Climate Change, Forests, & Forest Habitats

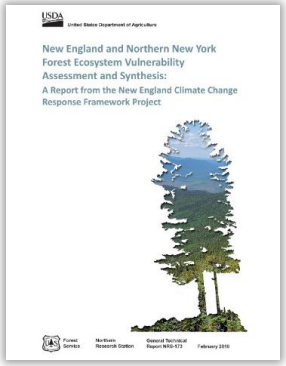
Climate Change Impacts

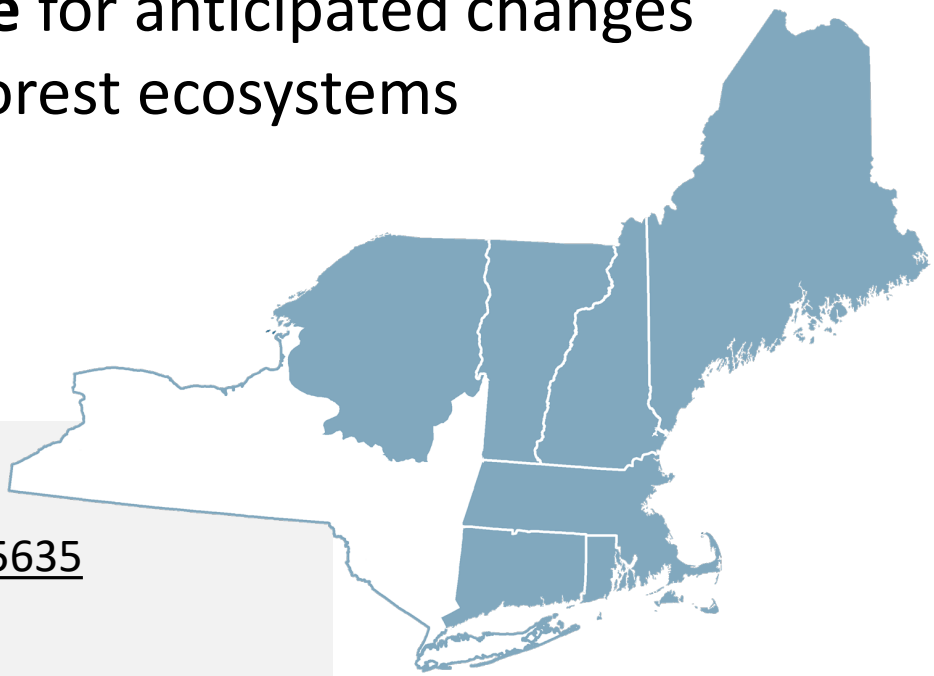
Maria Janowiak mjanowiak02@fs.fed.us
Northern Institute of Applied Climate Science
USDA Forest Service

Climate Change Response Framework
www.forestadaptation.org

Vulnerability Assessment

- **Synthesize** existing assessments and scientific literature
- Incorporate new results from **forest impact models**
- Draw on local expertise of **scientists and land managers**
- Describe **state-of-knowledge** for anticipated changes in climate and response of forest ecosystems

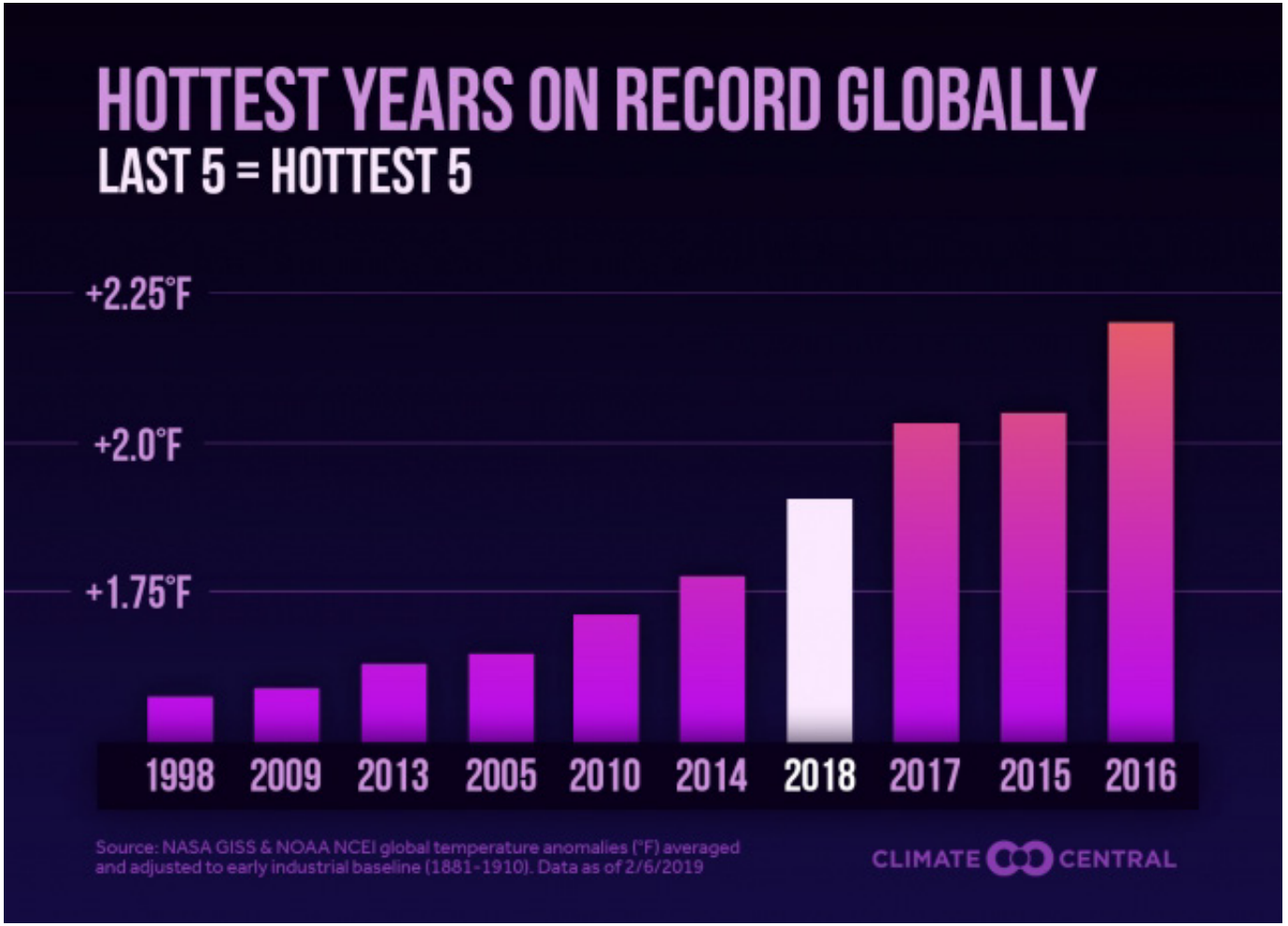




NEW REPORT!
www.nrs.fs.fed.us/pubs/55635

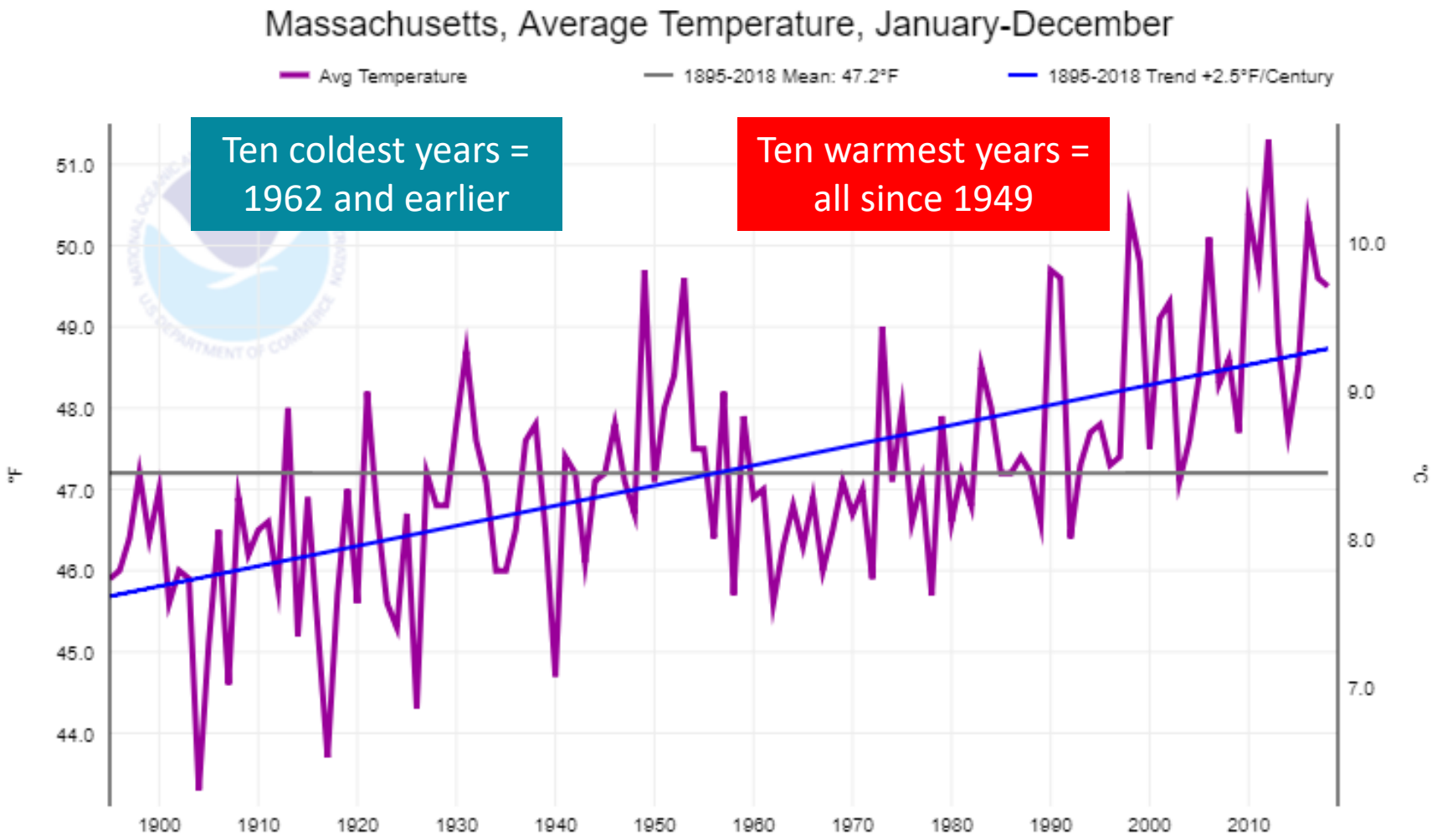
Additional resources:
www.forestadaptation.org/ne-assessment

A Warmer Climate



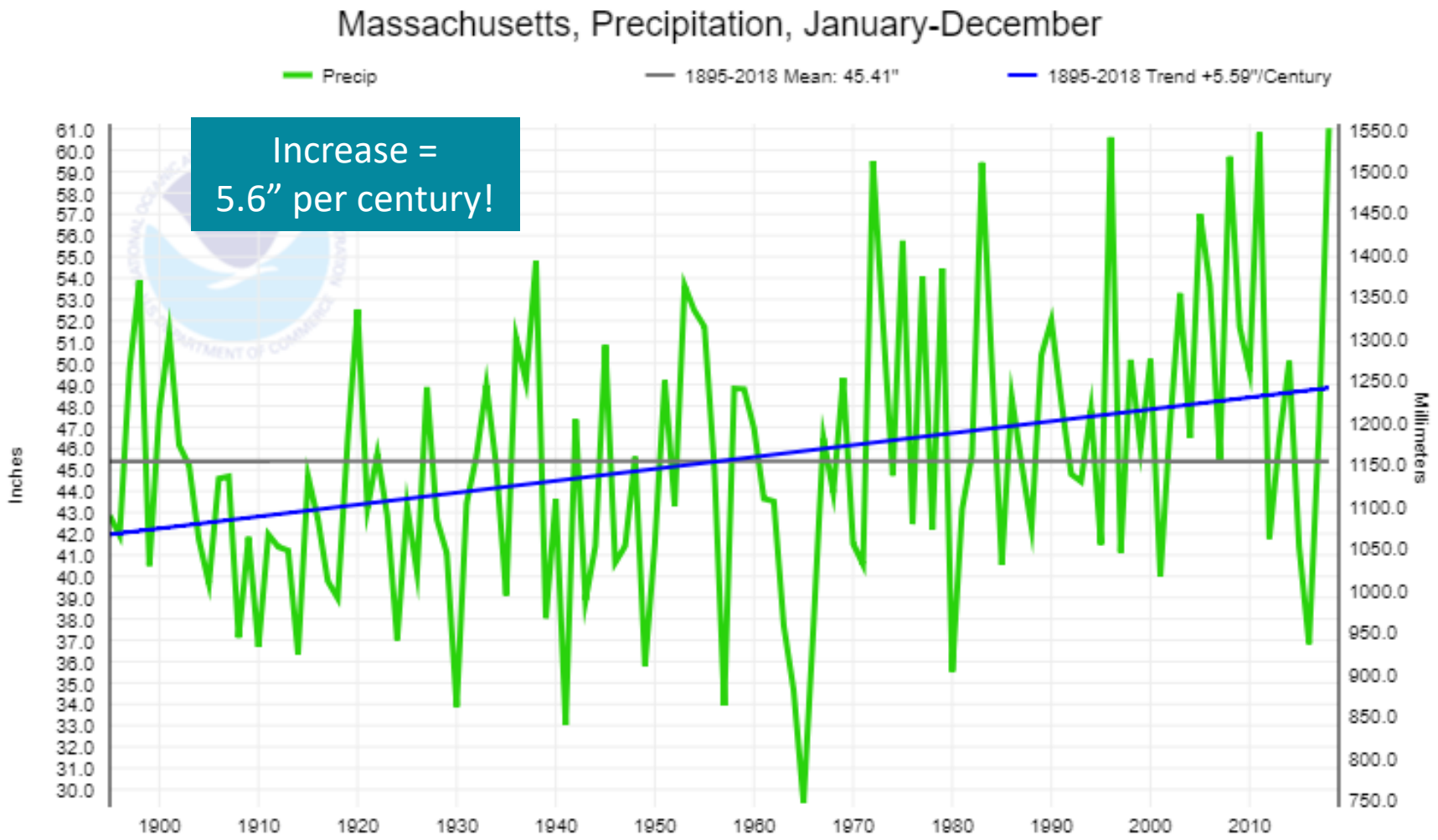
www.ClimateCentral.com

A Warmer Climate - MA



NOAA Climate-at-a-Glance Tool

A Warmer Climate - MA



NOAA Climate-at-a-Glance Tool

Not Just Warmer Temperatures

- More days with extreme heat
- Precipitation increased >5 inches
- Extreme rain events
- Extreme storms
- Coastal flooding

NOAA

VTRANS/VT ANR

Dan Turner, Cambridge Fire Dept.

NY DEC

Effects on Forests

SHIFTING SEASONS | SHIFTING SPECIES | SHIFTING STRESSORS

Effects on Forests

SHIFTING SEASONS | SHIFTING SPECIES | SHIFTING STRESSORS

THE GOOD:
Longer growing seasons.

Effects on Forests

SHIFTING SEASONS | SHIFTING SPECIES | SHIFTING STRESSORS

THE GOOD:
Longer growing seasons.

THE BAD:
Shorter, warmer winters.

Effects on Forests

SHIFTING SEASONS | SHIFTING SPECIES | SHIFTING STRESSORS

THE GOOD:
Longer growing seasons.

THE BAD:
Shorter, warmer winters.

THE UGLY:
More extreme events.

NY DEC

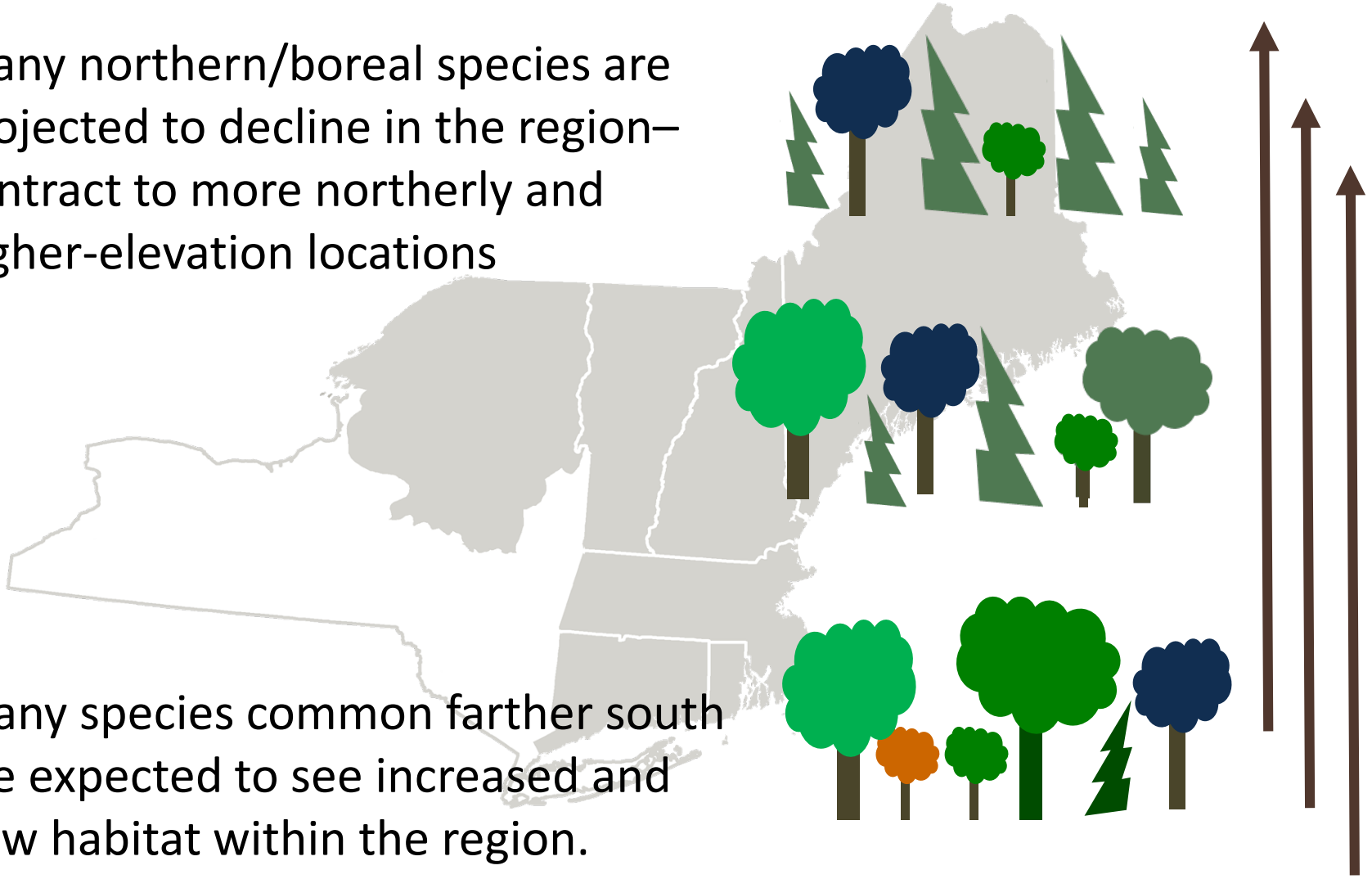
Effects on Forests

SHIFTING SEASONS | **SHIFTING SPECIES** | SHIFTING STRESSORS

Effects on Forests

SHIFTING SEASONS | **SHIFTING SPECIES** | SHIFTING STRESSORS

Many northern/boreal species are projected to decline in the region– contract to more northerly and higher-elevation locations



Many species common farther south are expected to see increased and new habitat within the region.

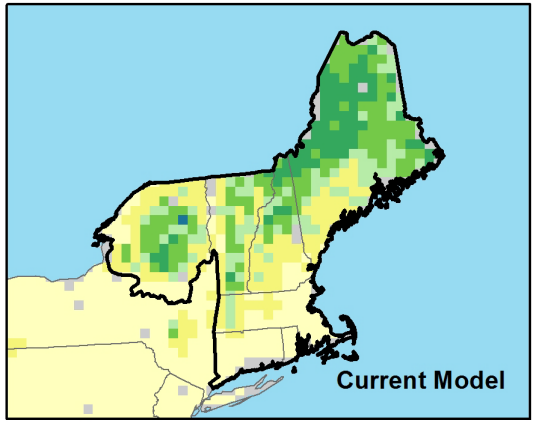
Effects on Forests

SHIFTING SEASONS | **SHIFTING SPECIES** | SHIFTING STRESSORS

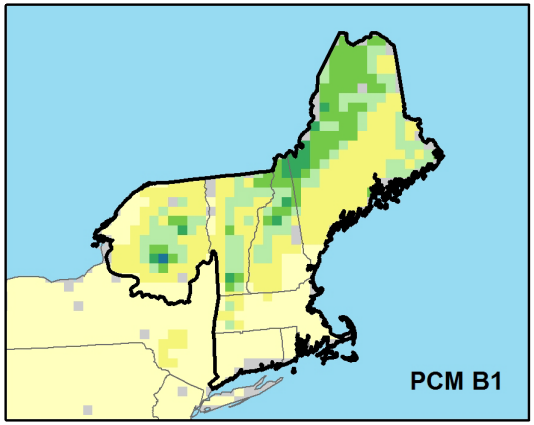
Red Spruce: Suitable Habitat

(Climate Change Atlas)

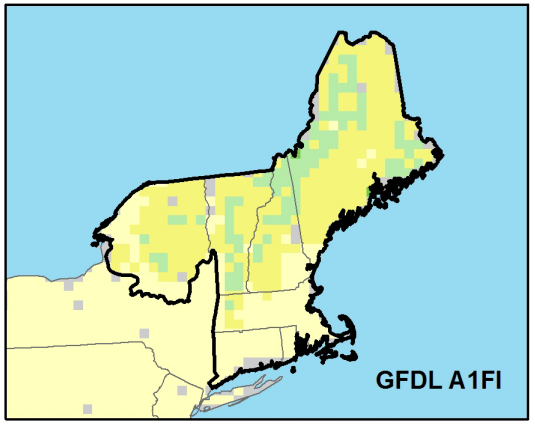
Current Distribution



PCM Low emissions (B1)
2070-2100



GFDL High emissions (A1FI)
2070-2100



Importance Value

Low

High

Less change

More change

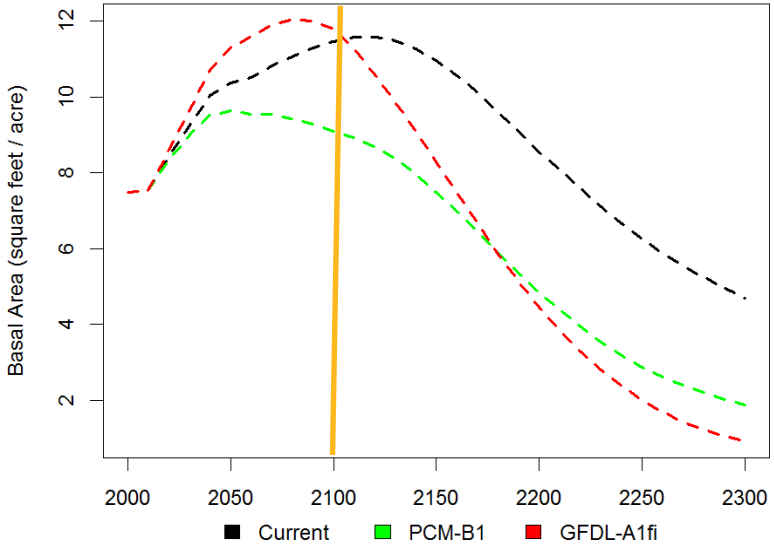
Effects on Forests

SHIFTING SEASONS | **SHIFTING SPECIES** | SHIFTING STRESSORS

Red Spruce

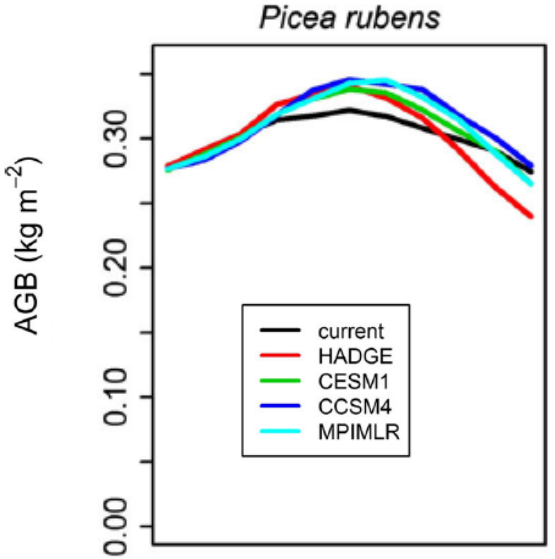
Basal Area

LANDIS-PRO



Aboveground Biomass

LANDIS-II; Duveneck et al. 2017



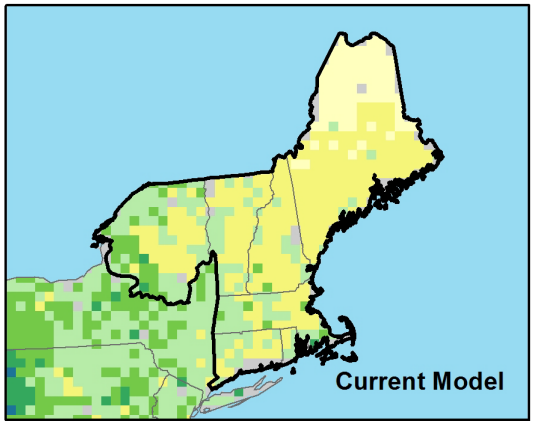
Effects on Forests

SHIFTING SEASONS | **SHIFTING SPECIES** | SHIFTING STRESSORS

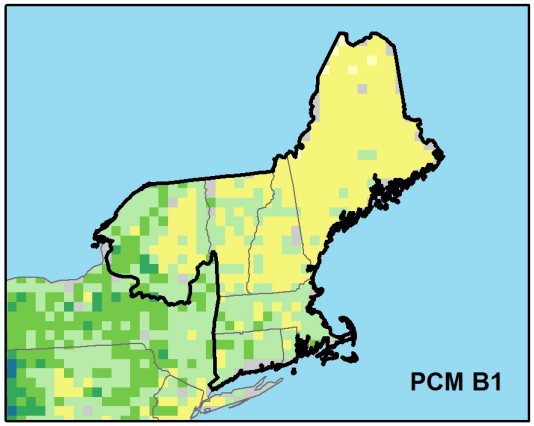
Black Cherry: Suitable Habitat

(Climate Change Atlas)

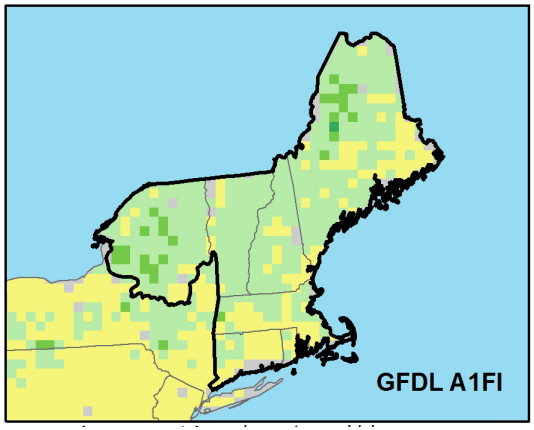
Current Distribution



PCM Low emissions (B1)
2070-2100



GFDL High emissions (A1FI)
2070-2100



Importance Value

Low

High

Less change ⟷ More change

Effects on Forests

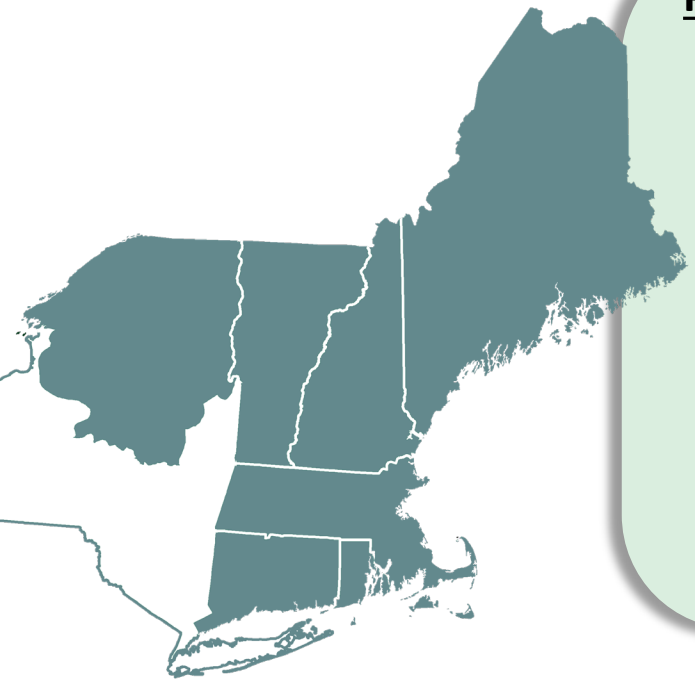
SHIFTING SEASONS | **SHIFTING SPECIES** | SHIFTING STRESSORS

Likely to decline

- Balsam fir
- Black, red, & white spruce
- Northern white-cedar
- Eastern hemlock
- Black ash
- Paper birch
- Quaking aspen
- Tamarack

Mixed model results

- American beech
- Sugar & red maple
- Yellow birch
- White pine



Potential "winners"

- American elm
- American basswood
- Black cherry
- Eastern hophornbeam
- Gray birch
- Northern red oak
- Serviceberry
- Silver maple
- Sweet birch
- White oak

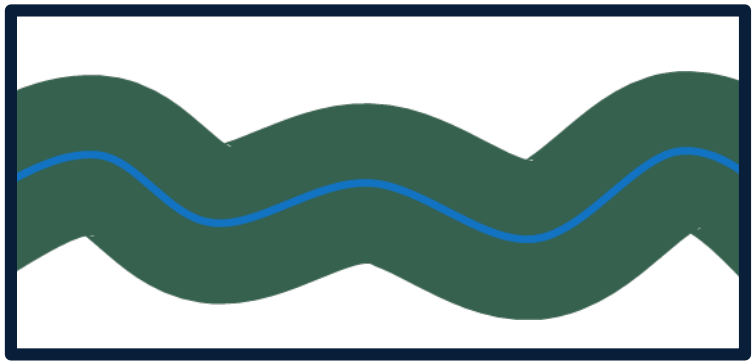
New habitat (esp. south)

- Black hickory
- Chinkapin oak
- Common persimmon
- Hackberry
- Loblolly pine
- Osage-orange
- Shortleaf pine
- Southern red oak
- Sweetgum
- Virginia pine

www.forestadaptation.org/ne-species

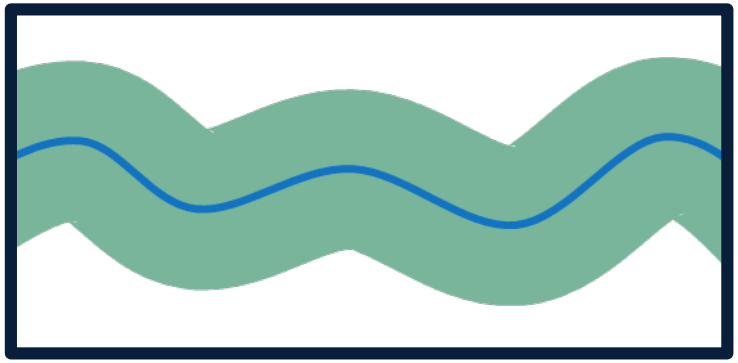
Effects on Forests

SHIFTING SEASONS | **SHIFTING SPECIES** | SHIFTING STRESSORS

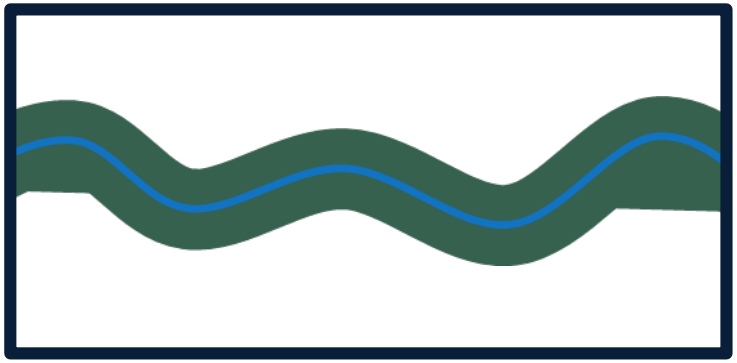


= species X suitable habitat

50% Reduction in Habitat:



Habitat reduced equally



Best habitats remain

Effects on Forests

SHIFTING SEASONS | **SHIFTING SPECIES** | SHIFTING STRESSORS

Forest communities will be affected differently

Forest system	Potential impacts	Adaptive capacity	Vulnerability
Central hardwood-pine	Neutral-Positive	Moderate-High	Low
Low-elevation spruce-fir	Neutral-Negative	Moderate	Moderate-High
Lowland/riparian hardwood	Positive and Negative	Moderate-High	Moderate
Lowland mixed conifer	Neutral-Negative	Low-Moderate	Moderate-High
Montane spruce-fir	Neutral-Negative	Moderate	Moderate-High
Northern hardwood	Positive and Negative	Moderate-High	Low-Moderate
Pitch pine-scrub oak	Neutral-Positive	Moderate	Low
Transition hardwood	Positive and Negative	Moderate-High	Low-Moderate

Effects on Forests

SHIFTING SEASONS | **SHIFTING SPECIES** | SHIFTING STRESSORS

- Many common tree species are projected to have reduced suitability in the future
- Changes will occur slowly—not instant dieback
- Mature and established trees should fare better
- Immense lags to occupy habitats
- Critical factors: competition, management, & disturbance

Risk may be greatest:

- Location is relatively near the southern extent of species range
- Trees are projected to decline and located on a marginal site
- Forest is composed of few species, esp. those projected to decline
- Something is "missing" from the ecosystem
- Other factors cause additional stress

Effects on Forests

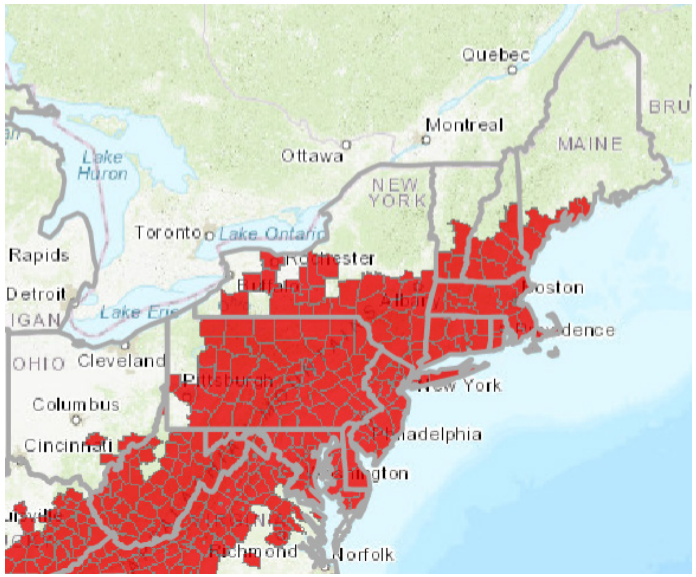
SHIFTING SEASONS | SHIFTING SPECIES | **SHIFTING STRESSORS**

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



Hemlock woolly adelgid incidence ~2015

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

Effects on Forests

SHIFTING SEASONS | SHIFTING SPECIES | **SHIFTING STRESSORS**

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

ıkes et al. 2009, Hellman et al. 2008;
ages: Invasives Plants Atlas of New
gland (www.eddmaps.org)

Effects on Forests

SHIFTING SEASONS | SHIFTING SPECIES | **SHIFTING STRESSORS**

Climate change is a "threat multiplier"

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

Interactions make all the difference.

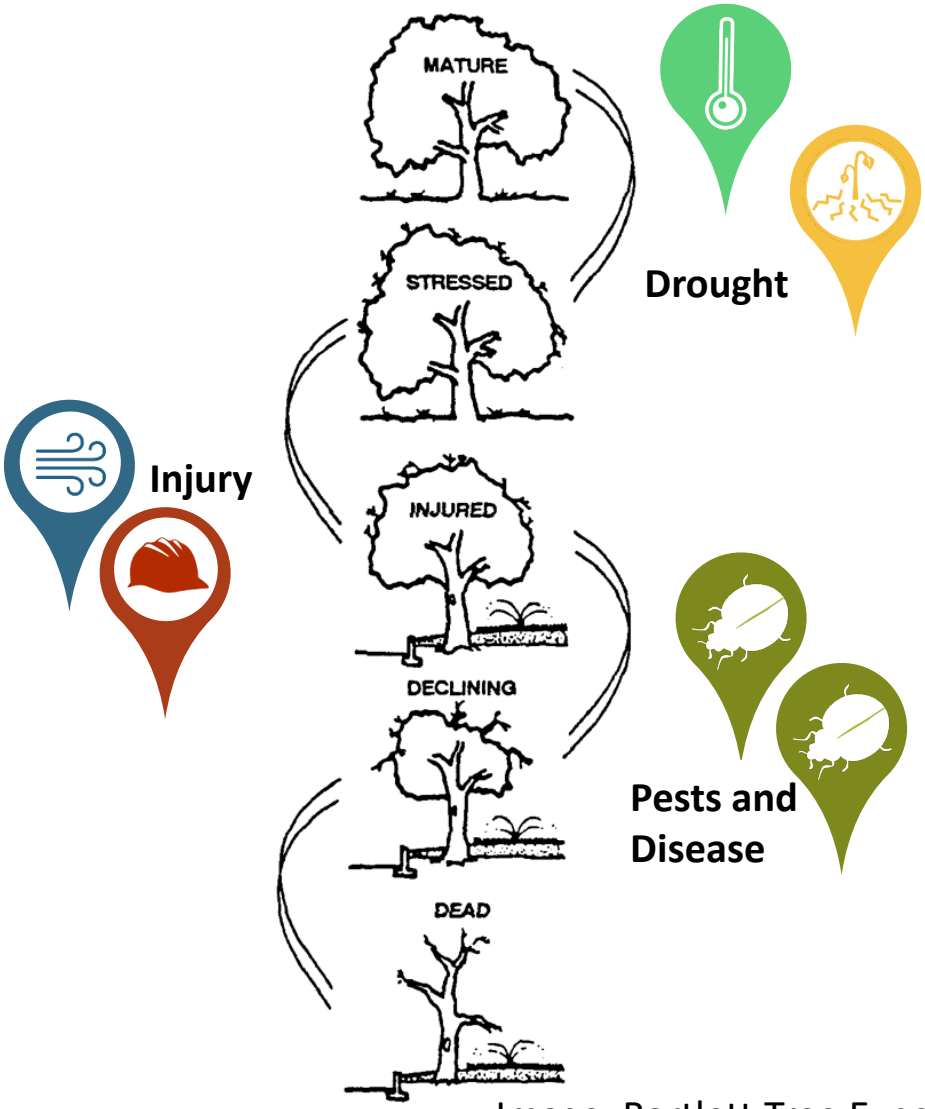


Image: Bartlett Tree Experts