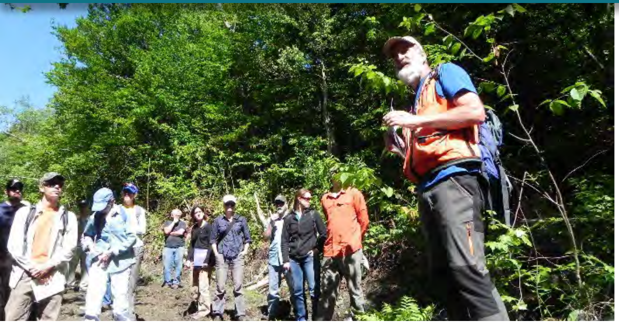
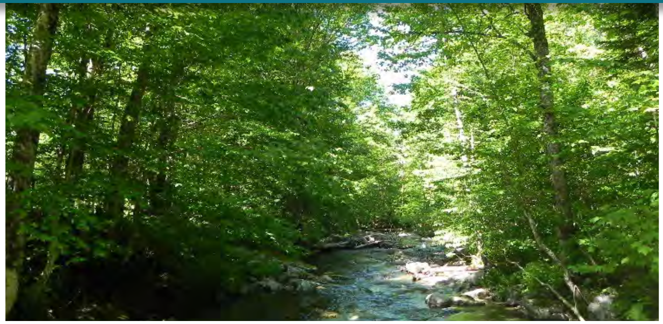
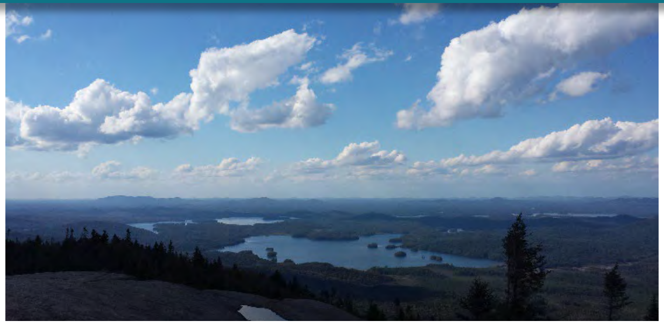
Climate-Smart Approaches to Caring for Your Woods







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Overview

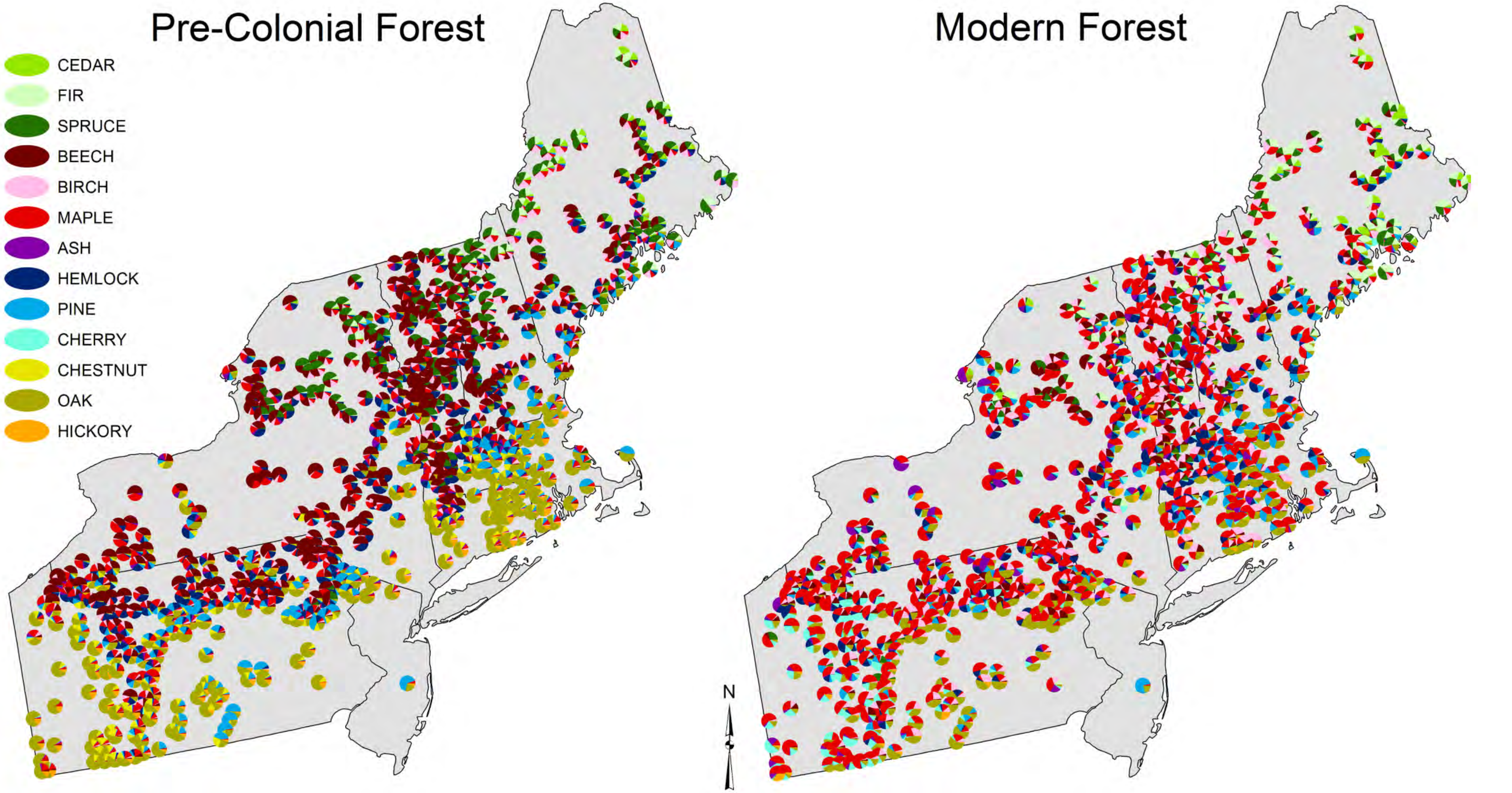
riwoods.org

- Past forest changes
- Observed and projected future climate & weather changes
- Mitigation vs. Adaptation
- Examples of mitigation
- Three adaptation pathways
- Examples of climate-smart management objectives
- RI climate-adaptive forestry research & demonstration site

Past Forest Change

Harvard Forest Dioramas: https://harvardforest.fas.harvard.edu/dioramas

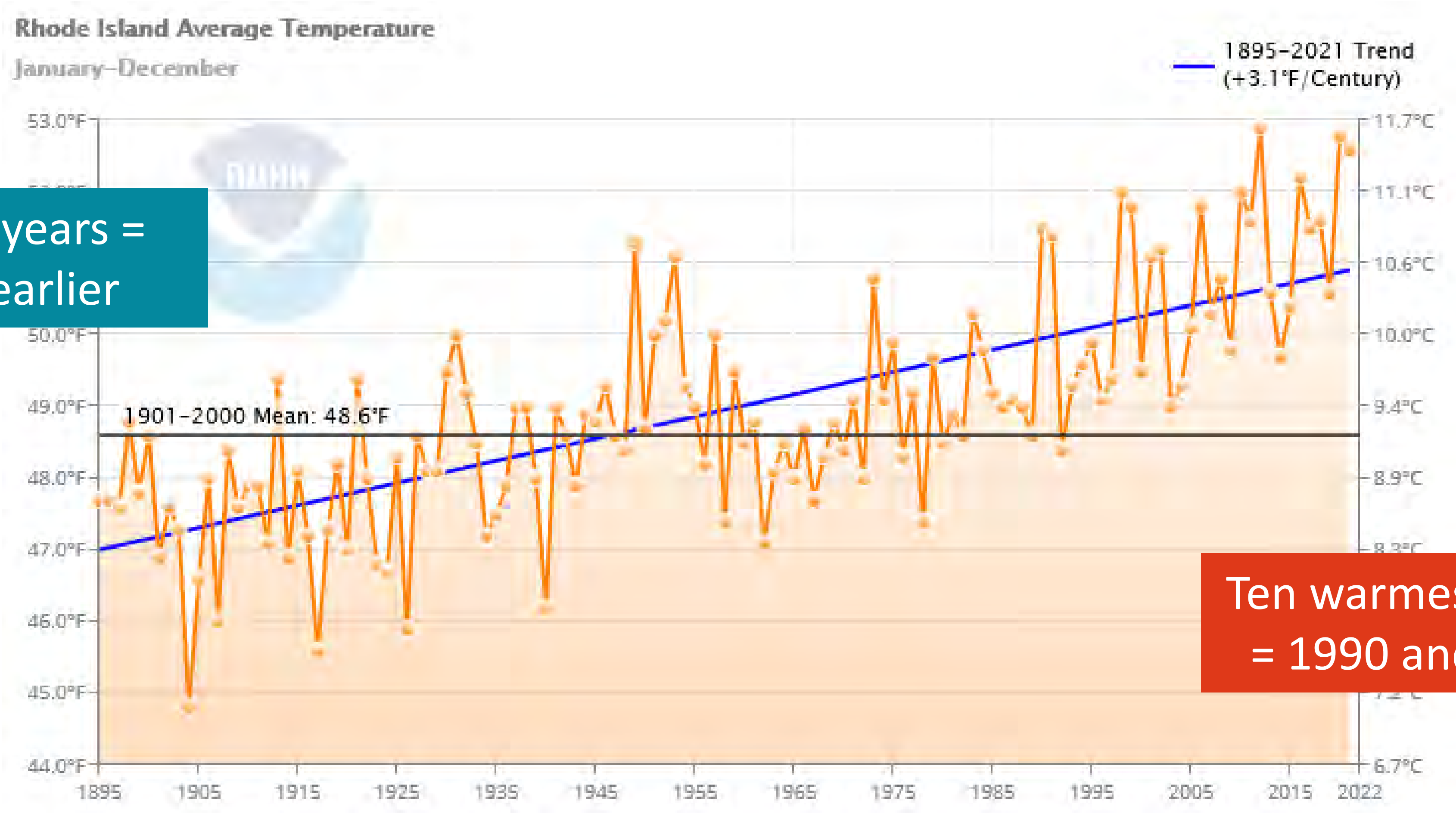
Past Forest Change



Thompson et al. 2013: https://doi.org/10.1371/journal.pone.0072540

Observed Changes in Climate (RI)

Temperatures have risen 3.1°F since 1900.



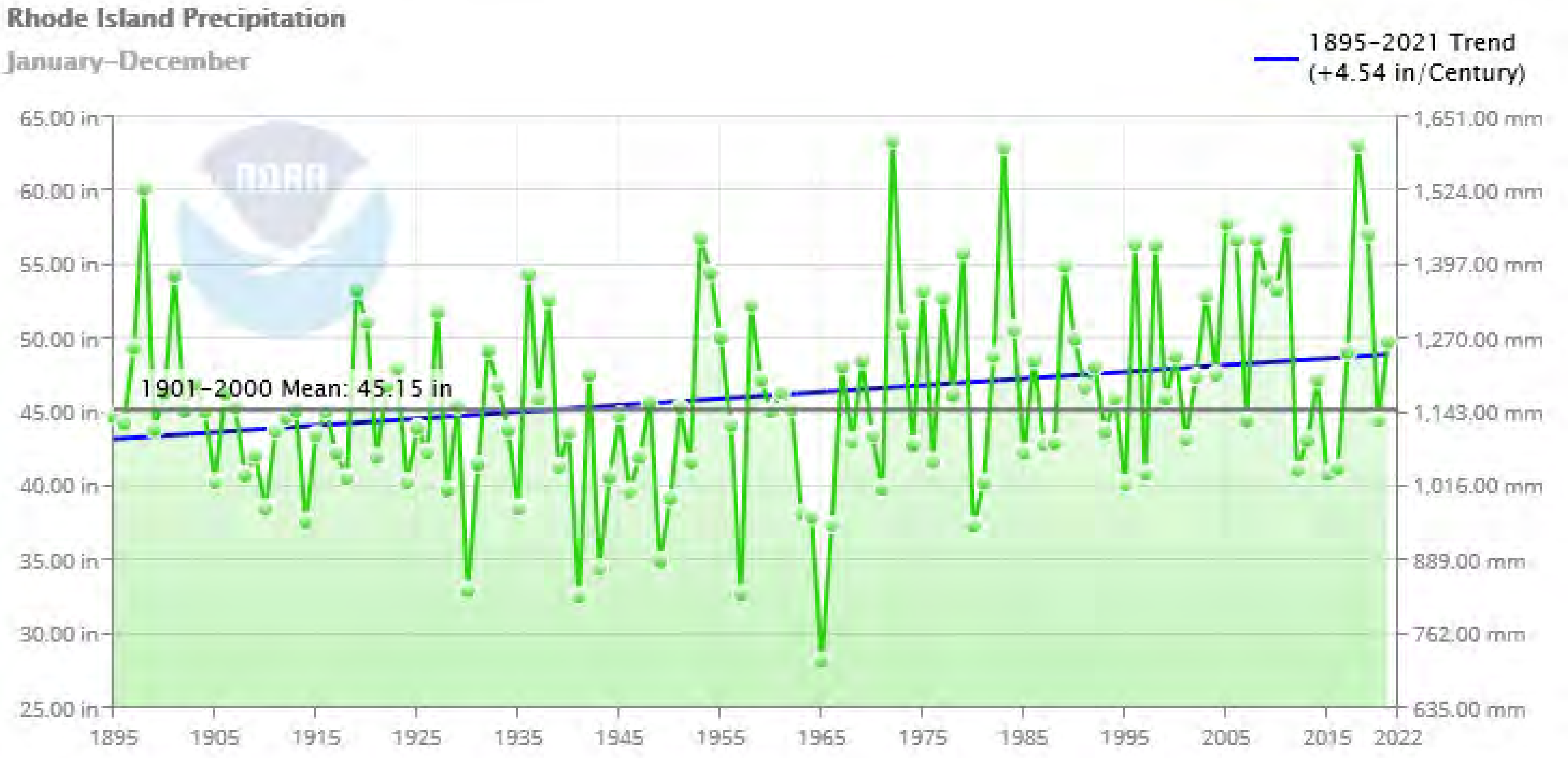
Ten coldest years = 1940 and earlier

Ten warmest years = 1990 and later

NOAA Climate-at-a-Glance Tool

Observed Changes in Climate (RI)

Annual precipitation has increased about 4.5 inches.



NOAA Climate-at-a-Glance Tool

Extreme Weather Events

Extreme events may become more frequent or severe

- Heavy precipitation
- Heat waves/droughts
- Windstorms
- Hurricanes
- Coastal flooding
- **“Events” are not well modeled**

Providence Journal, September 2023:
“Rhode Island’s summer of extreme weather left its mark on the landscape.”

Longer Growing Season

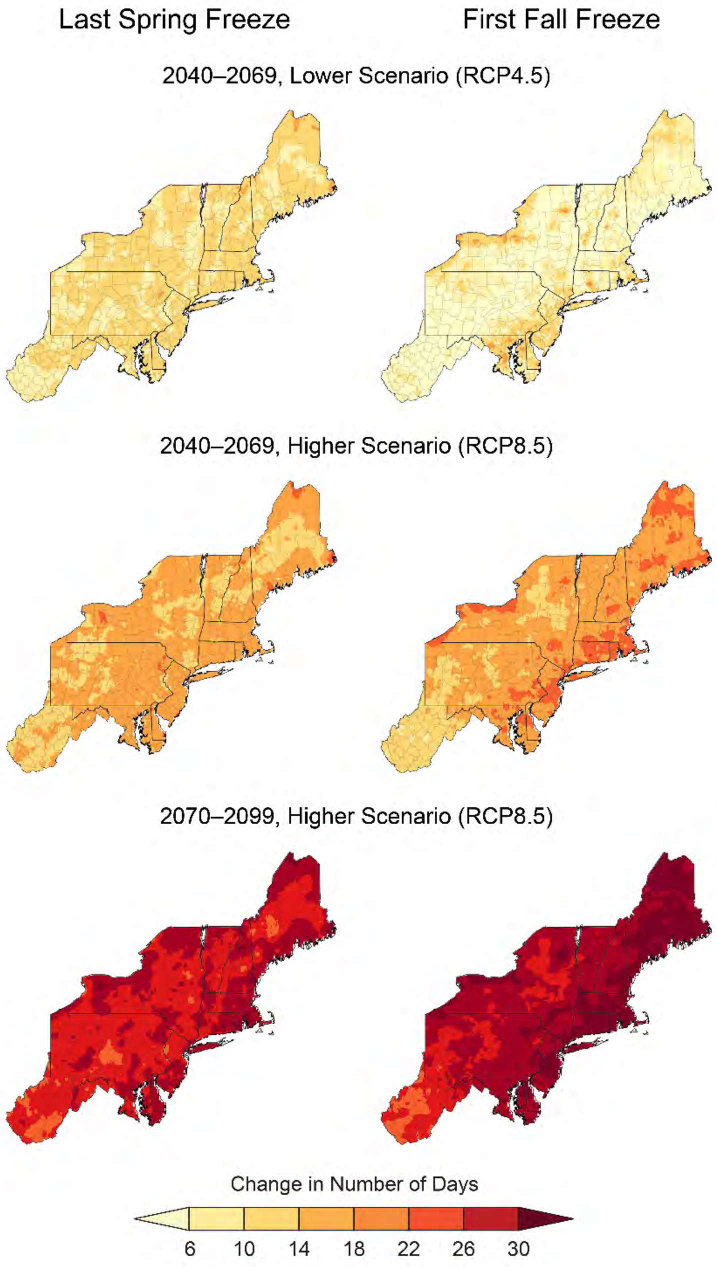
Warmer temps result in longer growing seasons

- Evidence of phenological shifts
- Projected to increase 3-7+ more weeks

Longer period for plant growth

Phenological changes/mismatches

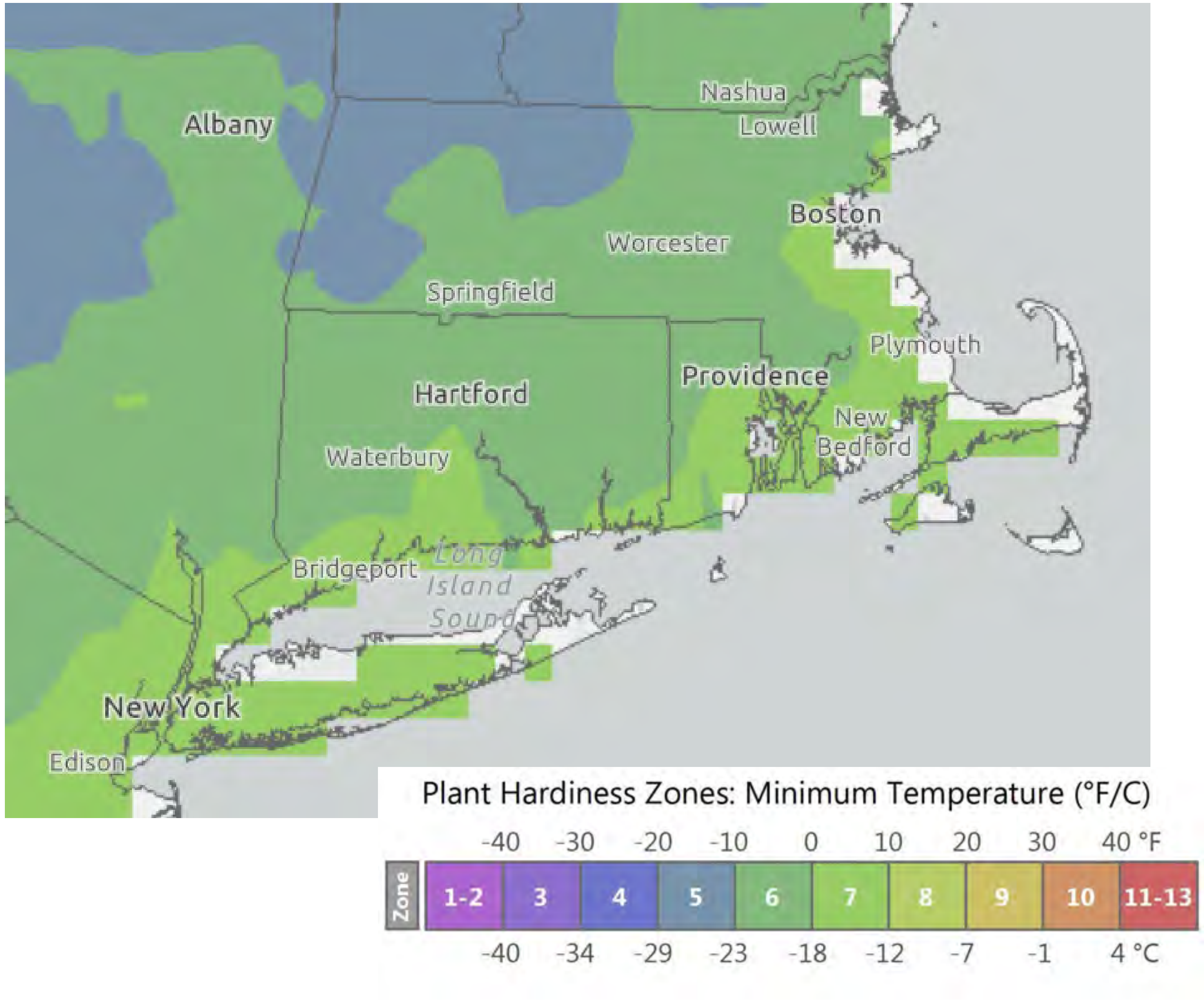
- Early bud break and frost damage freezing.



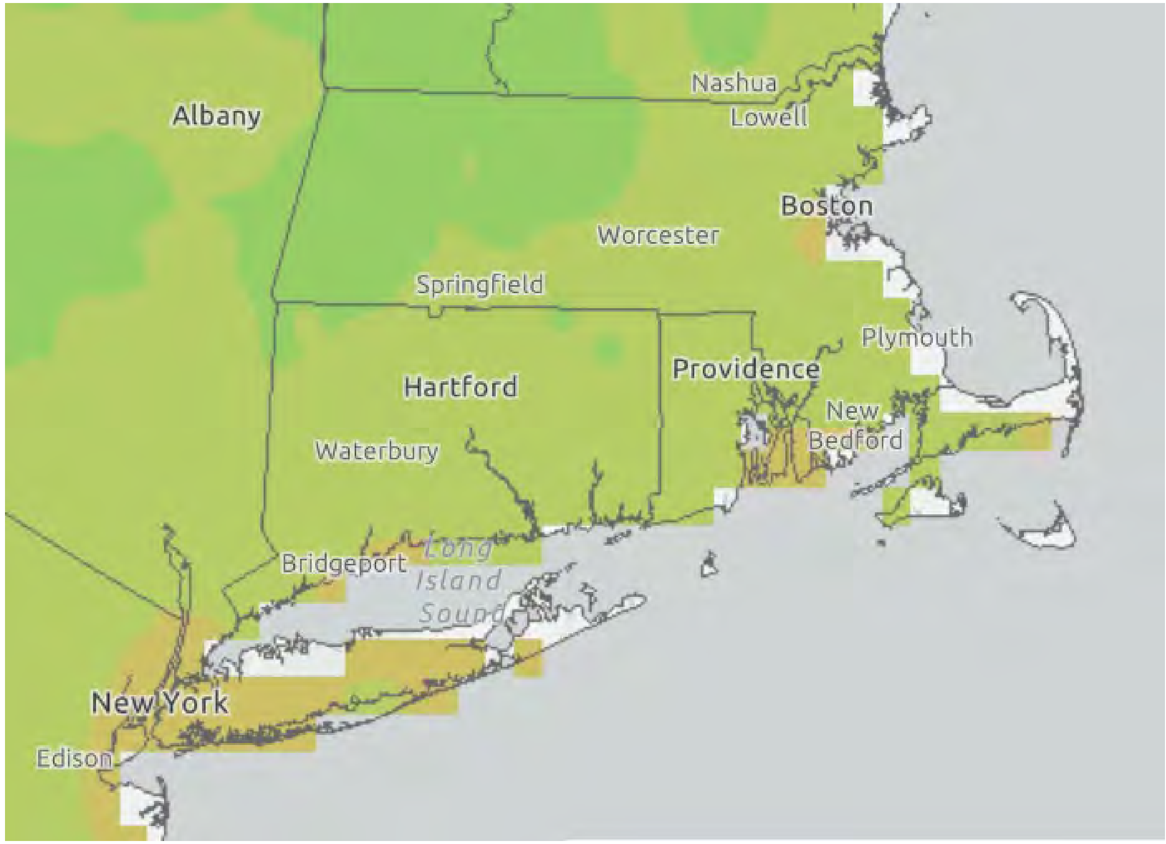
Melillo et al. 2014, Nelson Center 2014, NCA 2018

Longer Growing Season/Warmer Winter

1980-2009



2070-2099 (RCP 8.5)



Matthews et al. 2018

Warmer Winter (Less Snow)

Projected decreases in snow fall, cover, and depth

- 30-70% decreases in snowfall
- Greatest loss in December/January

Decreased snowpack

- Increased soil freeze-thaw cycles can damage roots and alter soil processes

Area with some snow on ground for 30 days per year

Red = historic
White = high emissions

Notaro et al. 2014, Figure: Frumhoff et al. 2007

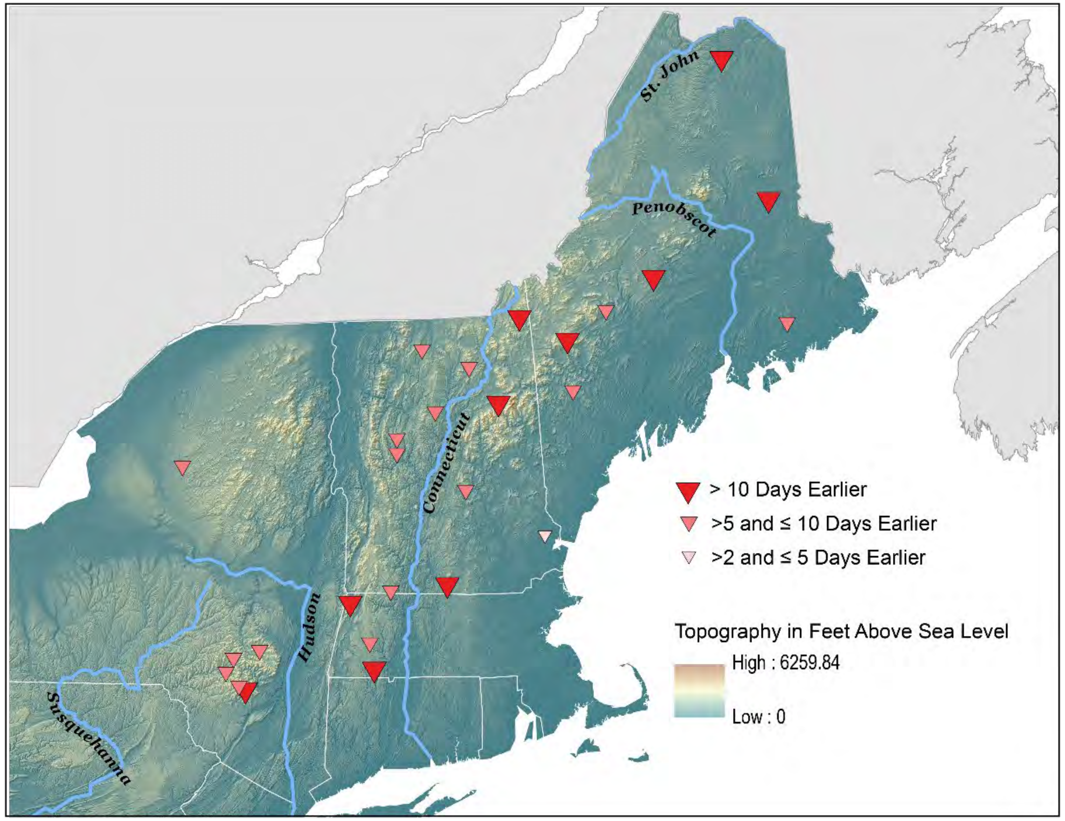
Warmer Winter (Less Snow, More Rain)

More rain

- Warmer temperatures
- Increased precipitation
- Extreme rain events

Earlier peak stream flows

- Flashiness and episodic high flows may increase



Historical changes in the timing of snowmelt-related streamflow (1960-2014)

What may be at risk: Increased erosion or sedimentation on susceptible sites; culvert washouts and road damage from extreme events; aquatic habitats and species

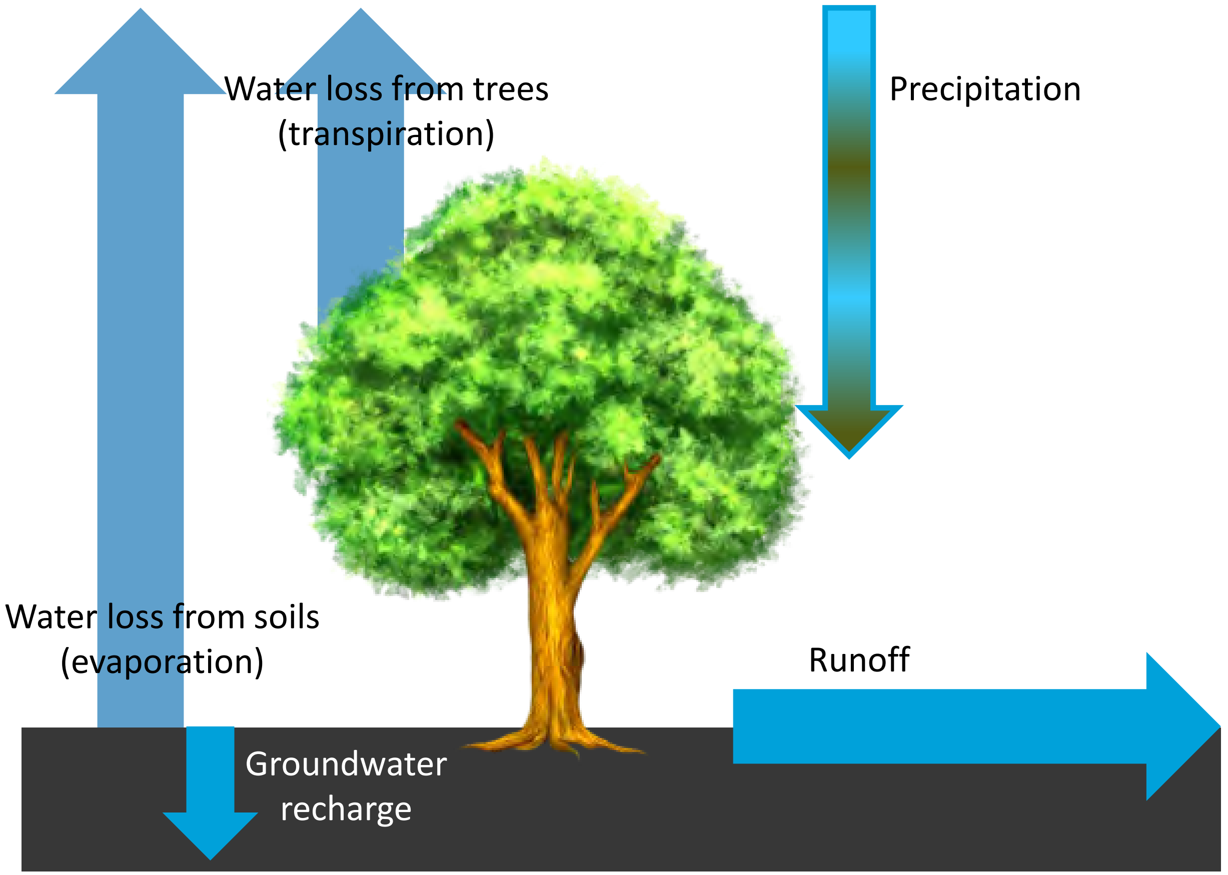
Dale et al 2001, Huntingon 2004, Parmesan 2006, NCA 2018

Increased Risk of Moisture Stress

Longer and warmer growing seasons may lead to drier conditions during the growing season.

Risk may be greatest:

- Sites with drought-prone or shallow soils
- South-facing ridges
- Mesic species on drier sites (marginal sites or off-site)



Changes in Forest Composition

Declining Habitat

- Balsam fir
- Eastern hemlock
- Paper birch
- Quaking aspen
- Red pine

Persisting Habitat

- Black cherry
- Black oak
- Eastern white pine
- Gray birch
- Northern red oak
- Red maple
- Sugar maple
- Scarlett oak
- Yellow birch
- White oak

Increasing Habitat

- American beech
- Black locust
- Chestnut oak
- Eastern redcedar
- Pignut hickory
- Shagbark hickory
- Yellow-poplar

New habitat

- Common persimmon
- Loblolly pine
- Post oak
- Shortleaf pine
- Southern red oak
- Sweetgum
- Virginia pine
- Willow oak

New DISTRIB-II data; www.fs.usda.gov/nrs/atlas/tree/ ; www.forestadaptation.org/new-england

Wildfire

Future climate conditions suggest increased risk of fire.

Wildfire may increase:

- Warmer/drier summers
- Increased tree stress or mortality
- Shift toward fire-associated species like oaks and pines

Wildfire may not change:

- Spring/early summer moisture
- Current regeneration of more mesic species
- Spatial patterns of land use and fragmentation
- Fire suppression

Clark et al. 2014, Guyette et al. 2014. Photo: Matthew Duveneck

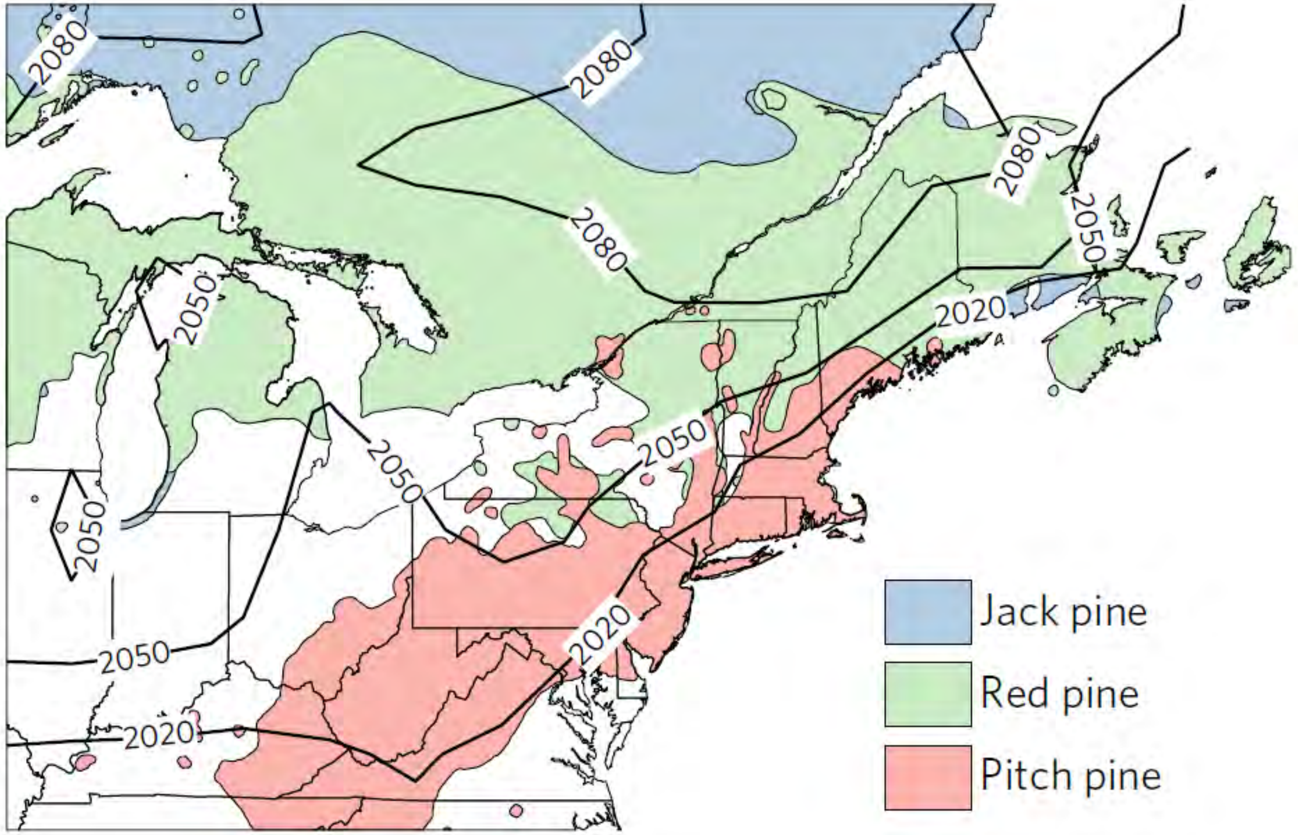
Insects and Diseases

Increased damage from forest insects & diseases

Indirect: Stress from other impacts increases susceptibility

Direct:

- Pests migrating northward
- Decreased probability of cold lethal temperatures
- Accelerated lifecycles



Projected southern pine beetle expansion into ranges of forest types with suitable dominant pine species (Lesk et al. 2017)

Ayres and Lombardero 2000, Parmesan 2006, Dukes et al. 2009, Weed et al. 2013, Sturrock et al. 2011, USFS 2019

Invasive Plants

Increased habitat for many noxious plants

Indirect: Stress or disturbance from other impacts can affect the potential for invasion or success

Direct:

- Expanded ranges under warmer conditions
- Increased competitiveness from ability of some plants to take advantage of elevated CO_2

Dukes et al. 2009, Hellman et al. 2008; Images: www.eddmaps.org)

Deer Herbivory

Here to stay.

Deer populations likely to be maintained or increase:

- More overwinter survival & better condition due to warmer conditions
- Potential increase in some diseases affecting deer?
- Effect much greater near northern edge of range.

Weiskopf et al. 2019, Image: Norcross Wildlife Foundation

Interactions are Critical

Climate change is a "threat multiplier"

- Chronic stress
- Disturbances
- Insect pests
- Forest diseases
- Invasive species

Interactions make all the difference.

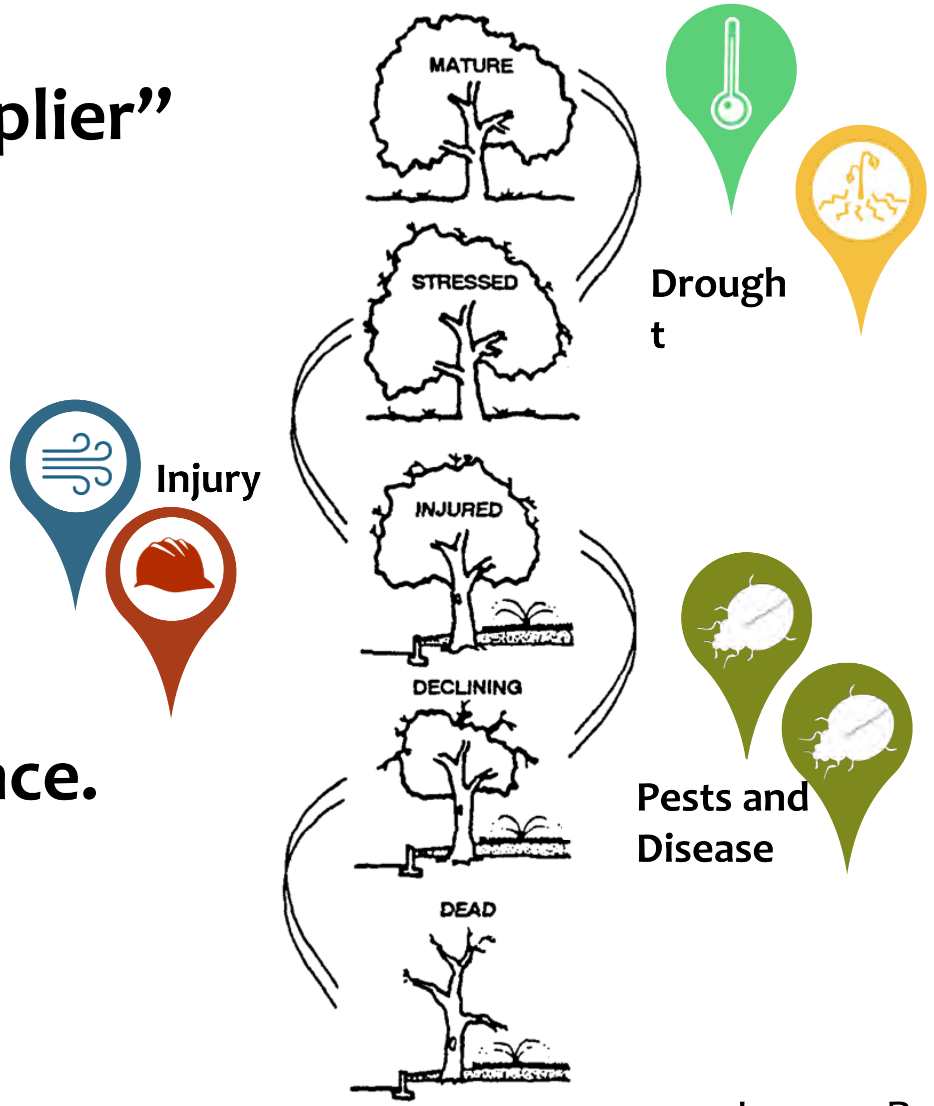


Image: Bartlett Tree Experts

Forests and Climate Change: Mitigation vs. Adaptation

Mitigation

- Goal is to prevent or minimize climate change impacts as much as possible
- While every acre of forest counts, impossible to implement practices on an individual forest property to prevent climate change
- Focus is on minimizing impacts

Adaptation

- Goal is to adjust to observed and anticipated changes in climate
- Efforts by humans to facilitate or help ecosystem accommodate new conditions
- Sometimes may be easier to conceptualize at a larger scale
- Three named forest adaptation approaches or "pathways" are currently widely recognized

Some overlap between mitigation and adaptation

Examples of forestry practices that help **mitigate** climate change impacts

Preventing forest loss

- Forest conversion is biggest loss of forest climate benefits
- Results in substantial emissions
- Loss of potential future carbon storage, sequestration, and other forest benefits

Kosiba 2022

Establishing reserves

- Passive or non-extractive management
- Can occur across many scales:
  - property
  - part of property
  - stand
  - groups
- May or may not be permanently conserved

Kosiba 2022

Protecting Soil and Leaf Litter

- Soil carbon builds very slowly, but can be easily disturbed
- Following BMPs to protect soil and water also protects soil carbon
- Dead wood can protect both, and may help build soil carbon over long-term

Kosiba 2022

Forest Climate Adaptation Approaches

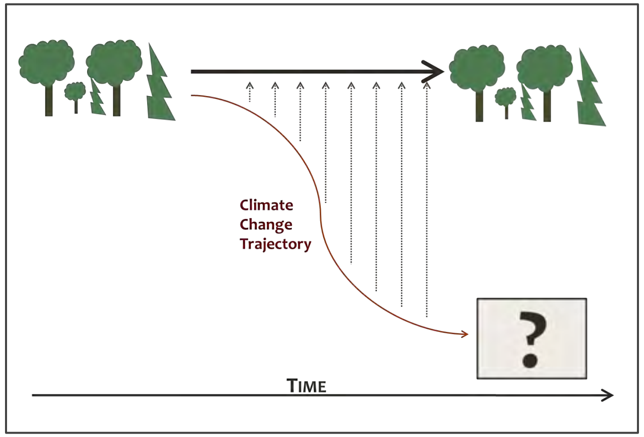
Manage for Persistence

Ecosystems are still recognizable as being the same system (character)

Manage for Change

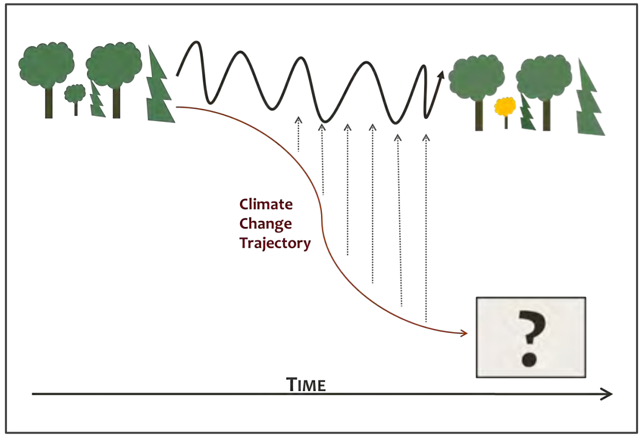
Ecosystems have fundamentally changed to something different

RESISTANCE



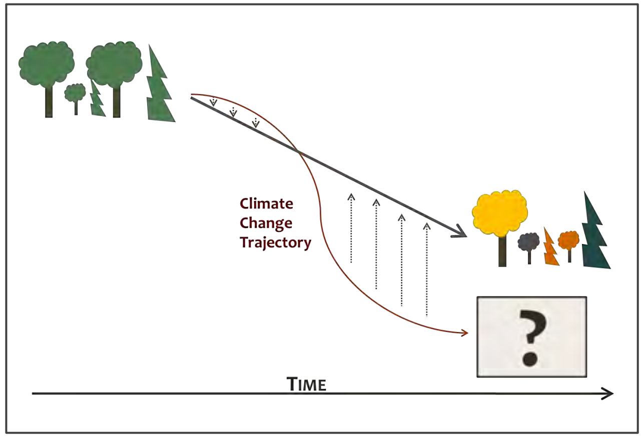
- Improve defenses of forest against change
- Maintain relatively unchanged conditions

RESILIENCE



- Accommodate some degree of change
- Return to prior condition after disturbance

TRANSITION



- Facilitate change
- Enable ecosystem to respond to new and changing conditions

Nagel et al. 2017

How can you think about climate considerations on your own property?

Improve the forest's defenses against unwanted change.

Protect water and soils.

Good road and trail systems

- Improve access
- Concentrate impacts to designated locations

Stream crossings

- Ensure culverts and bridges can withstand extreme events
- Protects habitat for fish and aquatic organisms
- Protects water quality

Improve the forest's defenses against unwanted change.

Prevent and control non-native plants and weeds.

Early detection and action

- Stress or disturbance from other causes can allow plants to establish or expand
- Become familiar with our local offenders!

Images: Invasives Plants Atlas of New England (www.eddmaps.org)

Improve the forest's defenses against unwanted change.

Improve ability trees to resist bugs and disease.

Early detection and action – again!

- Promote healthy and vigorous trees
- Remove unhealthy trees
- Stress or disturbance from other causes can increase risk from pests or diseases
- Specific treatments for different insects and diseases

Images: USFS Northeastern Area, Mass Audubon

Improve the forest's defenses against unwanted change.

Protect rare or sensitive plant and animal communities.

Consider what is special or sensitive on your property

- Rare plants or plant communities
- Rare animals or unique habitat features
- Streams, creeks, seeps, and other water features
- Wetlands, including seasonal pools

Promote diversity in the forest.

Promote a diversity of tree species and sizes.

Tree species diversity

- Different tree species in case one performs poorly
- Species that are more tolerant of hotter and drier conditions

Tree size diversity reduces risk

- More sizes generally means a variety of ages, including young trees
- Can increase resistance to strong winds

Promote diversity in the forest.

Promote a diversity of tree species and sizes.

Forest management

- Unhealthy trees targeted for removal (worst first)
- Keep trees of less common species
- Keep trees that may do well in future conditions
- Retain good habitat

Promote diversity in the forest.

Promote a diversity of tree species and sizes.

Common forest management practice = Thinning

- Removing some trees, providing more growing space to the remaining trees

Promote diversity in the forest.

Promote a diversity of tree species and sizes.

Common forest management practice = Creating gaps/patches (a.k.a. group selection)

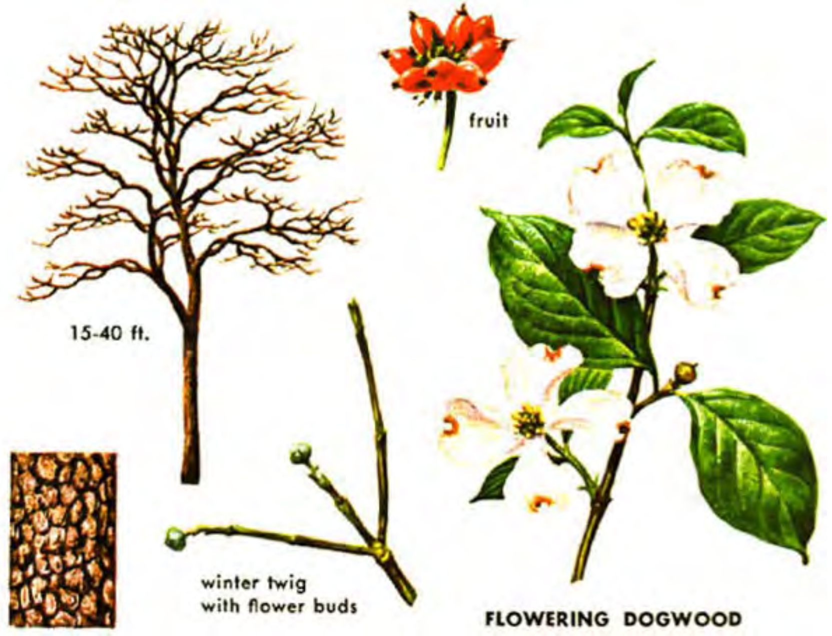
- Removing more trees in a concentrated area to promote small trees and regeneration

Be proactive in adapting the forest to changing conditions.

Consider which tree species you might want to promote.

Trees adapted to future conditions

- Match trees to site
- Trees that can take a wide range of conditions
- Trees that can handle hotter and drier conditions



Be proactive in adapting the forest to changing conditions.

Try to reduce damage to understory regeneration from excessive deer browsing.

Many landowners like to see deer on their land but don't recognize their impacts on vegetation

- Deterrence – *shoo, deer!*
- Avoidance – less palatable species
- Protection – fenced exclosures, fencing individual trees, tree shelters, piled tree tops
- Repellents – sprays, etc.

Be proactive in adapting the forest to changing conditions.

Monitor your woods and the effects of different management tactics.

Be observant to changes in the woods:

- Look for changes and “weird things”
- Early spring – many invasives green up first
- After big rains – soil erosion, sedimentation, ponding, etc.
- If nothing else: take photos!

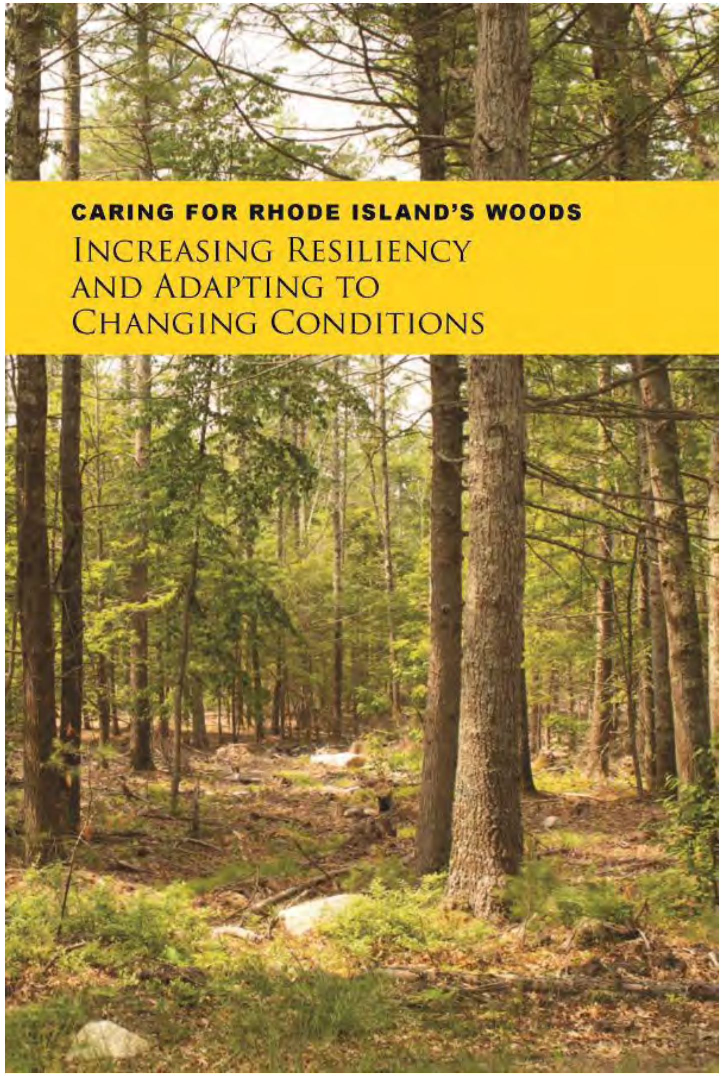
Be proactive in adapting the forest to changing conditions.

Learn from professionals and other landowners.

Take advantage of available resources and professionals who have specific expertise:

- Consulting foresters
- NRCS and RI DEM service forestry staff
- Land trusts
- University extension programs
- Lawyers, legal professionals
- RI Woods website (riwoods.org)
- RIFCO (forest landowner association)

New publication for RI landowners



- Summary of climate changes in RI and how they are affecting forests
- Examples of types of actions to…
  - Protect ecosystem functions
  - Reduce stressors
  - Build resilience
  - Facilitate transition
- Checklist for taking action
- List of additional resources with website links

NRCS practices can support climate change adaptation

- Included in a series of handouts developed specifically for NRCS:
  - “Climate Change, Your Forest, and You”
  - “Wildlife, Wetlands & Climate Change: Your Land, Your Plan”

https://www.climatehubs.usda.gov/hubs/northern-forests/topic/nrcs-practices-can-support-climate-change-adaptation

A few examples of some
climate-smart management objectives,
adaptation approaches

OBJECTIVE: Improve Degraded Plant Communities

ADAPTATION APPROACHES

- Reduce competition
- Restore native species diversity
- Prevent & control invasive plants

OBJECTIVE: Increase Native Plants

ADAPTATION APPROACHES

- Establish or encourage new mixes of native species
- Favor existing species better adapted to future conditions
- Introduce species adapted to future climate conditions

OBJECTIVE: Increase forest carbon storage & sequestration

ADAPTATION APPROACHES

- Use active and/or passive management to maximize carbon
- Increase structural complexity (both living and dead wood)
- Reforest cleared lands

OBJECTIVE: Create or Enhance Wildlife Habitat

ADAPTATION APPROACHES

- Improve food sources for climate-sensitive species
- Create sources of food, water, and cover for future conditions
- Create or manage microhabitats

Summary Points: Climate-Smart Forestry

- Significant management decisions (or lack thereof) may have long-term climate implications
- Keeping forests as forests is the most important action we can take
- Also important to consider management effects on forest carbon
- Consider goals and possible tradeoffs
- Connect with professionals and other landowners who can help you think about climate considerations in your woods
- Traditional conservation-minded forestry practices are often examples of climate-smart forestry
- Continuous learning; use monitoring to inform future actions

Climate-adaptive forestry research:
The Adaptive Silviculture for Climate Change (ASCC) project

- Southern New England Oak affiliate site project initiated by UConn in 2020, with URI joining in 2021
- Funding from two separate USDA grants (CT and RI)
- Collaboratively funded RI DEM Division of Forest Environment project

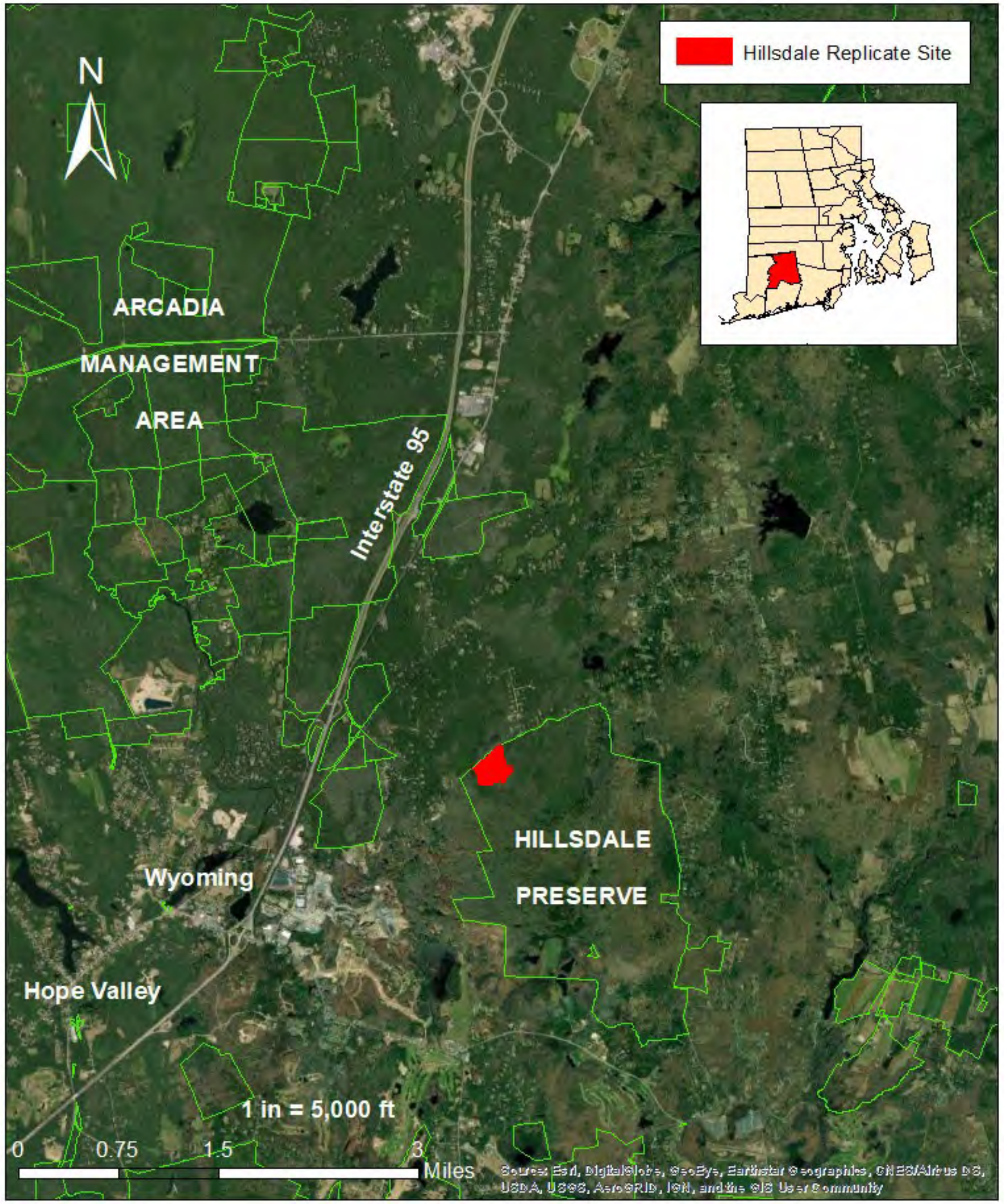
Southern New England Exurban Oak Affiliate Site

- Study adapted to small-scale landscape
- Replicate sites and monitoring plots established before implementing treatments
- Also social science research on factors affecting climate-adaptive forestry
  - identify opportunities and obstacles

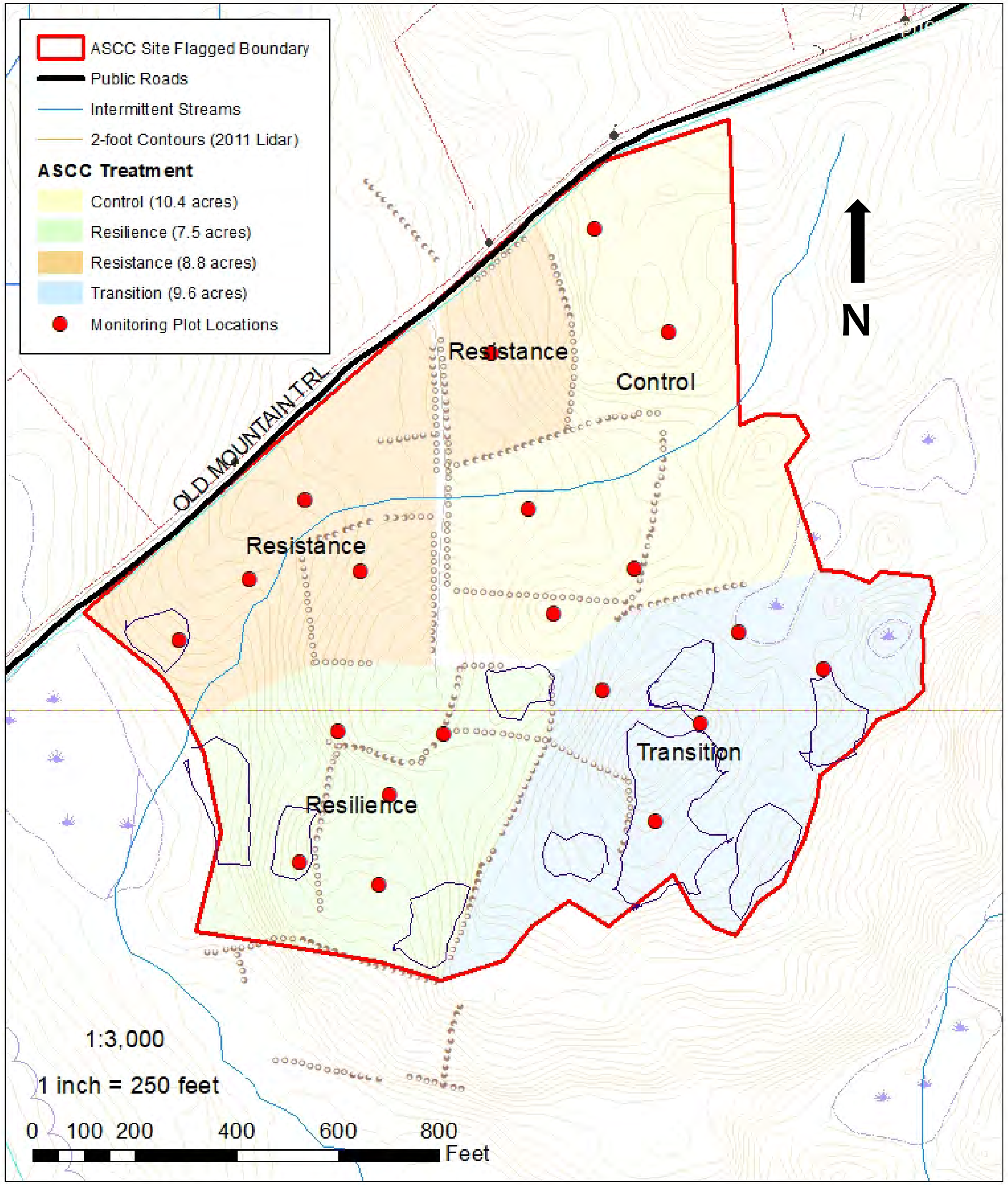
Three replicate sites to date in eastern CT and RI:

1. Mohegan State Forest (CT)
2. Hillsdale Preserve (RI)
3. University of Connecticut Forest (CT)

SOUTHERN NEW ENGLAND ASCC PROJECT REPLICATE SITE
RIDEM Hillsdale Preserve, Richmond, RI
Locus Map



Treatment Areas with Stone Walls and Site Features



ASCC Southern New England Replicate Study Area

RI DEM's Hillsdale Preserve
Richmond, RI

Almost 40 acres


Typical Southern New England woods:
Oak-hickory canopy with birch-maple subcanopy

Hillsdale Preserve replicate site:
High oak mortality from drought and defoliations from spongy moth
Note understory greenbriar (present in many areas and very heavy here)

Oak mortality readily visible from above

Initial treatment implementation harvest conducted over Fall 2023 - Winter 2024

RESISTANCE

- Maintain oak-hickory dominance, promote health of existing trees
- Gradually regenerate oak & hickory and other species using multi-stage "shelterwood" harvest method
- Reserves and one gap for habitat
- Retain more standing dead trees than in other treatment areas

RESILIENCE

- Work with canopy mortality to expand and create new gaps favoring oak & hickory and promote overall diversity
- Where possible, retain more trees in areas of heavy greenbriar ("reserves")
- In gaps, plant native trees including oaks matched to site conditions
- Retain some standing dead trees

TRANSITION

- Promote future-adapted species and multi-age structure
- Larger gaps centered on high-mortality areas
- Plant oaks adapted to projected future conditions; possibly other species such as hickories
- Retain fewer standing dead trees

CONTROL

- Area includes a mix of site conditions present in the three treatment areas
- Passive management = left alone (no tree cutting or planting)
- Same monitoring as other areas
- Serves as a reference or comparison for three active treatments

Ongoing Monitoring
(3 Treatment Areas and No-Cut Control)

- 20 intensive monitoring plots (5 in each treatment area)
- Pre-treatment baseline monitoring
- Standard forest inventory before & after treatments
- Will continue (pending funding)
- Survival & growth of planted oaks

Come visit the Hillsdale project site on a tour!

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