Adapting to Wisconsin's Changing Climate

FEMA

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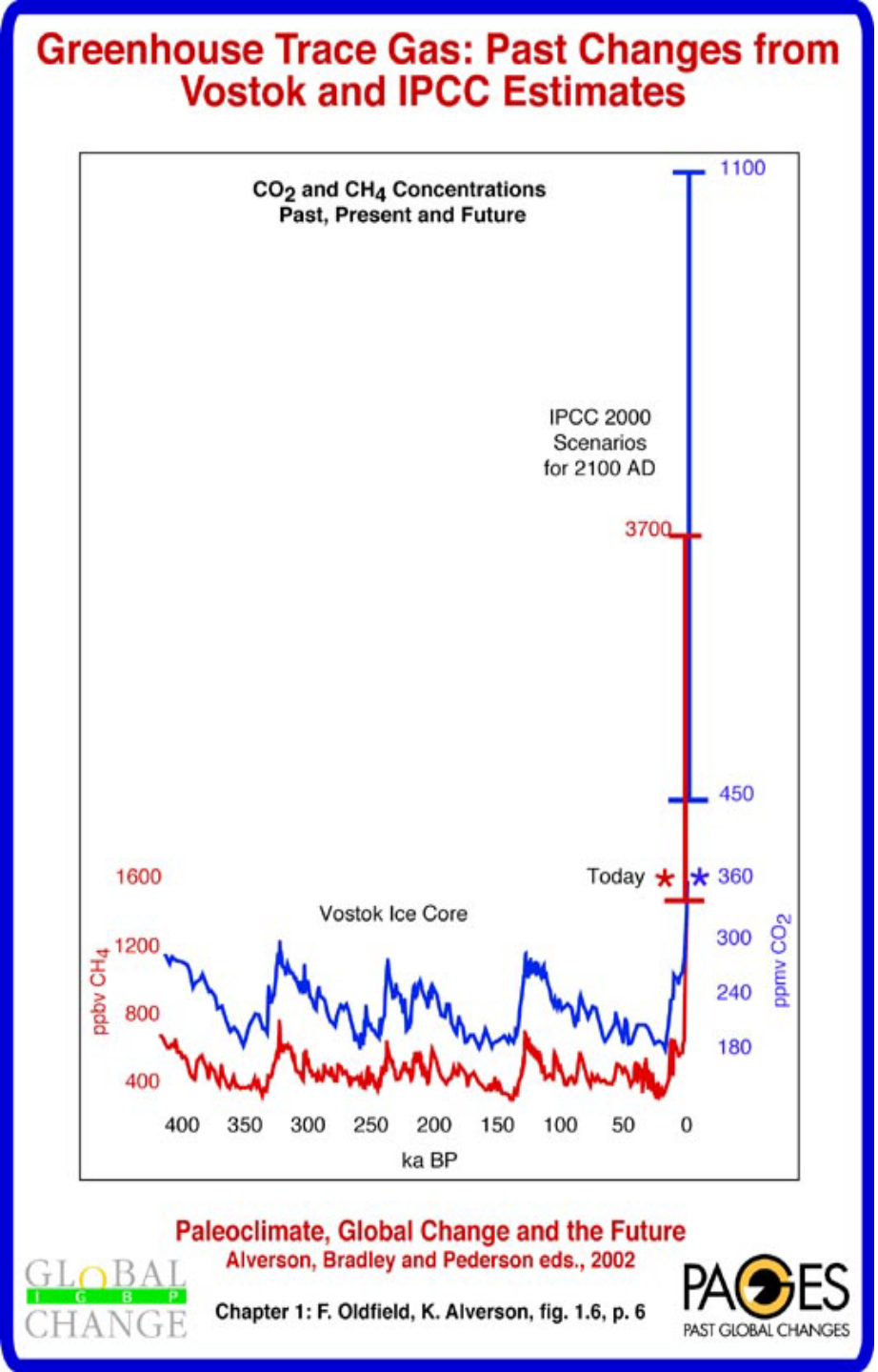
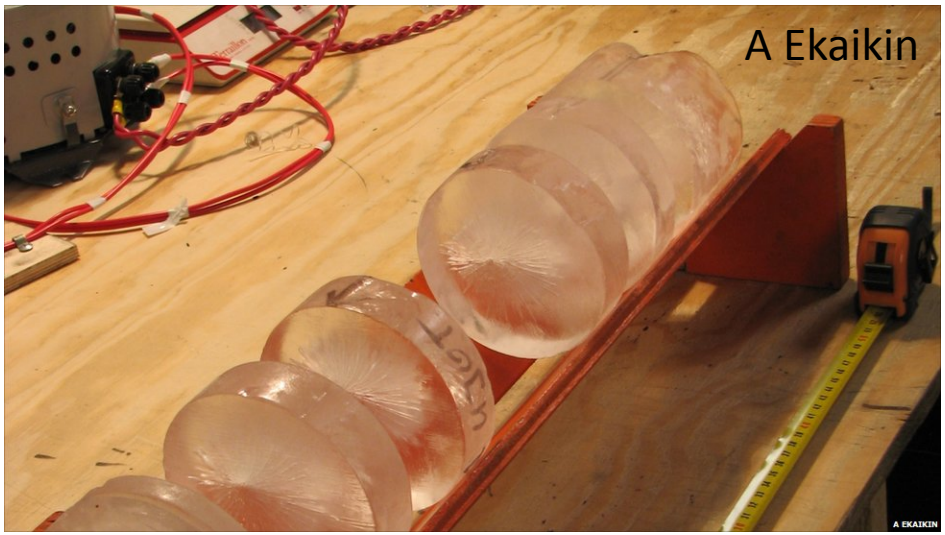
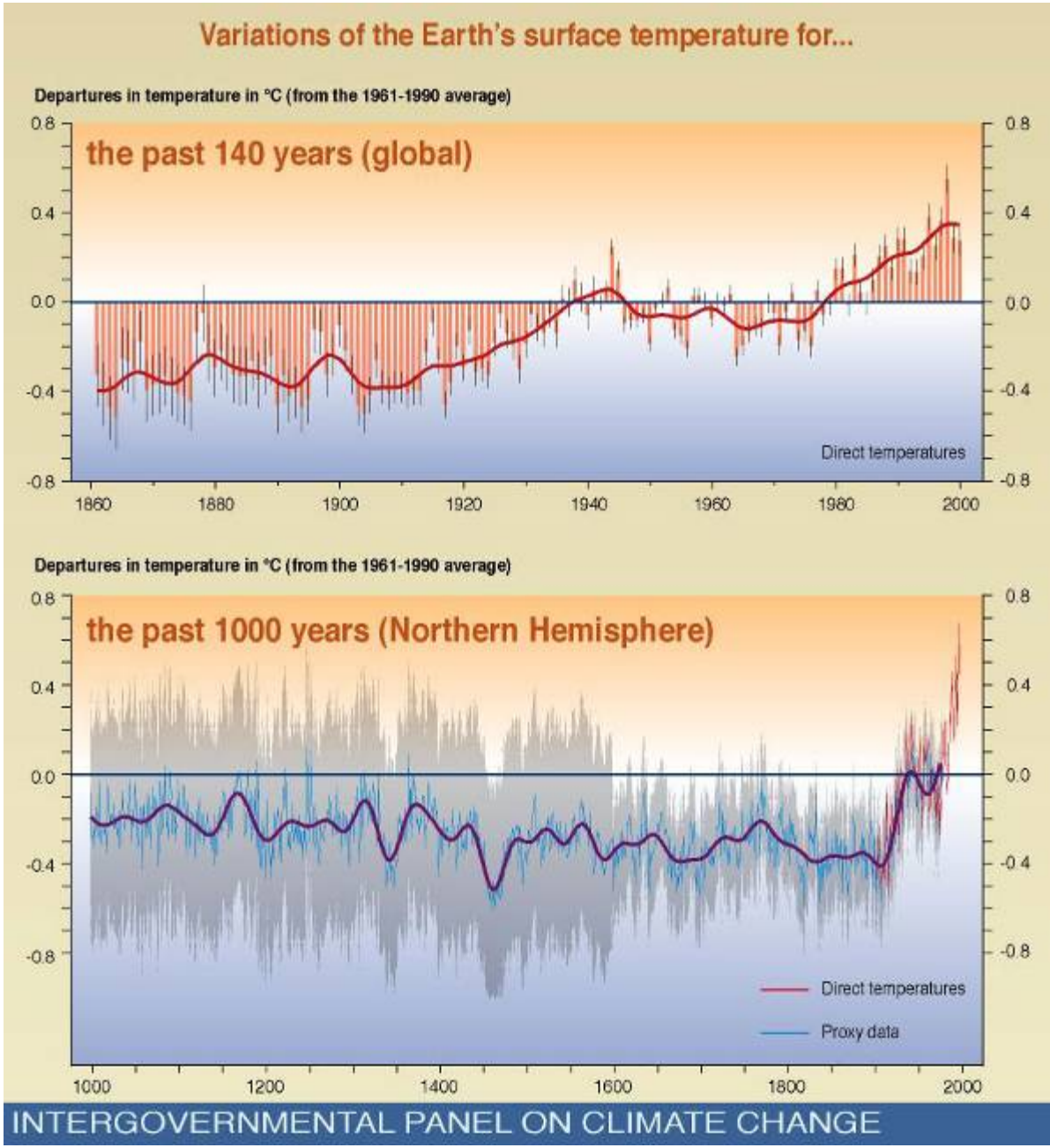


- The concentration of CO_2 is at a record high compared to the past 650,000 years.
- The rate of increase in CO_2 is faster than before at 80ppm over the past 100 years compared to 80 ppm over 5,000 years following previous ice ages.



“Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global mean sea level.”

IPCC, 2007



Global Climate Change

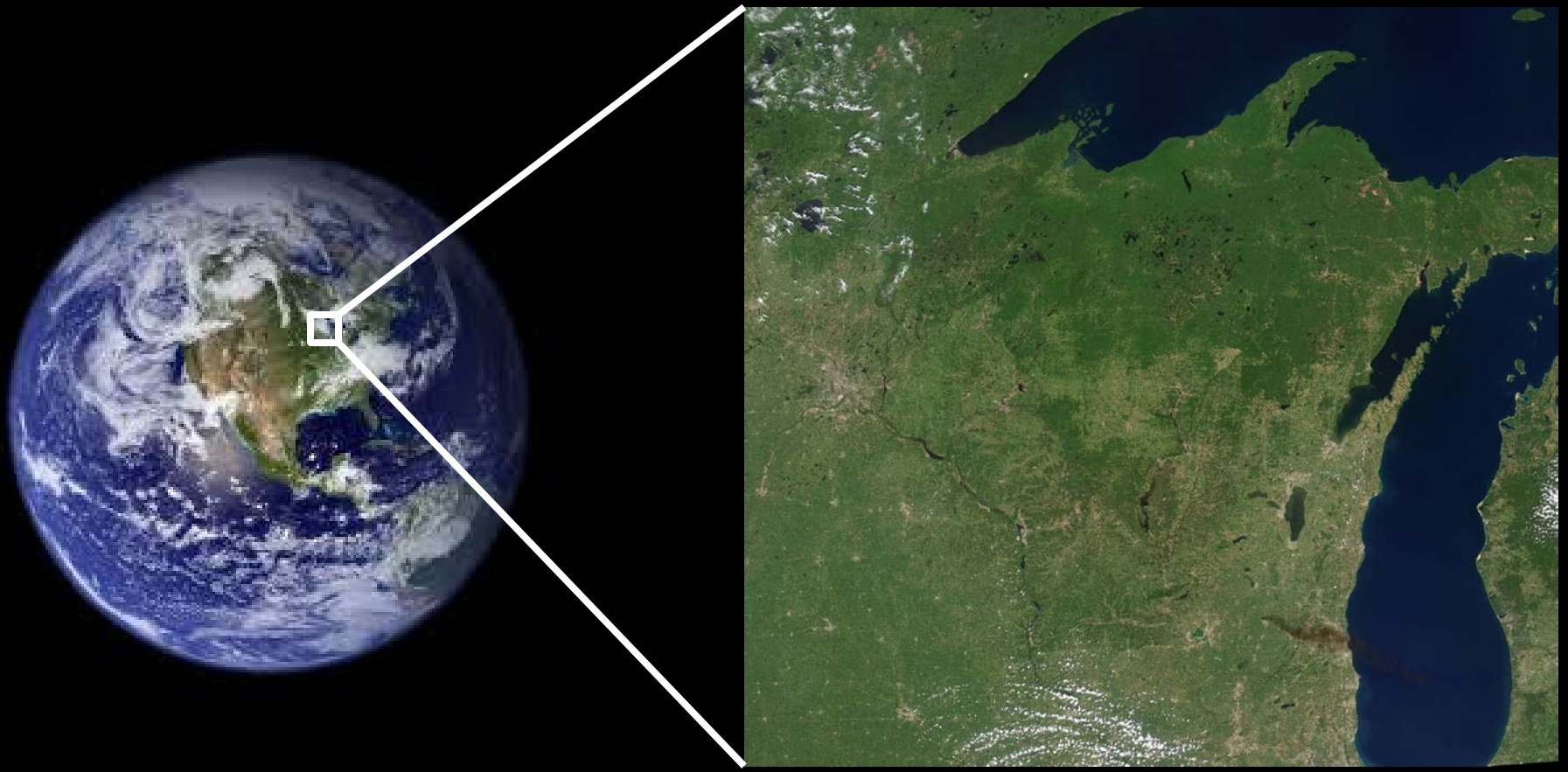
- Rate of warming is faster than any known period in the past

  650,000 years
- Broad perspective in

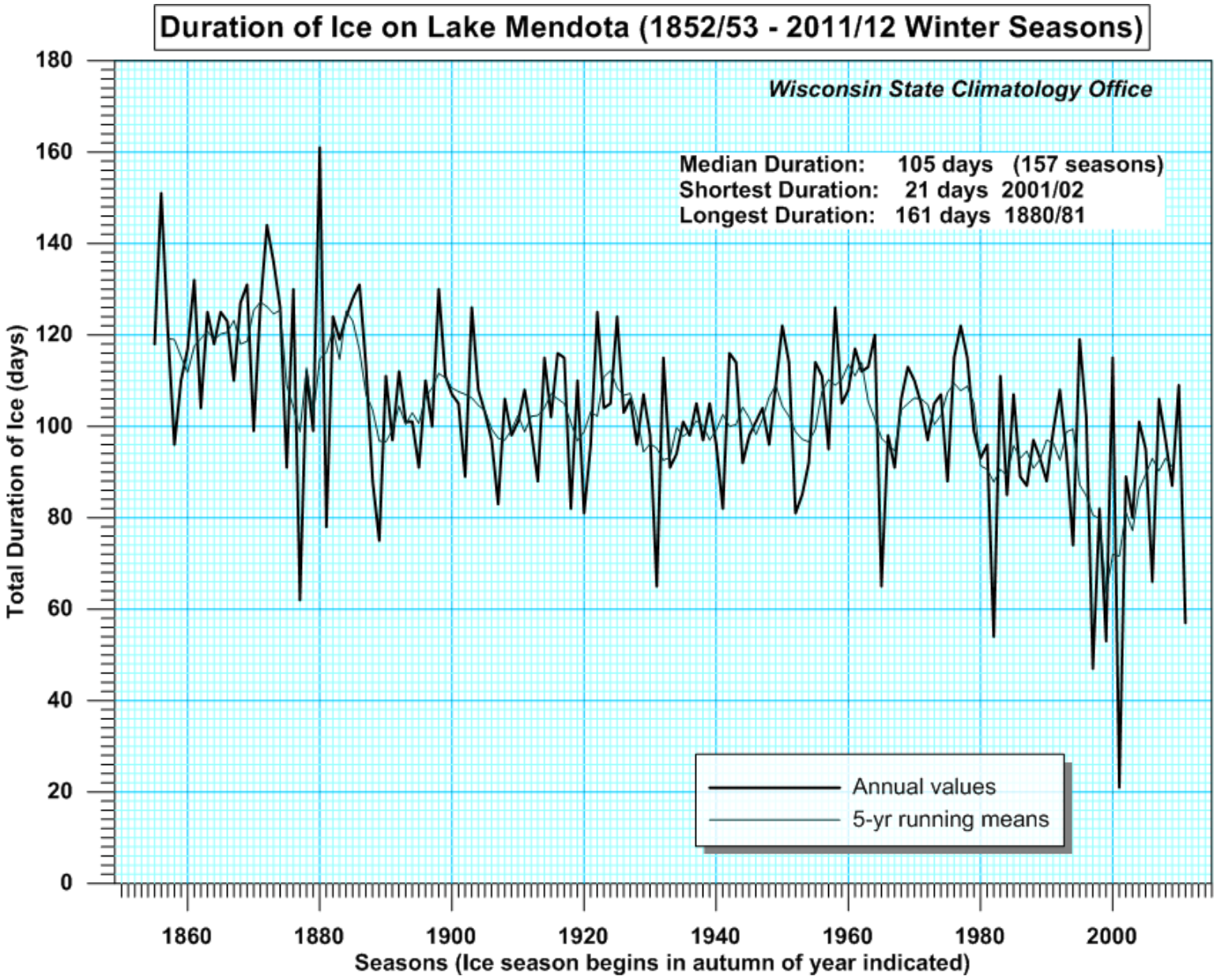
  space and time
- Projected temperature

  change greatest near the poles
- The past century is no longer a reasonable guide to the future for water management

Climate Change in Wisconsin

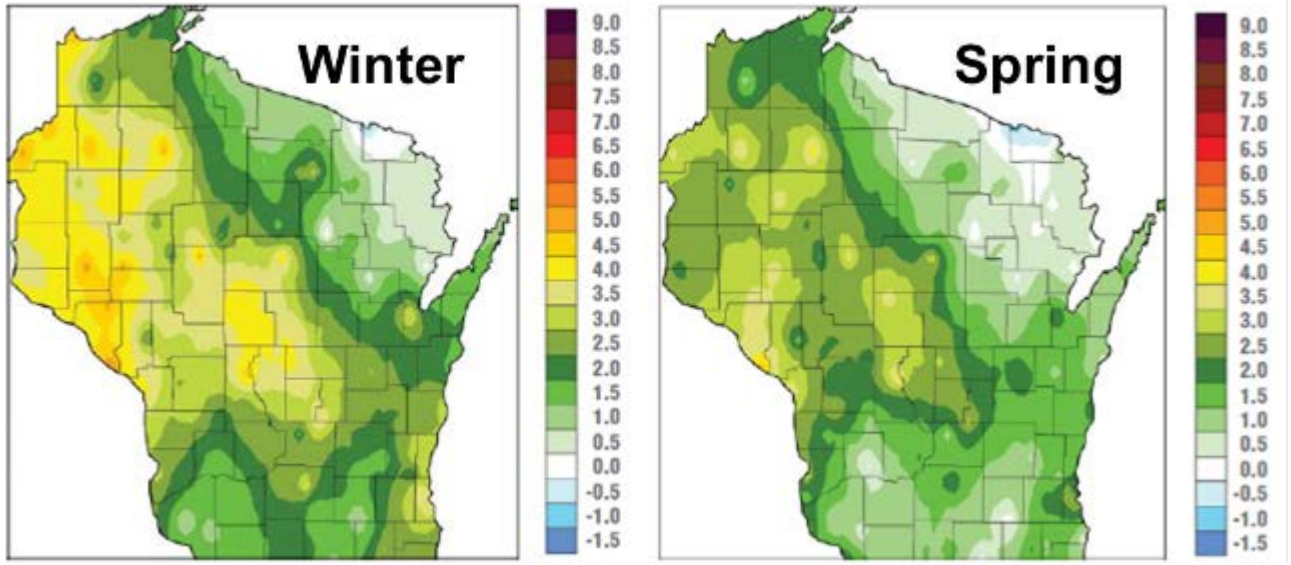


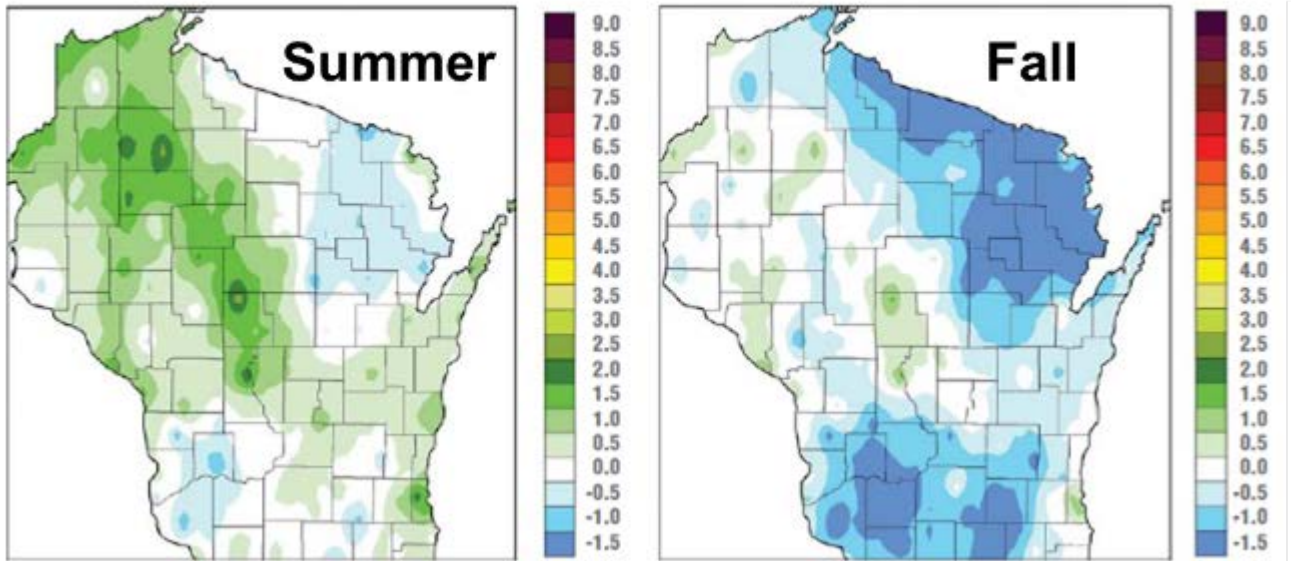
Shorter periods of ice cover on lakes



Observed Change in Average Temperatures

°F from 1950 to 2006





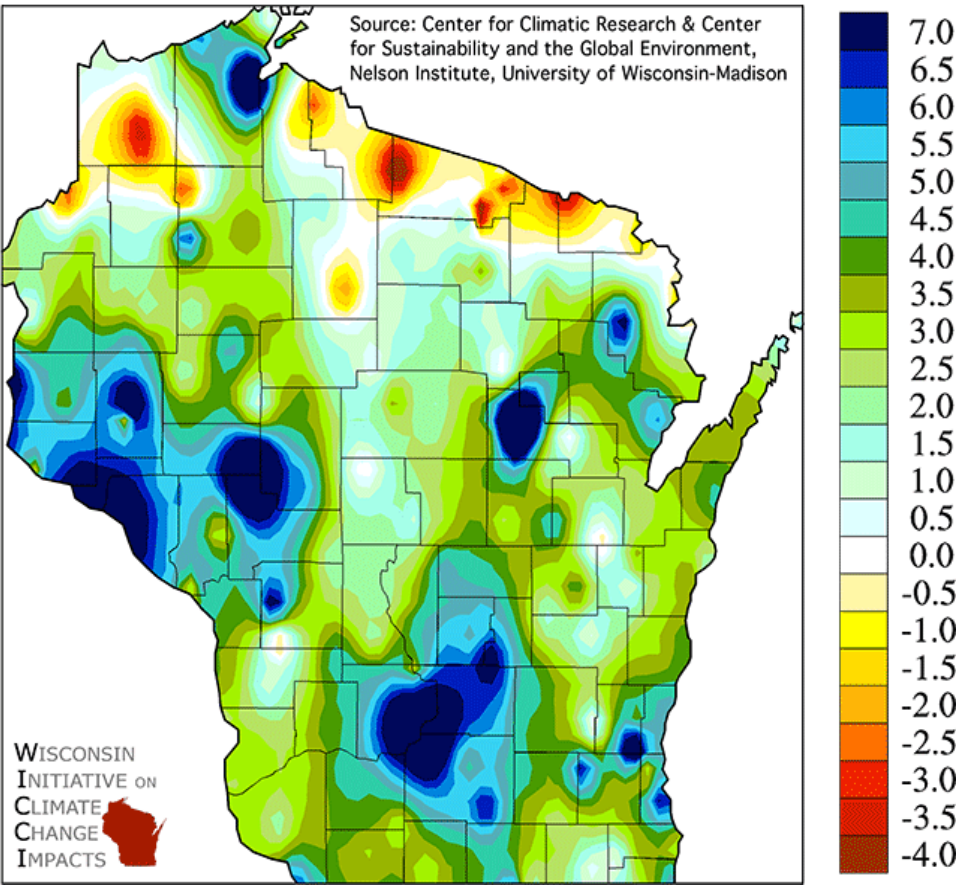
Winter temperatures have warmed more than any other season in recent decades, especially in northwestern Wisconsin.

(from Serbin and Kucharik 2009)

Summary of recent historic climate

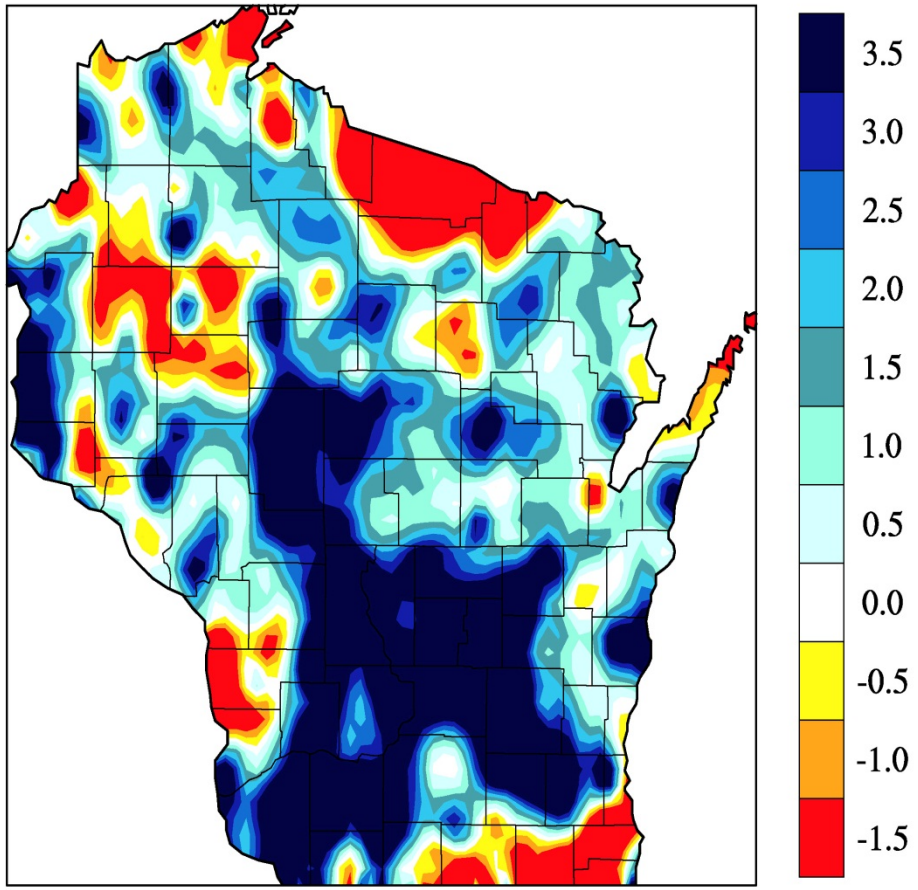
1950-2006 (based on NWS records)

Change in annual average precipitation (inches) 1950 to 2006



↑7” to ↓4” (drought)

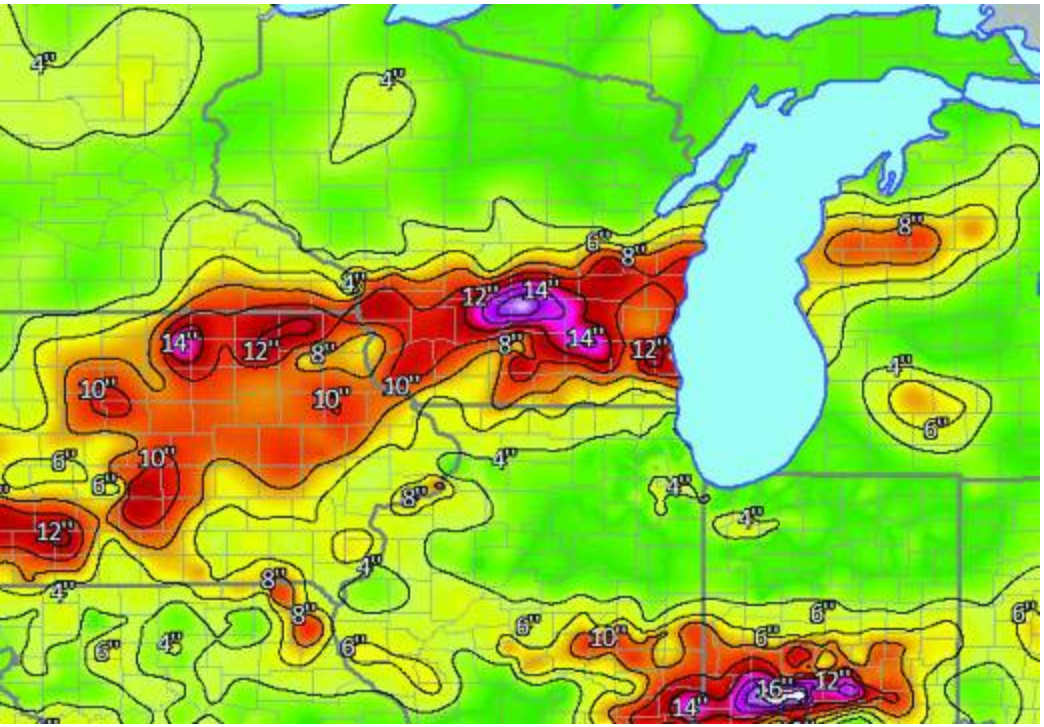
Increase in 2” rainfalls (days/decade) 1950 to 2006



↑3.5 days to ↓1.5 days (regionally variable)

Extreme events: June 2008 storms

Total Precipitation (inches), June 1-15, 2008

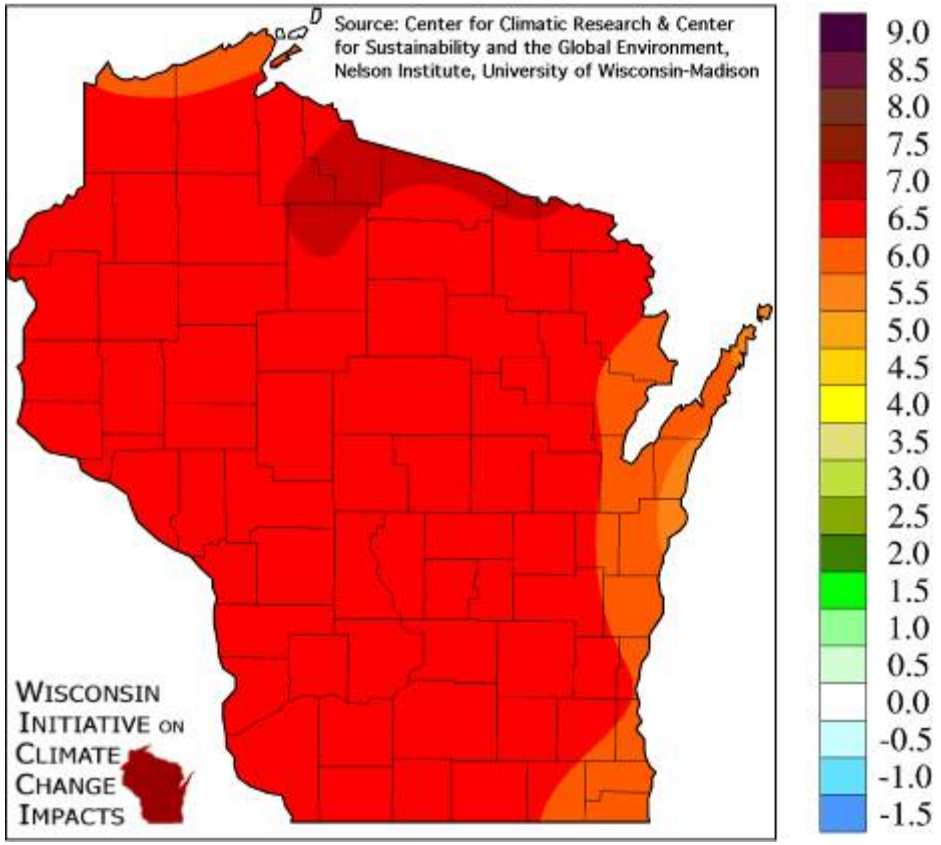


- **Stormwater infrastructure was overwhelmed**
- **Massive flooding (810 sq. mi)**
- **Water from private wells contaminated (28%)**
- **Raw sewage overflows (90 million gallons from 161 wastewater treatment plants)**
- **FEMA paid $34 million in flood damage claims**

Few communities even today can handle these kinds of extreme events!

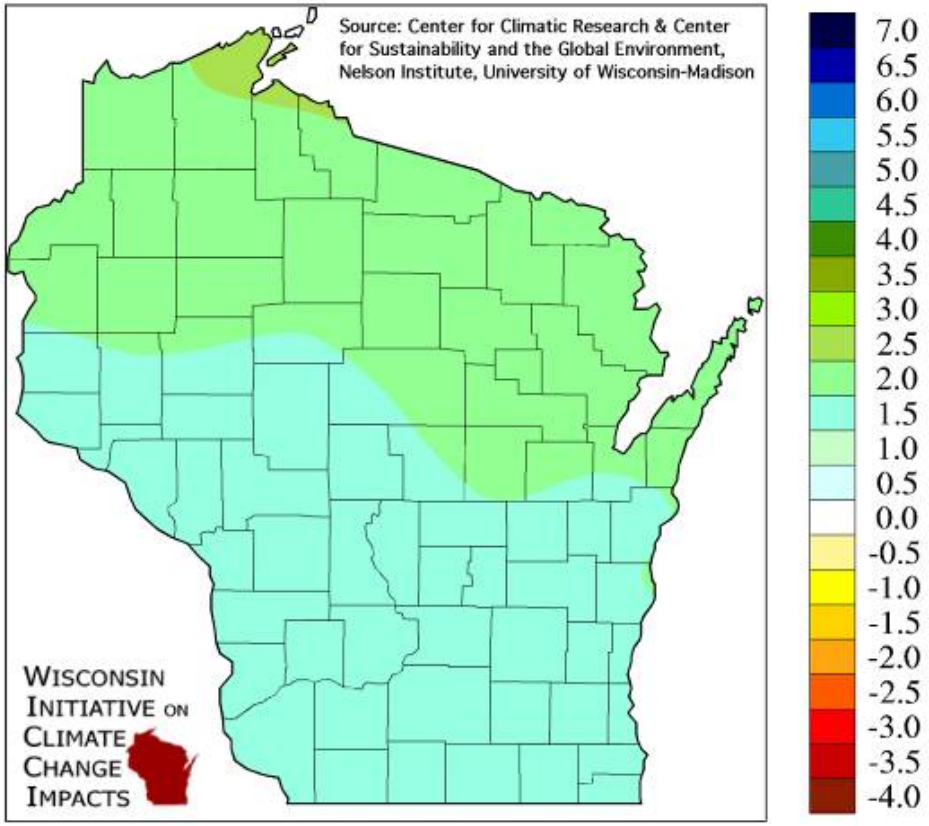
Future Climate

Projected Change in Annual Average Temperature (°F) from 1980 to 2055



Wisconsin will warm by 5.5 – 7.5 °F by mid-21st century

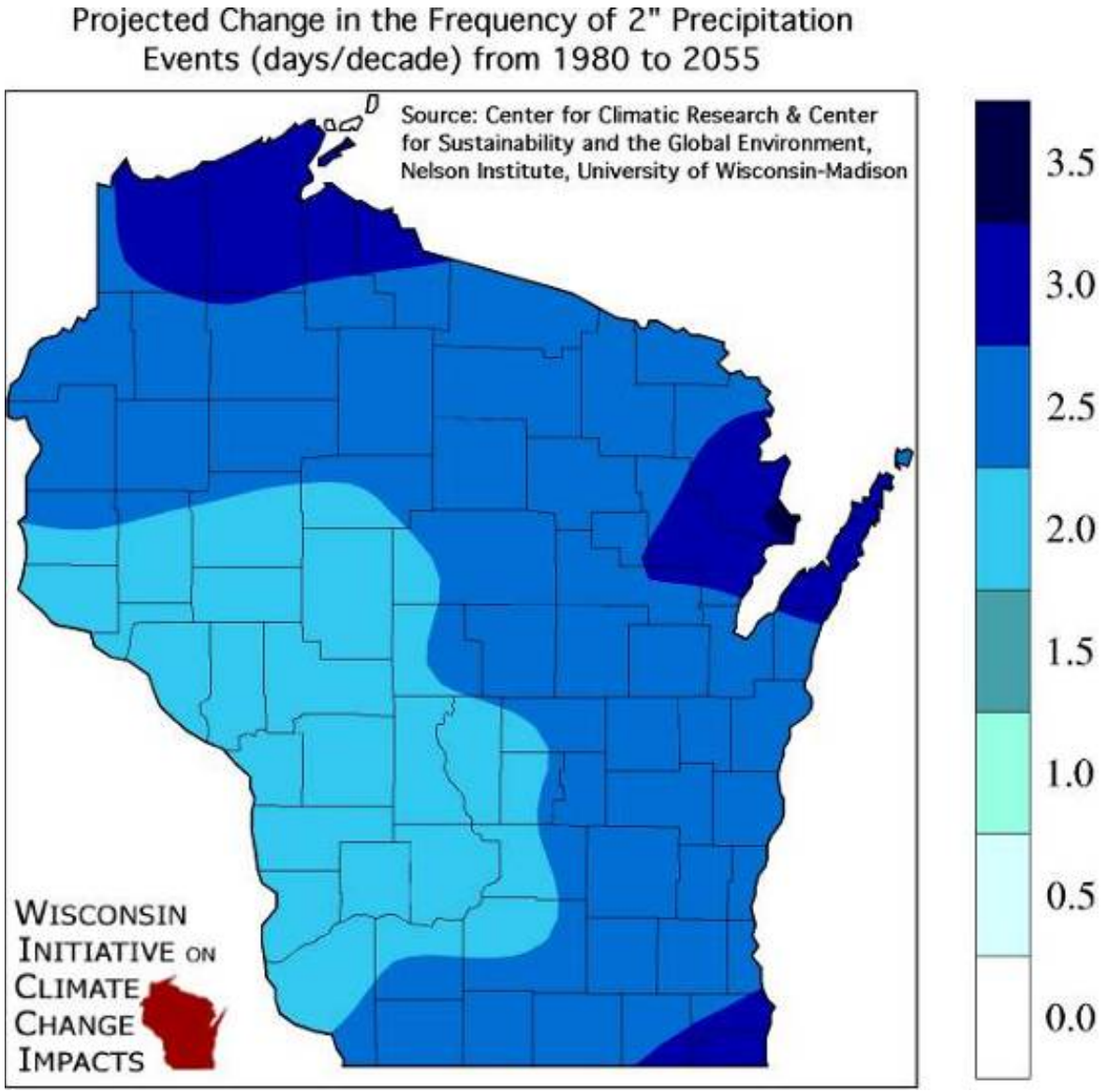
Projected Change in Annual Average Precipitation (inches) from 1980 to 2055



Wetter winters and early springs (0-40% increase), but summer rainfall uncertain

Source: Adapted from D. Vimont, UW-Madison

Future Increase in Extreme Precipitation Events



“Stationarity is dead.” Science 2008

“Traditionally, hydrologic design rules have been based on the assumption of stationary hydrology, tantamount to the principle that the past is the key to the future…

…This assumption is no longer valid.”

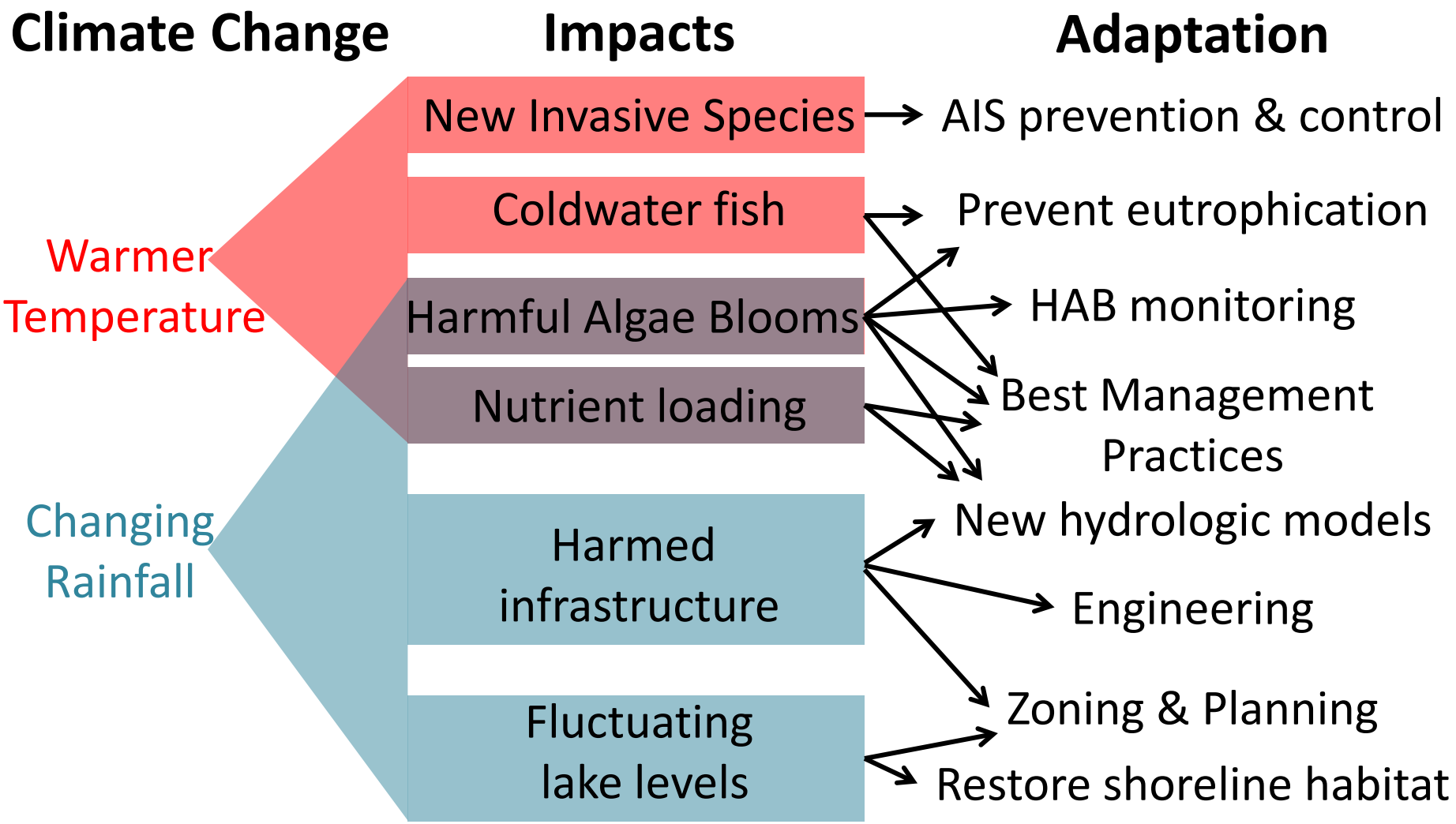
Kundzewicz et al 2007. Contribution of Working Group II to IPCC

Adaptation!

WICCI: How humans will respond to climate change in a way that will make our natural and human systems more resilient.

So where do we go from here?

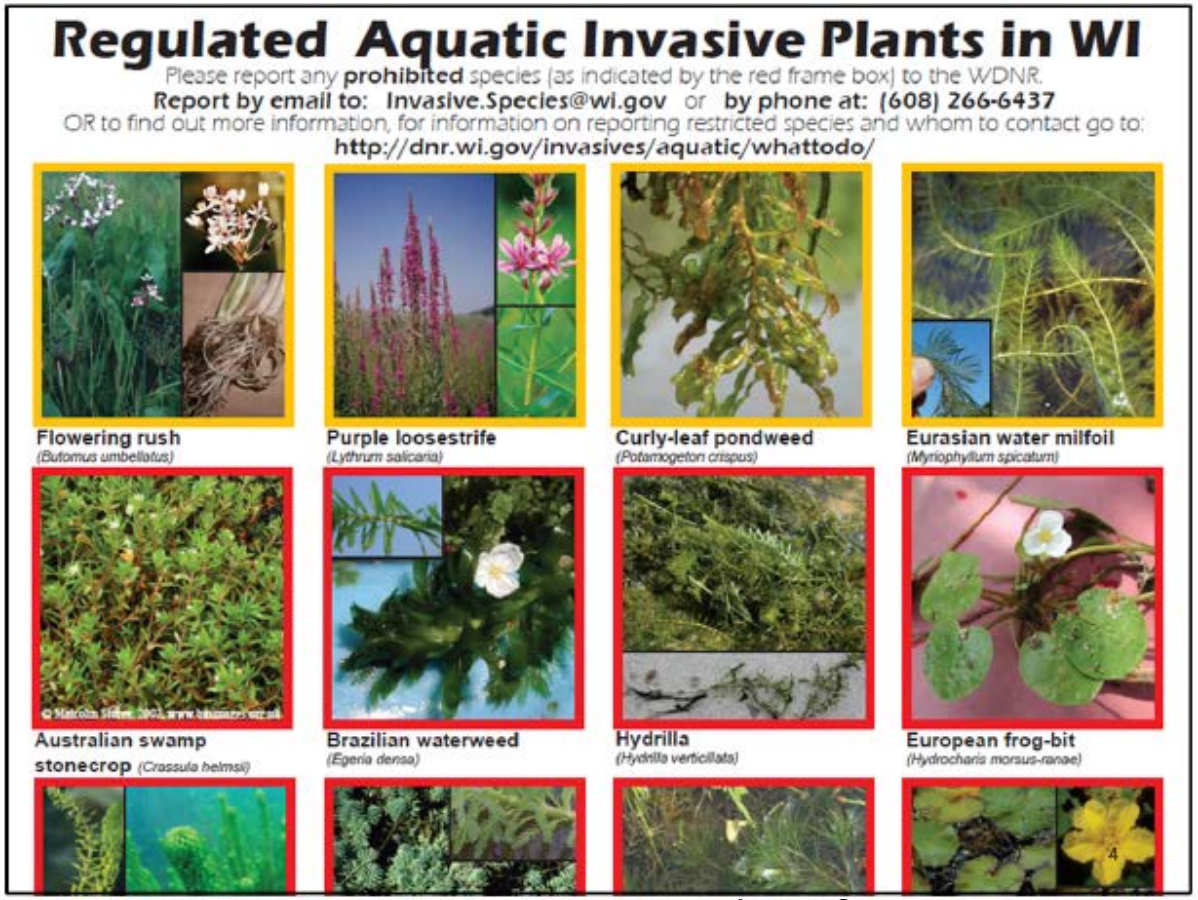
Impacts of Climate Change to Wisconsin Lakes & Adaptation Strategies



Aquatic Invasive Species

Impact: Increased threat due to warmer temperatures and flooding

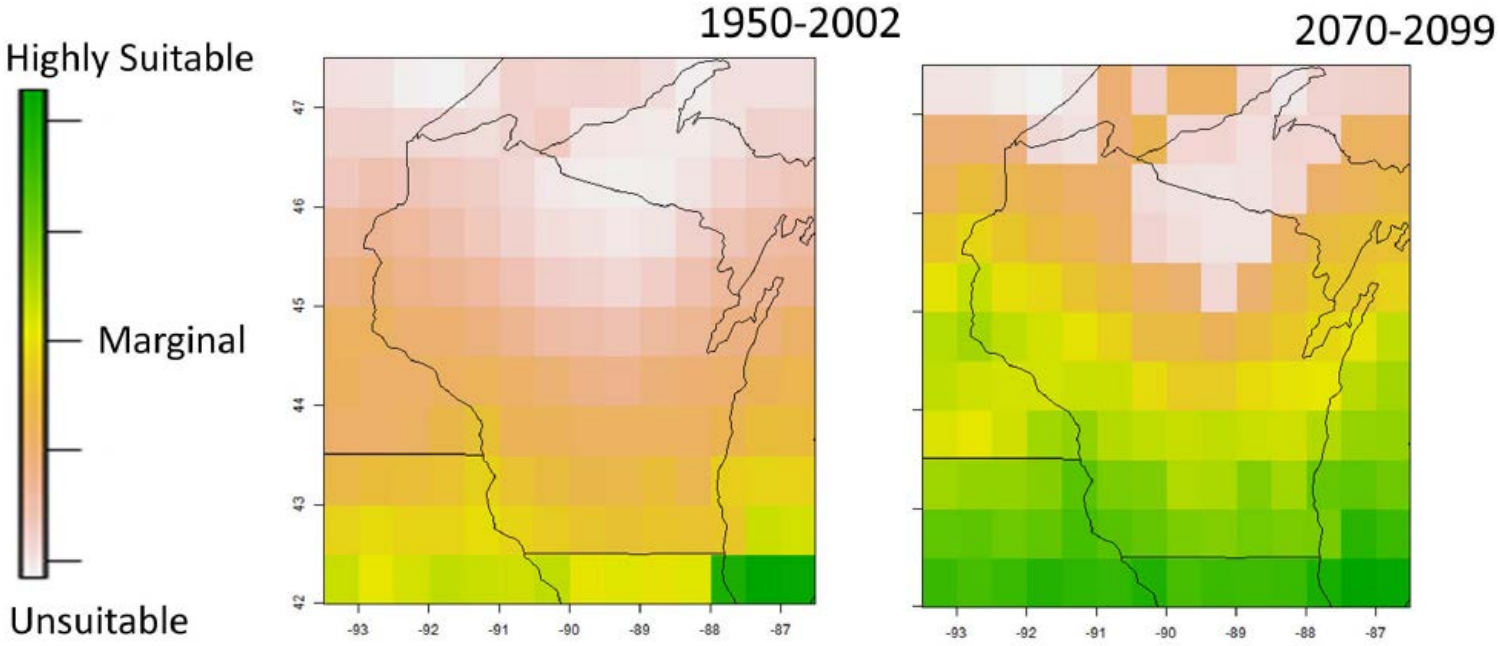
Adaptation: prevent spread, regulation, education



NR40 Invasive Species Identification, Classification, and Control Rule

Anticipate Future Invaders Given Climate Change

Example:
Wisconsin's climate is not suitable for Water Hyacinth today, but models predict that it will be in the future.

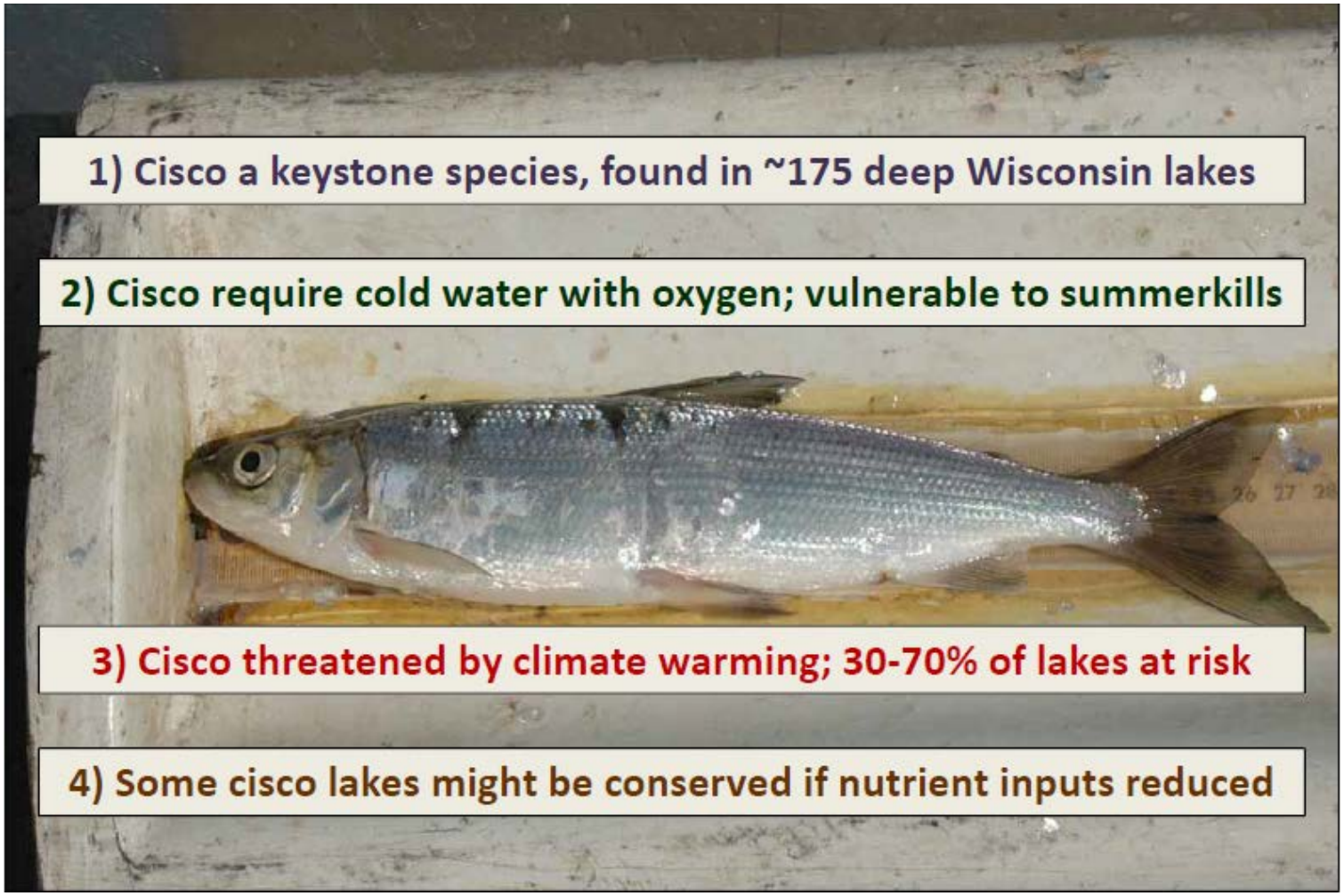


Courtesy of Ali Mikulyuk

Coldwater Fish

Impact: Cisco extinctions in some lakes due to warming

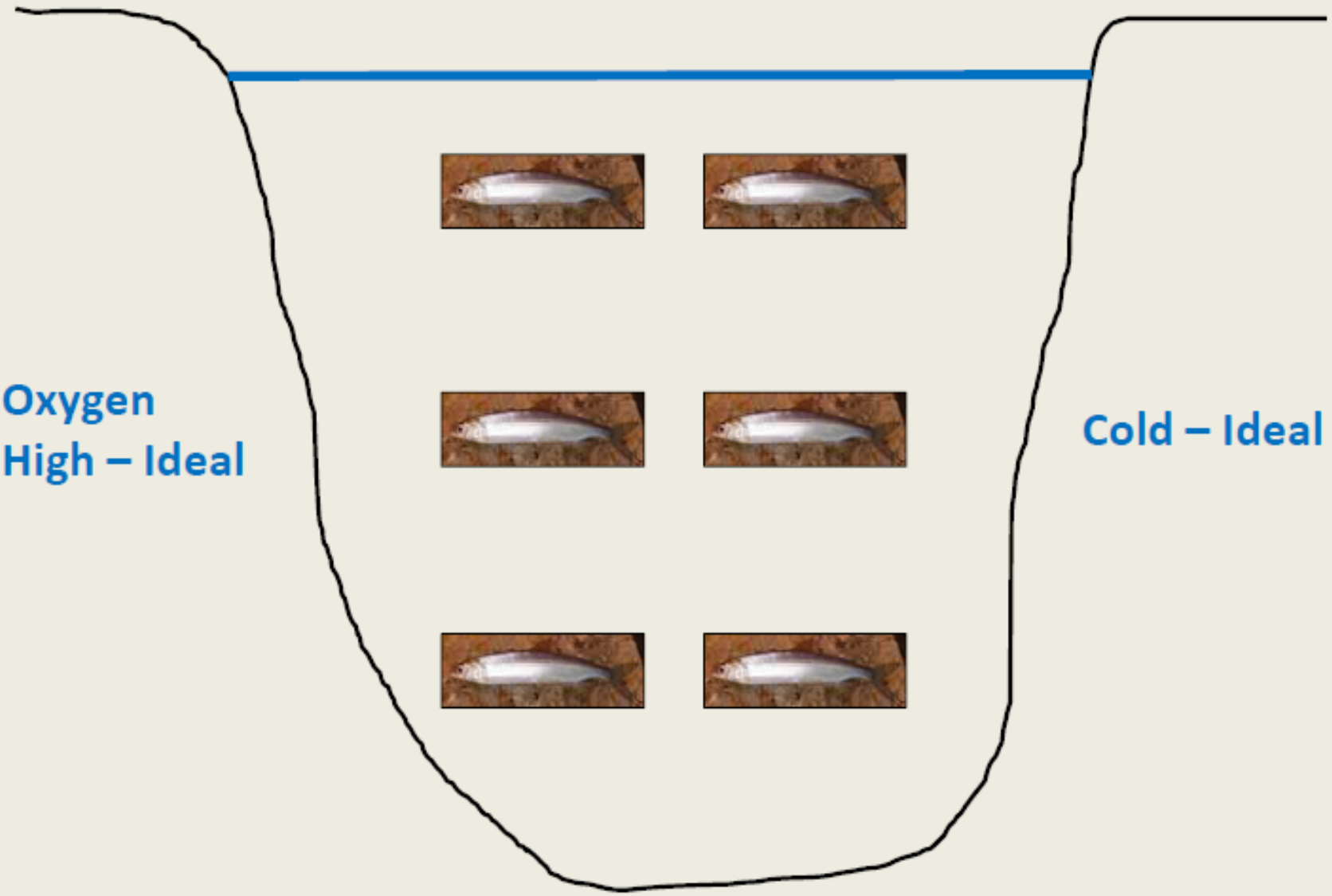
Adaptation: Reduce nutrient inputs



Courtesy of John Lyons

Where Do Cisco Live in Lakes?

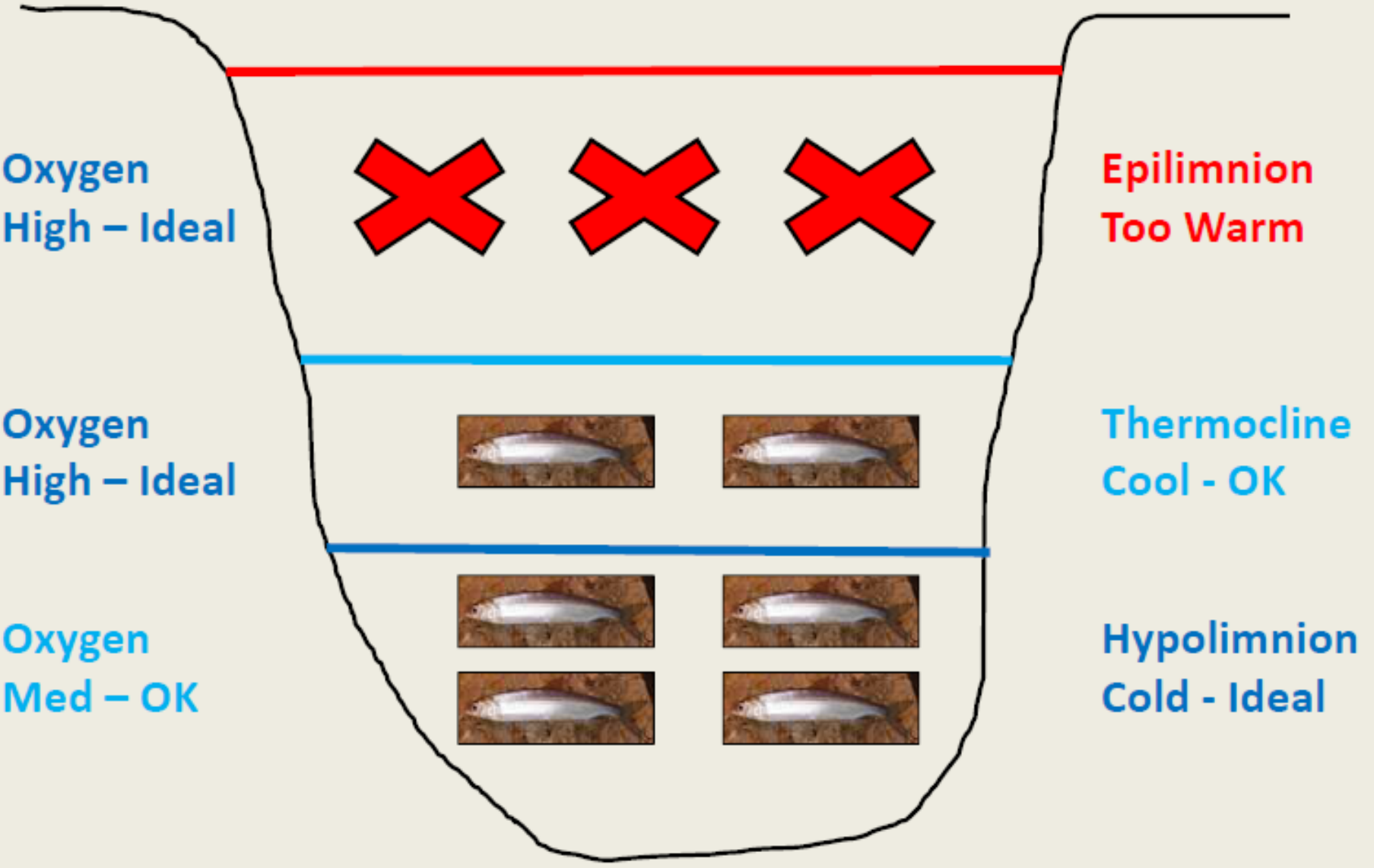
Fall, Winter, and Spring



Courtesy of John Lyons

Where Do Cisco Live in Lakes?

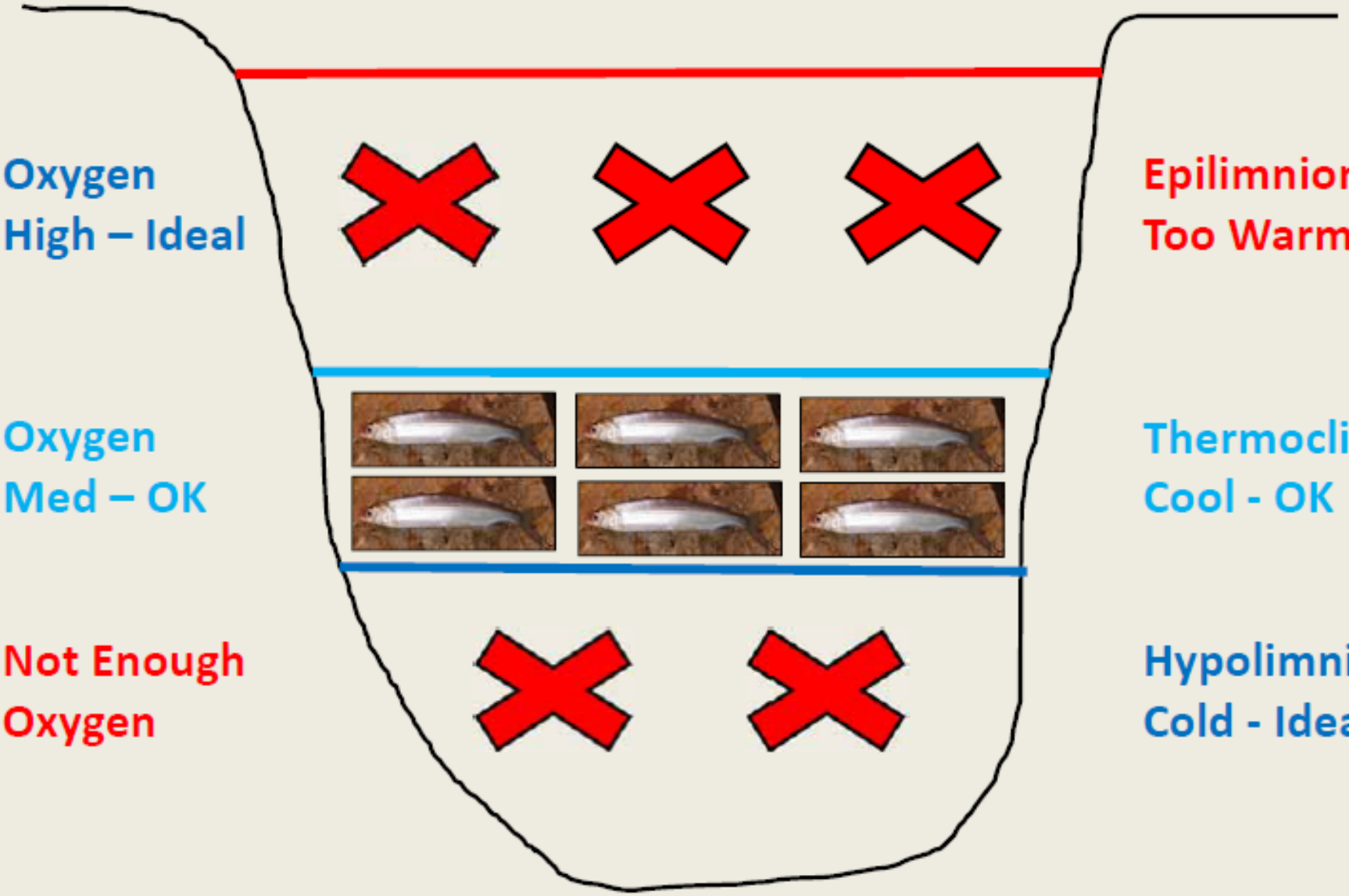
Early Summer



Courtesy of John Lyons

Where Do Cisco Live in Lakes?

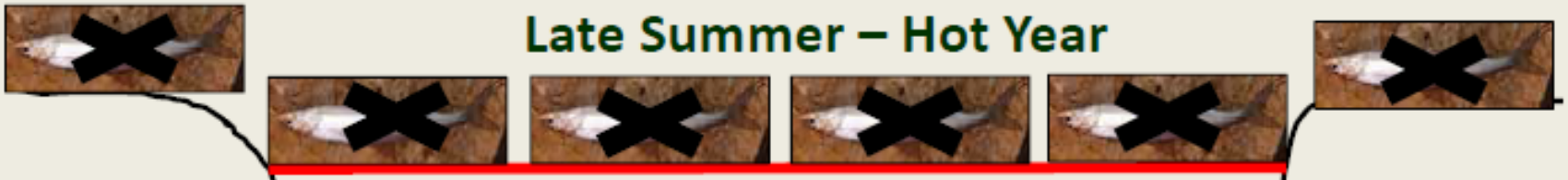
Late Summer



Courtesy of John Lyons

Where Do Cisco Live in Lakes?

Late Summer – Hot Year



Oxygen
High – Ideal

Epilimnion
Too Warm

Not Enough
Oxygen

Thermocline
Cool - OK

Not Enough
Oxygen

Hypolimnion
Cold - Ideal

SUMMER FISH KILL!

Courtesy of John Lyons

Climate Change Adaptation: Reduce Nutrient Inputs

Improve Watershed Land Use

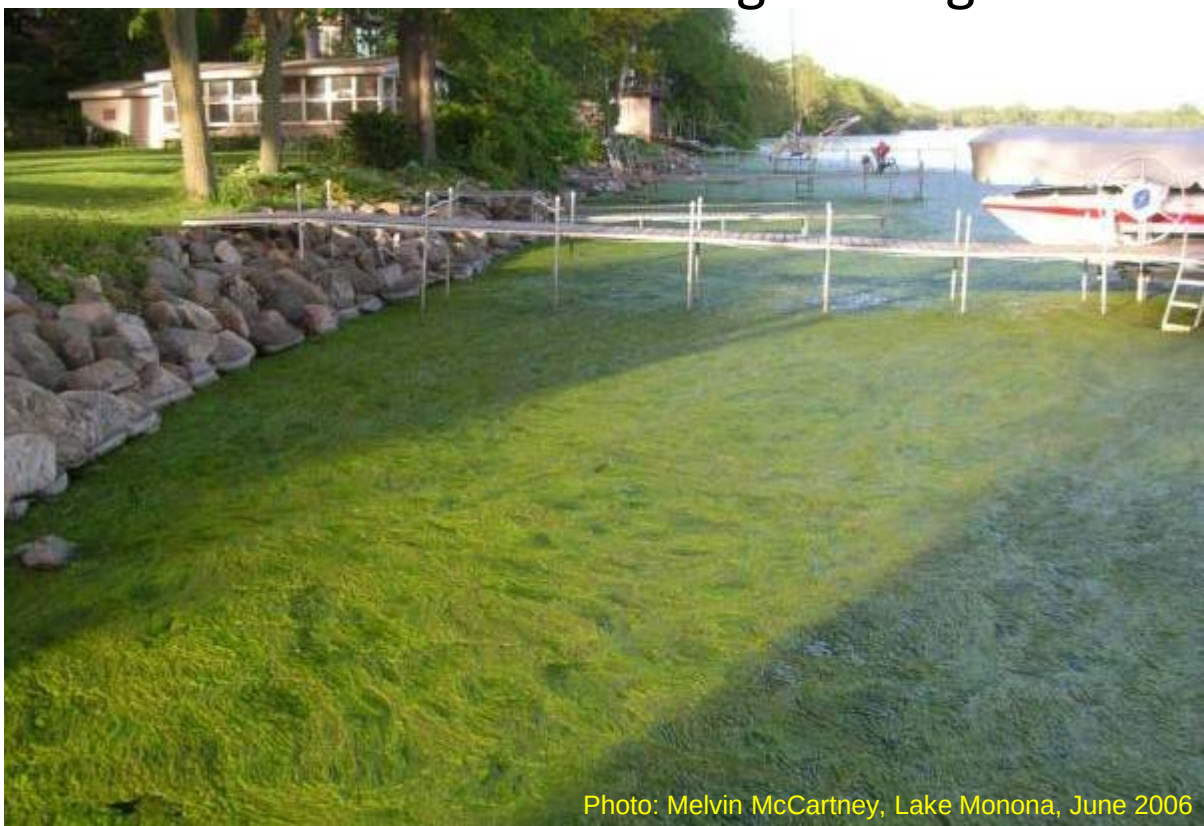
Protect Natural Shorelines

Courtesy of John Lyons

Harmful Algae Blooms

Impact: more HABs due to warming and increased runoff

Adaptation: Reduce nutrient inputs
Create a HAB surveillance program
Improve predictive capacity
Develop statewide standards for blue-green algae



Nutrient Loading

Impact: Greater nutrient loading due to increased runoff

Adaptation: Improve hydrologic models
Agricultural Best Management Practices
Rain gardens, Riparian buffers
Stormwater retention ponds

$$P = \frac{L(1-R)}{zp} \qquad P = \frac{L}{z\left(0.162(L/z)^{0.458} + p\right)}$$

Infrastructure

Impact: Buildings, roads, and water/sewer systems not designed for future precipitation patterns

Adaptation: Update hydrologic models
Improve predictive capacity
Redesign/Rebuild infrastructure
Zoning and planning

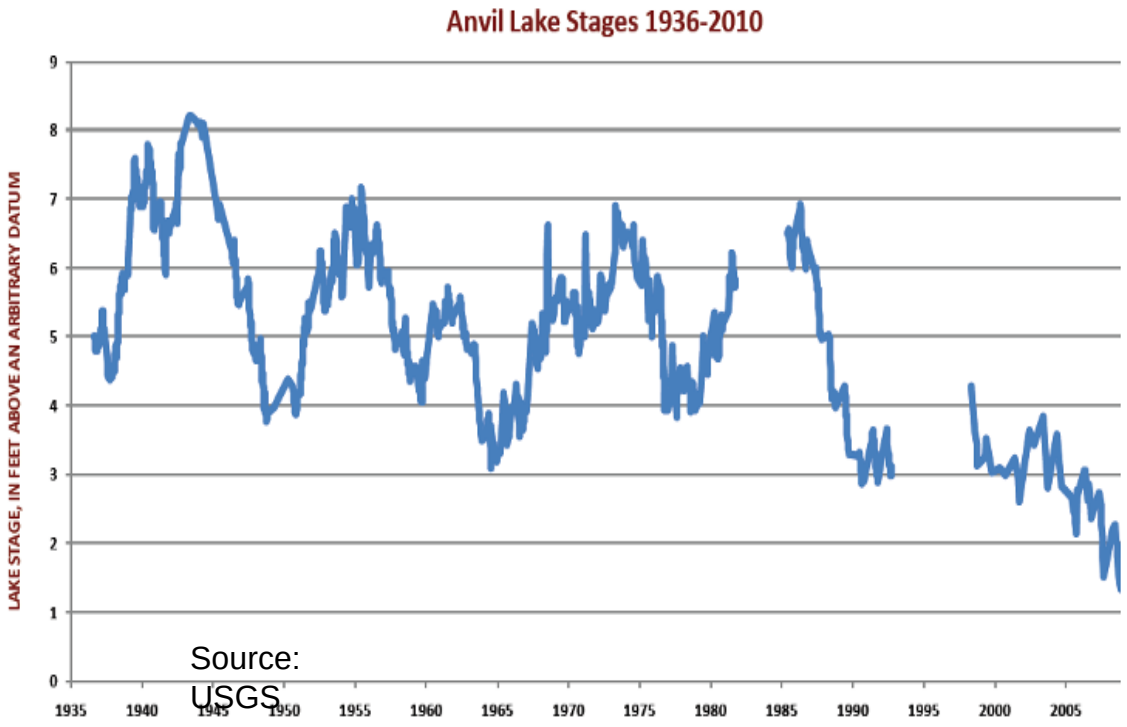
Photo: Michael Kienitz


Photo: Steve Zibell

Lake Levels

Impact: Changing water levels due to variable precipitation, recharge, and increased evaporation

Adaptation: Restore shoreline habitat
Enhance infiltration
Planning and zoning

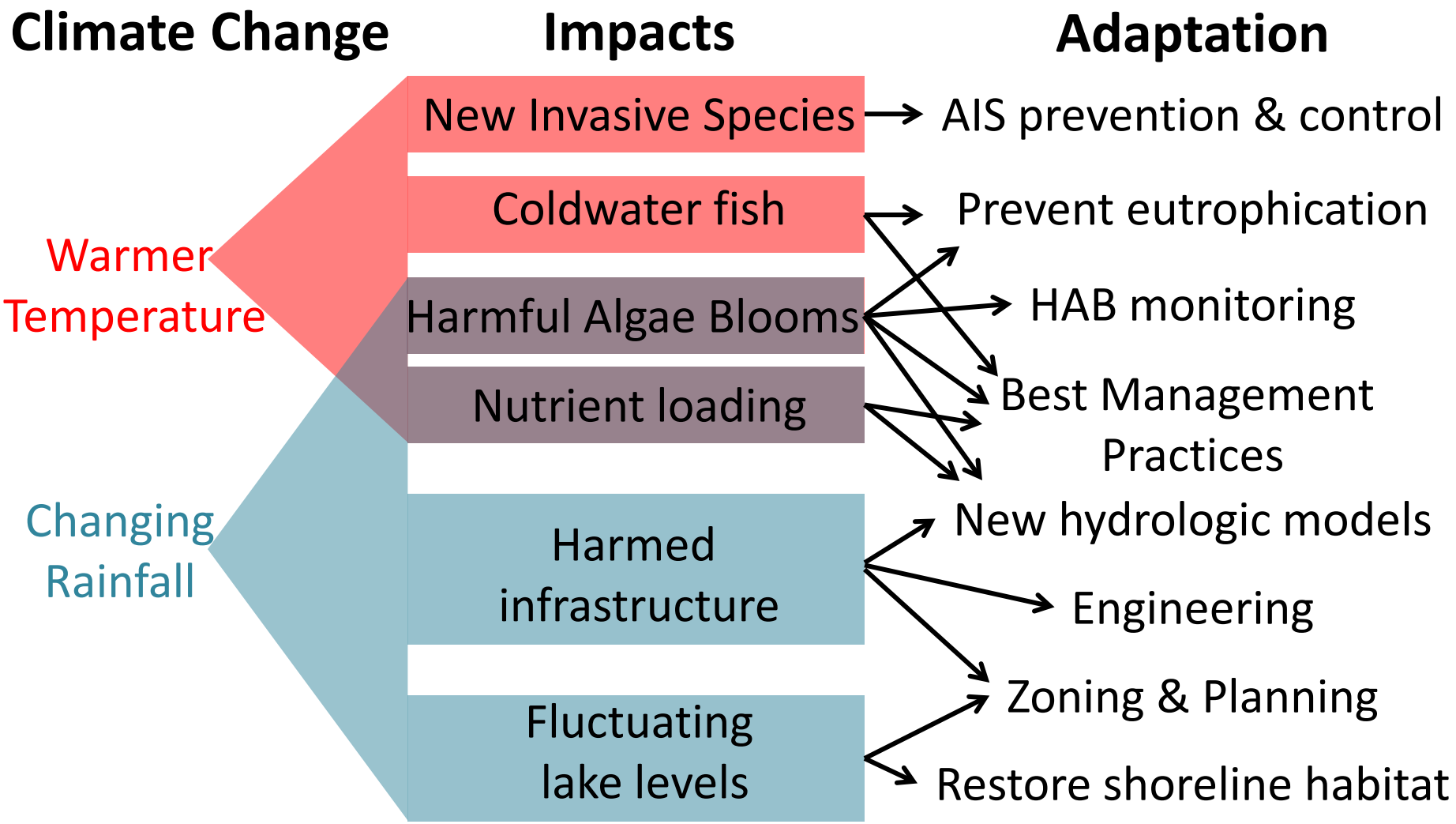


Source: USGS

Photo – WDNR

Photo – Janesville Gazette

Impacts of Climate Change to Wisconsin Lakes & Adaptation Strategies



Resources

http://www.wicci.wisc.edu/

http://www.ipcc.ch/index.htm