VULNERABILITY AND ADAPTIVE CAPACITY OF TREES IN THE BOSTON REGION

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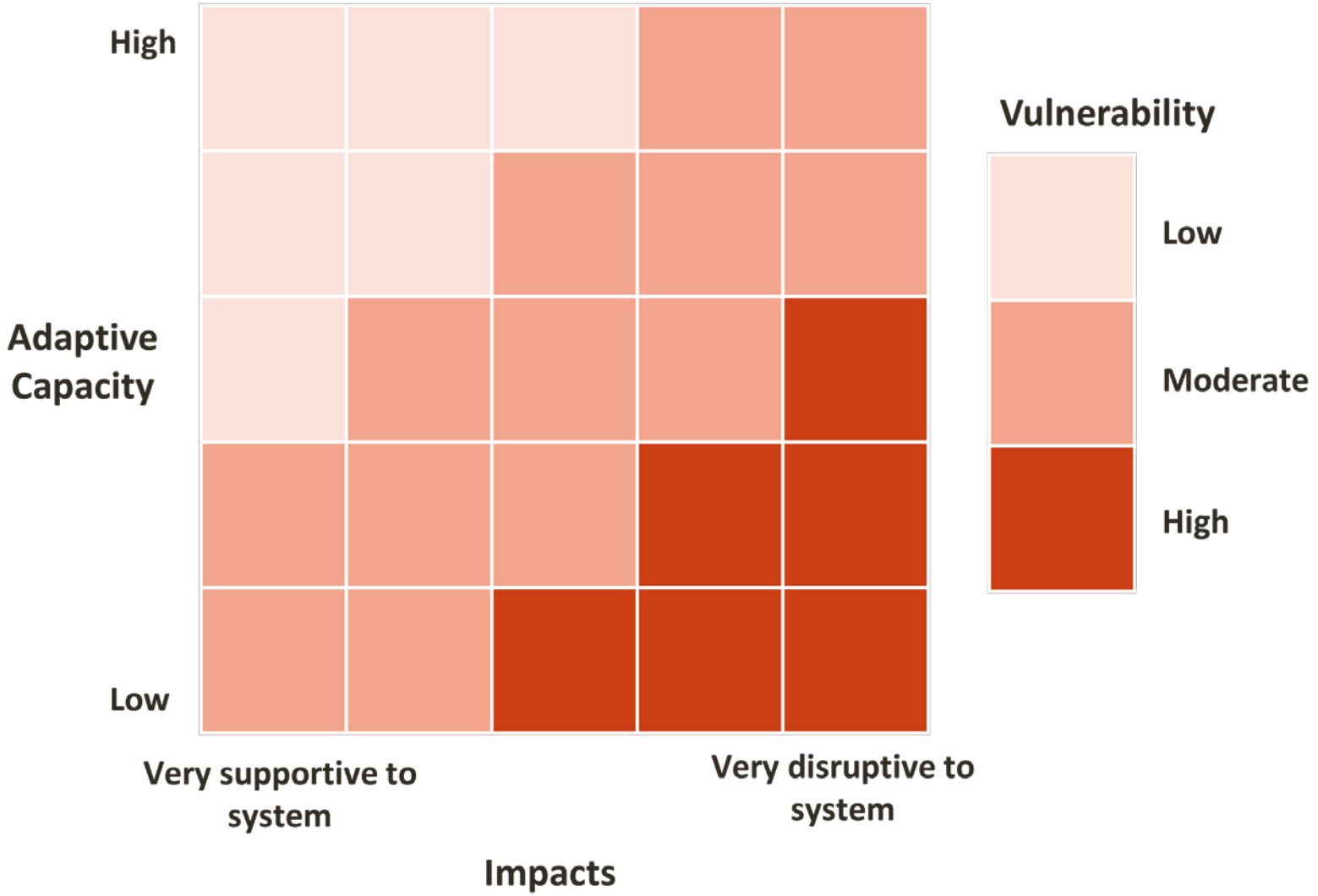
URBAN TREES ARE VULNERABLE TO…

What is Vulnerability?



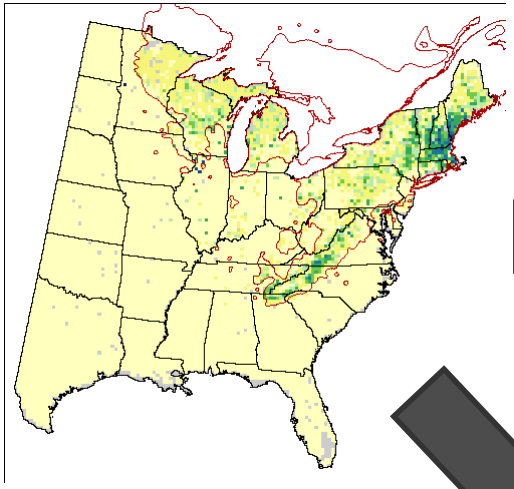
Swanston et al. 2016

Future Impacts: Native Trees

http://www.fs.fed.us/nrs/atlas/

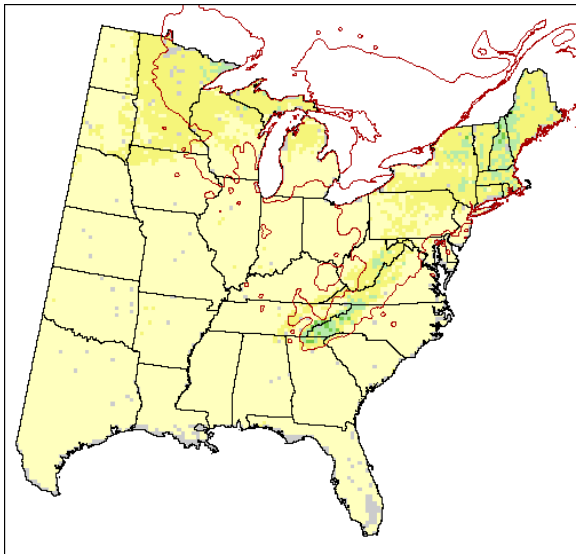
Models and Emissions Scenarios

Habitat Suitability Loss-White Pine



Current habitat

future habitat
high emissions



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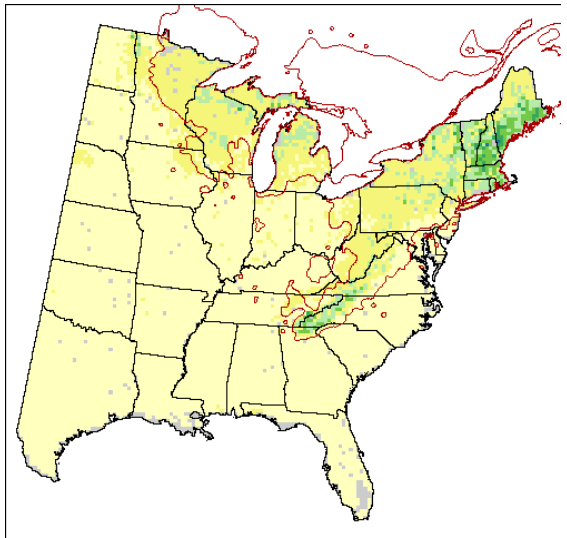
low emissions



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Biggest Losers

Balsam fir

Aspen

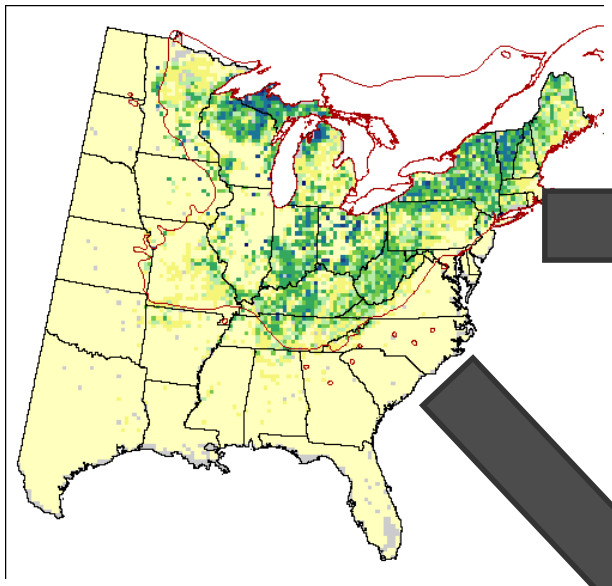
Birch

Chokecherry

Red spruce

Red pine

Retains Habitat- Sugar Maple



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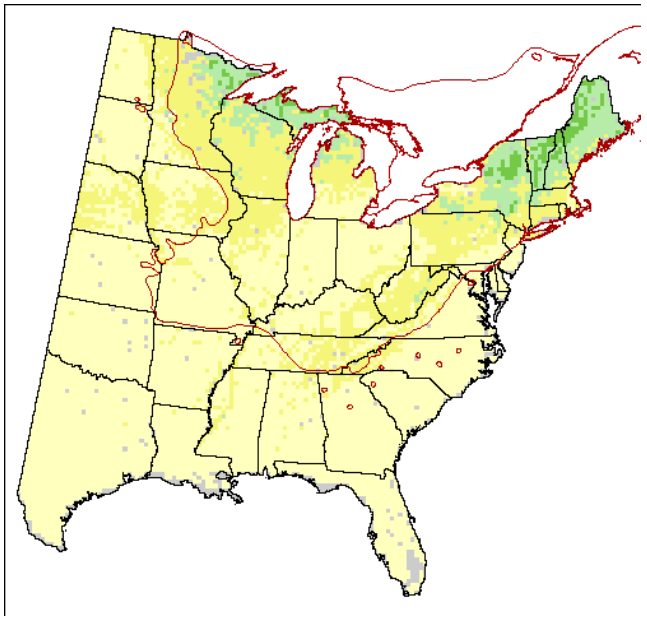

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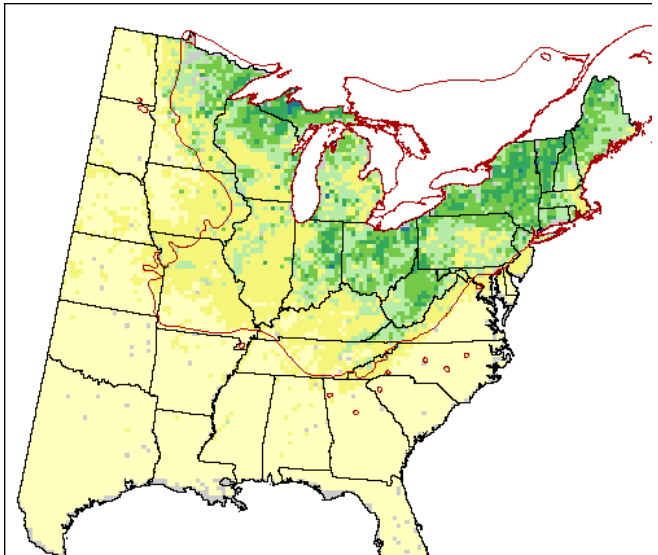


http://www.fs.fed.us/nrs/atlas/

Holding Steady

Atlantic white-cedar

American beech

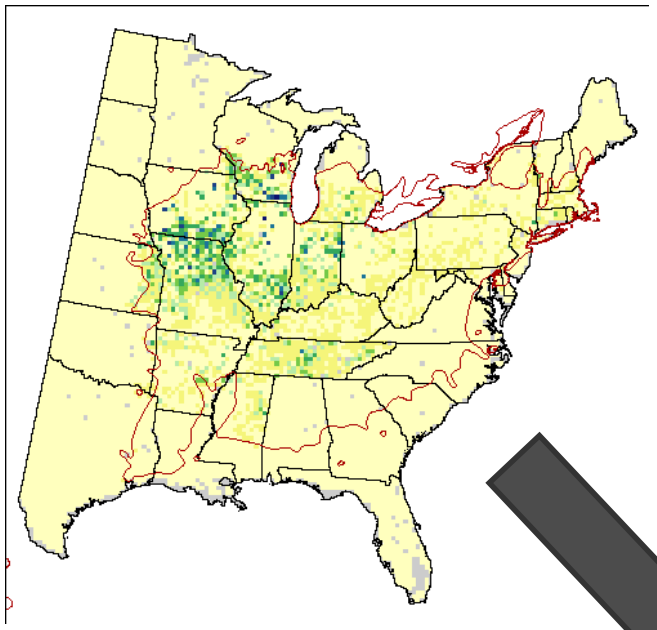
Black cherry

American holly

Pitch pine

Swamp chestnut oak

Gains Habitat- Shagbark Hickory



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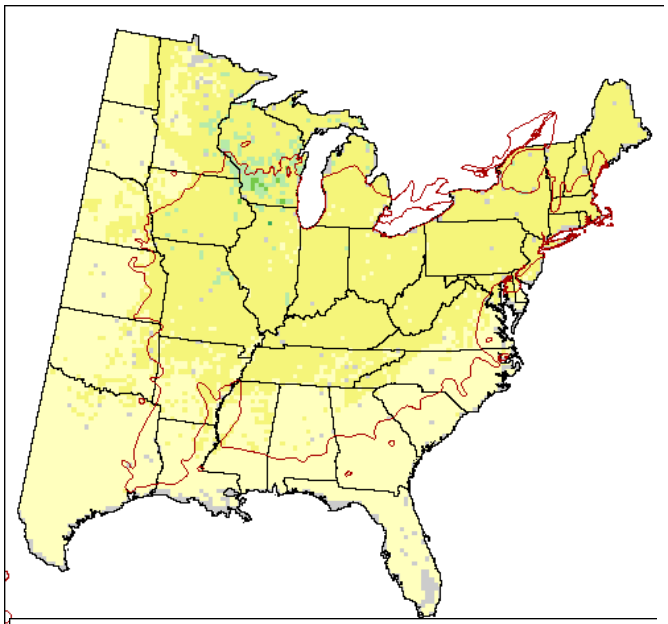

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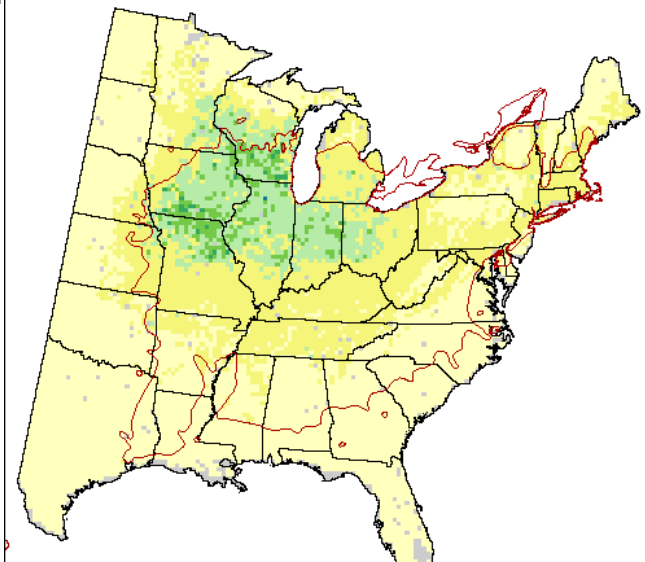


http://www.fs.fed.us/nrs/atlas/

Big Gainers

Silver maple

American hornbeam

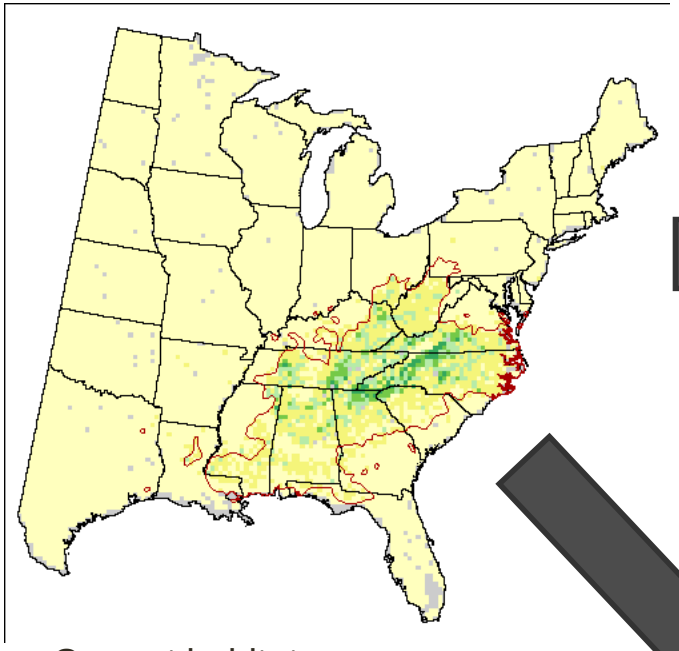
Mockernut hickory

Flowering dogwood

Eastern redcedar

White oak

New Habitat- Sourwood



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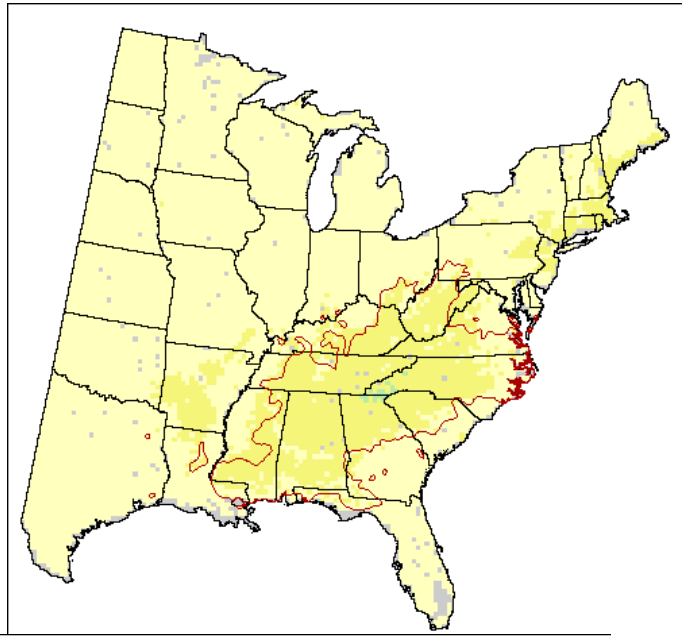

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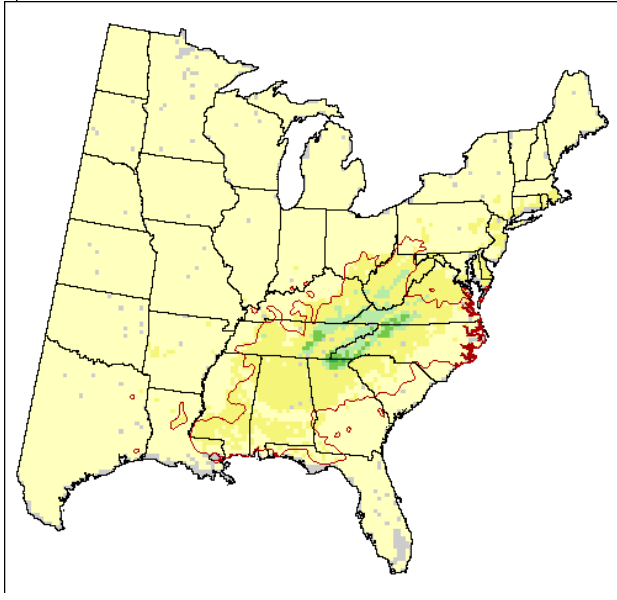

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New Species to Try

Pawpaw

Eastern redbud

Baldcypress

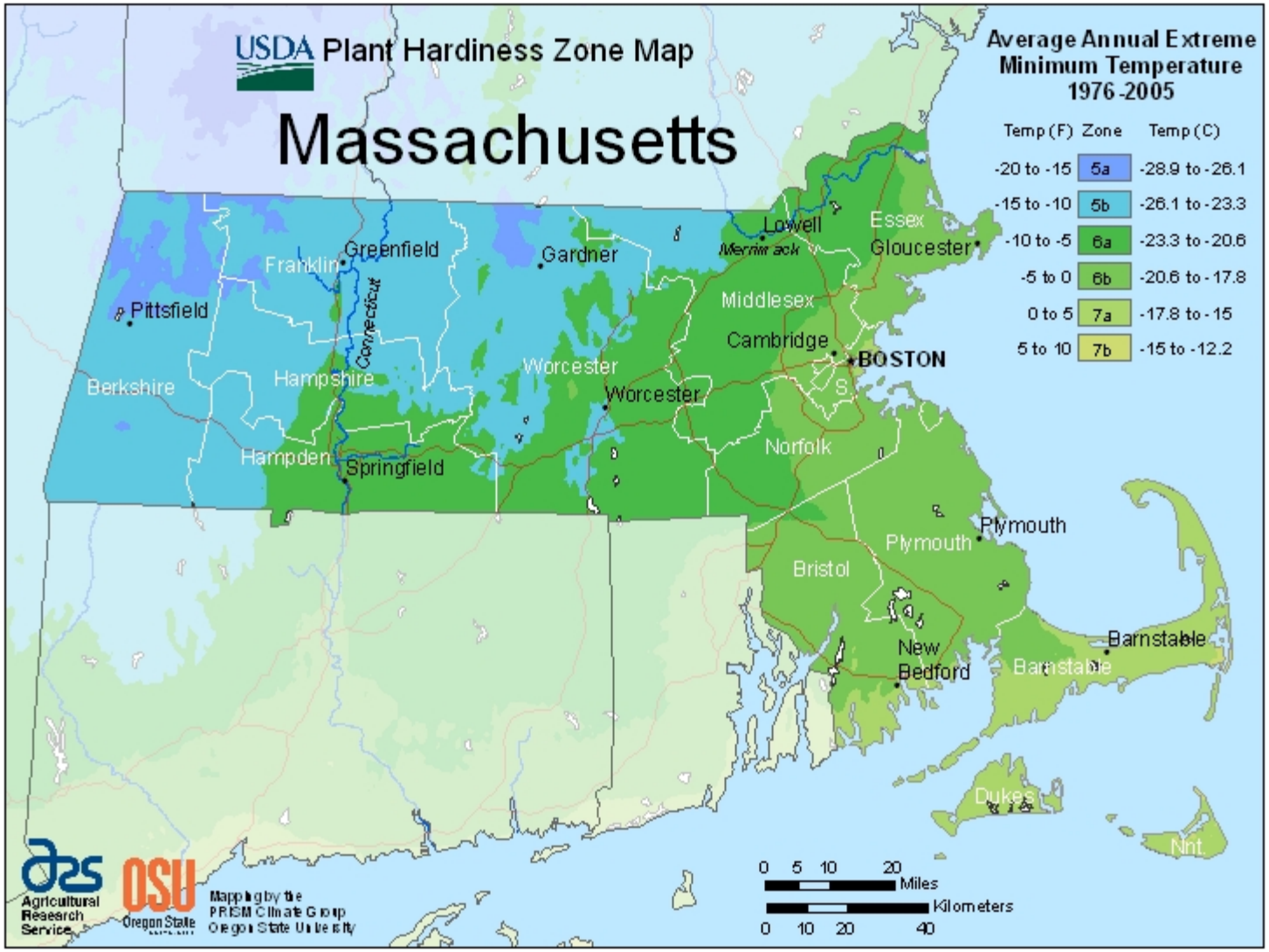
Tulip tree

Sweetgum

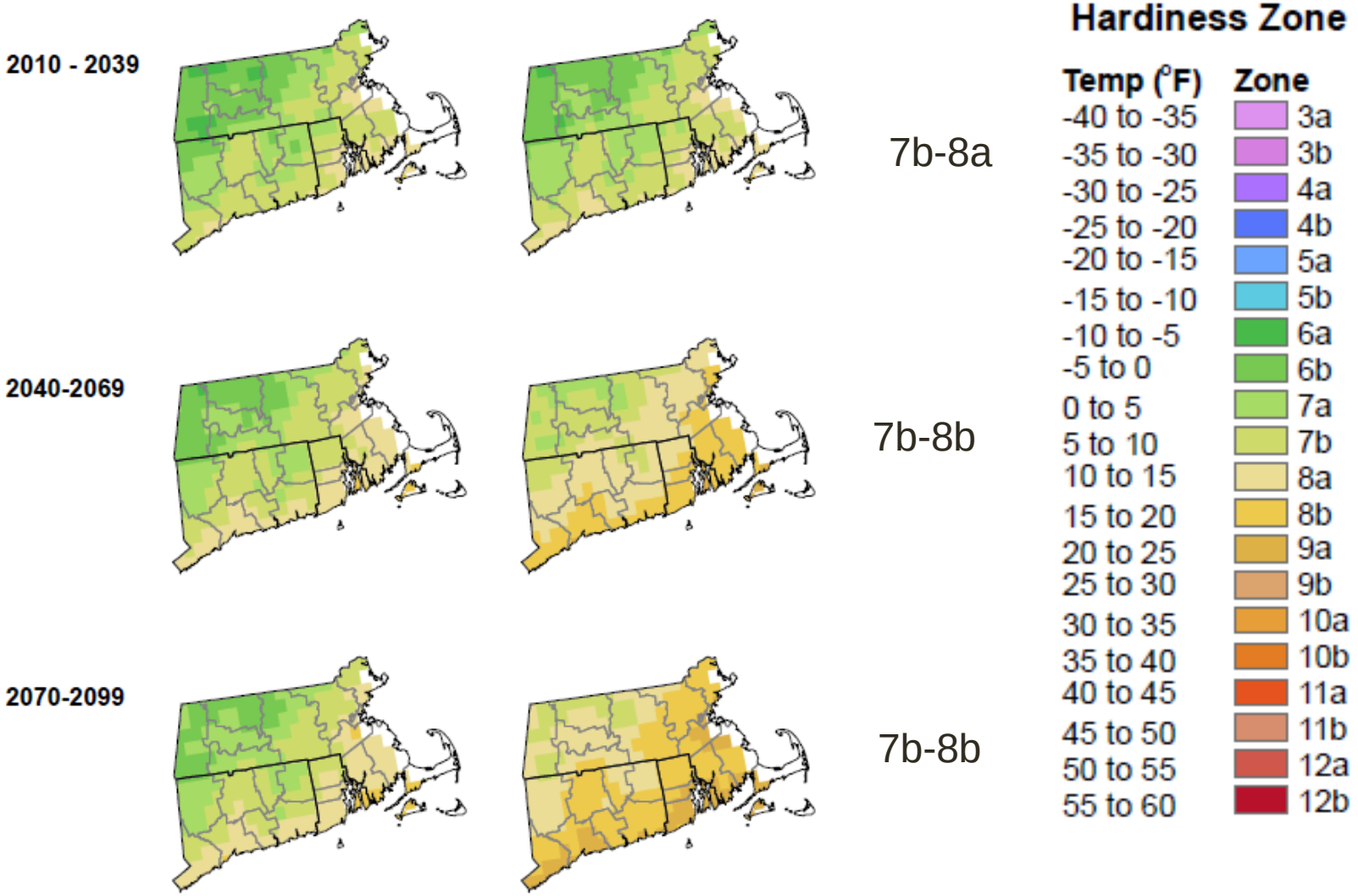
Persimmon

Non-Natives, Invasives, Cultivars?

Current USDA Hardiness Zones



Hardiness Zone Projections



Species That Could Benefit from Hardiness Zone Shifts

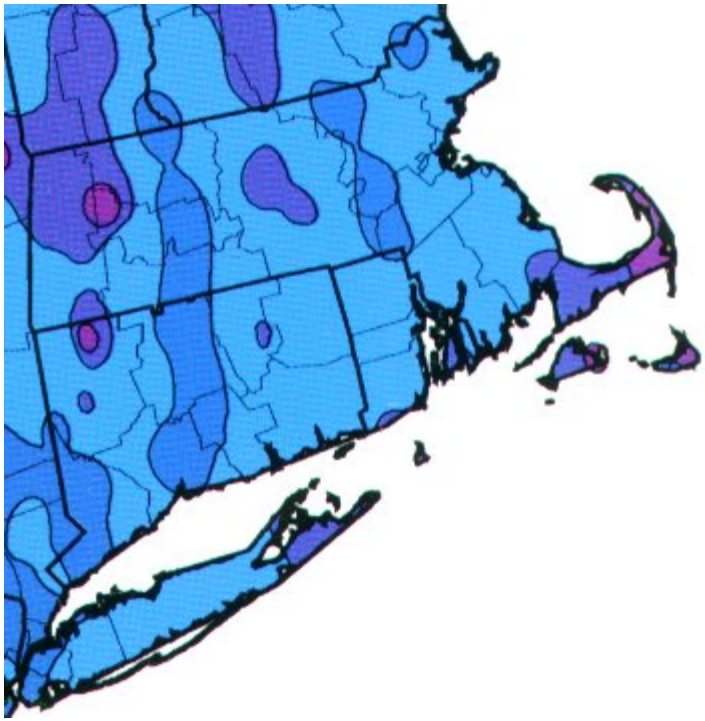
Dawn redwood

Kwanzan cherry

Weeping willow

Chinese elm

Current AHS Heat Zones

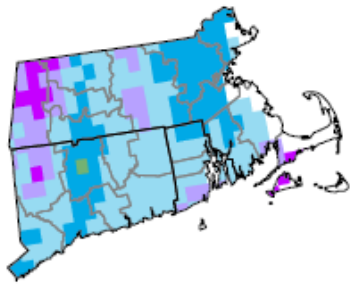


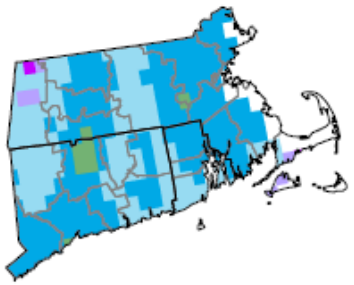
Average Number of Days per Year Above 86°F (30°C)	Heat Zone
< 1	1
1 to 7	2
> 7 to 14	3
> 14 to 30	4
> 30 to 45	5
> 45 to 60	6
> 60 to 90	7
> 90 to 120	8
> 120 to 150	9
> 150 to 180	10
> 180 to 210	11
> 210	12

Heat Zone Projections

Low Emissions High Emissions

2010 - 2039





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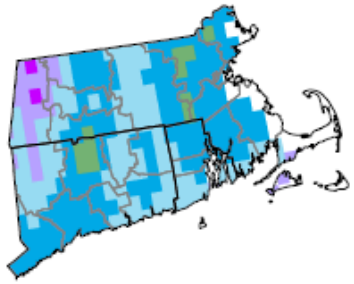
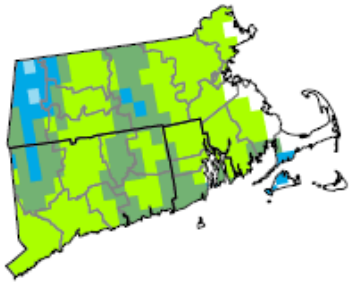
2040-2069





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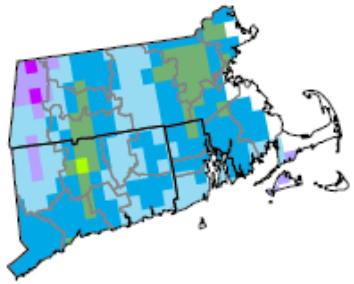
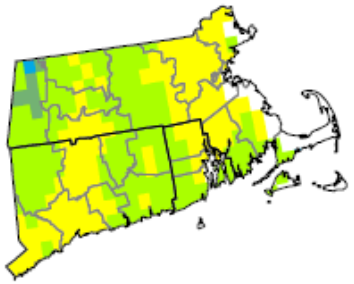
2070-2099





5-8

Heat Zone (days over 86°F)

- 1: < 1
- 2: 1 to 7
- 3: >7 to 14
- 4: >14 to 30
- 5: >30 to 45
- 6: >45 to 60
- 7: >60 to 90
- 8: >90 to 120
- 9: >120 to 150
- 10: >150 to 180
- 11: >180 to 210
- 12: > 210

Species that could Potentially be Negatively Affected by Heat Zone Shifts

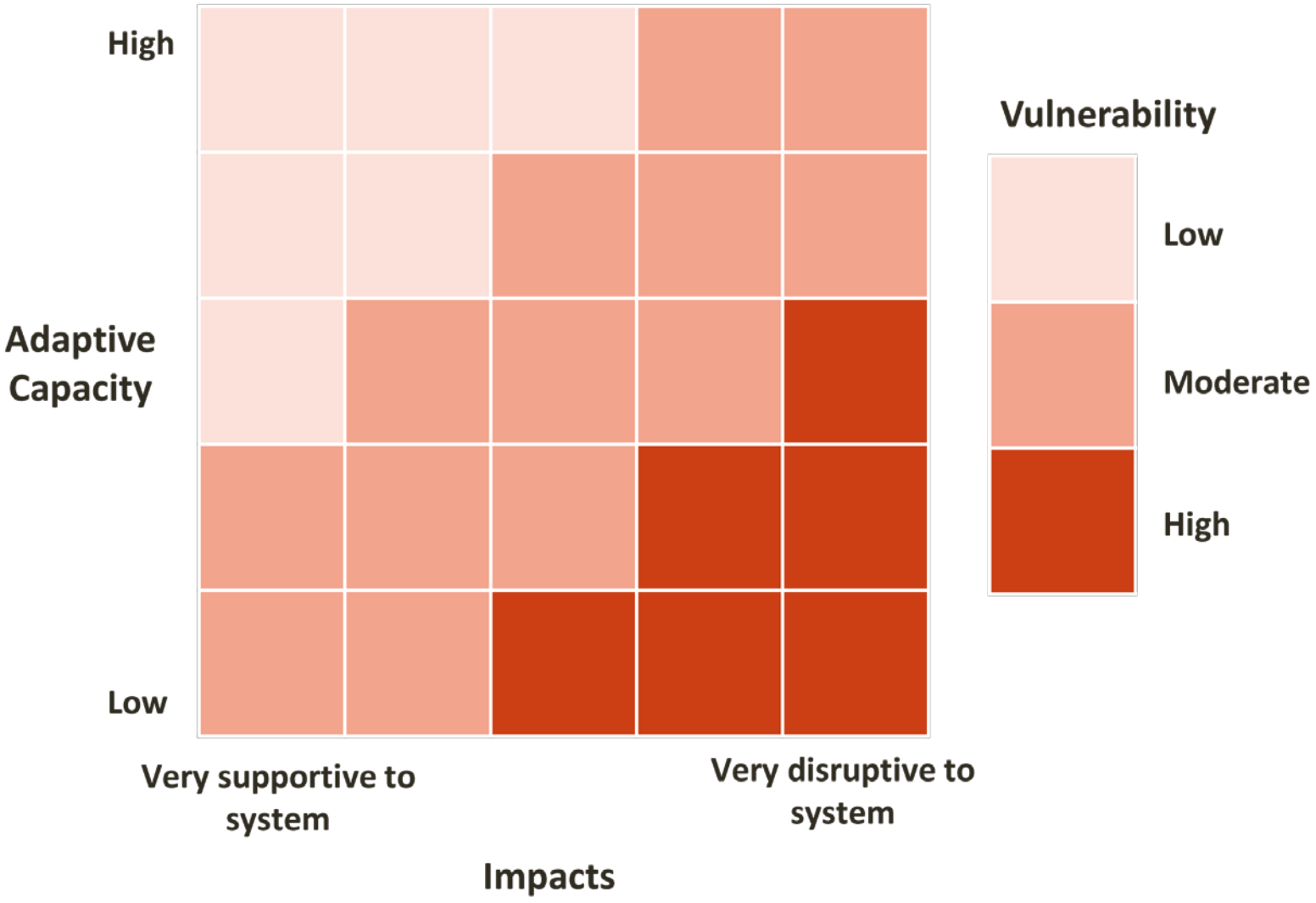
Norway maple

Amur maackia

Japanese tree lilac

Littleleaf linden

VULNERABILITY



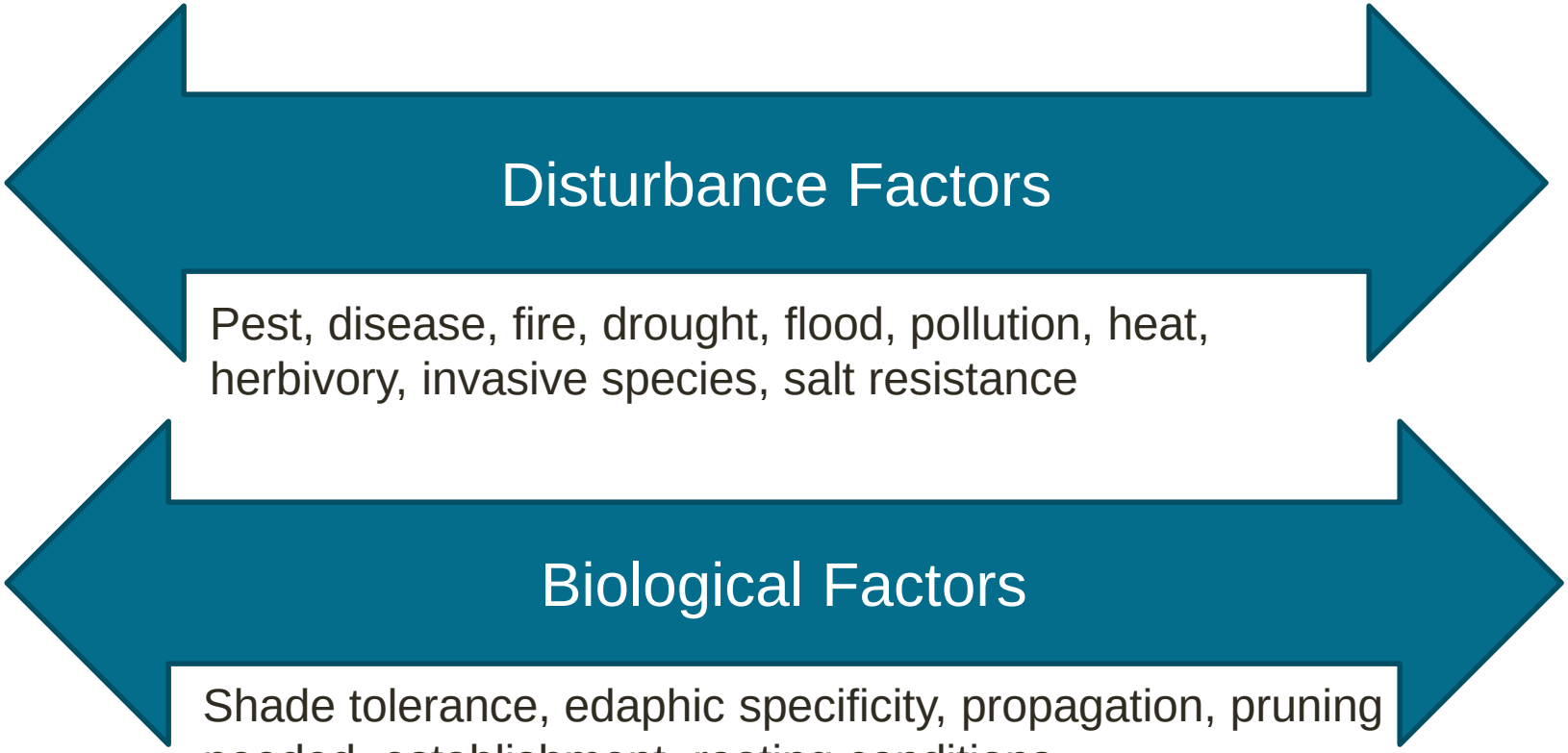
Swanston et al. 2016

Adaptive Capacity

the ability of a system to accommodate or cope with potential climate change impacts with minimal disruption.

Adaptive Capacity Factors

Based on Matthews et al. 2011



2 Separate Scores

Planted

Includes nursery propagation, restricted rooting conditions, maintenance, planting site

Naturally-Occurring

Dispersal ability, regeneration capacity

Species with High Adaptive Capacity

- Not generally susceptible to pests, disease that lead to mortality/reduced growth
- Drought-tolerant
- Flood-tolerant
- Not susceptible to breakage/mortality from wind and/or ice
- Tolerates a wide range of temperatures
- Tolerates urban conditions like salt, pollutions, restricted rooting conditions
- Shade-tolerant
- Can be planted on a range of sites, soils
- Easily propagated and established once planted

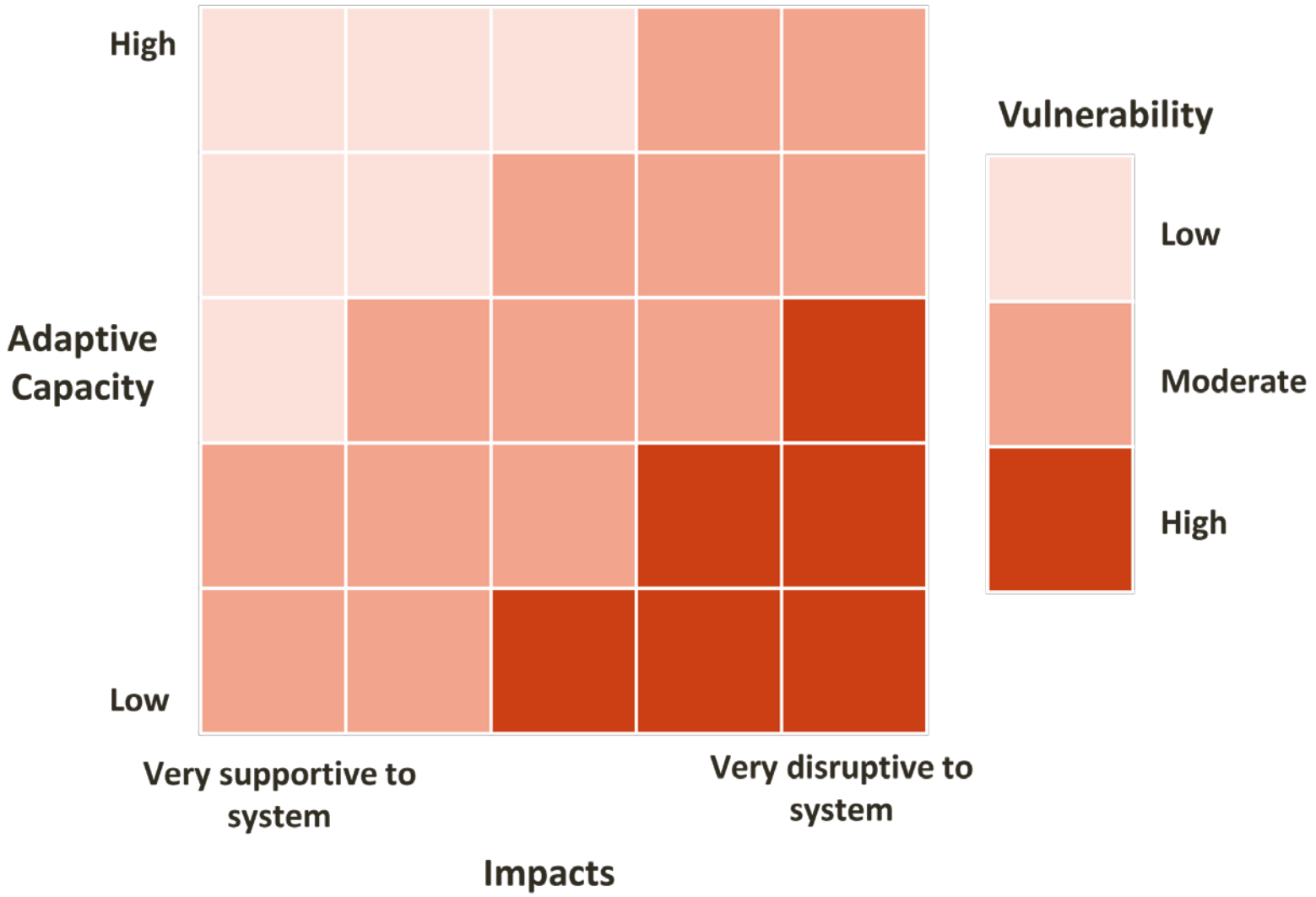
High Adaptive Capacity: Kentucky Coffeetree

- No major pest/disease issues
- Adaptable to a range of soils, climates
- Urban-tolerant
- Low maintenance
- Widely available

Low Adaptive Capacity: Paperbark Maple

- Susceptible to Asian longhorned beetle
- Drought-intolerant
- Susceptible to leaf scorch
- Difficult to propagate

VULNERABILITY



Swanston et al. 2016

Overall Vulnerability

Most Vulnerable

- Red pine
- Pitch pine
- Eastern white pine
- Bigtooth aspen
- Quaking aspen
- Canadian hemlock

Least Vulnerable

- Eastern redcedar
- Blackgum/Black tupelo
- Mockernut hickory
- Eastern hophornbeam/ironwood
- American Hornbeam
- Serviceberry species
- Yellowwood
- Kousa Dogwood
- Ginkgo
- Kentucky Coffeetree
- Persian Ironwood
- Yoshino Cherry
- Snowgoose Cherry
- Okame Cherry
- Japanese zelkova

Summary

- Vulnerability=Impacts + adaptive capacity
- We expect a decrease in suitability for northern trees and an increase for southern trees
- Hardiness zones may shift by 1 to 2 full zones by the end of the century.
- Heat zones may shift by 1-4 zones, meaning up to four months each year may be above 86 degrees F
- Trees vary in their capacity to adapt-consider multiple factors
- Overall, more northern trees that are susceptible to pests, disease, and disturbances will be the most vulnerable
- The least vulnerable trees are those that can tolerate a range of environmental conditions and are at the center or north end of their range here.