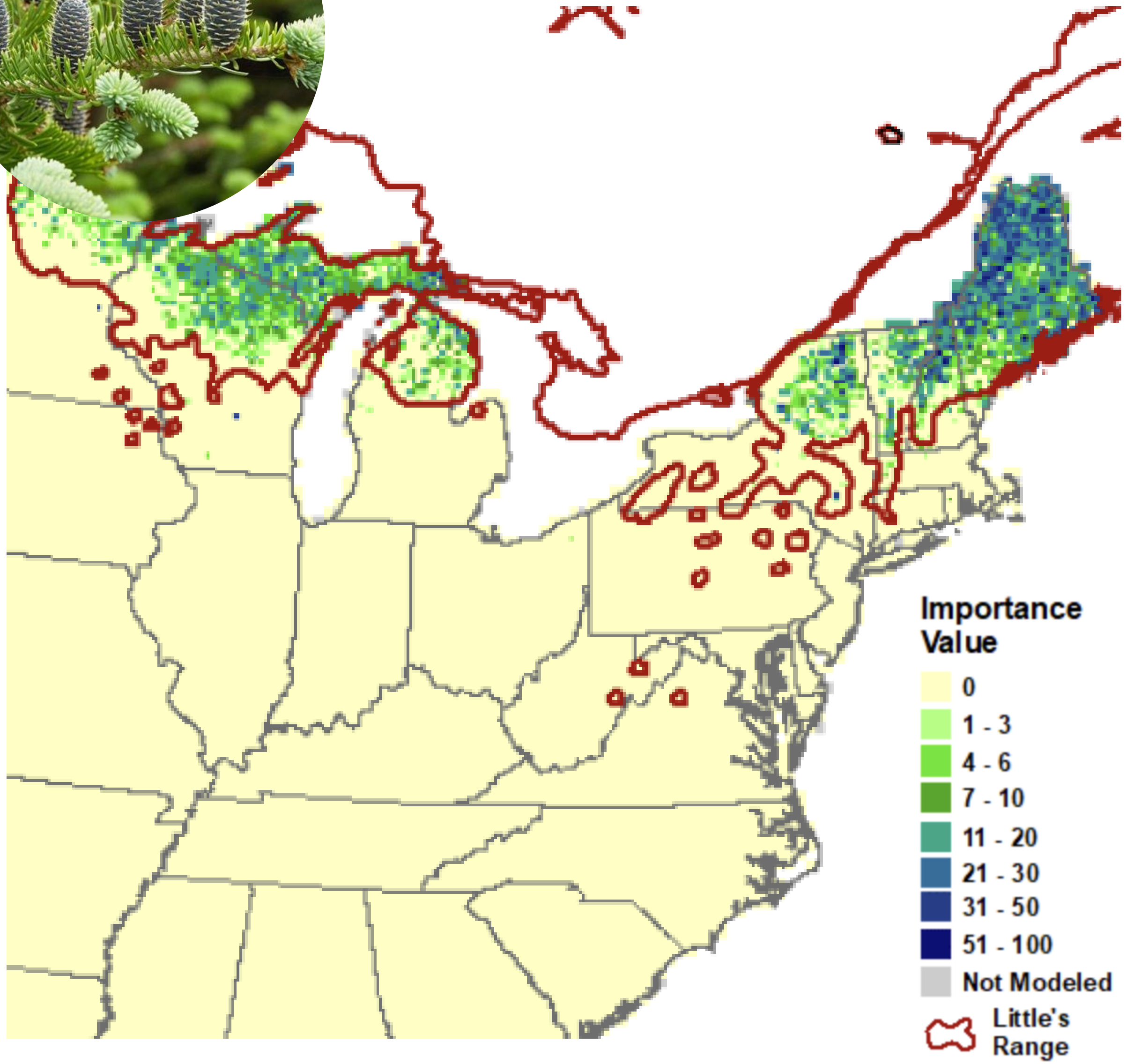
Source: Drought Monitor

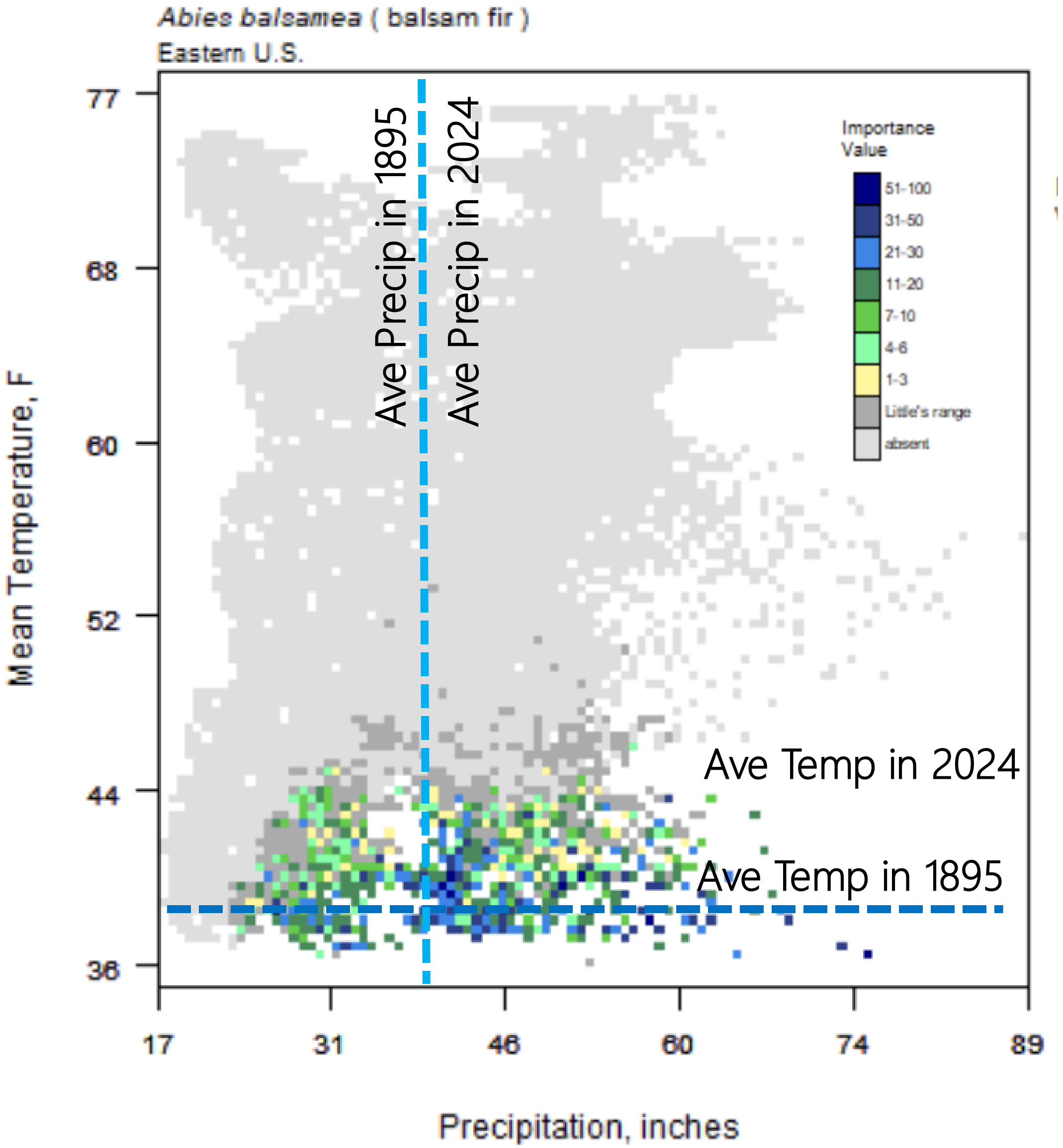
Cold-adapted species may be more stressed





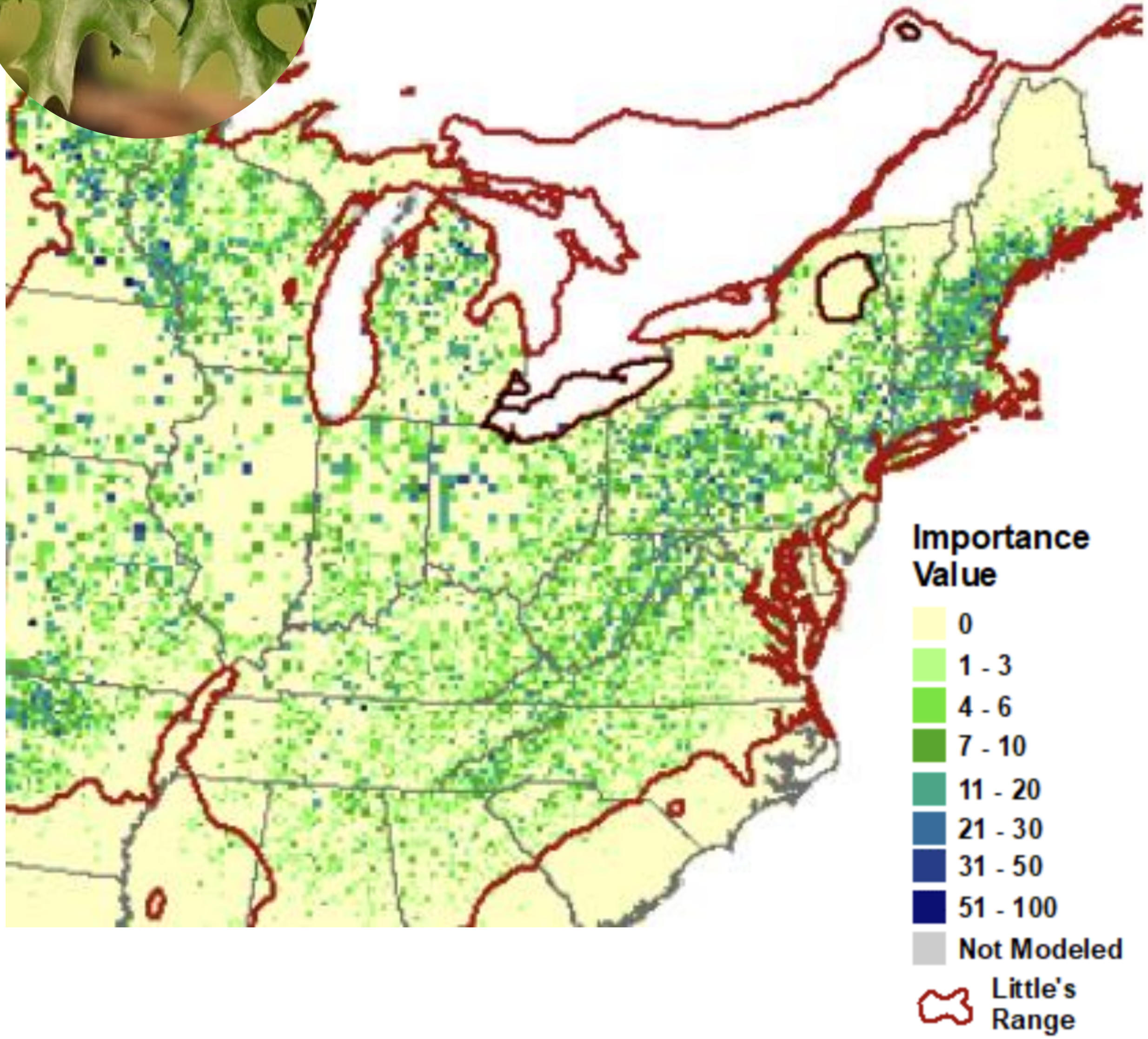
Balsam fir ("cold adapted species")

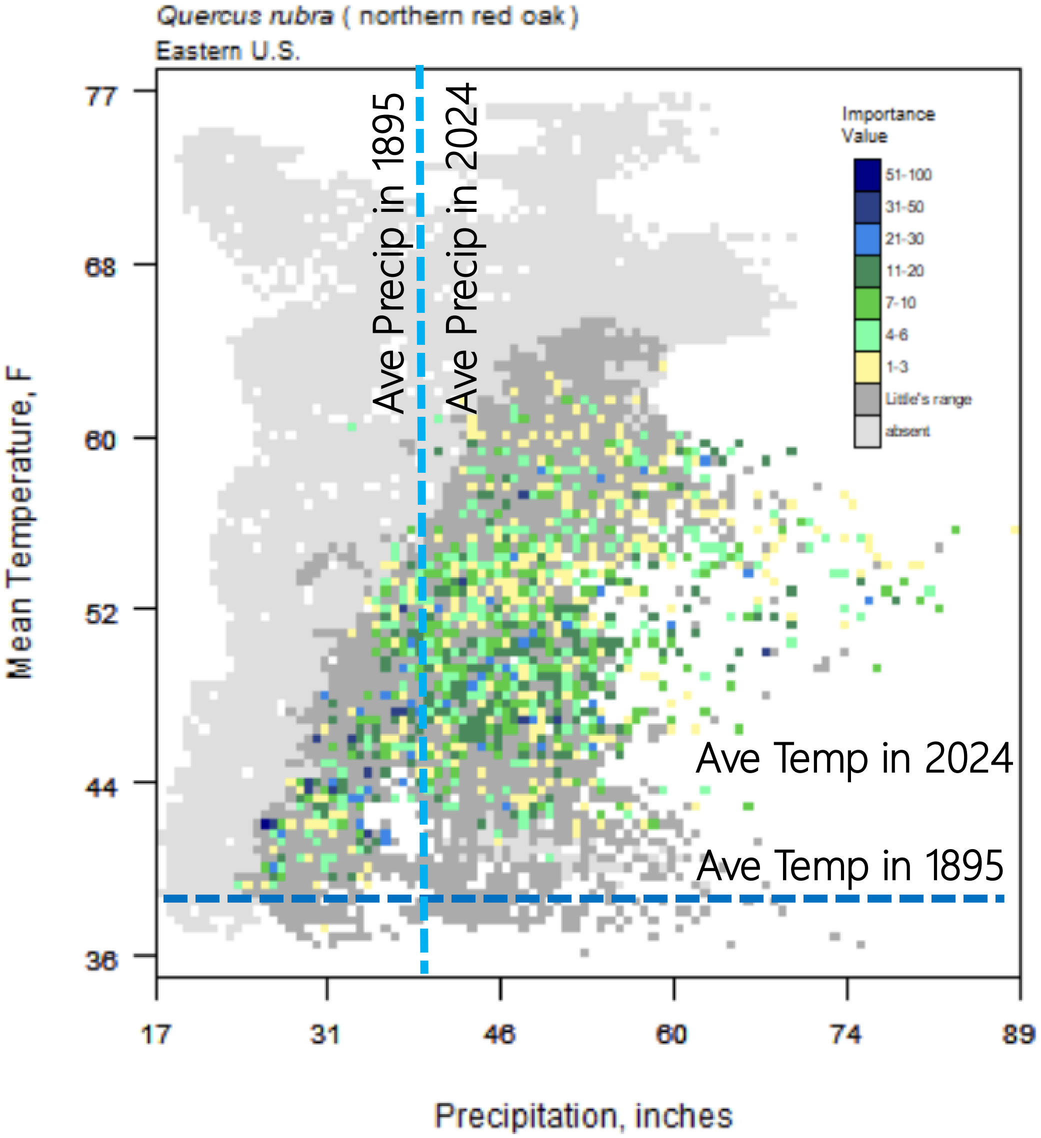




Source: USFS Climate Change Tree Atlas

Red oak (“warm adapted species”)





Source: USFS Climate Change Tree Atlas

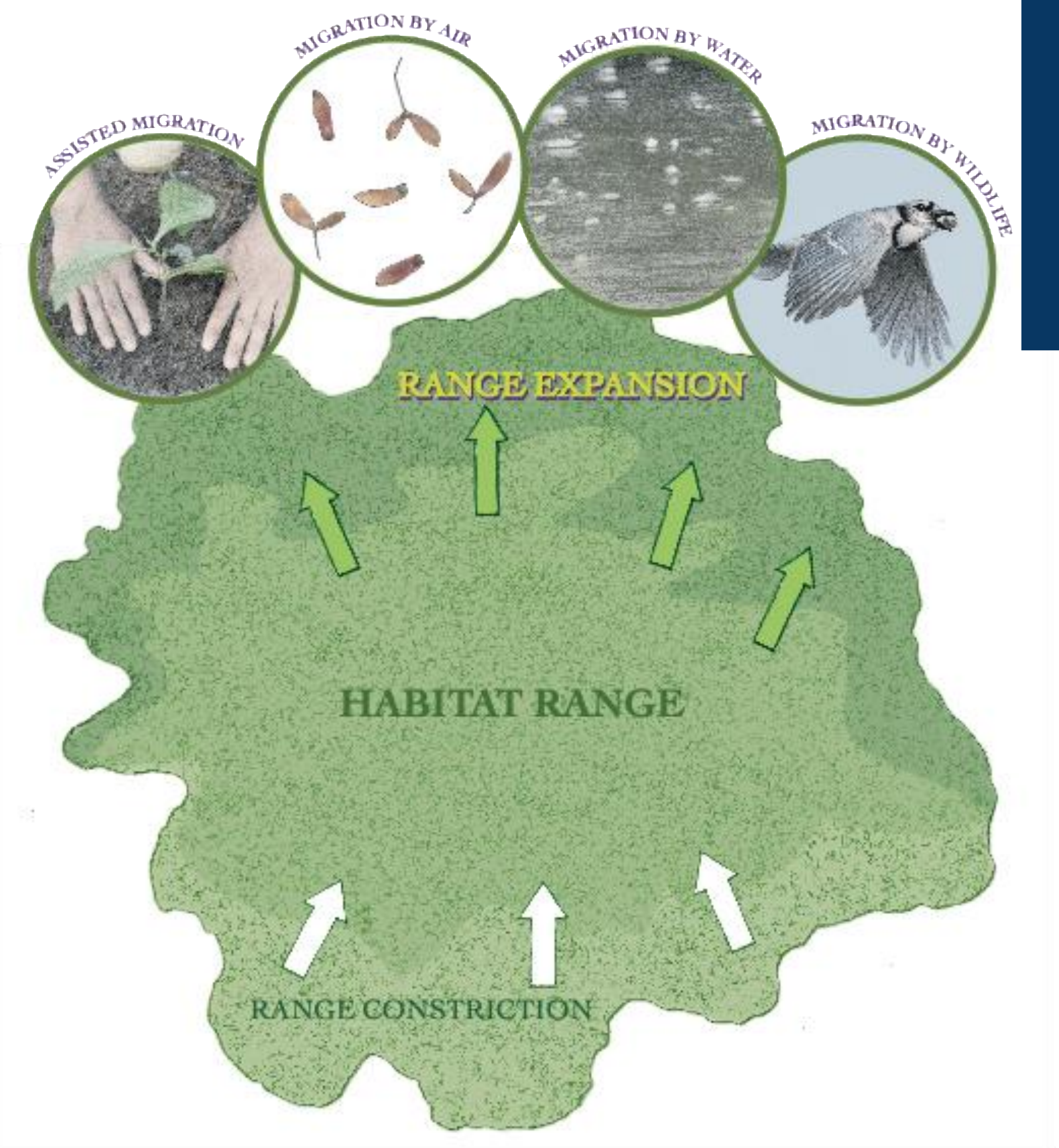
Trees can’t relocate to a more favorable location

Perish

Adapt to new conditions

Move to new locations through regeneration





We may see changes in where species grow and thrive

- Takes decades for a tree to produce seed
- Seed production is dependent on conditions
- Seed movement dependent on wind, animals, water
- Seed germination requires specific conditions
- Establishment requires gaps in forest canopy

Climate-Adaptive Management

Incorporating climate change into forest management and stewardship to reduce vulnerability and advance resilience

It includes sustainable management, conservation, and restoration

Vulnerability is the degree to which a forest is susceptible to and unable to recover from climate change.

Certain forest conditions and disturbances can make a forest more or less vulnerable to climate change impacts.

Resilience is the ability of a forest to recover or adapt following disturbance or change.

Climate-Adaptive Forest Management

The goal of climate-adaptive forestry is to maintain the ecosystem services that the forest provides into the future

Adaptation

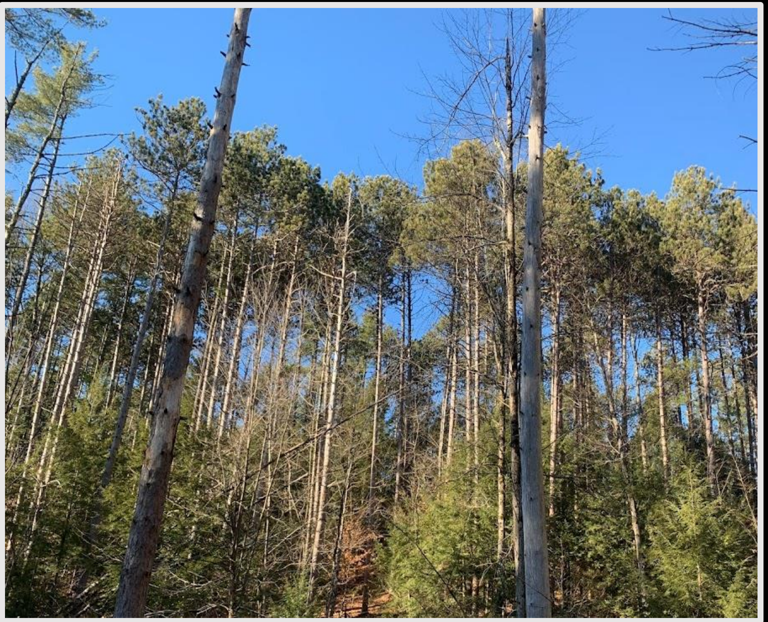
- How we harvest
- When we harvest
- What we harvest
- How we use and value wood products

Resilience

Assess Site Vulnerabilities

Forest vulnerabilities

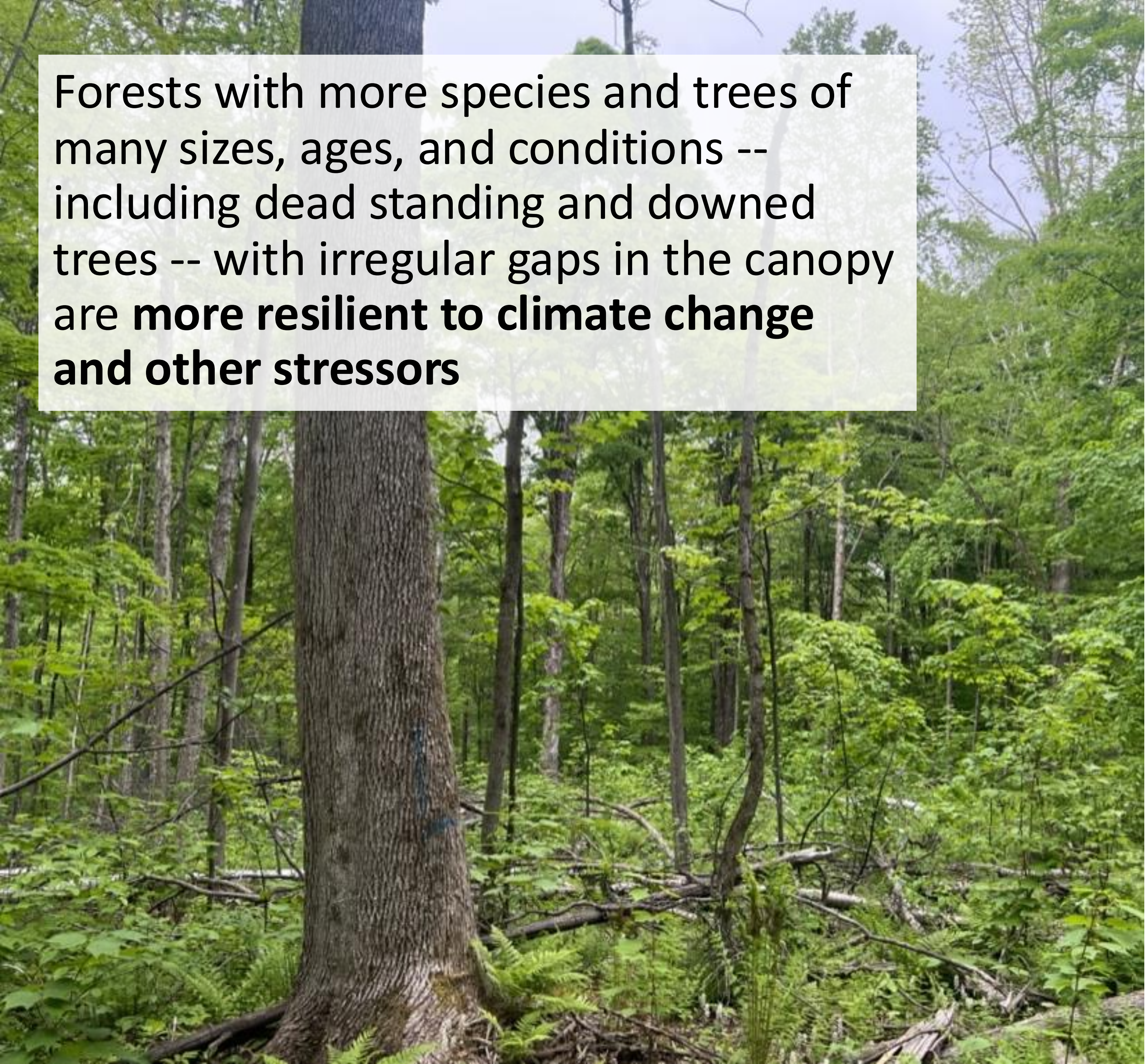
Conditions that may affect tree regeneration and the future forest



Conditions of the trees that suggest they are less resilient to extreme events and disturbances

Conditions of the forest that affect soils and water quality

Forests with more species and trees of many sizes, ages, and conditions -- including dead standing and downed trees -- with irregular gaps in the canopy are **more resilient to climate change and other stressors**



Manage for increased rainfall

Increase species diversity

Increase structural complexity

Promote regeneration

Keep biological legacies

Retain and improve the amount and distribution deadwood

Manage other stressors

Promote future climate-adapted species

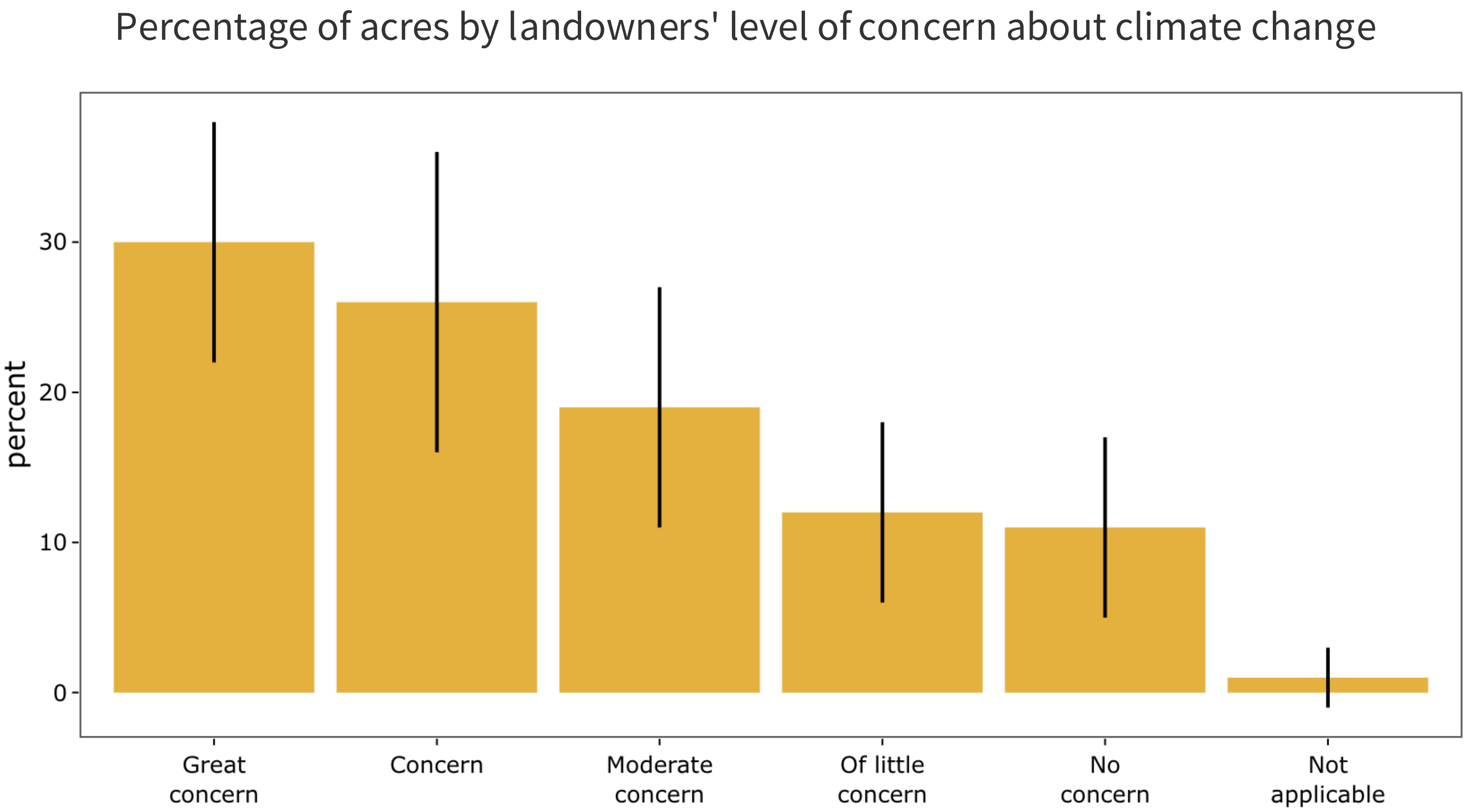
Factor in the broader landscape

Adapt forest operations to changing conditions

Protect and restore soils

Strategic Wood Additions:
add large trees to streams to slow down flows, provide fish habitat, and reduce flooding

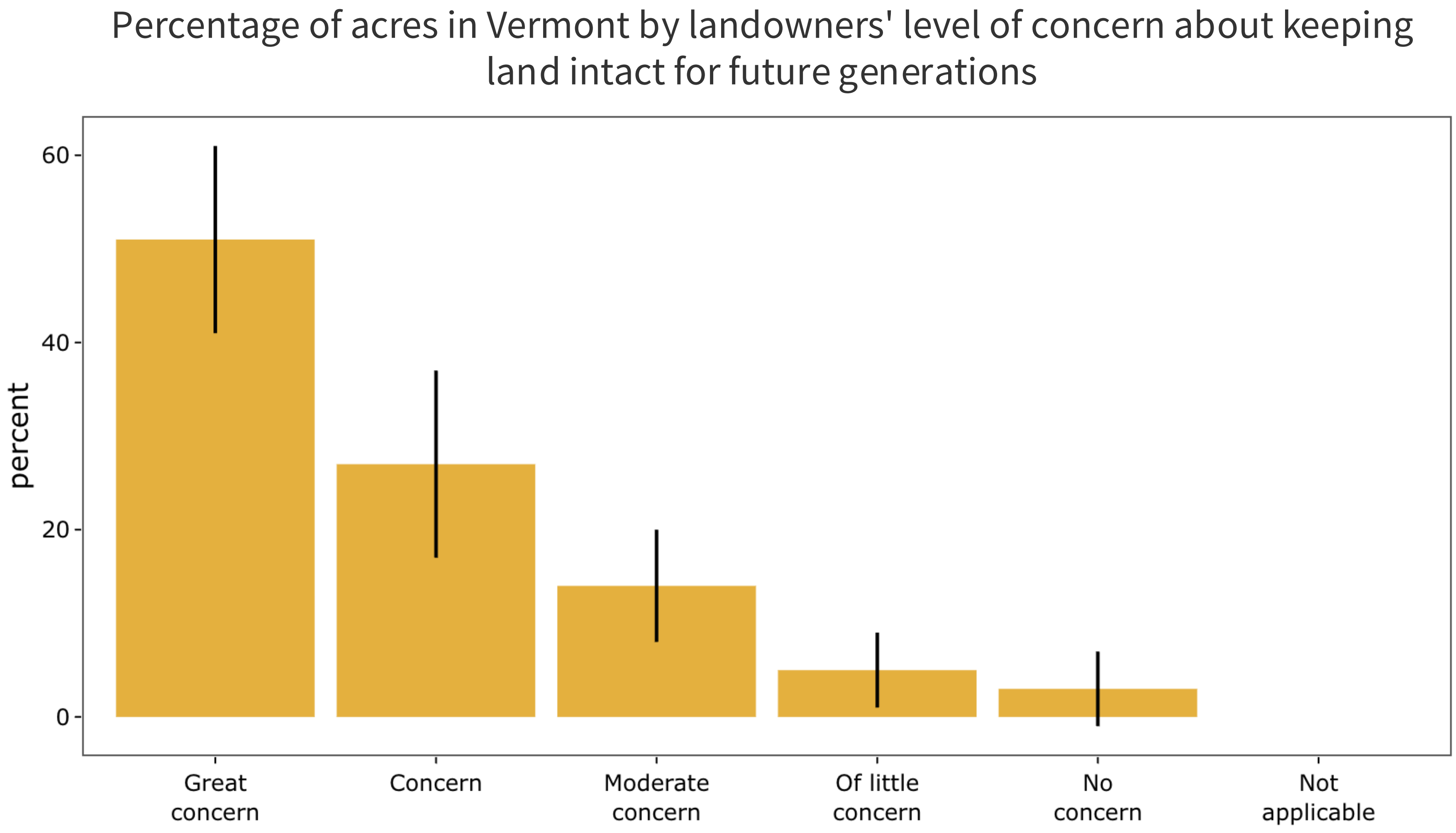
Most VT forestland owners are worried about climate change



74% of VT forestland owners have a moderate or greater concern about climate change

National Woodland Owners' Survey (VT, 2018)

VT landowners are concerned about keeping forests intact



92% of VT forestland owners have a moderate or greater concern about keeping land intact

National Woodland Owners' Survey (VT, 2018)

Need more ways to incentive resilience-focused actions

Forests provide many benefits

- Forest canopies and soils **lessen the impact of heavy rain events**
- Tree roots help **retain soil**
- Forest canopies intercepts sunlight, **keep soils cool**
- Forest canopies **slow down wind**
- Water evaporation from forest **cools the the air**
- Vermont's forests **absorb ~70% of the State's greenhouse gas emissions**
- Local wood products **lessen dependency on outsourcing resource needs**
- Plus, scenic beauty, wildlife, recreation, etc. etc. etc.