Climate Change and Northern Forests: A Review

Brad Hutnik
Northern Forest Birds Network 2023 Conference
Forestry for Birds in a Changing Climate
October 18, 2023

Climate Change and Northern Forests: A Review

I. “Givens”
II. Projected climate change impacts on Wisconsin forests
III. What does this mean for forest management?

What is sustainable forestry?

Sustainable forestry is the practice of managing dynamic forest ecosystems to provide ecological, economic, social, and cultural benefits for present and future generations.

WDNR Division of Forestry

What is sustainable forestry?

Sustainable forestry practices must be based on:

- Compatible landowner objectives
- The capabilities of each site
- Scientifically sound silviculture

∴ Each of these factors is equally important

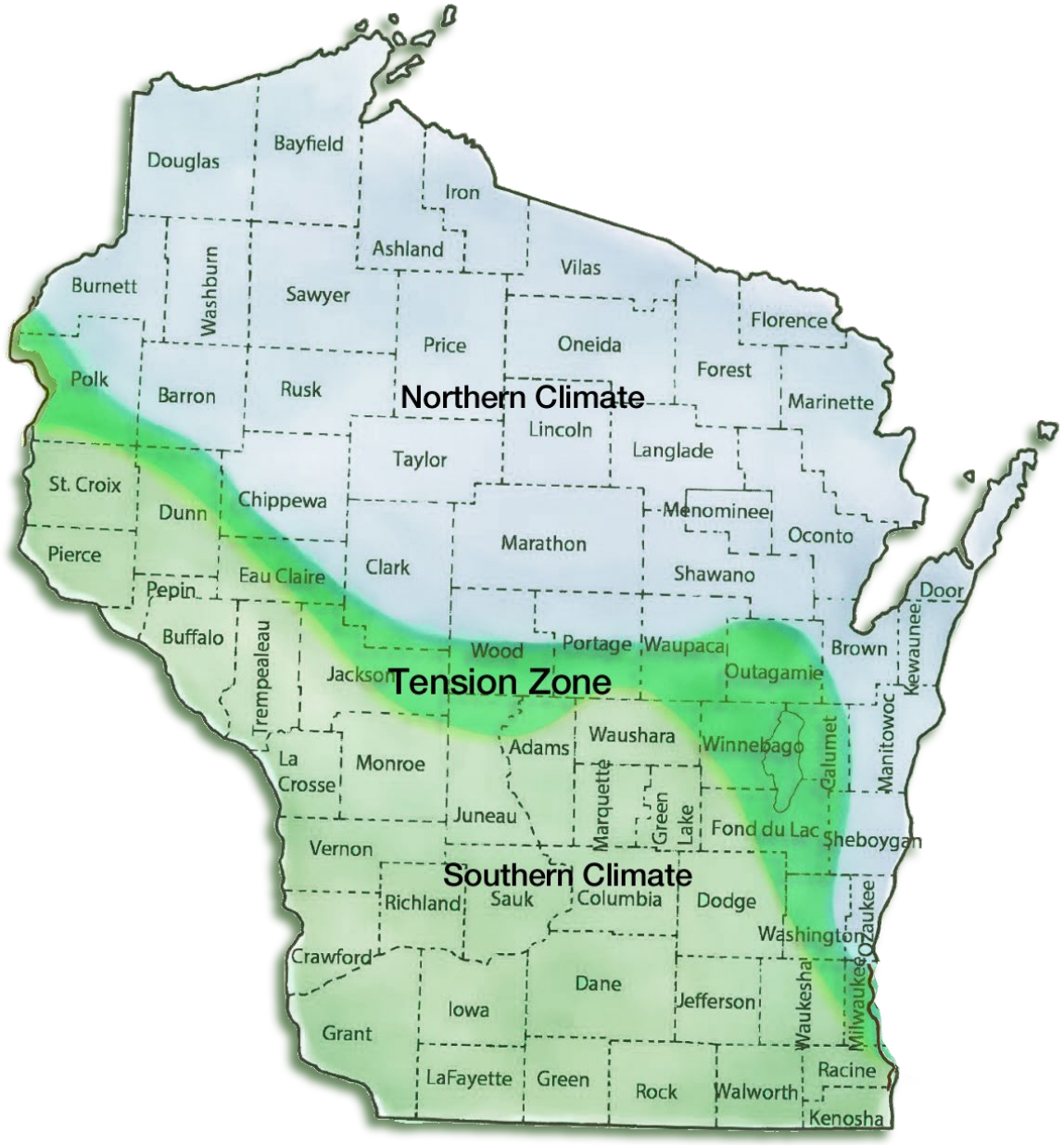
What is silviculture?

Definition

The art and science of controlling forest composition, structure, and growth to maintain and enhance the forest's utility for **any** purpose.

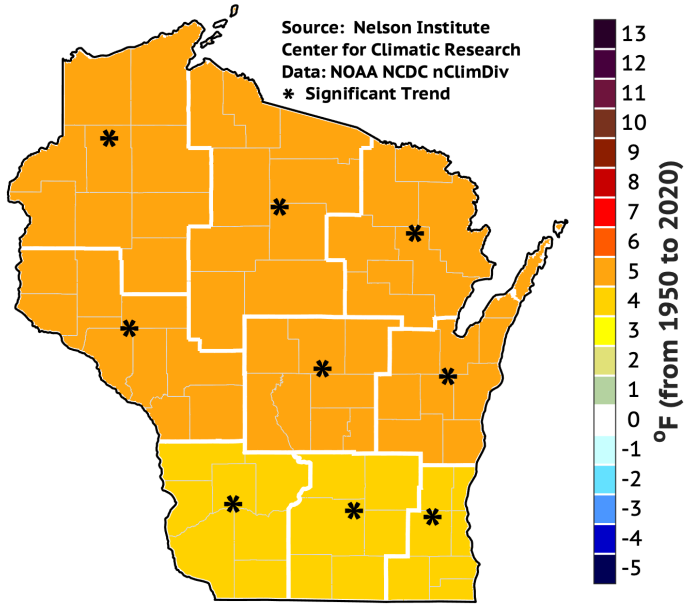
Though the purpose may change, the theory and tools will be essentially the same.

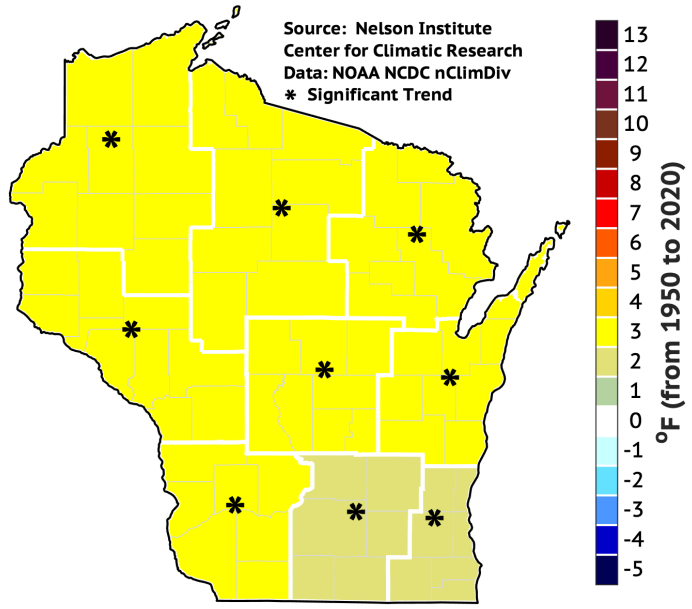
The challenge for silviculture will be how to adapt existing tools to meet new goals and objectives.


Douglas
Bayfield
Iron
Ashland
Vilas
Florence
Burnett
Washburn
Sawyer
Price
Oneida
Forest
Polk
Barron
Rusk
Northern Climate
Marinette
Lincoln
Langlade
Taylor
St. Croix
Dunn
Chippewa
Menominee
Oconto
Marathon
Pierce
Clark
Shawano
Eau Claire
Pepin
Door
Buffalo
Trempealeau
Wood
Portage
Waupaca
Brown
Kewaunee
Jackson
Tension Zone
Outagamie
Waushara
Winnebago
Calumet
Manitowoc
Adams
La Crosse
Monroe
Marquette
Green Lake
Fond du Lac
Sheboygan
Juneau
Vernon
Southern Climate
Richland
Sauk
Columbia
Dodge
Ozaukee
Washington
Crawford
Dane
Jefferson
Waukesha
Milwaukee
Iowa
Grant
Racine
LaFayette
Green
Rock
Walworth
Kenosha

It's Been Warming in Every Season. . .

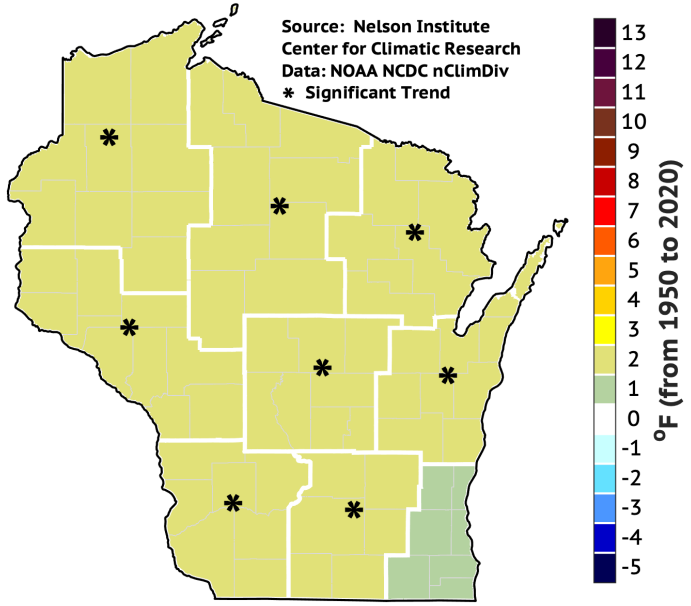
Winter

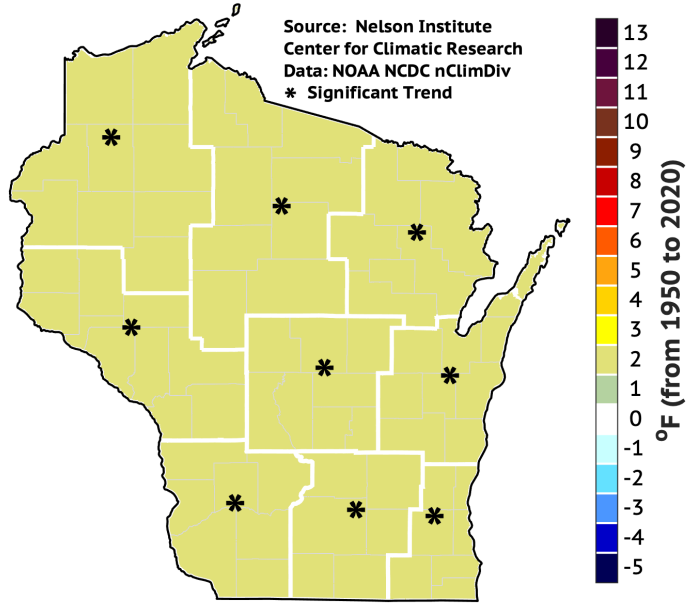




Spring

Summer

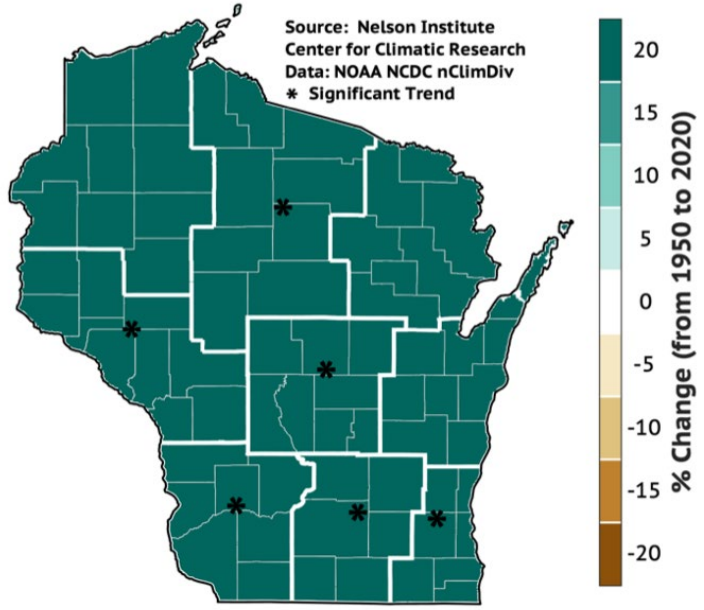




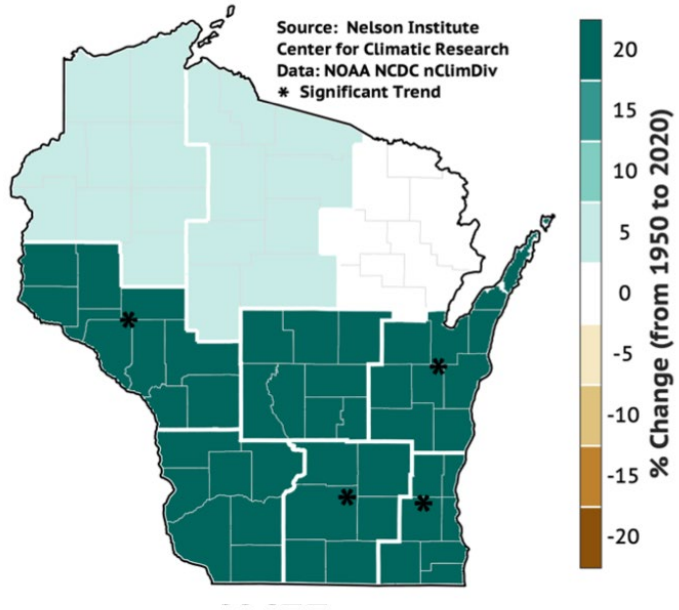
Fall

And Wetter in Every Season. . .

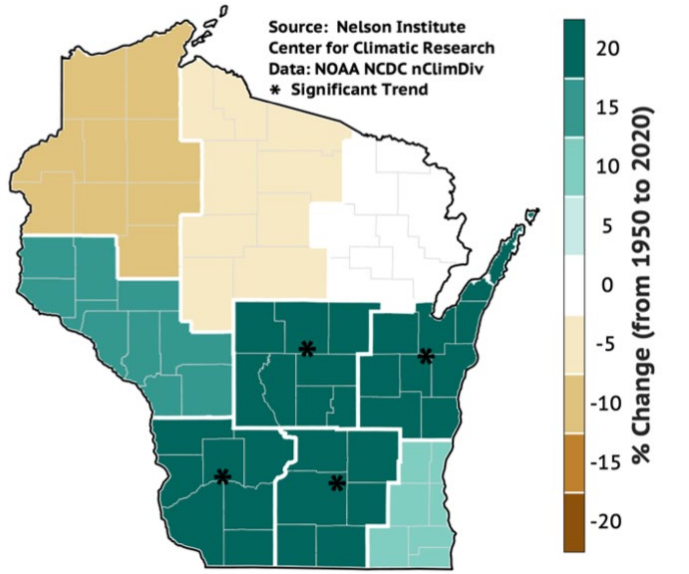
Winter



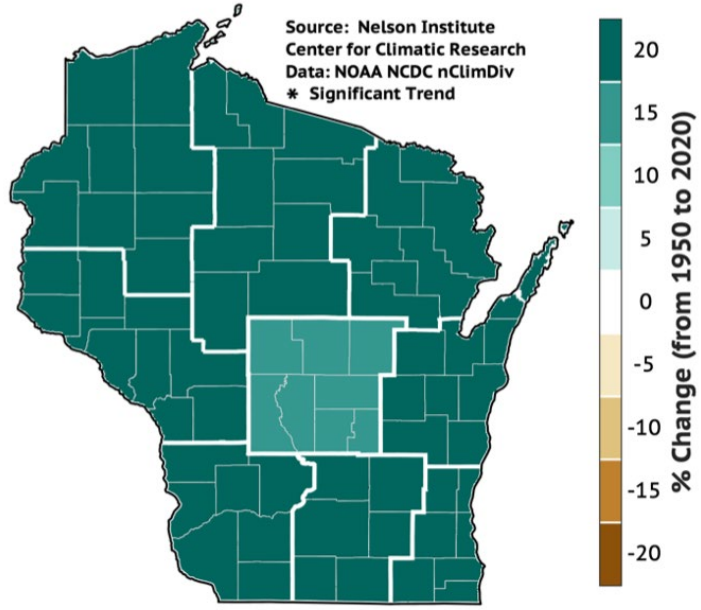
Spring



Summer



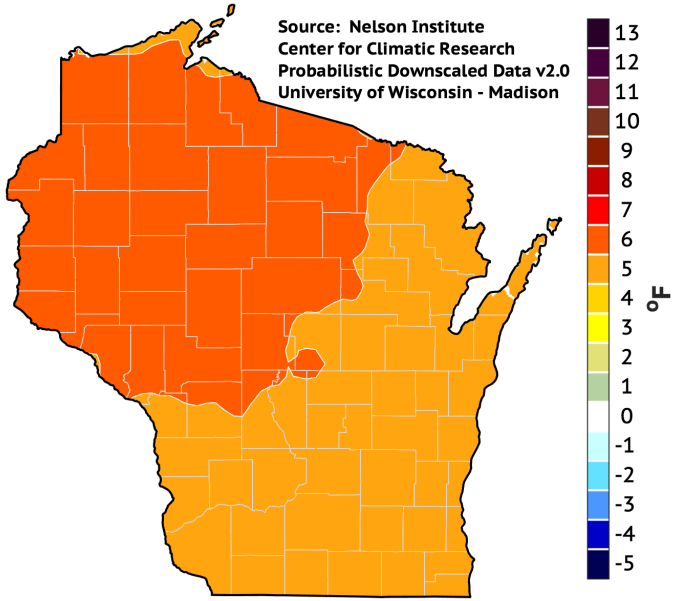
Fall

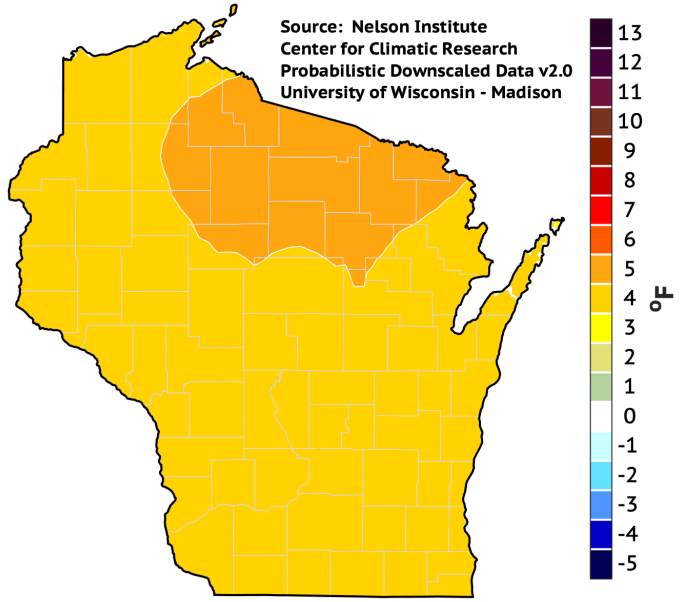


Warming to continue in every season. . .

Projected Temperature Change 2041-60

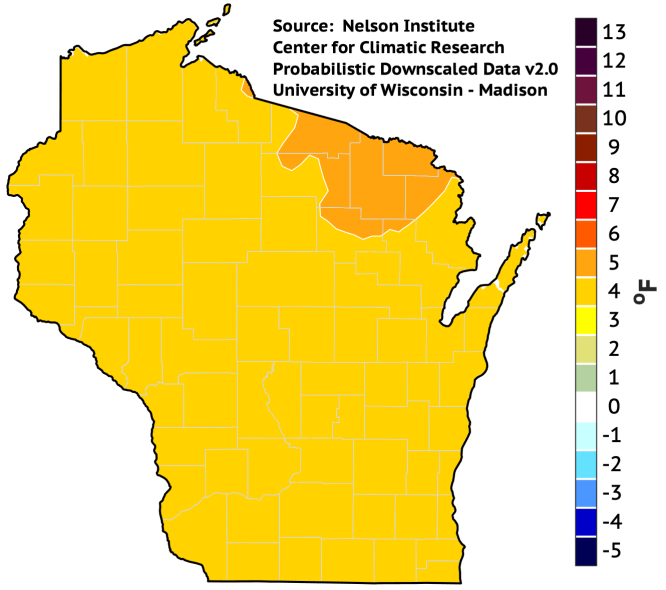
Winter

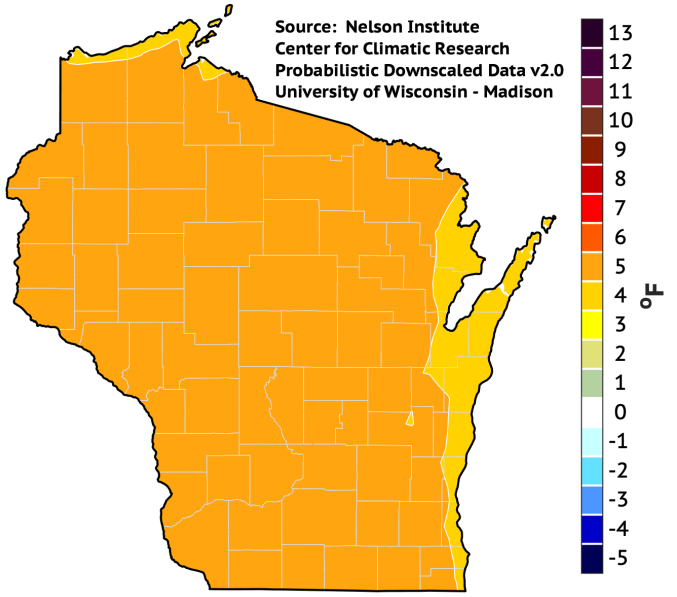




Spring

Summer



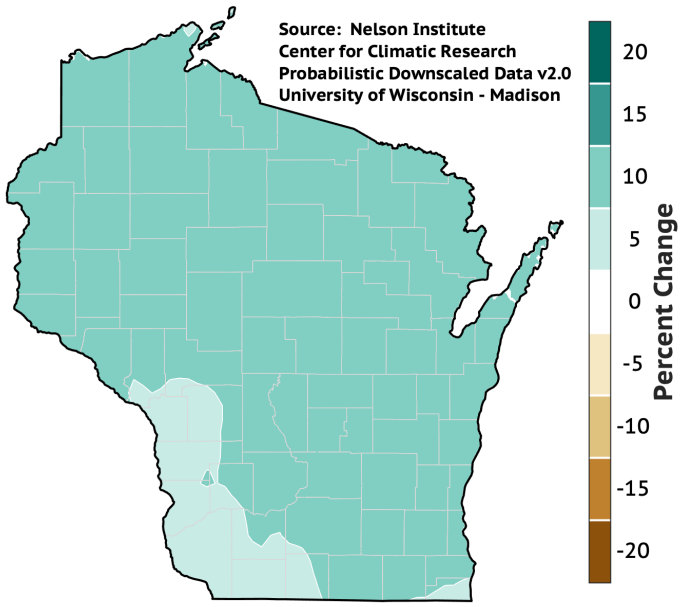


Fall

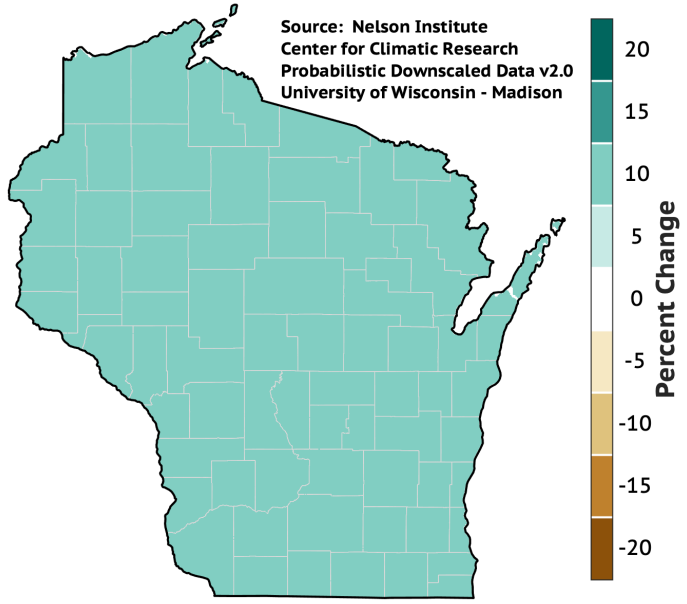
Generally wetter throughout the year. . .

Projected Precipitation Change 2041-60

Winter

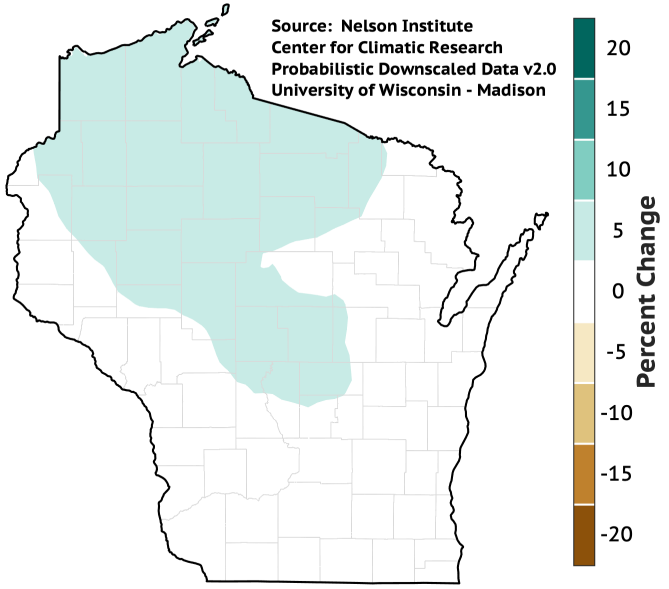


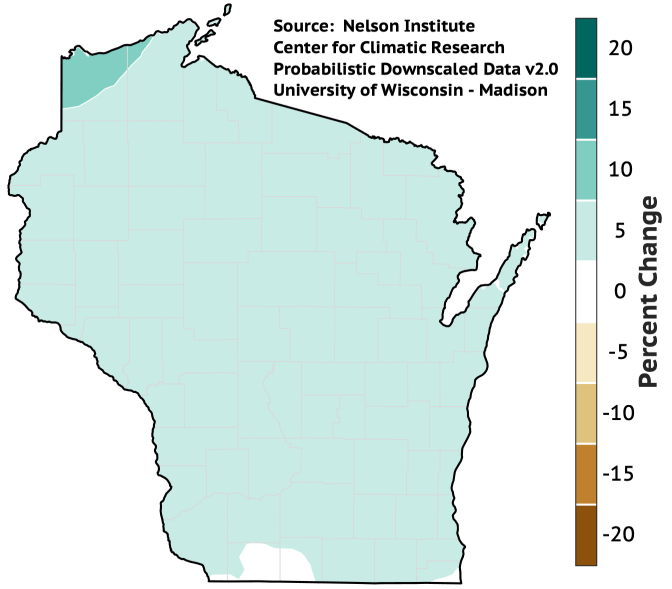
Spring



Summer

?





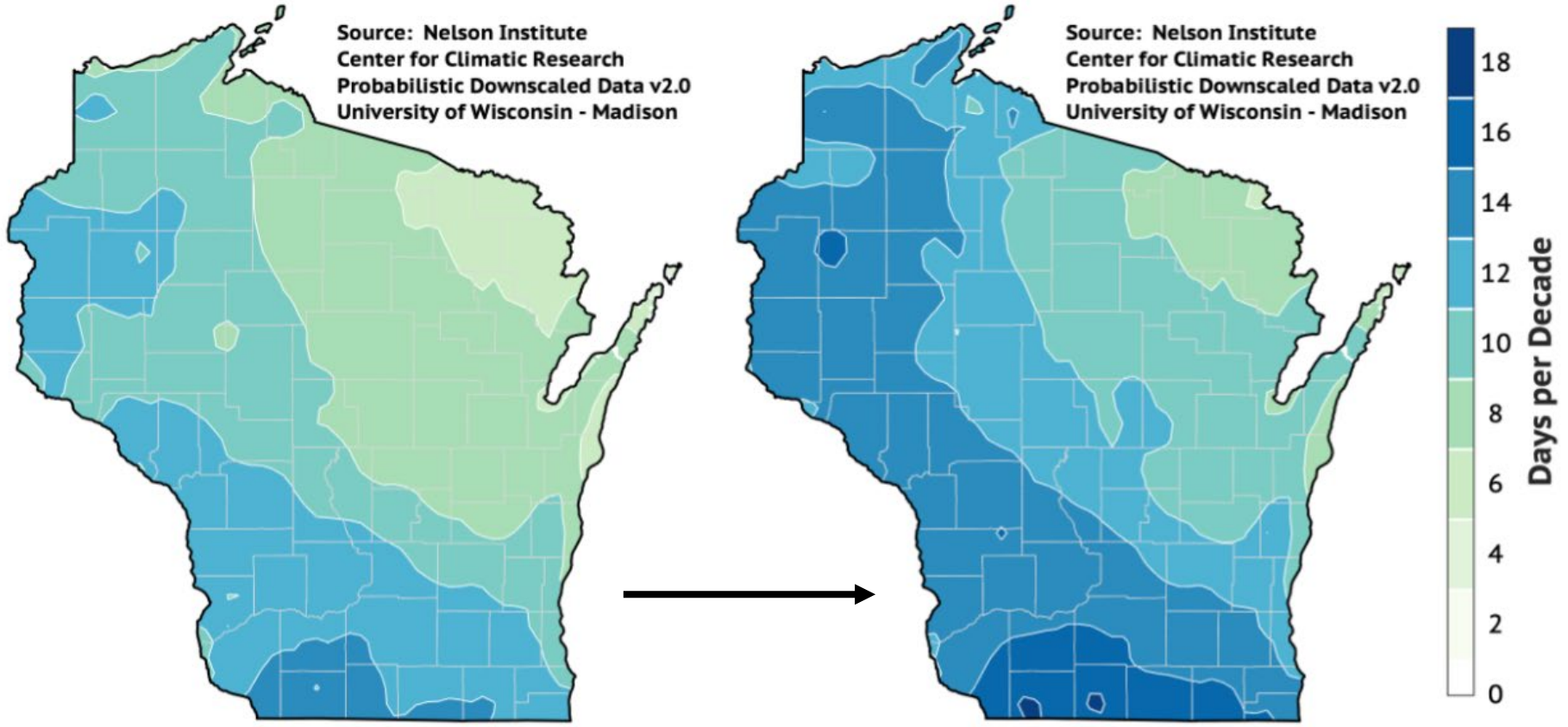
Fall

Wisconsin's Future Climate by Late Century?: Extremes

Extreme Rain: 2-inch daily rainfalls

PAST: 1981-2010 average

FUTURE: 2040-2060 average



Extreme rainfall to increase in the future throughout Wisconsin

Projected Climate Change Impacts on WI Forests

- Longer growing seasons
  - Early spring frost damage
- Higher growth rates
- Increased drought risk
- Precipitation
  - More precipitation
  - Heavier precipitation
  - Increased flooding and inundation
- Extreme wind events
- Winter storm, ice damage
- Less frozen ground
- Increased fire risk
- Species range shifts
- Forest pests and diseases
- Vertebrate species herbivory
- Stacked stressors

Handler et al. 2014

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Handler et al. 2014

Longer Growing Season

Benefits:

- More time for growth!

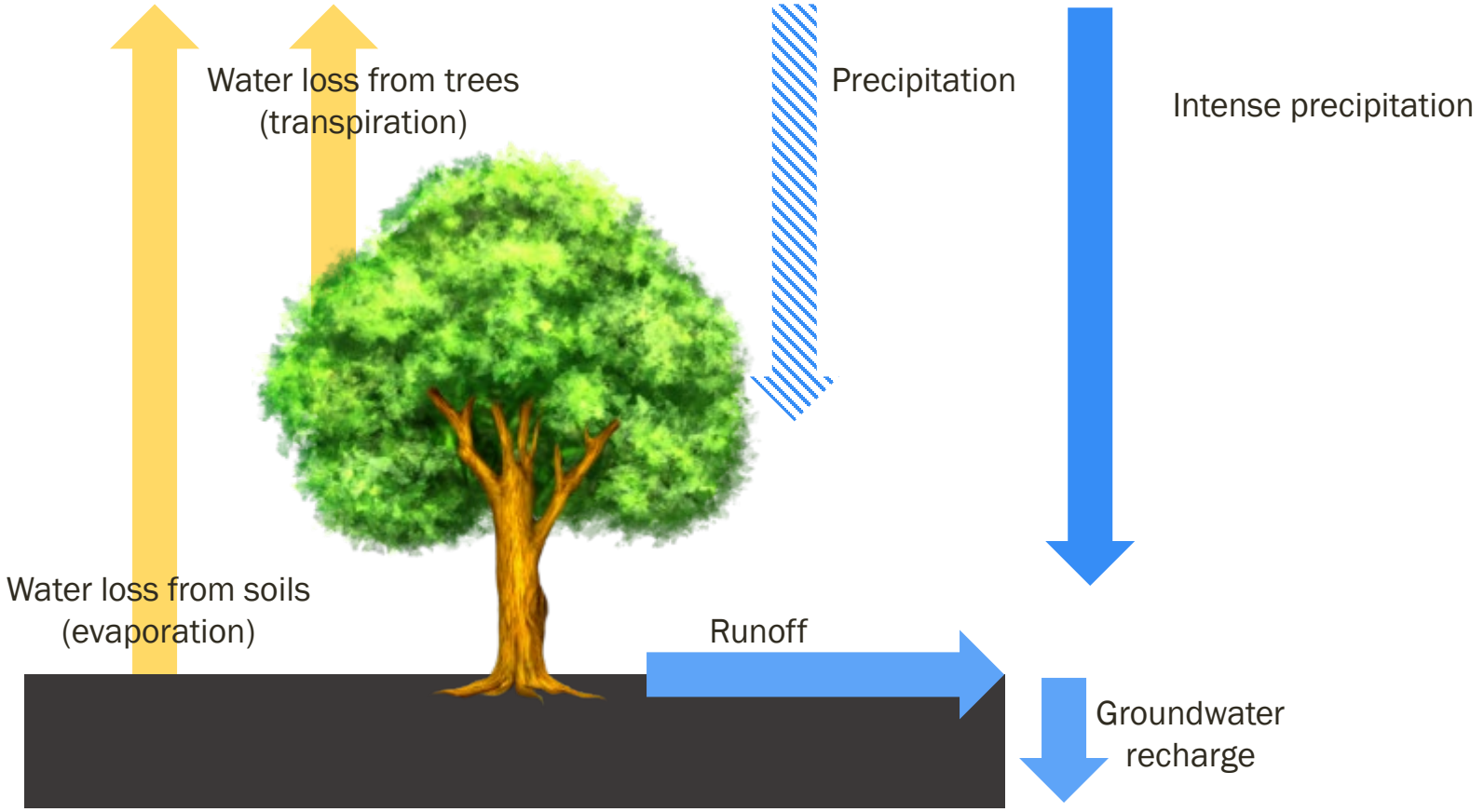
Limits:

- Early bud break/loss of cold hardening
- Frost damage with spring frosts

Ainsworth and Long 2005, Ainsworth and Rogers 2007, Norby and Zak 2011

More Drought Stress

Greater uncertainty about future precipitation, but great risk of summer moisture stress



Extreme Weather Events

Extreme events are rare and hard to model.

- Uncertainty is very high
- High wind events may increase in northern latitudes (above 40-50º)
- Average wind speeds may decrease slightly across the central US
- Regeneration may not follow the usual pattern

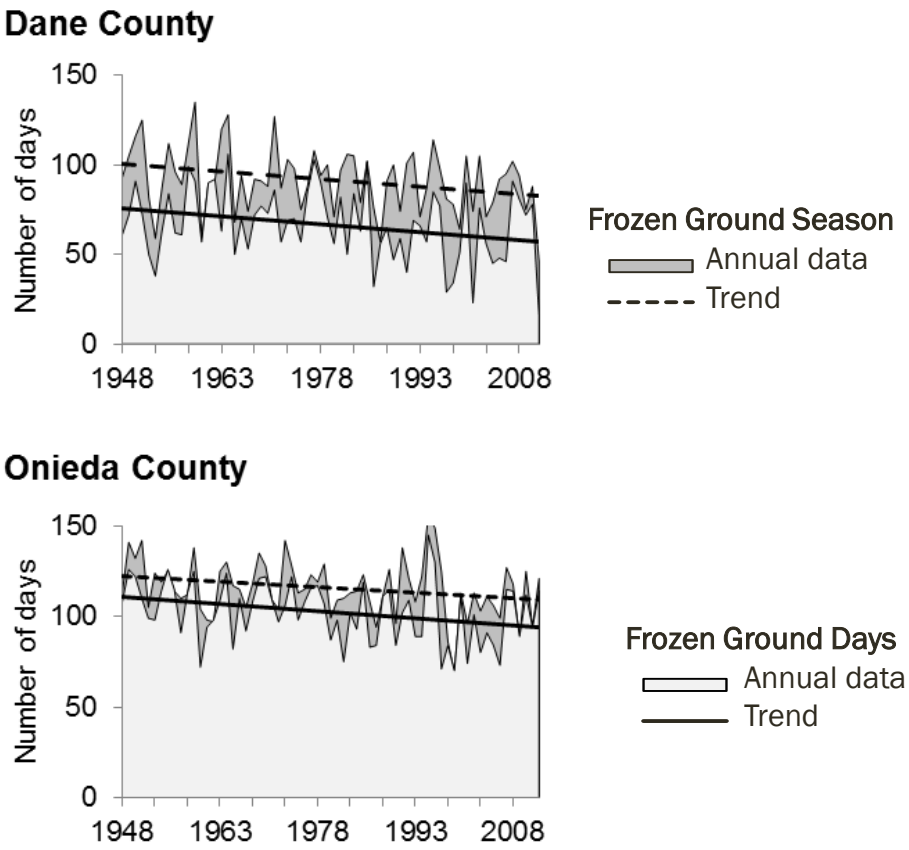
Gastineau and Soden 2009, Kumar et al. 2015, Karnauskas et al. 2018

Winter Storm, Ice Damage

Sabrina Ullman, WDIO

Less Frozen Ground

Frozen ground conditions have decreased across over the last 60+ years



Source: C. Rittenhouse (UConn) and A. Rissman (UW-Madison), in review

Wildfire Risk

Fire may increase, because:

- Warmer/drier summers
- Increased mortality from stress, pests, events
- More frequent weather conditions that promote large fires

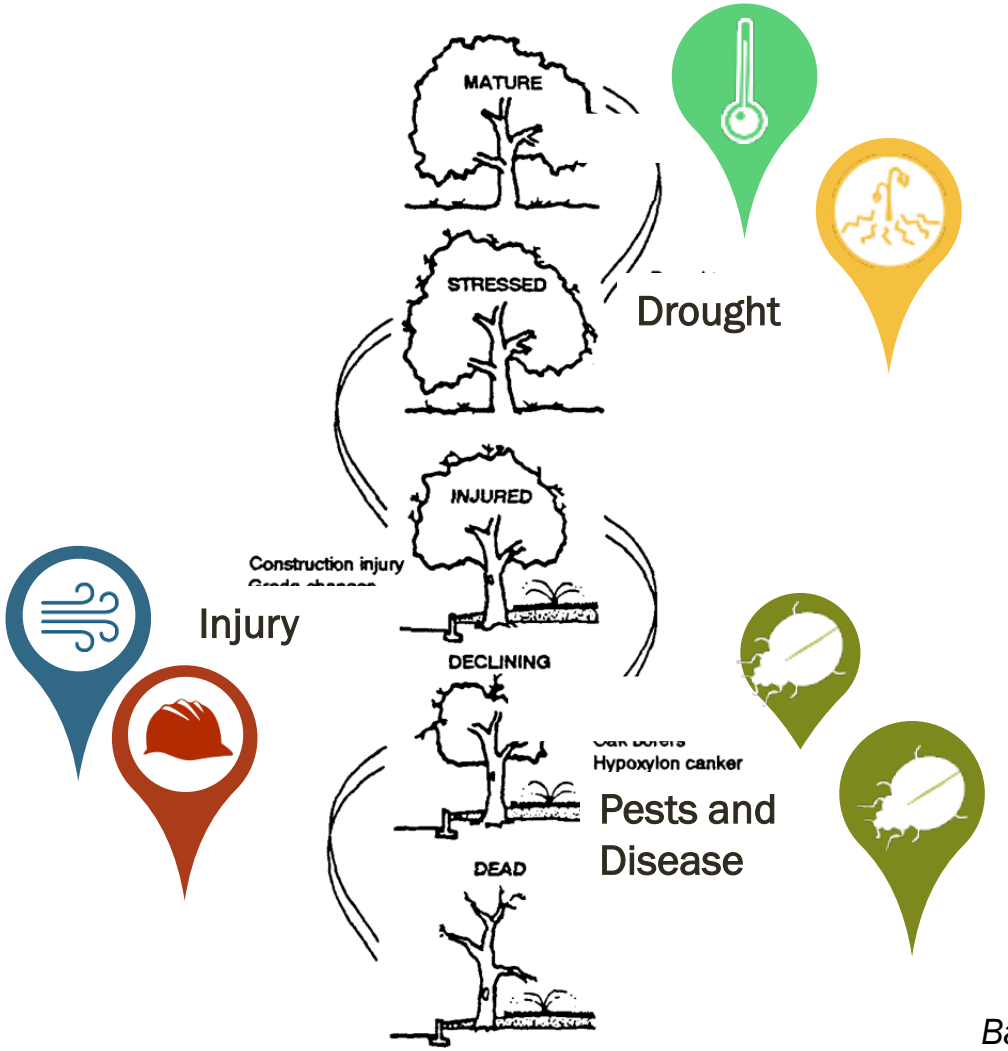
...or maybe not, because:

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

Source: Guyette et al. 2014, Tang et al. 2014, Miranda et al. 2012, Moritz et al. 2012, Nowacki et al. 2014

A “Threat Multiplier”

- Interactions can trigger big changes
  - Stress
  - Disturbance
  - Invasive species
  - Insect pests
  - Forest diseases



Bartlett Tree Experts

What does this mean for forest management?

Can forest management mitigate climate change?

Forests are a natural carbon sink that absorb 10-15 percent of our nation's greenhouse gases.

Forests in the upper Midwest, including Wisconsin, have been a steadily growing carbon sink for decades.

With additional stressors brought about by climate change, we must work to ensure that Wisconsin's forests continue to store carbon.

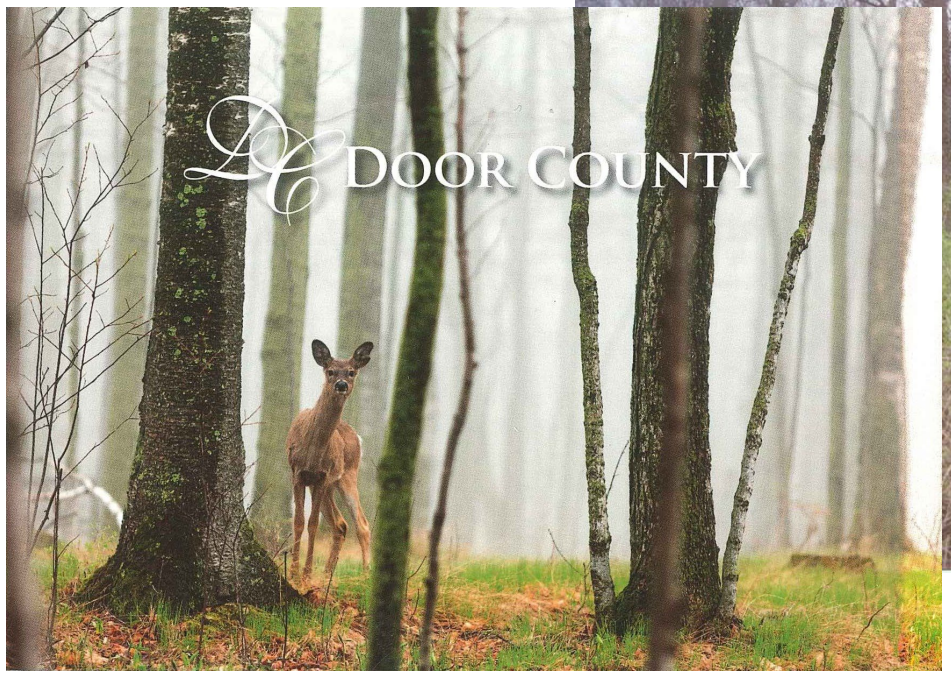
2009

2014

2021

Principles of Resilient Forest Management

1. Keep forests as forests
2. Reduce stressors
3. Address vulnerabilities



WICCI 2021 Assessment: Forestry Solutions

1. Keep forests as forests

- ❑ *2020 Wisconsin Statewide Forest Action Plan*
  - ✓ Goal C: Keep forests as forests to maintain the long-term value & benefits they provide.

2. Support holistic deer management

- ❑ *2020 Wisconsin Statewide Forest Action Plan*
  - ✓ Goal H: Forested land & ecosystem functions are maximized, while losses due to forest health threats are minimized.
    - ○ Strategy 4: Reduce impacts to regeneration from invasive species, deer, catastrophic weather events, and climate change.

3. Expand rural and urban forest cover

- ❑ *2020 Wisconsin Statewide Forest Action Plan*
  - ✓ Goal K: Carbon storage in forests & forest products is increased.
    - ○ Strategy 3: Increase Wisconsin's forested area to increase total stored carbon in the State.

4. Support climate-focused planning and management

- ❑ *2020 Wisconsin Statewide Forest Action Plan*
  - ✓ Goal J. Forests are resilient & adaptable to future conditions.
    - ○ Strategy 11 Use best available science and research on climate change adaptation strategies to guide forest management.

5. Support WI Wood Product Utilization

- ❑ *2020 Wisconsin Statewide Forest Action Plan*
  - ✓ Goal K: Carbon storage in forests & forest products is increased.
    - ○ Strategy 6: Increase use and marketing of forest products, including wood-based construction.

Definitions

Silviculture:

1. The practice of controlling forest composition, structure, and growth to maintain and enhance the forest's utility for any purpose.
2. The **art** and science of controlling the establishment, growth, composition, health, and quality of forests to meet the diverse needs and values of landowners and society on a sustainable basis.

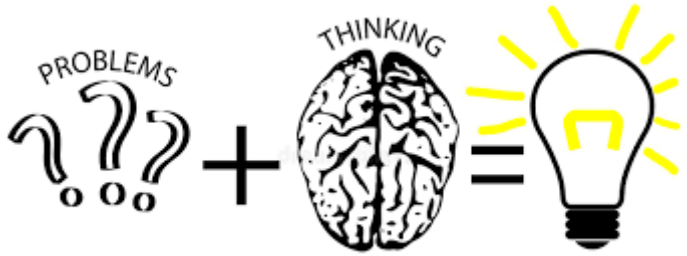
https://dnr.wisconsin.gov/sites/default/files/topic/ForestManagement/FR805_AppendixA.pdf

Art:

An ability or a skill that you can develop with training and practice

a. *Example: "I've never **mastered the art** of making bread."*

https://www.oxfordlearnersdictionaries.com/us/definition/english/art_1#:~:text=%2F%C9%91%CB%90rt%2F,modern%2Fcontemporary%20art



Definitions

Tinker:

To repair, adjust, or work with something in an unskilled or experimental manner (Merriam-Webster 2013),

1. Stems from the necessity to act when there is not enough knowledge or resources to solve a problem.
2. Con's
   a) inability to replicate
   b) lack of clear methodology, accounting, and note-taking

"Intelligent tinkering":

- The epithet "intelligent" raises the practice of tinkering to a higher plane. The tinkerer must resort to trial-and-error approaches.

- If well done, intelligent tinkering resolves the problem, even though what can be learned may be limited.

Murcia and Aronson 2014

Climate Change Tree Atlas & Stand Data

FEC Stand 4

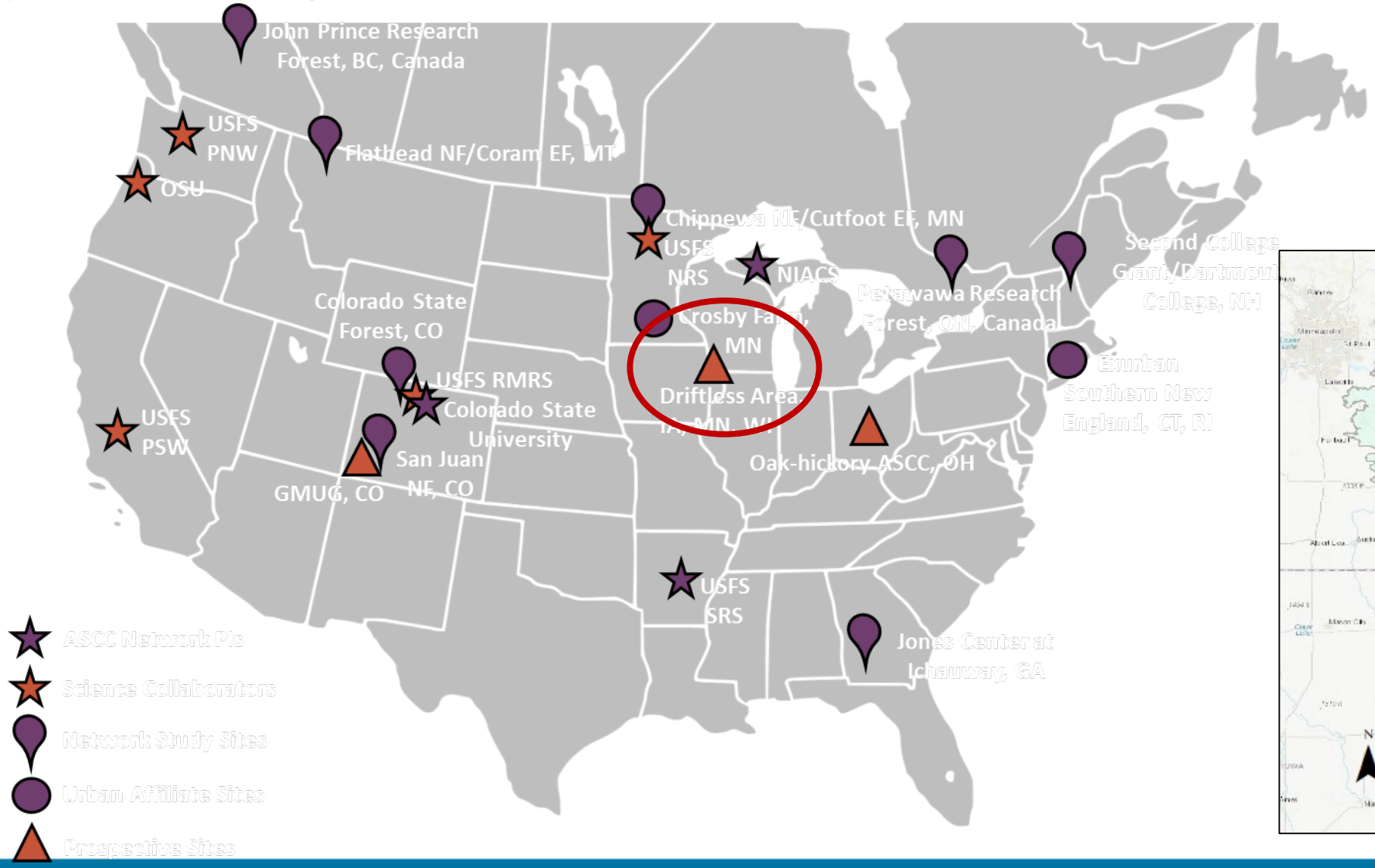
Overstory (2022)

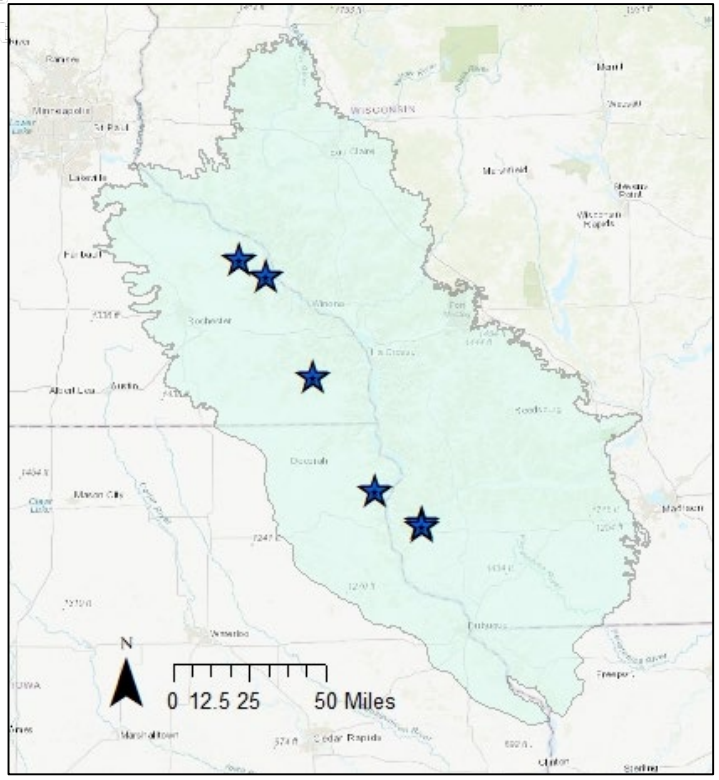
Species	Adaptability	Model Reliability	Stems Per Acre	Frequency	Basal Area	Importance Value	Low Emissions Capability Rating	Low Emissions "At risk" %	High Emissions Capability Rating	High Emissions "At Risk" %
white oak	High	Medium	25.3	87.5	54.4	32.69	Very Good	0	Very Good	0
sugar maple	High	High	28	100	32.4	19.43	Good	0	Good	0
northern red oak	High	Medium	15.5	75	62.4	37.48	Good	0	Good	0
white ash	Low	Medium	11.8	62.5	10.6	6.38	Fair	0	Fair	0
black cherry	Low	Medium	5.8	12.5	1.3	0.76	Fair	0	Poor	0.76
American basswood	Medium	Medium	3.4	12.5	2.8	1.66	Poor	1.66	Poor	1.66
American elm	Medium	Medium	1.9	12.5	2.7	1.6	Good	0	Good	0
Total			91.7	362.5	166.6	100		**1.66**		**2.42**

Low Emissions Capability Rating	Low Emissions IV%	High Emissions Capability Rating	High Emissions IV%
Very Good	32.69	Very Good	32.69
Good	58.51	Good	58.51
Fair	7.14	Fair	6.38
Poor	1.66	Poor	2.42
Very Poor	0	Very Poor	0

ASCC

Adaptive Silviculture for Climate Change



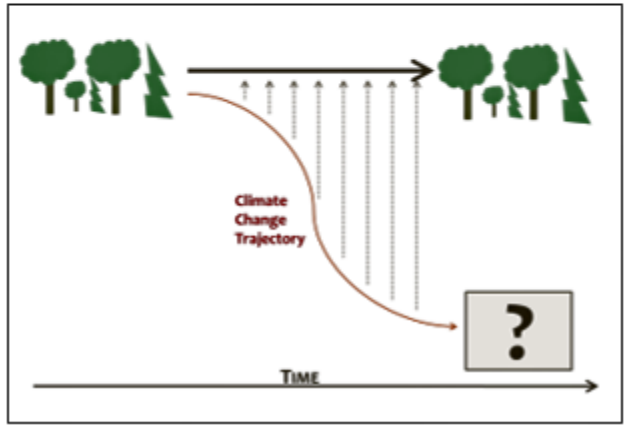


Climate Change Adaptation Options

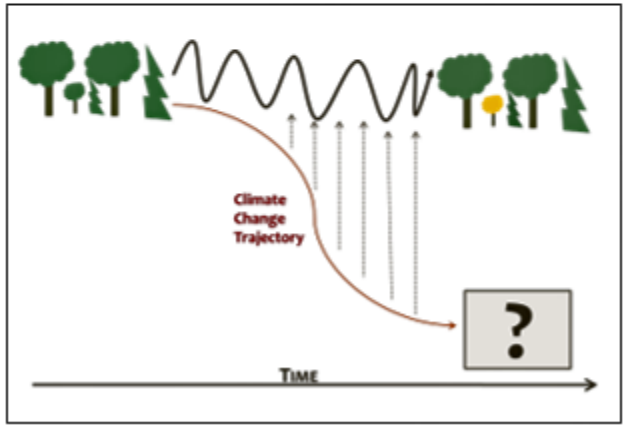
Manage for Persistence
Ecosystems are still recognizable as being the same system (character)

Manage for Change
Ecosystems have fundamentally changed to something different

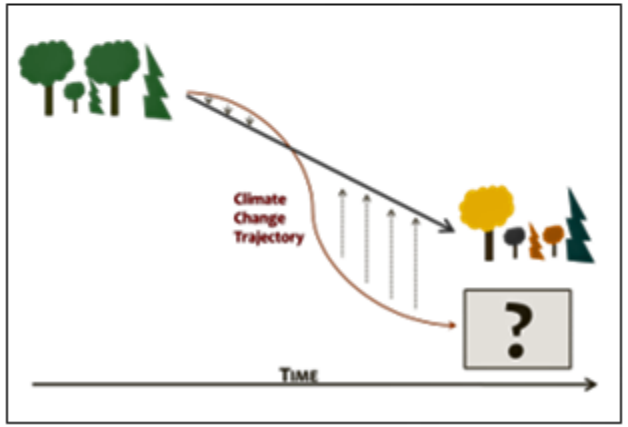
RESISTANCE



RESILIENCE



TRANSITION



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Carbon, WHAT?!!

6-24-2022

In this episode, part 1 of our 2 part series, we talk with Alexandra Kosiba, Ph.D., the first state climate forester with the Vermont Department of Forest, Parks, and Recreation, to better understand the basics of forest carbon.

Learn more, **earn CEUs/CFEs**, and listen here.

The Carbon Cycle Won't Leave Me Alone

7-29-2022

In part 2 of our carbon series, we explore ways to enhance carbon storage and sequestration through silviculture with Luke Nave, Ph.D. and Todd Ontl, Ph.D of the Northern Institute of Applied Climate Science.

Learn more, **earn CEUs/CFEs**, and listen here.

Climate Change Help Desk?

11-15-2021

On this episode of SilviCast, we dig into one tool that helps answer our climate change questions, The Climate Change Tree Atlas.

Learn more and listen here.

Right Tree, Right Place, Right Time

4-15-2021

In this episode we explore the challenges of artificial regeneration with Doug Jacobs, the Fred M. van Eck Professor of Forest Biology and Associate Head of Extension at Purdue University.

Learn more and listen here.

The Upshot

Climate change is and will continue to be one of the most critical factors affecting Wisconsin's forests.

Climate change adaptation often looks like "traditional, scientifically sound forest management." Often the real difference is the intention behind the practice.

We will all need to become "tinkerers."

CONNECT WITH US

Questions?

Contact Brad Hutnik

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"WILD WISCONSIN:
OFF THE RECORD"