Warmer, Wetter and Wilder

ANTICIPATED EFFECTS OF CLIMATE CHANGE ON

DOOR COUNTY AND GREEN BAY, LAKE MICHIGAN

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APPLETON, WISCONSIN

24 June 2022

Door County


(www.doorcounty.com)


(Paul M. Lurie)


(WI DNR)


(Lopolo/Shutterstock)


(doorcountymom.com)

(www.doorcounty.com)

Presentation Outline

- Climate Measurements (Historical & Projected)
  - Temperature (Warmer)
  - Precipitation (Wetter)
  - Extreme/Intense Events (Wilder)
- Green Bay Ecosystem and the “Dead Zone”
- Door County (Impacts and Actions)

Wisconsin Initiative on Climate Change Impacts

(wicci.wisc.edu)

- <u>Mission:</u>

  Generate and share information that can foster solutions to climate change in WI

- Collaborative Effort: Scientists & Stakeholders

  (State &Federal agencies, Universities, Tribes, Businesses, Municipalities, Non-profits)

- Initial Report: WICCI 2011 Assessment Report
- Update Report: WICCI 2021 Assessment Report

WISCONSIN DEPT. OF NATURAL RESOURCES

Nelson Institute for Environmental Studies
UNIVERSITY OF WISCONSIN-MADISON

WICCI
WISCONSIN INITIATIVE ON CLIMATE CHANGE IMPACTS

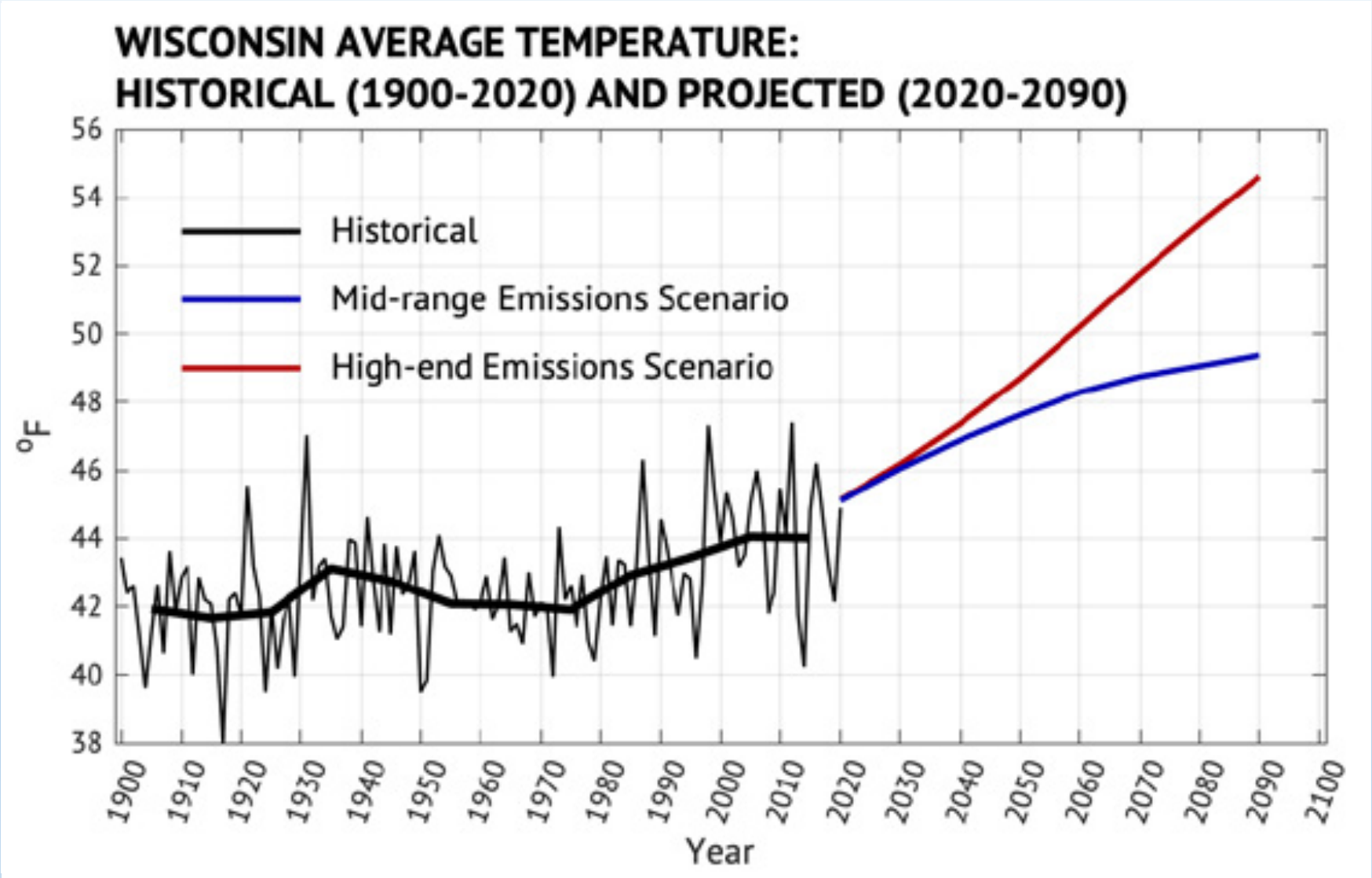
WICCI Working Groups

Air Temperatures

Baseline:
1900-1950

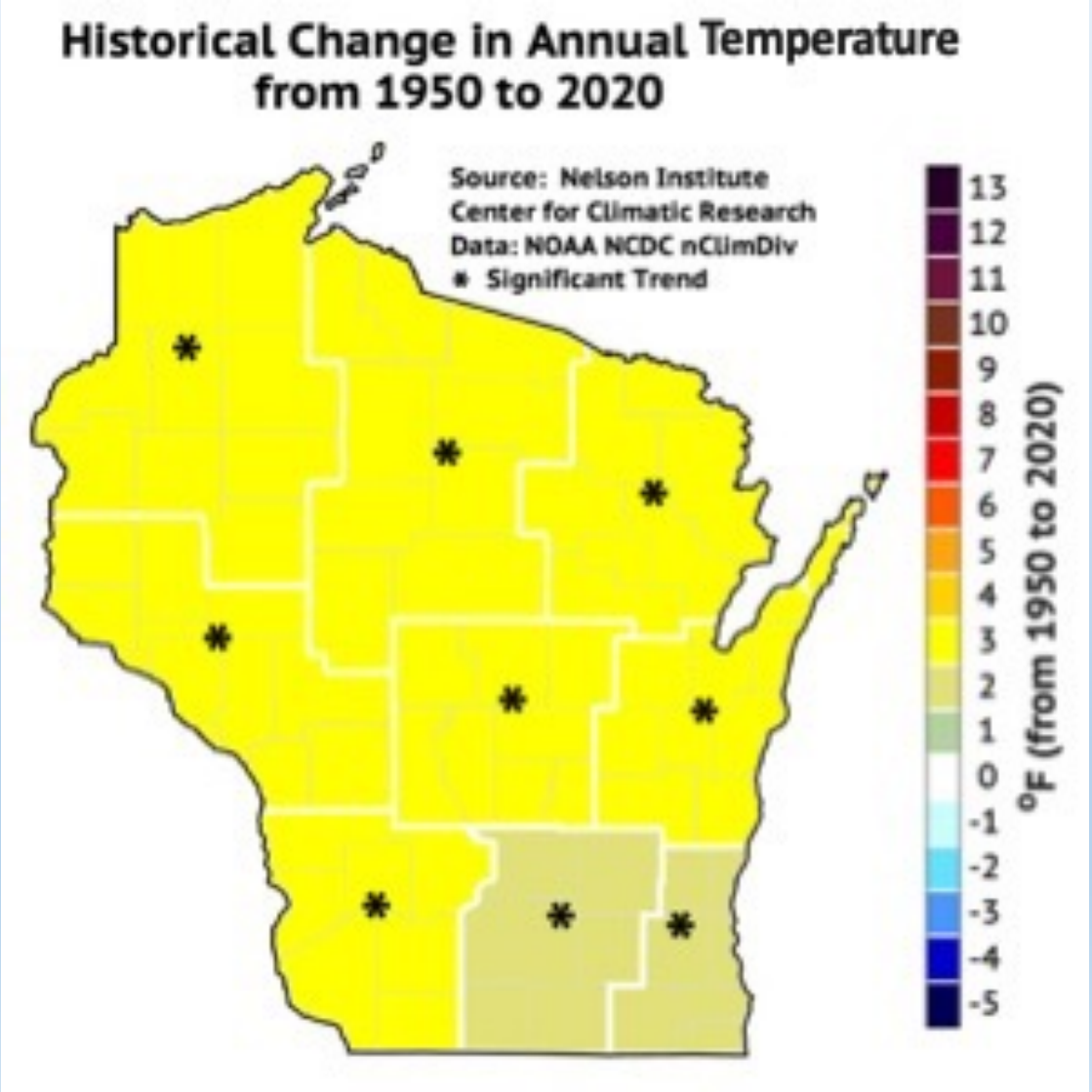
Projections:
High & Mid-range

2050 Projection:
4^{O} – 6^{O} F increase



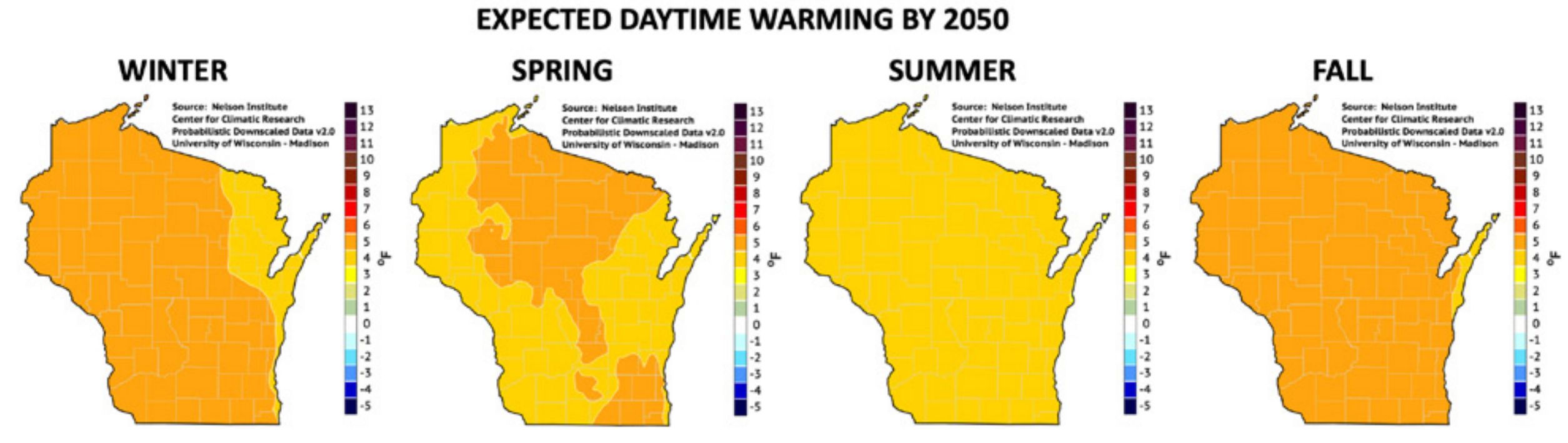
(WICCI 2021)

Historical Warmer Temperatures



(WICCI 2021)

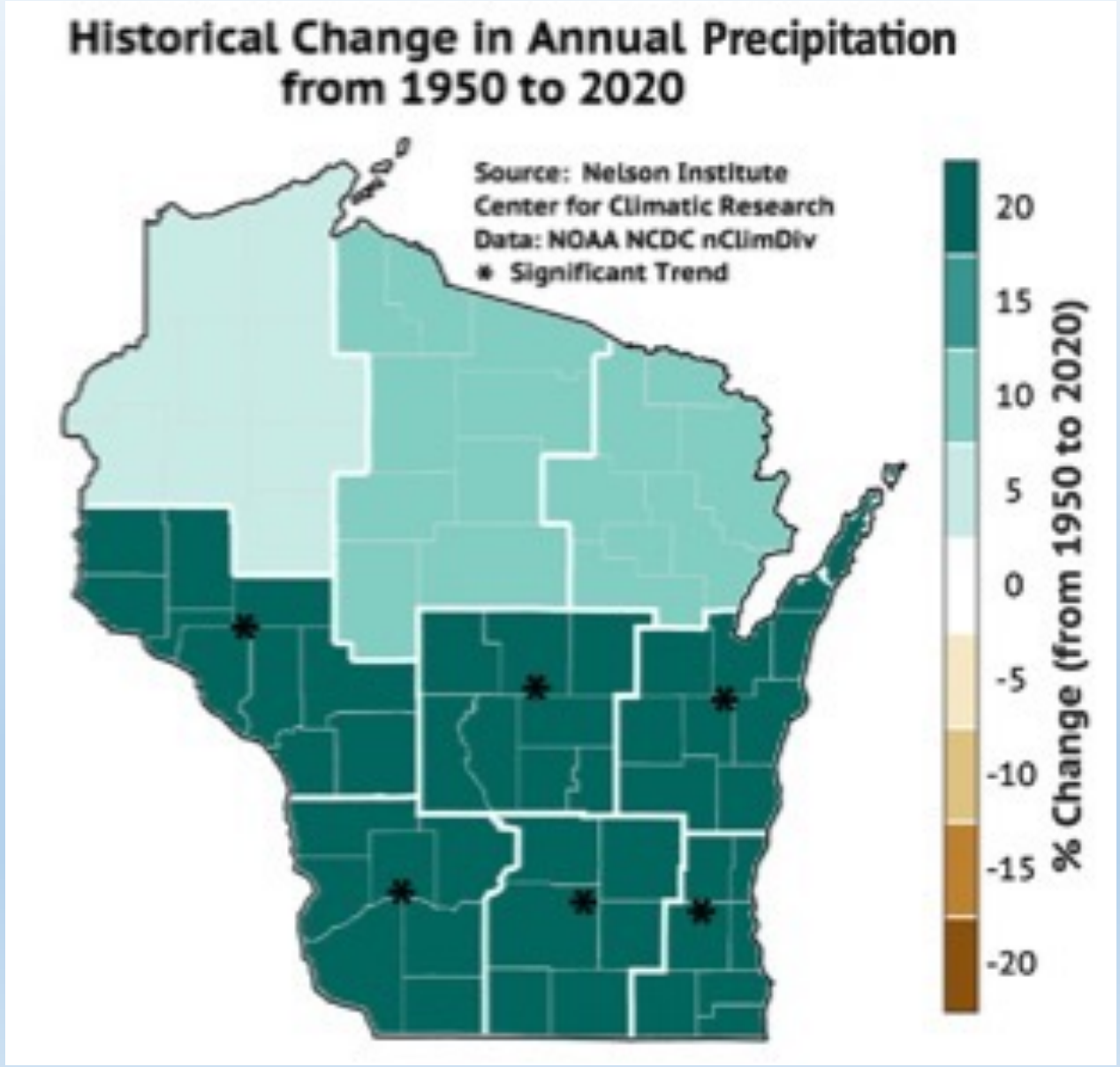
Projected Warmer Temperatures



Winter & Fall:
Higher Warming

(WICCI 2021)

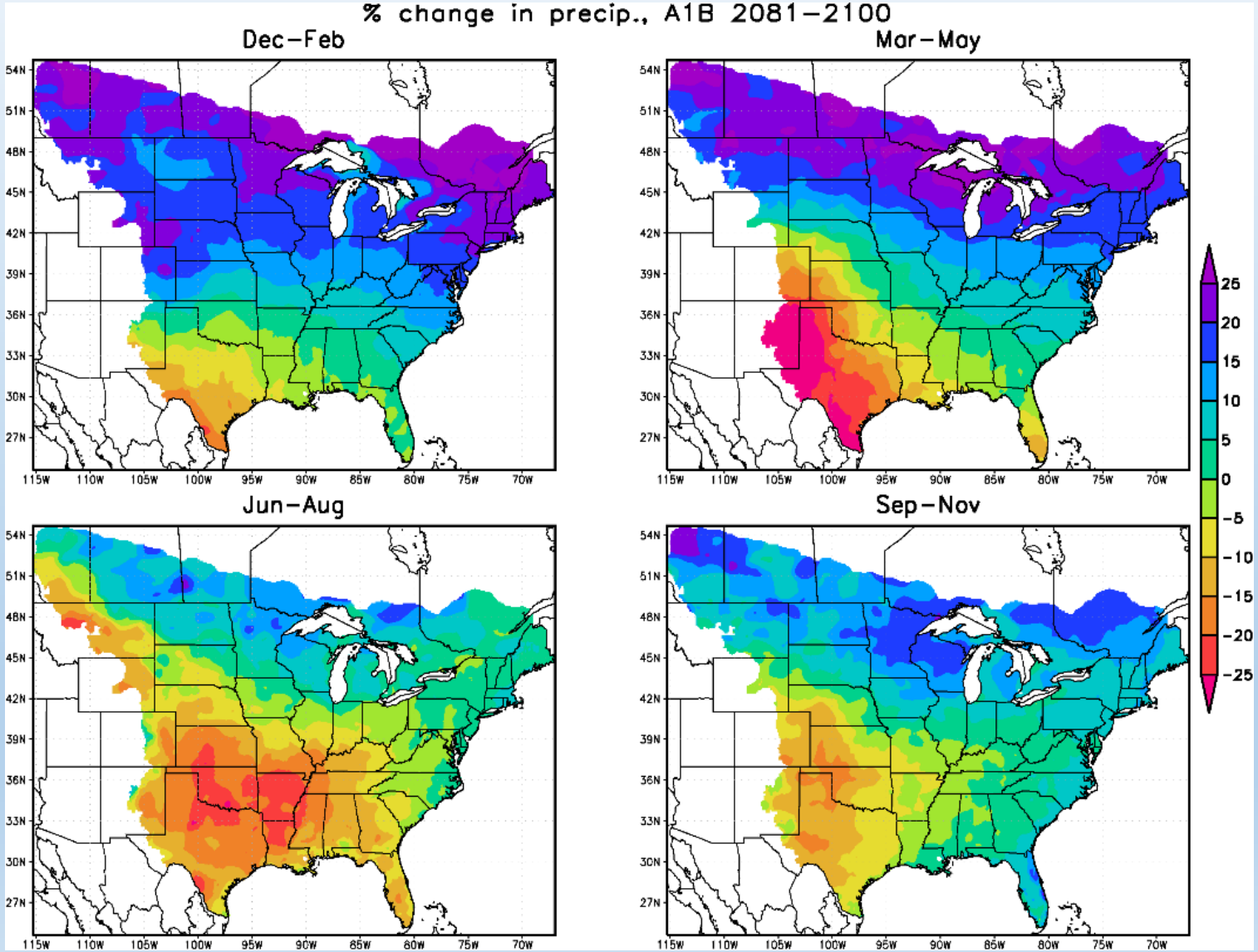
Wetter Conditions



(WICCI 2021)

Expected Regional Precipitation Increases

Bigger Increases
Winter & Spring

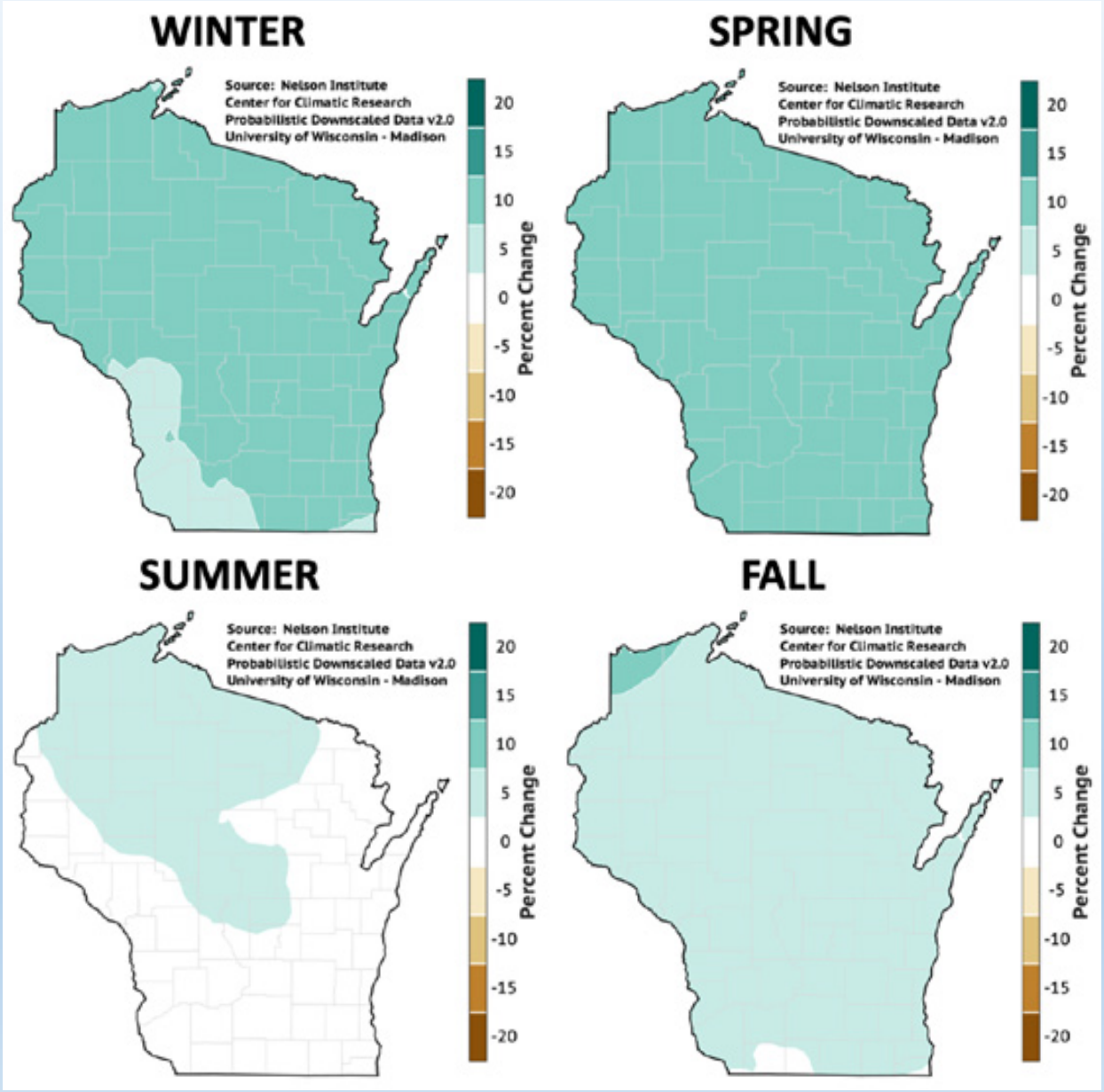


Klump & Fermanich (2017)

EXPECTED PRECIPITATION CHANGE BY 2050

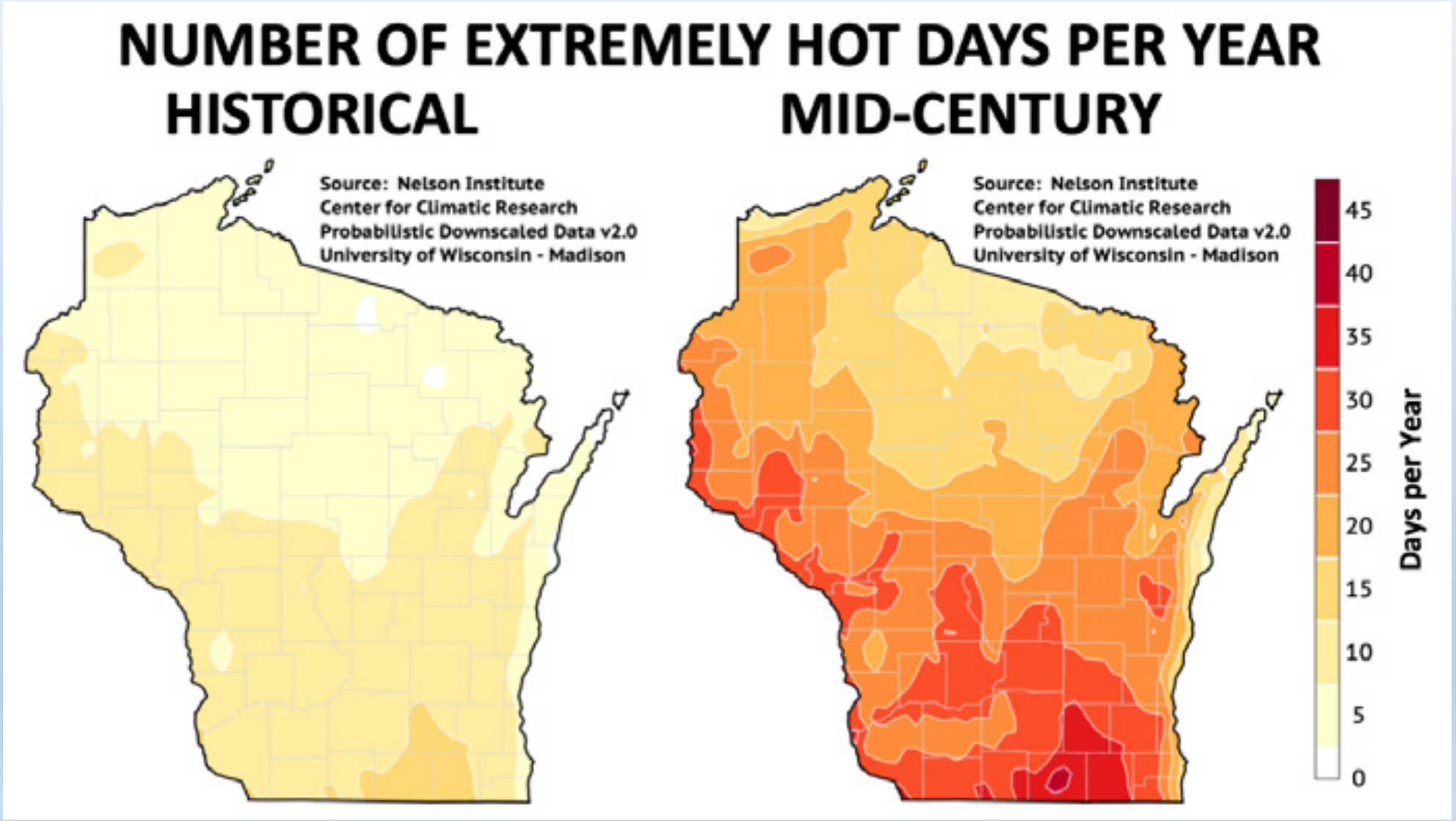
Bigger Increases Winter & Spring

Increased Rain during Winter



(WICCI 2021)

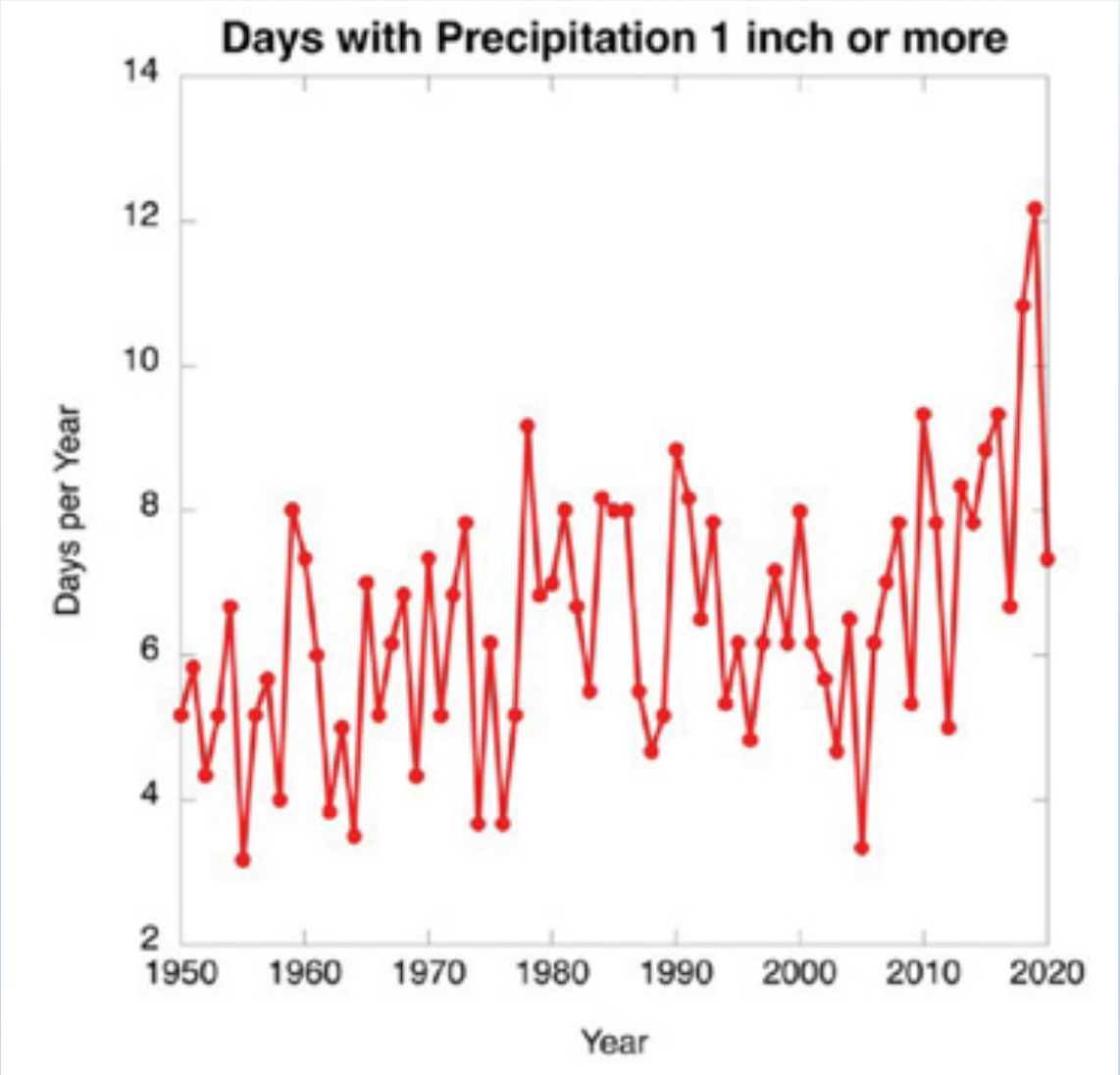
Wilder: Extreme Temperatures



(WICCI 2021)

Wilder Conditions

More Heavy Rainfall

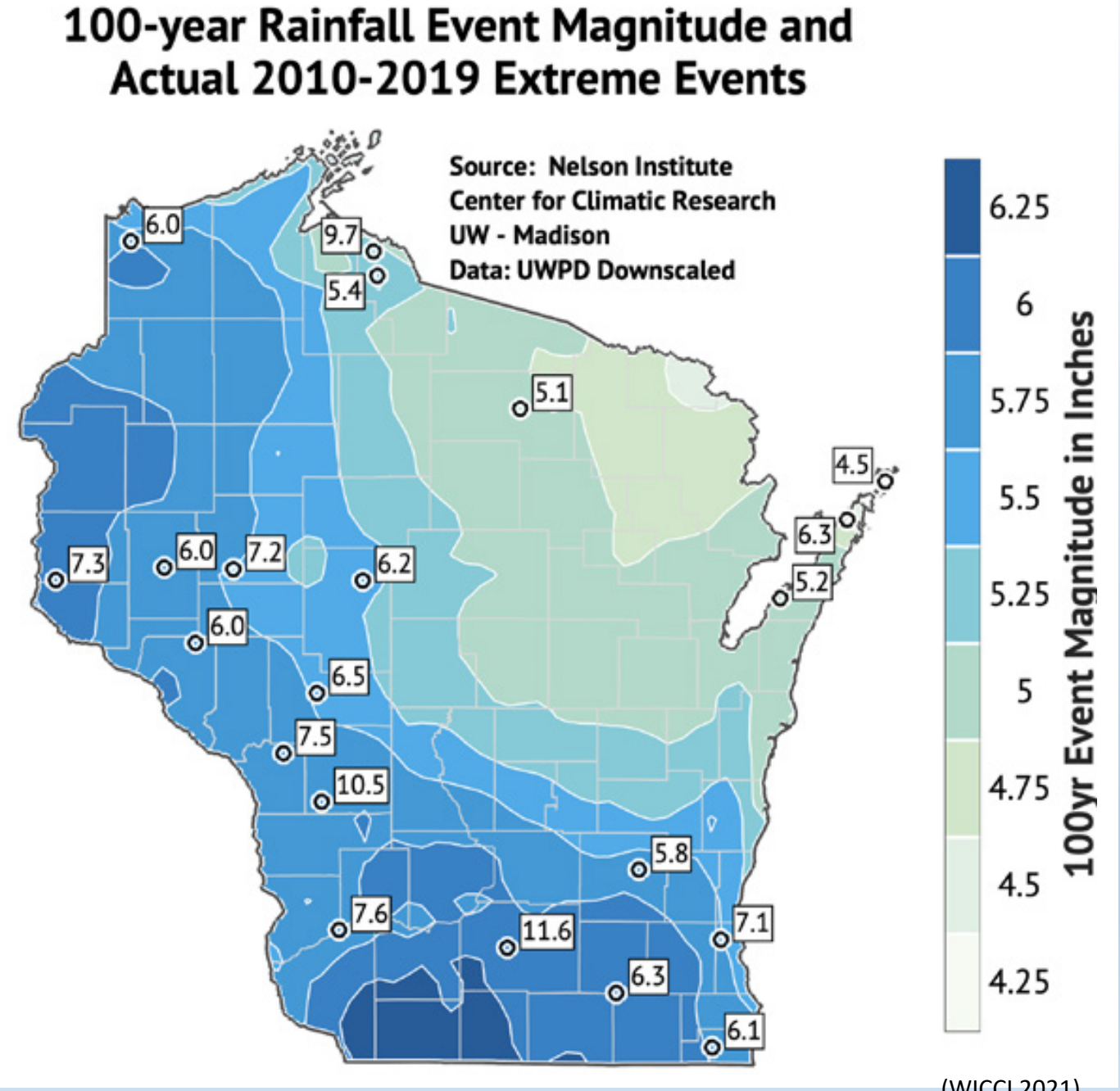


(WICCI 2021)

Wilder Conditions: More Extreme Rainfall Events

- "100-yr" Events based on past rainfall patterns
- Recently have exceeded those amounts

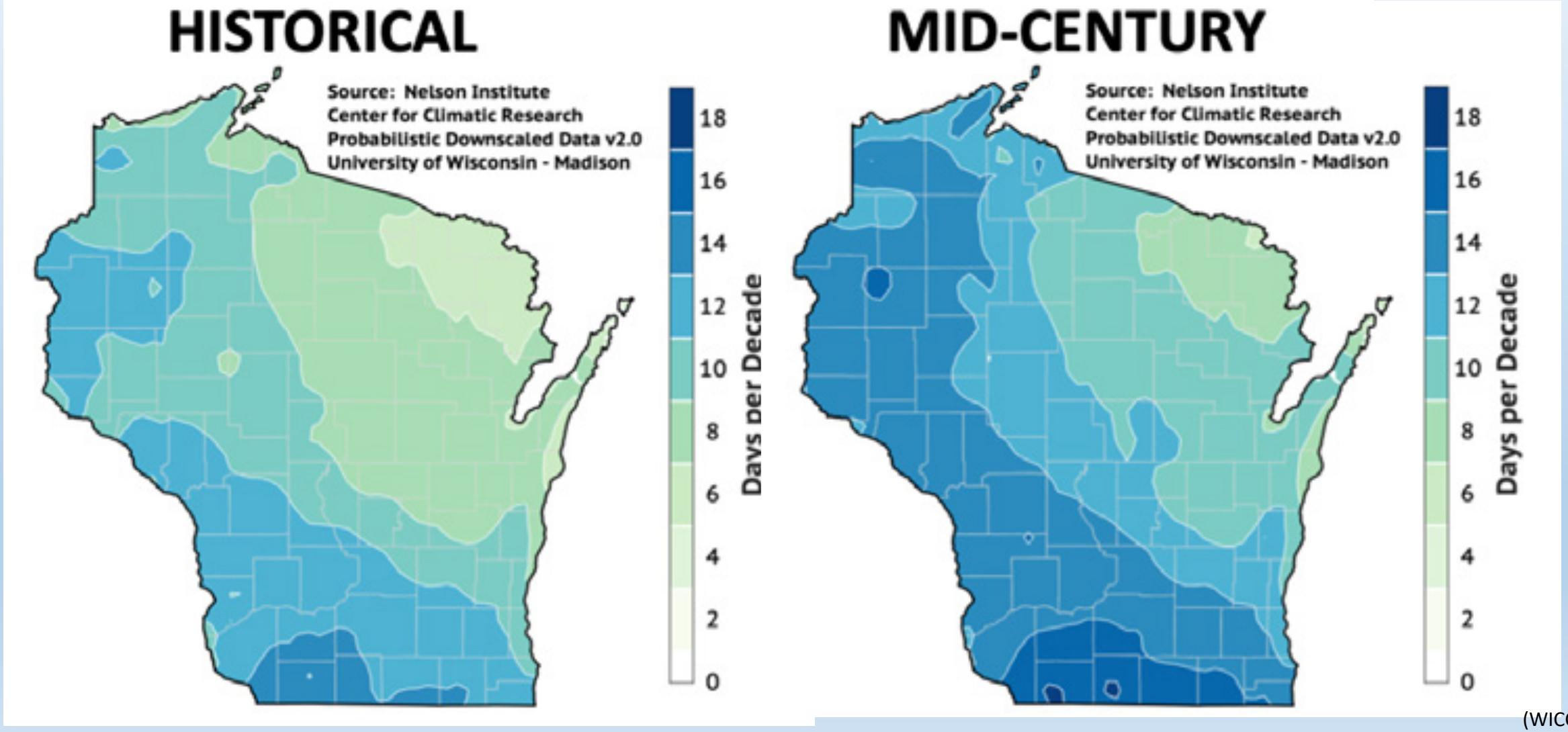
(21 events in past 10 years)



(WICCI 2021)

Wilder Conditions

Frequency of Extreme Rainfall (>2 in)



(WICCI 2021)

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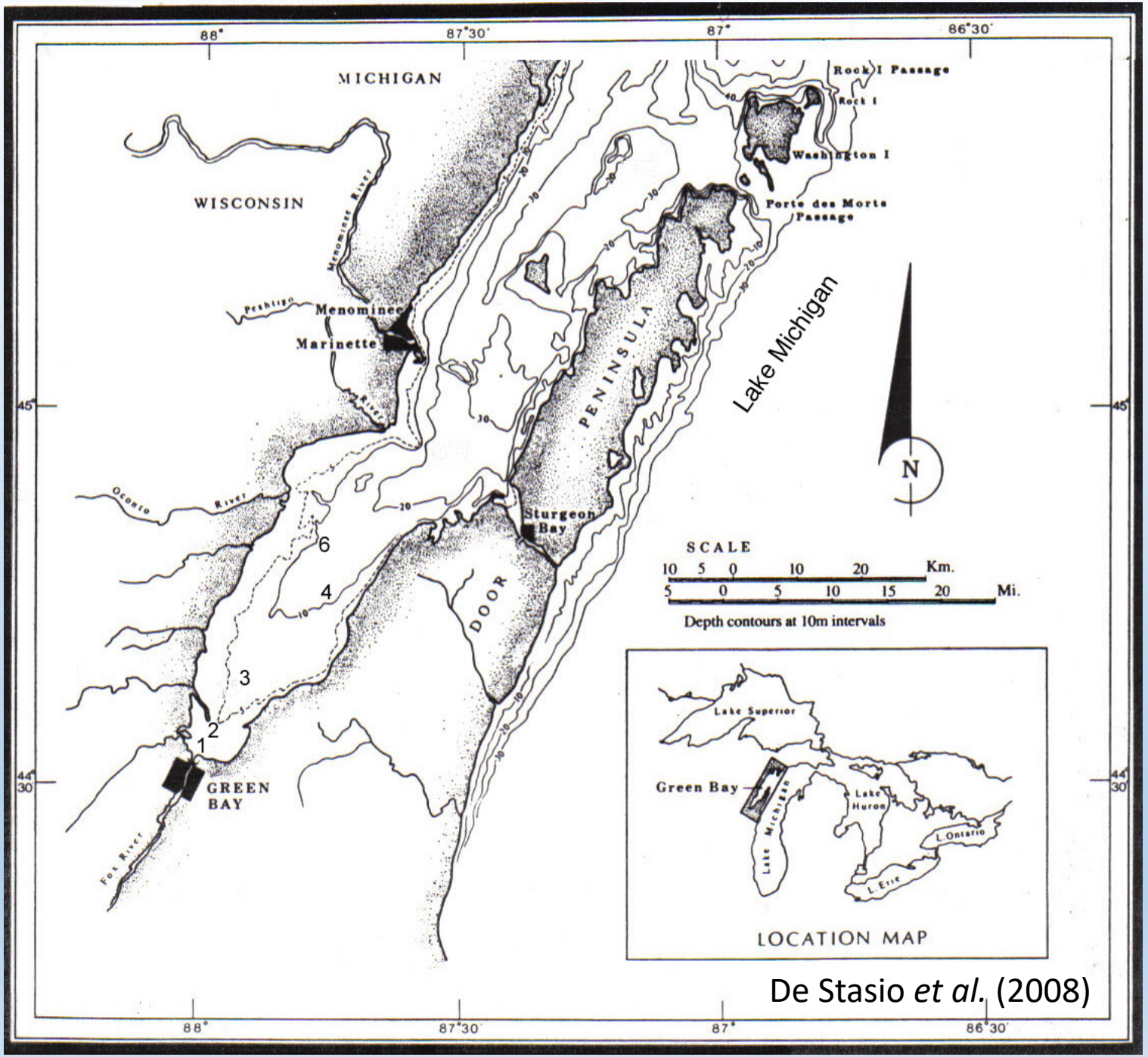
Imagery courtesy of the Environmental Remote Sensing Center University of Wisconsin-Madison

Green Bay Watershed

NOTE:
Door County Flows into both
Green Bay and Lake Michigan

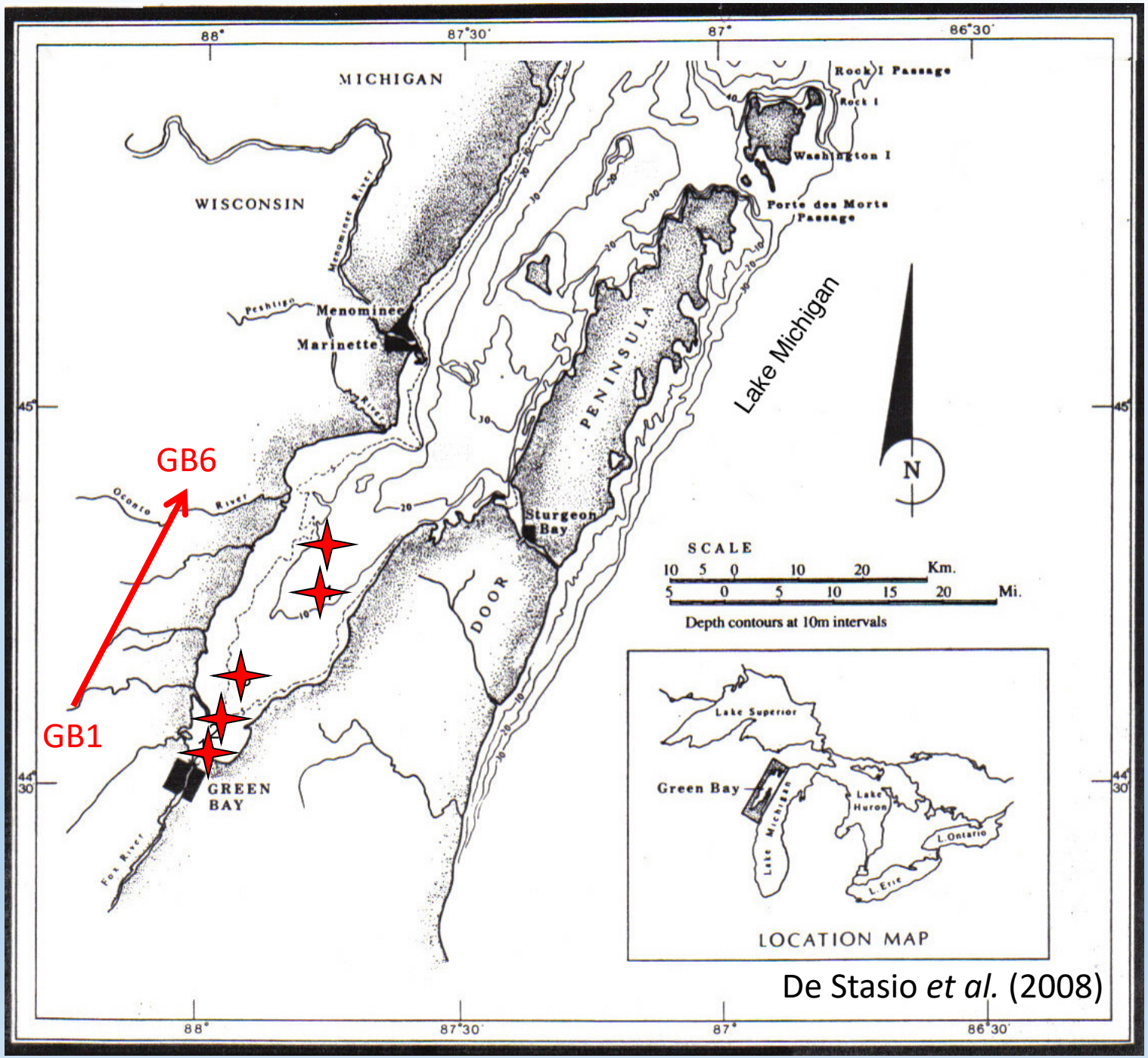
The Nature Conservancy



De Stasio *et al.* (2008)

Green Bay Food Web Studies

1980s – 2000s



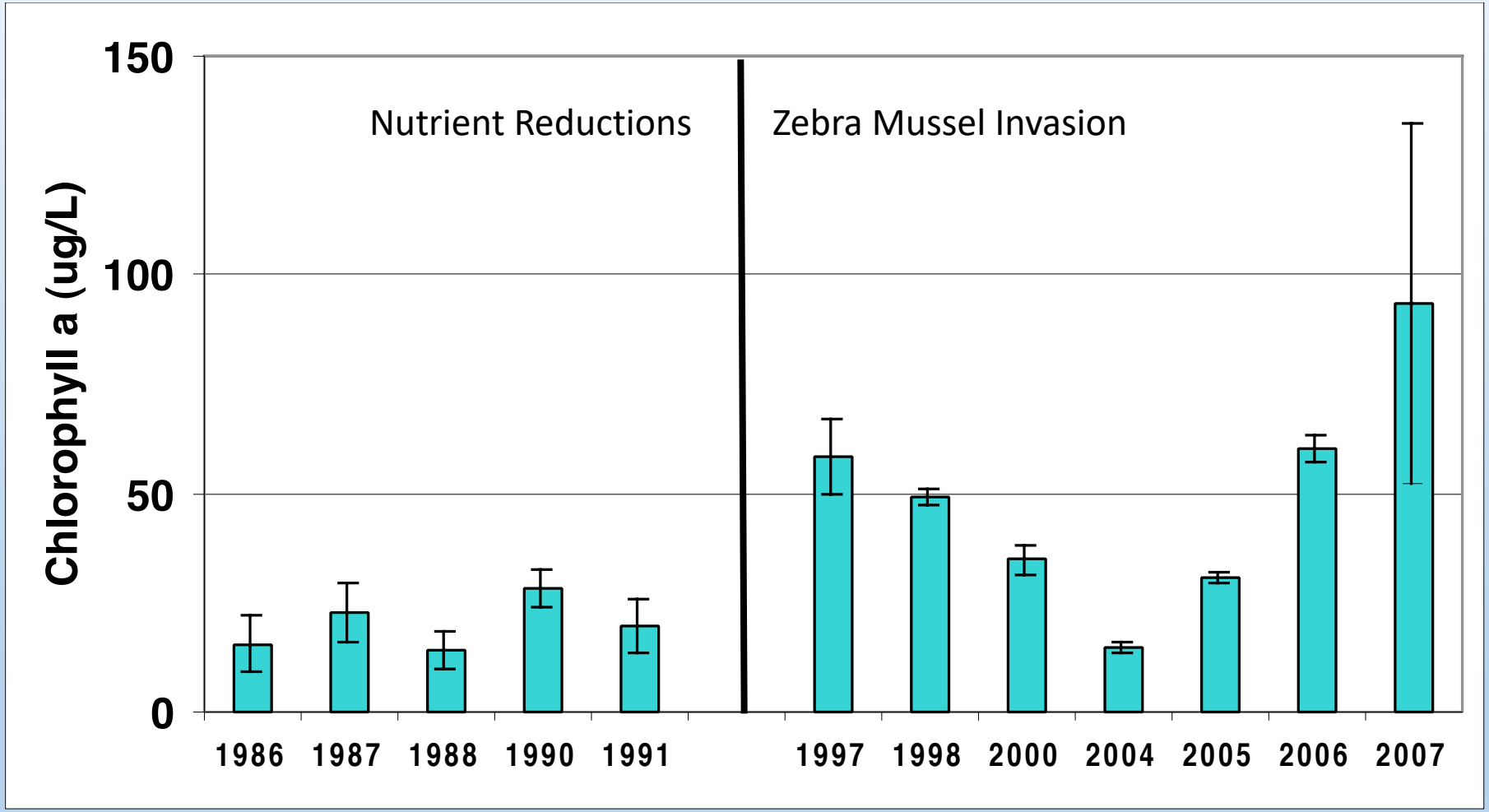
De Stasio *et al.* (2008)

Green Bay Ecosystem

- Shallow → Deep
- High Nutrients from Fox River
- Eutrophication (high nutrient input)
- High Algae Abundance

Green Bay Algae

Lower Bay



Summer Average (+/- 1SEM)

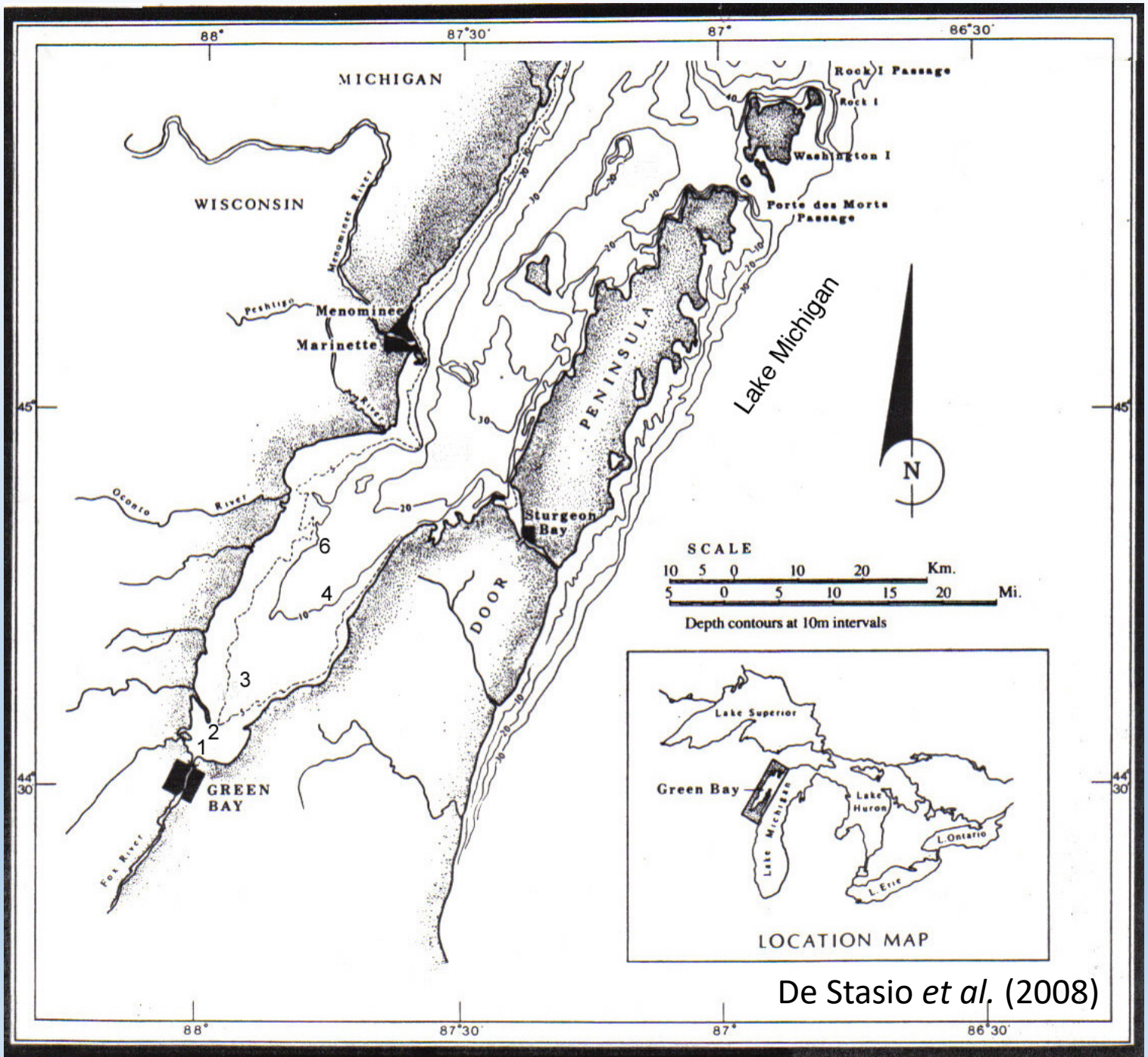
De Stasio *et al.* (2009)

Green Bay Depth Gradient

Shallow → Deep

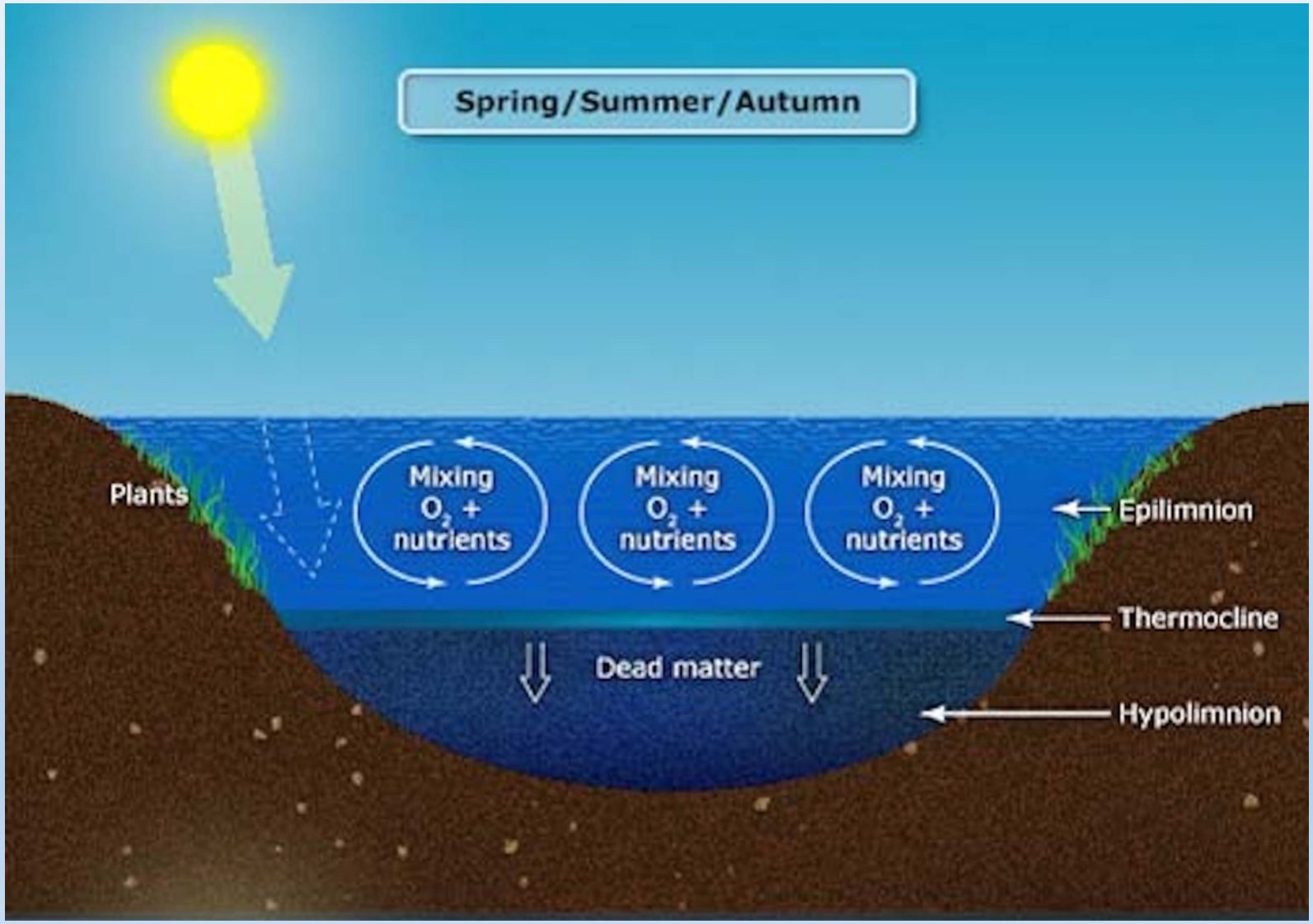
Shallow regions mix

Deeper regions stratify



De Stasio *et al.* (2008)

Summer “Stratification” of Lakes



<u>During Stratification</u>

Surface water gets oxygen

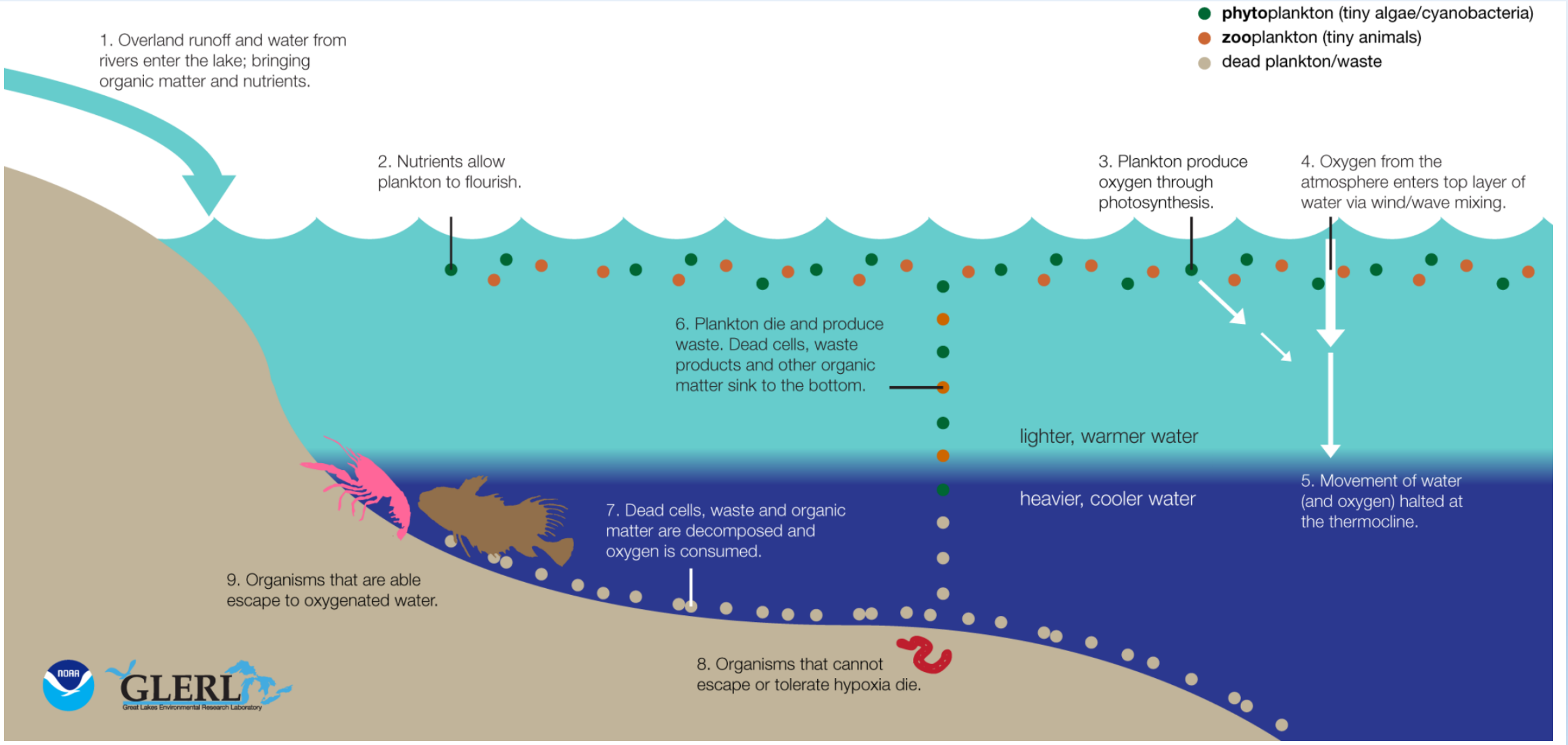
- From air above water
- From algae production

Bottom water is isolated

- Dead matter settles
- Bacteria use oxygen
- Oxygen can get depleted
- Depends on eutrophication

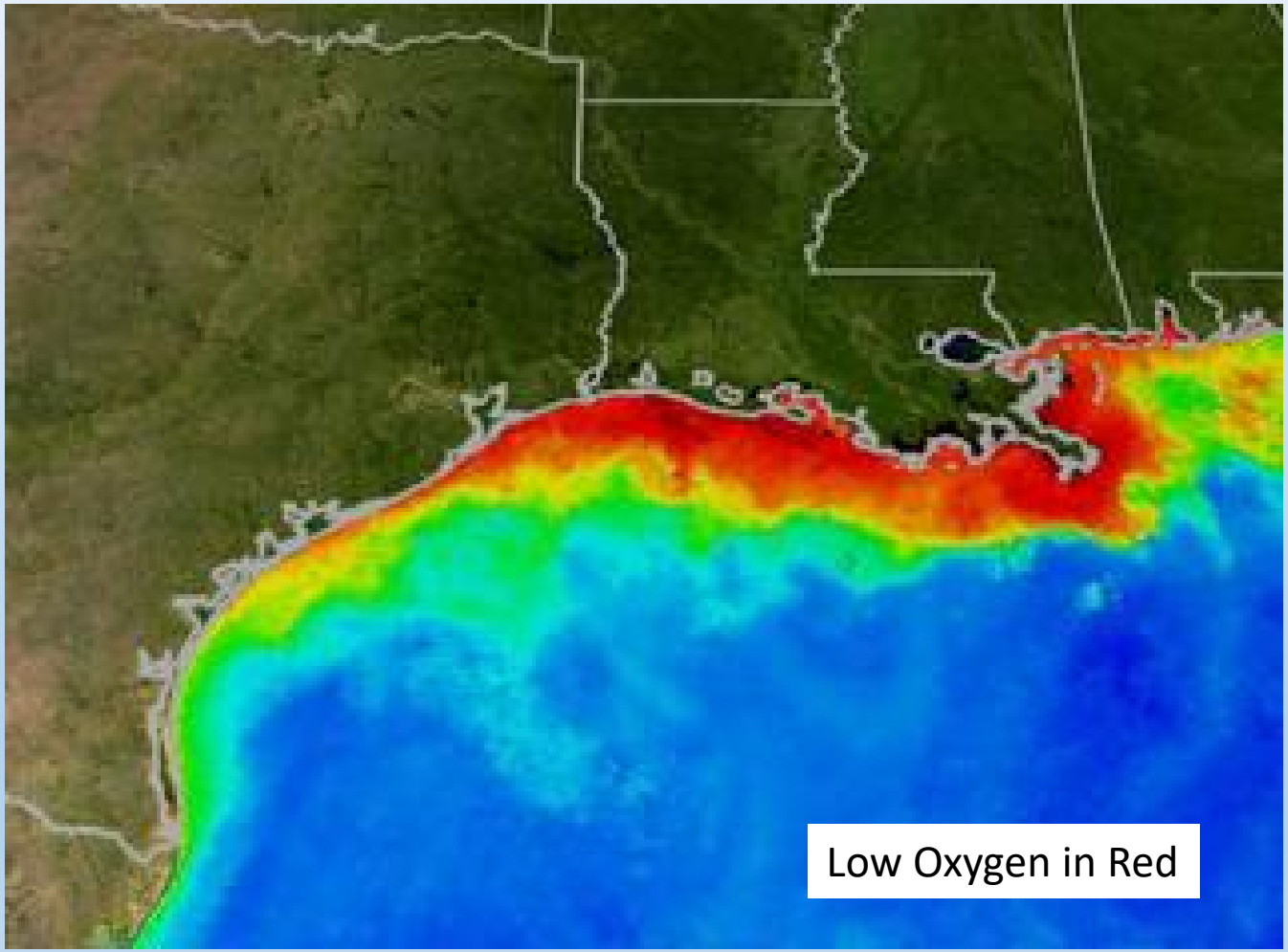
https://teara.govt.nz/en/diagram/11817/water-circulation-in-a-lake

Eutrophication can create “Dead Zones”



Mississippi River Watersheds & “Dead Zone”

Gulf of Mexico “Dead Zone” caused by Eutrophication



(Source: NOAA)

“Dead Zones” caused by Eutrophication

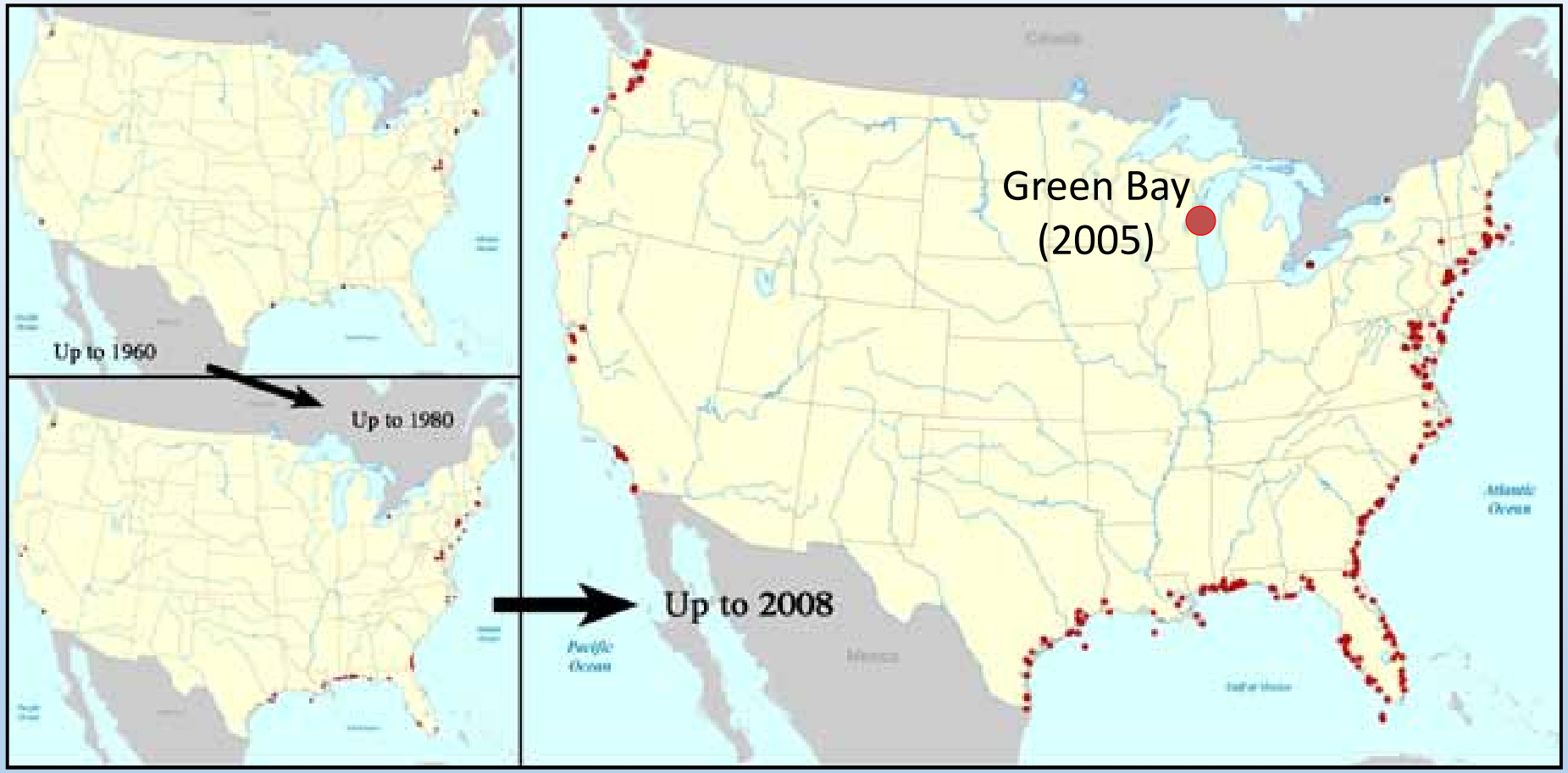
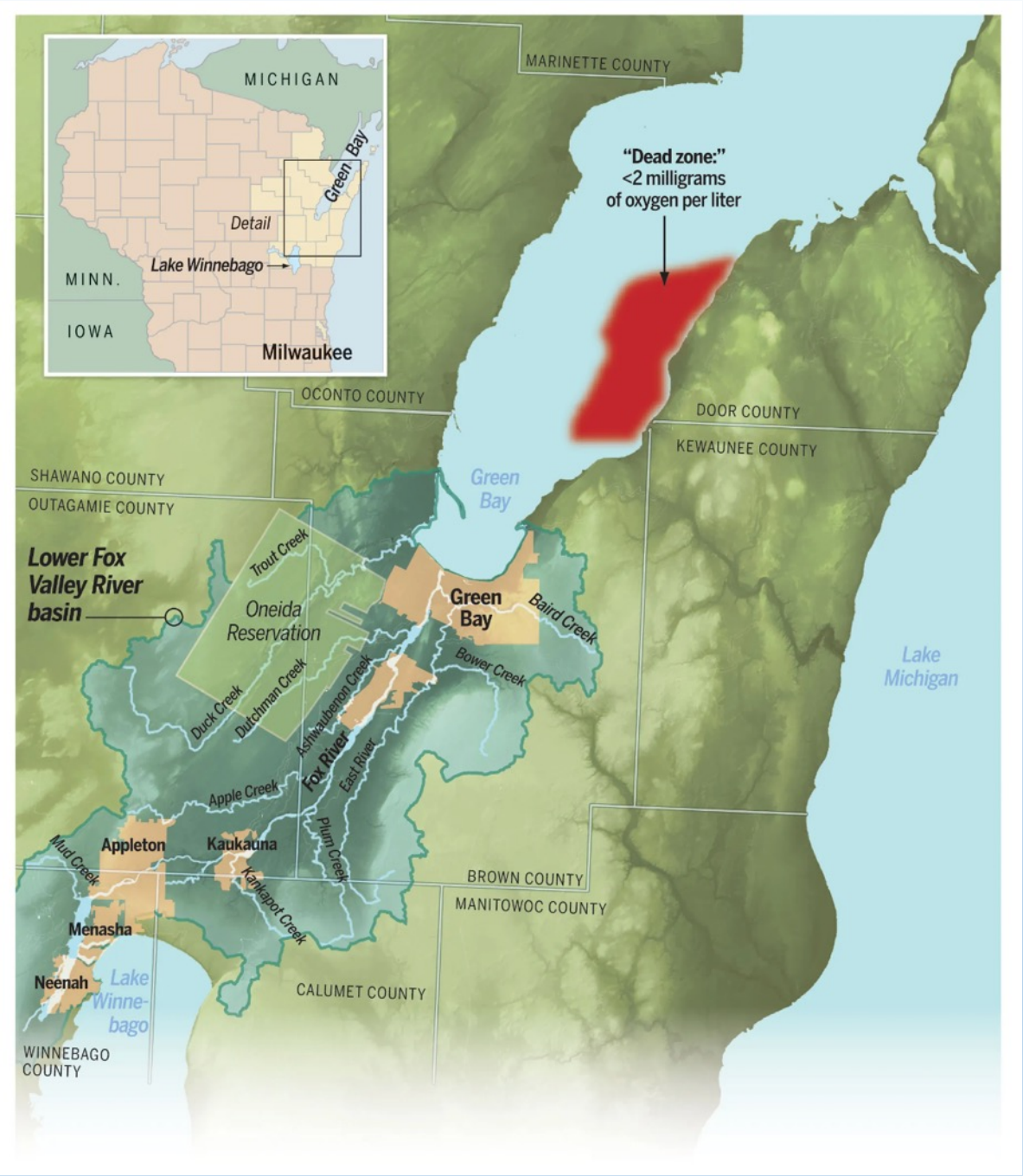


Figure 2. Change in number of U.S. coastal areas experiencing hypoxia from 12 documented areas in 1960 to over 300 now (Appendix III). Not shown here are one hypoxic system in Alaska and one in Hawaii.

Committee on Environment and Natural Resources (2010)

Green Bay Dead Zone



Green Bay Bottom Anoxia Zones

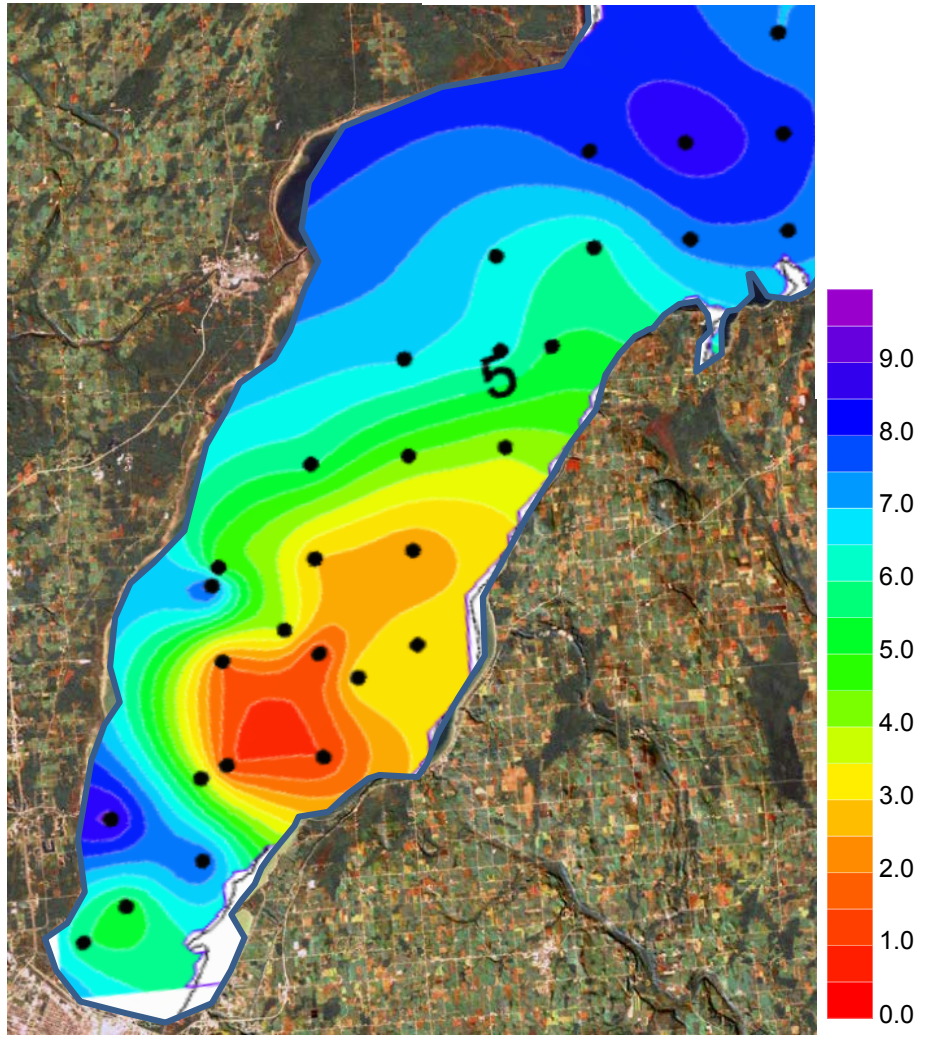
<u>Dead Zones can Cause:</u>

Fish kills

Loss of bottom feeders

Loss of invertebrates

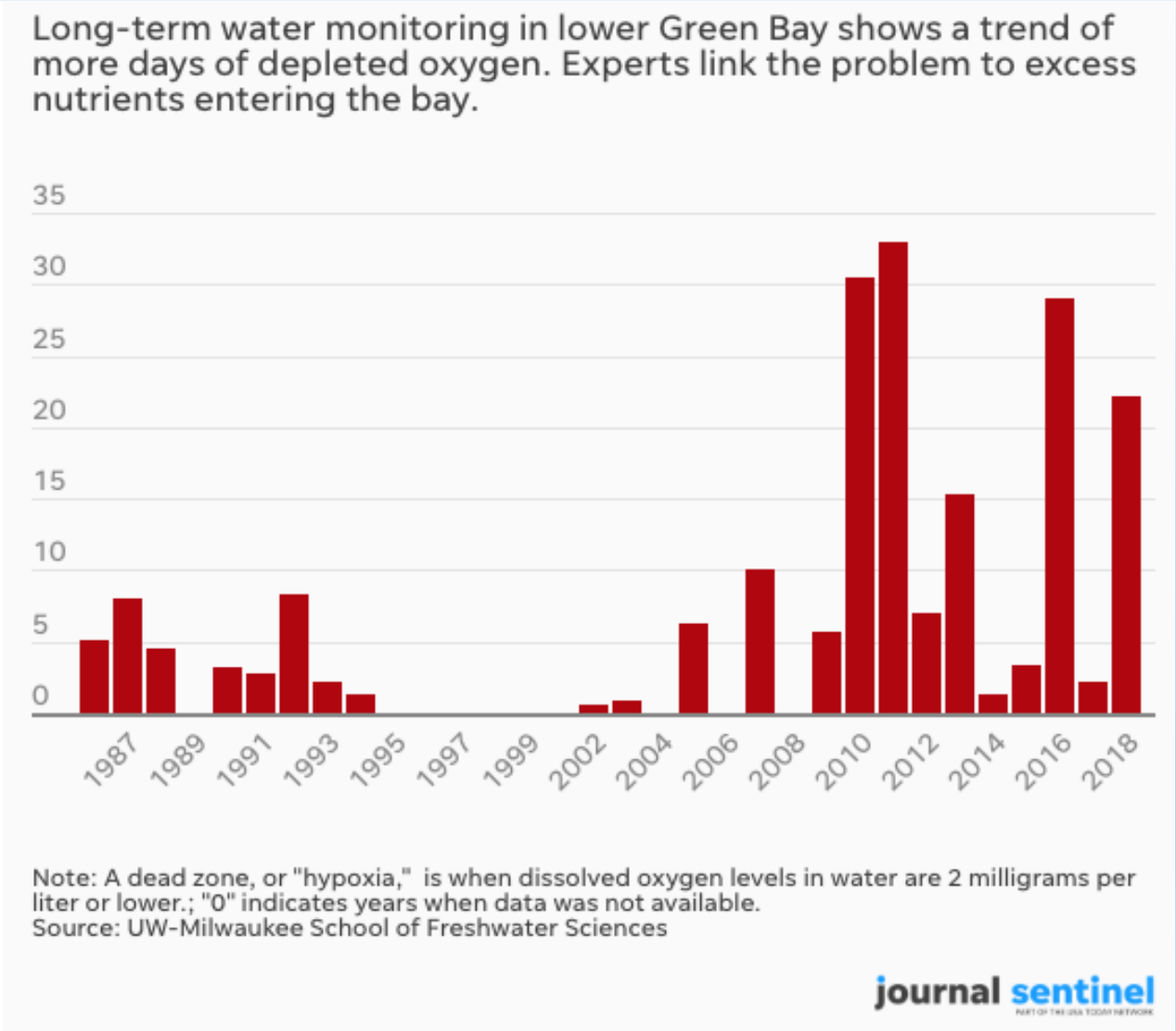
(mayflies, caddisflies, etc.)



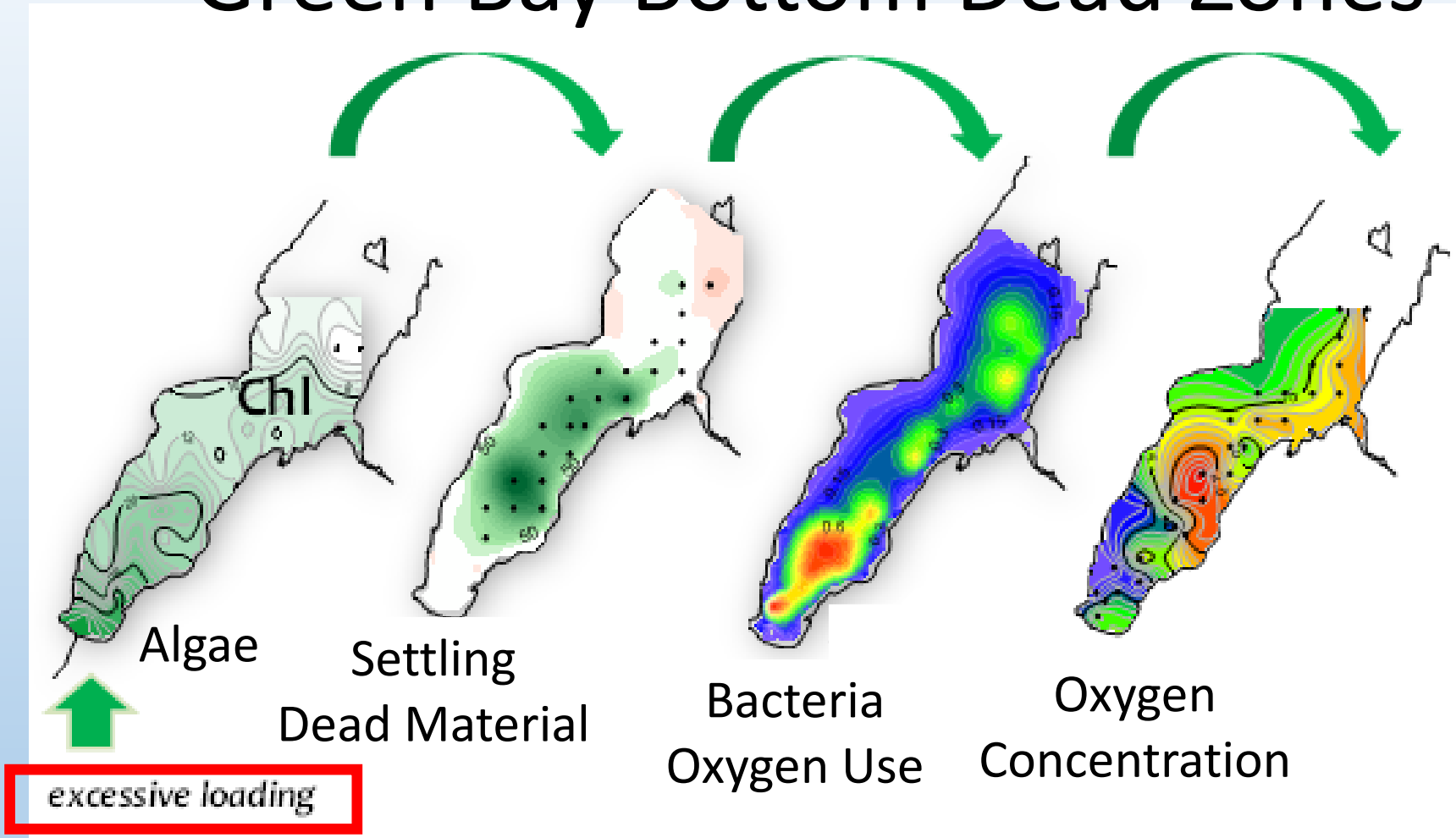
The Green Bay "Dead zone"

Klump & Fermanich (2017)

Dead Zone days per year

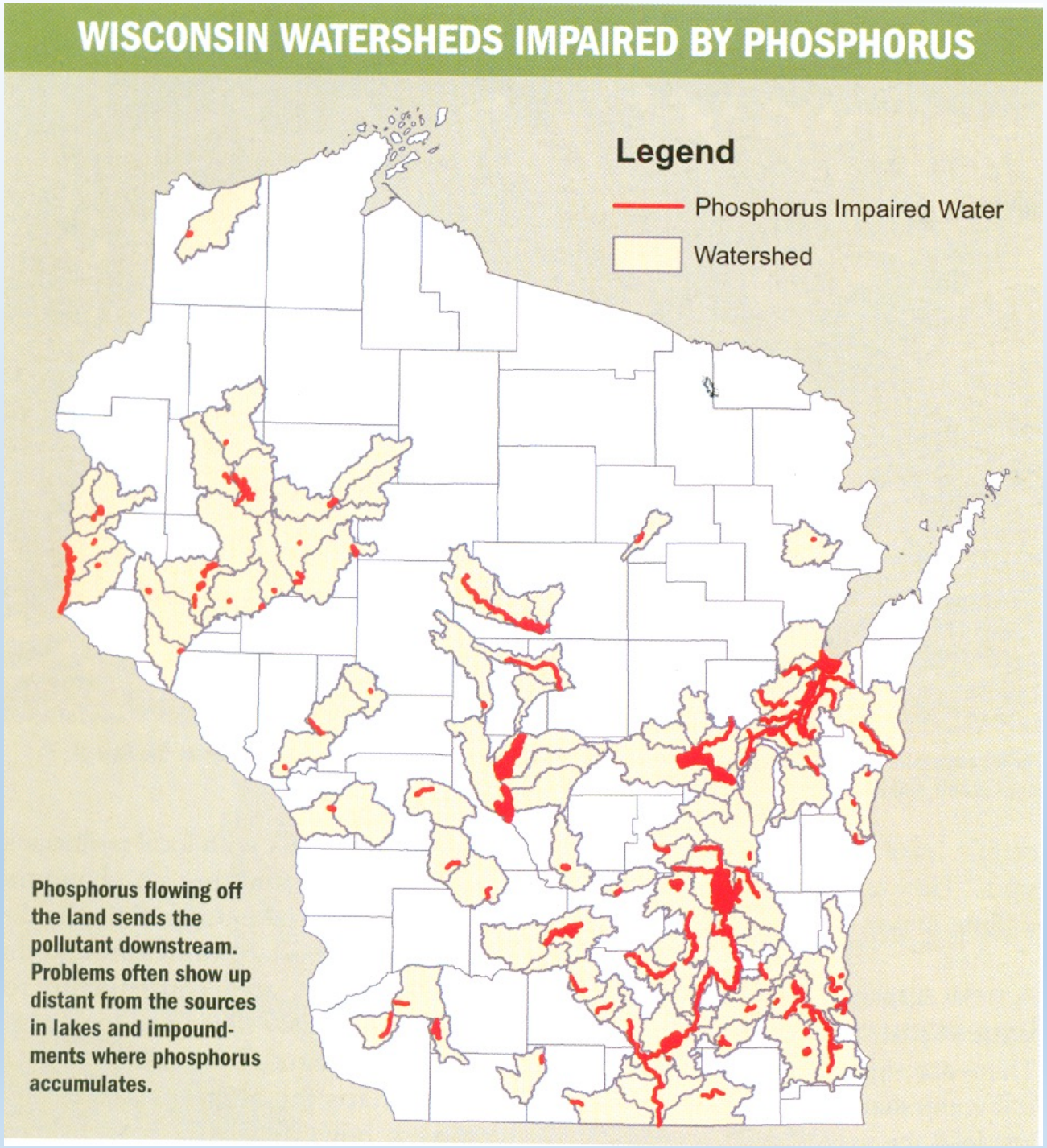


Green Bay Bottom Dead Zones

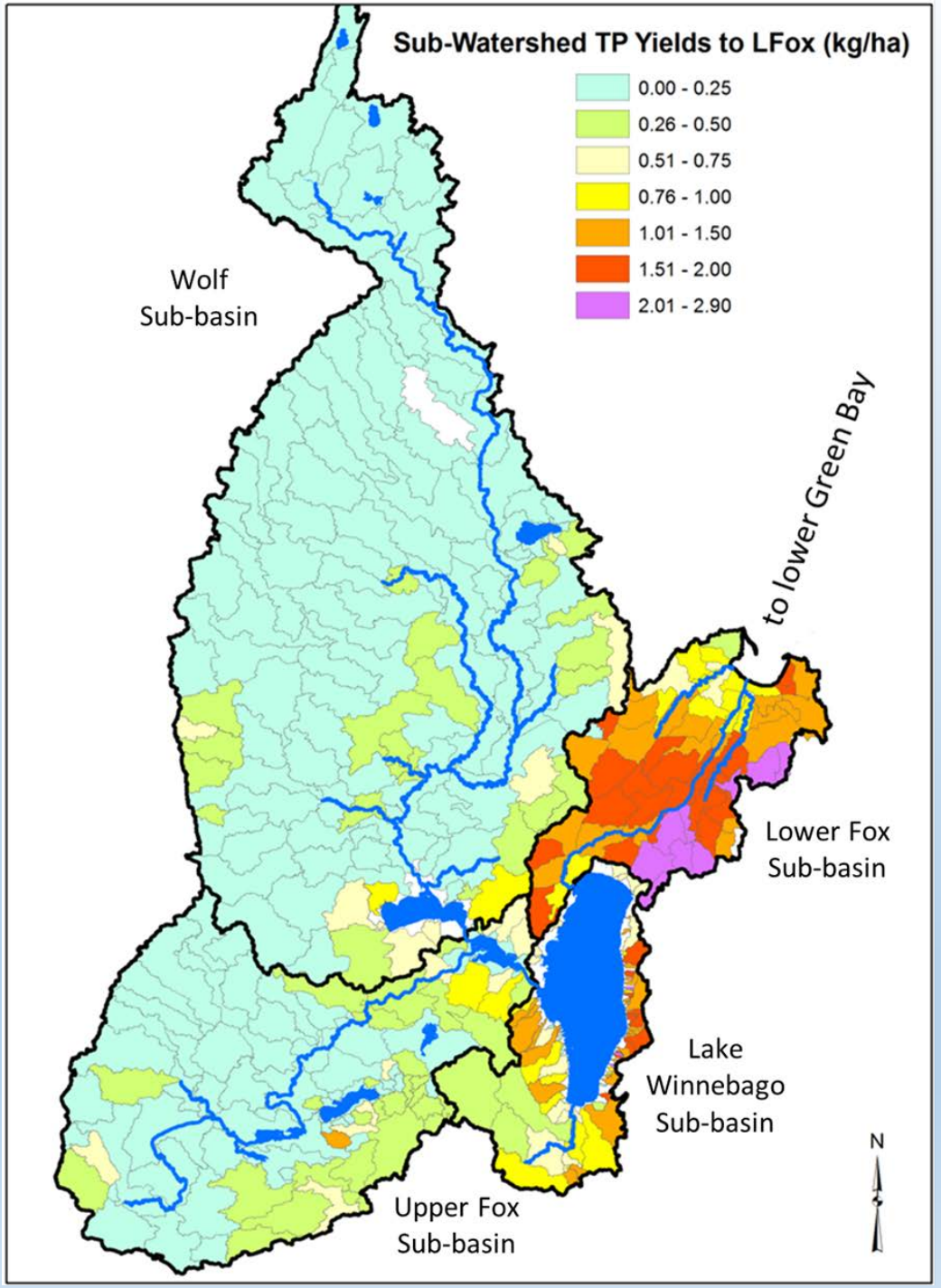


Klump & Fermanich (2017)

Eutrophication: Phosphorus Impaired Waters



Lower Fox River Basin highest phosphorus inputs



Klump & Fermanich (2017)

Eutrophication: Land Use

Agricultural

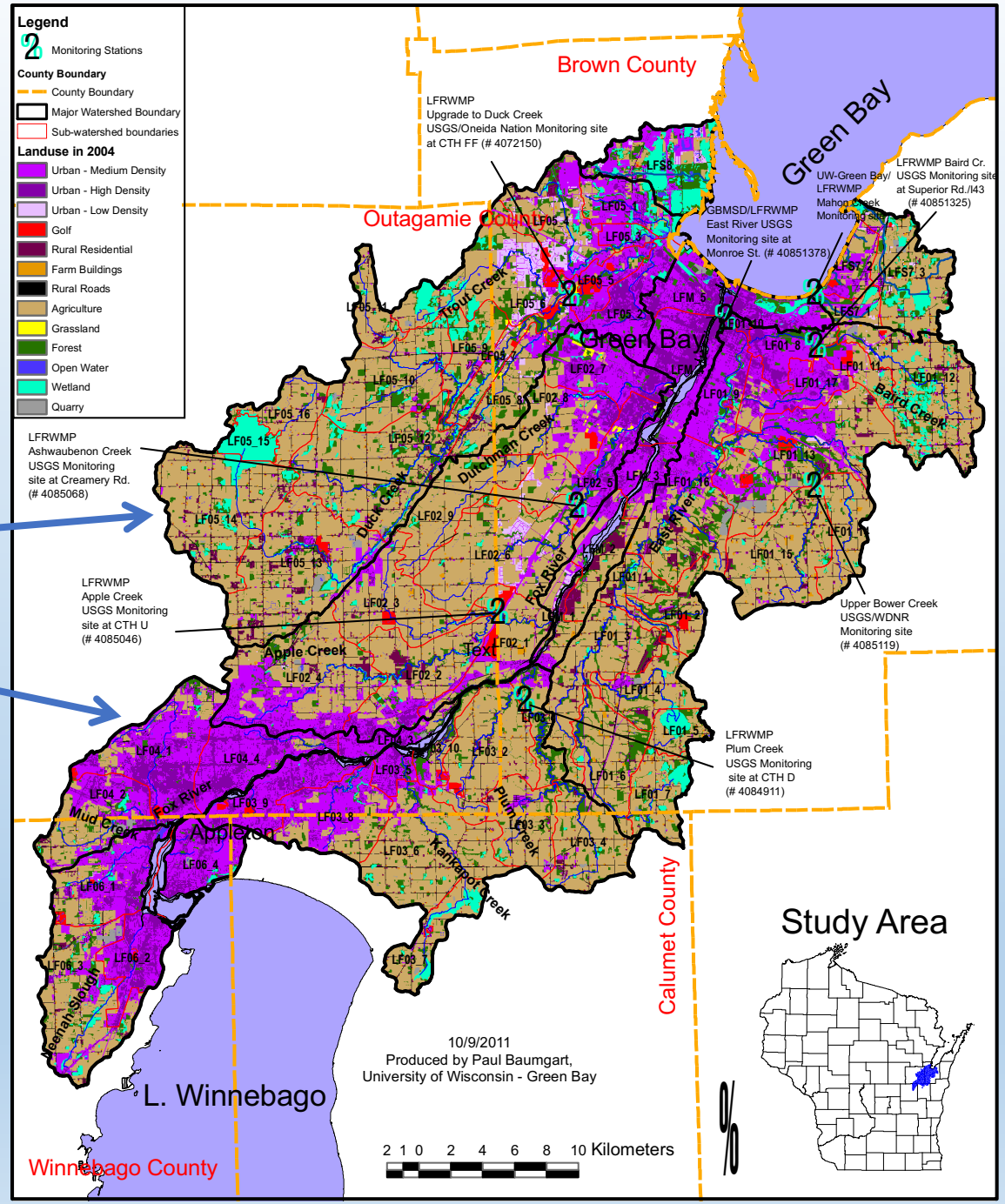
Urban

Lower Fox River Basin
Concentrated Animal Feeding Operations
(CAFO)

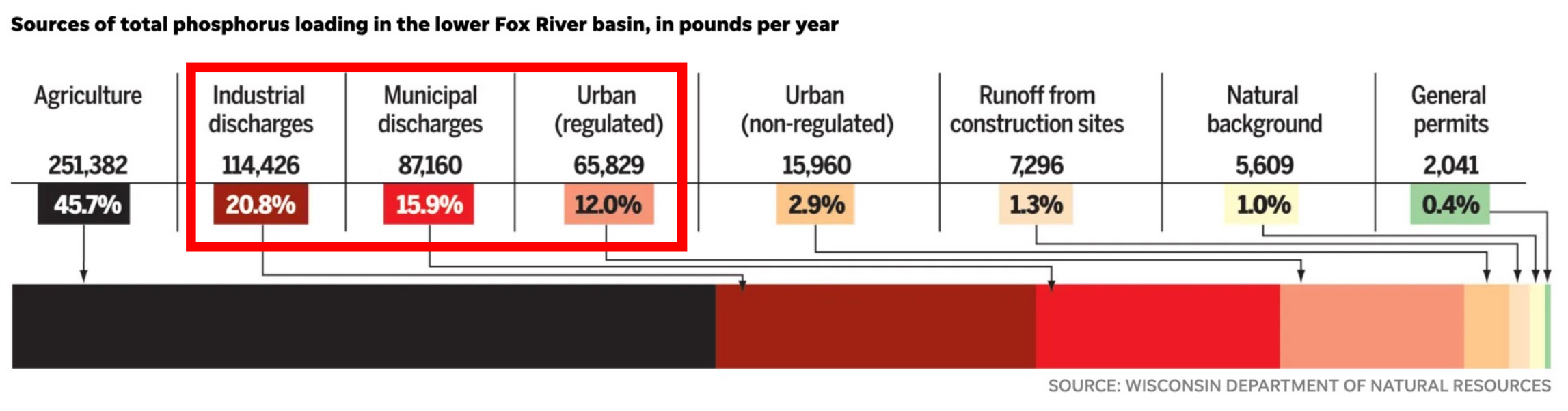
2012: 15 CAFOs

2014: 25 CAFOs (70,000 cows)

{waste from 1 cow = 18 humans}



Lower Fox River Phosphorus Sources
(2014)



Clean Water Act

Climate Change Impacts on Green Bay

- Warmer Temperatures
  - Longer stratification
  - Faster algae growth rates
  - Toxic Cyanobacteria (Blue-Green Algae) dominate in
  - Shifts in fish species (more warm water species)

Climate Change Impacts on Green Bay

- Wetter (Increased Rainfall)
  - More runoff & nutrients into system
  - Higher water levels
  - Flooded marsh areas

- Wilder (more extreme events)
  - More nutrients run off agricultural lands
  - Increased algae from increased nutrients
  - More/longer Dead Zones from eutrophication

Strategies to Reduce Climate Change Impacts on Green Bay Dead Zone

- Manage Lands to Reduce Flooding & Run-off
  - Protect marshes & wetlands
  - Plant riparian and buffer zones
  - Employ low-tillage and no-til farming

- Reduce Nutrient Sources to Watershed
  - Continue to Regulate Point Sources (industry, municipal, urban)
  - Reduce nutrient additions from CAFOs and Agriculture
  - Foster collaborations to implement Management Analysis (https://fyi.extension.wisc.edu/gbem/)

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Shorelines & Coastal Communities

Potential Issues:

- Fluctuating Lake Levels (low & high)
- Declining Ice Cover
- Increased Wave Energy
- Increased Precipitation

Possible Impacts:

- Increased Flooding
- Increased Coastal Erosion
- Lower Bluff Stability
- Impaired Navigation
  (low & high water issues)

WICCI (2021)

Shorelines & Coastal Communities

Strategies:

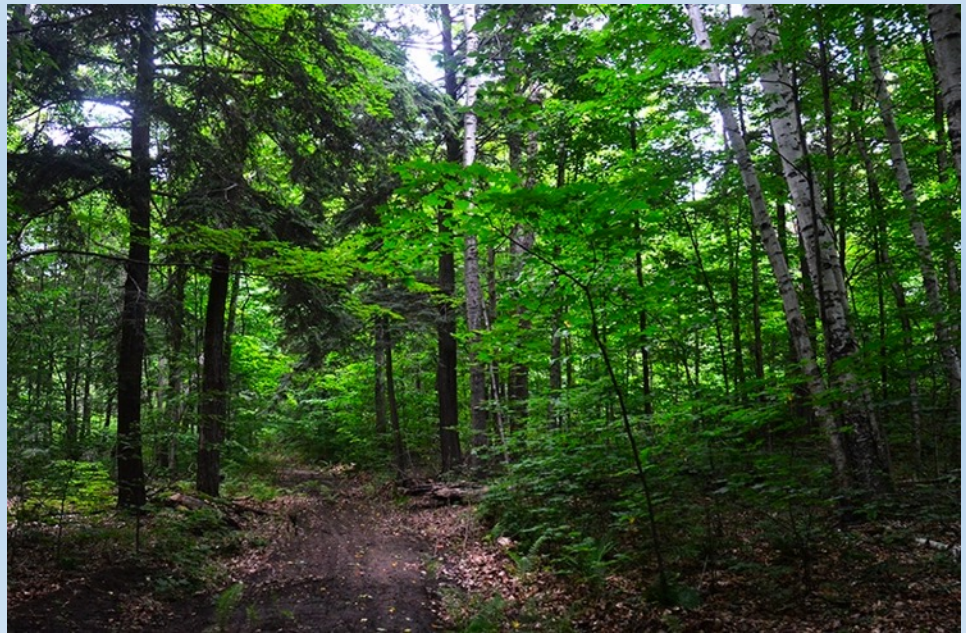
- Plan Proactively for Changes
- Address Root Cause of Issues
- Consider Nature-based Solutions
- Consider Relocation Strategies

WICCI (2021)

Plant & Natural Communities

Issues:

- Warmer Temperatures & extremes
- Longer summer drought periods
- More Intense Rainfall
- Less Snow
- Wetter Winters (on frozen ground)



WICCI (2021)

Plant & Natural Communities

Impacts:

- Drying soils and groundwater
- Mores sediment into wetlands
- Stressed Boreal Forests
- More freeze-thaw cracking
- Increased seepage into karst

WICCI (2021)

Plant & Natural Communities

Strategies:

- Climate-ready Stormwater management
- Boreal Forest Protection
- Habitat Protection/Restoration
- Monitoring groundwater issues
- Regulating manure/fertilizer
- Carbon Storage/Sequestration
- Tree Planting

WICCI (2021)

Plant & Natural Communities

The 2nd annual Door County Big Plant was conceived and coordinated by the Climate Change Coalition of Door County to inspire community action during a county-wide planting event. The month-long project has resulted in the planting of **12,500 TREES AND PLANTS** throughout the county. Please join the Climate Change Coalition in thanking the **60 ORGANIZATIONS**, services clubs, municipalities, community groups, local students/schools, and individuals listed below for their leadership and commitment to combating climate change, and give a big shout-out to all those who were inspired by the Big Plant to plant trees on their own!

Acknowledgements

- Green Bay Food Web Information Network Participants
  - Sea Grant Institute
  - Wisconsin DNR
  - Green Bay Metropolitan Sewerage District
  - Lawrence University
  - University of Wisconsin- Green Bay
  - University of Wisconsin- Milwaukee
- Lawrence University students

  Michael Schrimpf, Ashley Beranek,

  Brendan Cornwell, Will Daniels
- Wayne Krueger