Adapting to Climate Change

In the Great Lakes

Bob Krumenaker
Superintendent
Apostle Islands National Lakeshore
Bayfield, Wisconsin

Photo by William Cronon

Today's Plan

Adapting to Climate Change in the Great Lakes

- Climate change is already happening *here*
- Climate change projections for the Great Lakes
- Defining climate change *Adaptation* and what it means for the Great Lakes

Stockton Island, Apostle Islands National Lakeshore
Photo by William Cronon

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Temperature & Phenological Changes

Spring Is Coming Earlier

- Nina Leopold Bradley replicated her father Aldo's phenology studies at "The Shack" near Baraboo, WI.

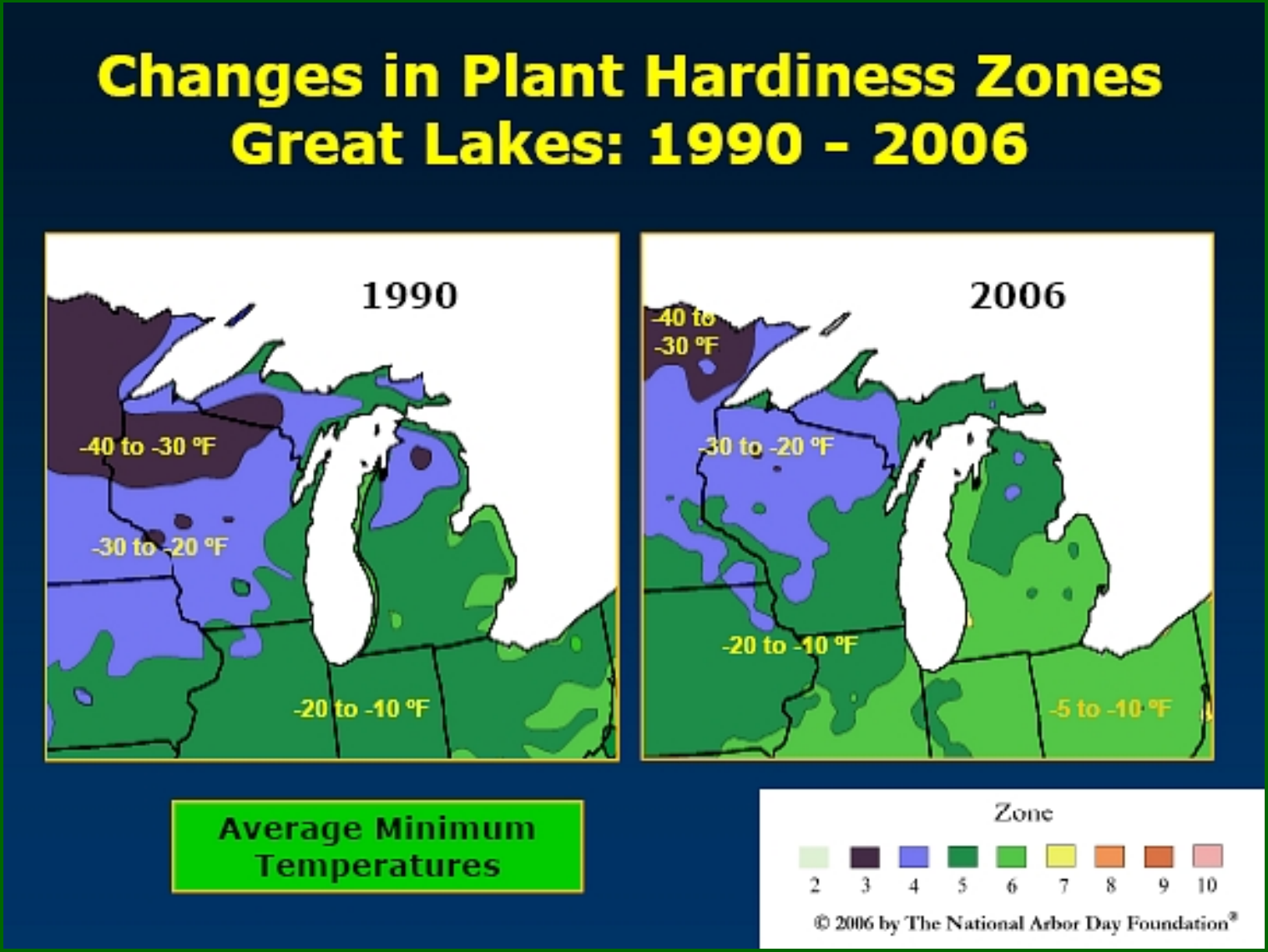
Event	Average 1936-1947	Average 1976-1998
Robin arrival	March 20	March 12
Hepatica first bloom	April 15	April 8
House wren arrival	May 4	April 23
Columbine first bloom	May 19	May 10
Baptisia first bloom	June 14	May 29

- Spring has arrived 1.2 days earlier per decade over the last 60 years, correlating with a gradual increase in regional temperature.

From the Proceedings of the National Academy of Sciences 96:9701-04 (1999) at http://www.pnas.org/cgi/reprint/96/17/9701 and the newsletter of the Aldo Leopold Foundation at http://www.aldoleopold.org/Publications/newsletters/winter2003.pdf

Plant Hardiness Zones Are Moving North

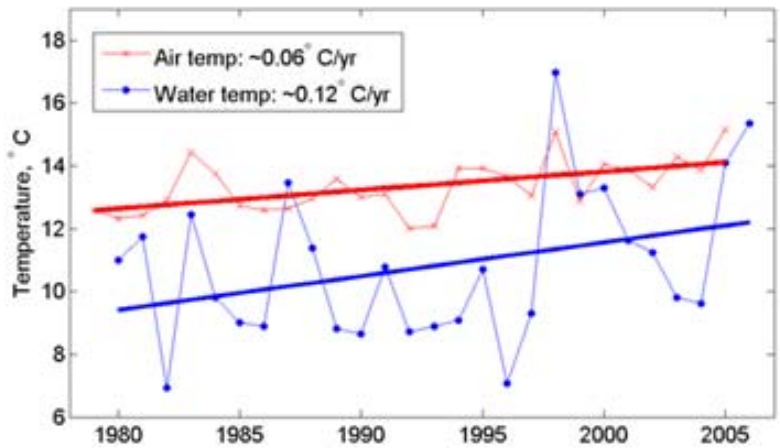
Local Impacts

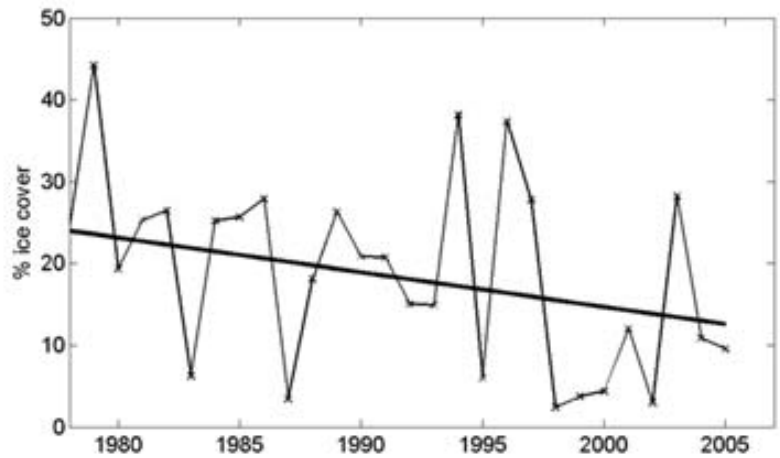


From http://www.arborday.org/media/zones.cfm

Great Lakes Water Temperature Increases

Lake Superior is Warming Rapidly





- Lake Superior water temperature is rising at twice the rate of air temperature since 1980
- This correlates with decreasing ice cover over the same period

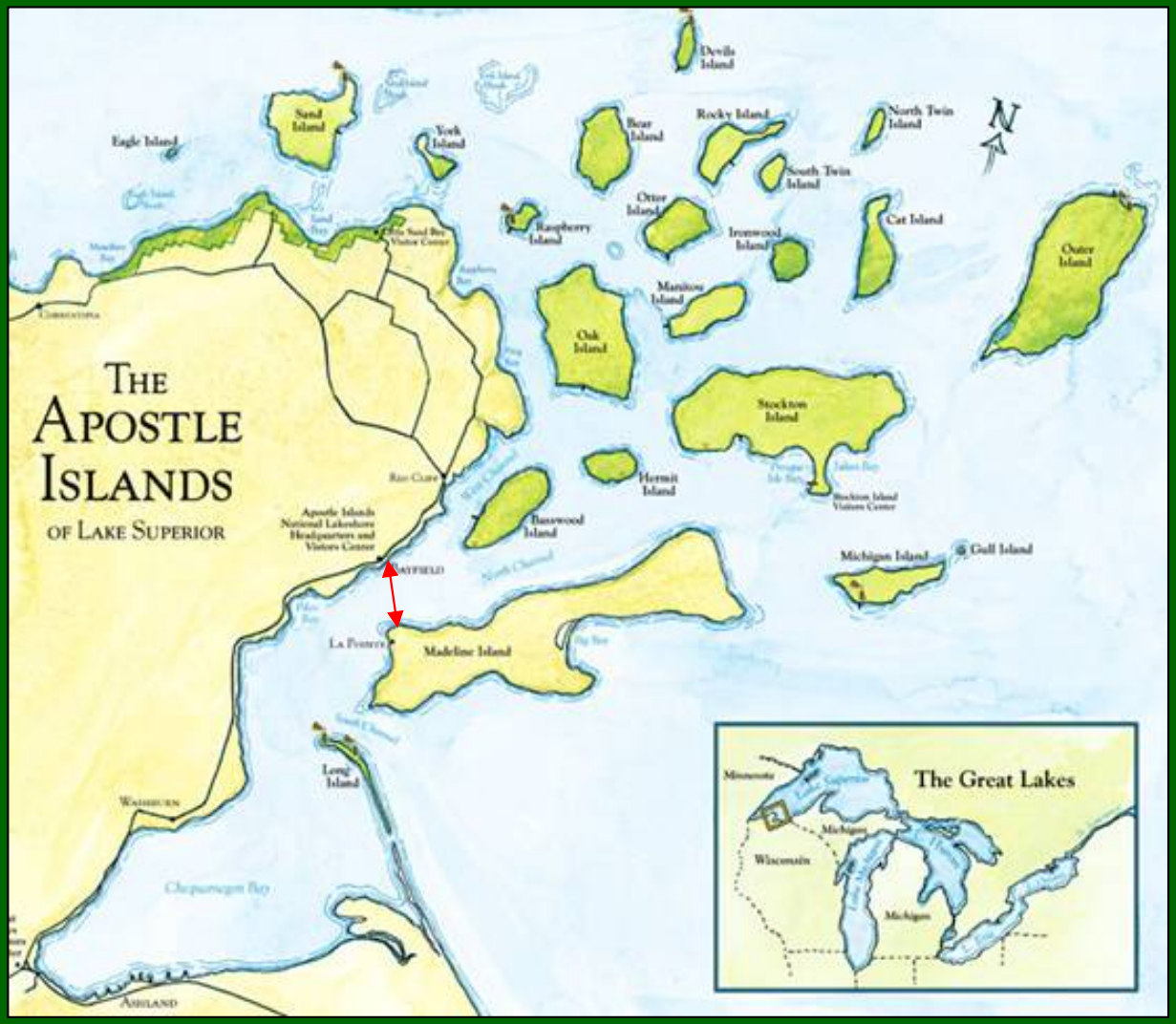
From http://www.d.umn.edu/~jaustin/ICE.html
(Austin and Colman, 2007)

- A similar pattern has been noted in Lake Baikal (Russia)

From http://www.planetark.org/dailynewsstory.cfm?newsid=48179

Ice Decline on the Great Lakes

Madeline Island Ice Road, Lake Superior



Ice Decline on the Great Lakes

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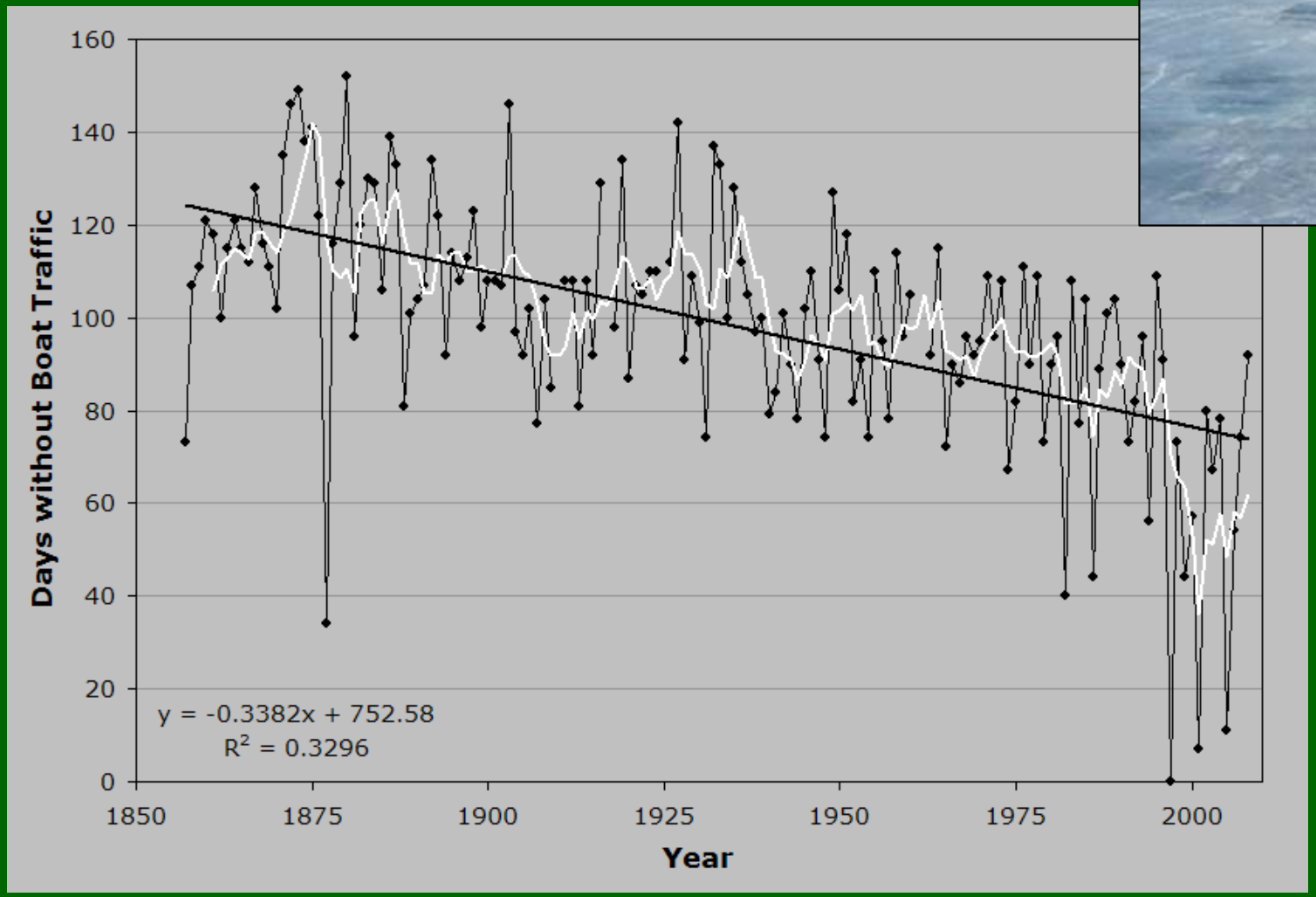
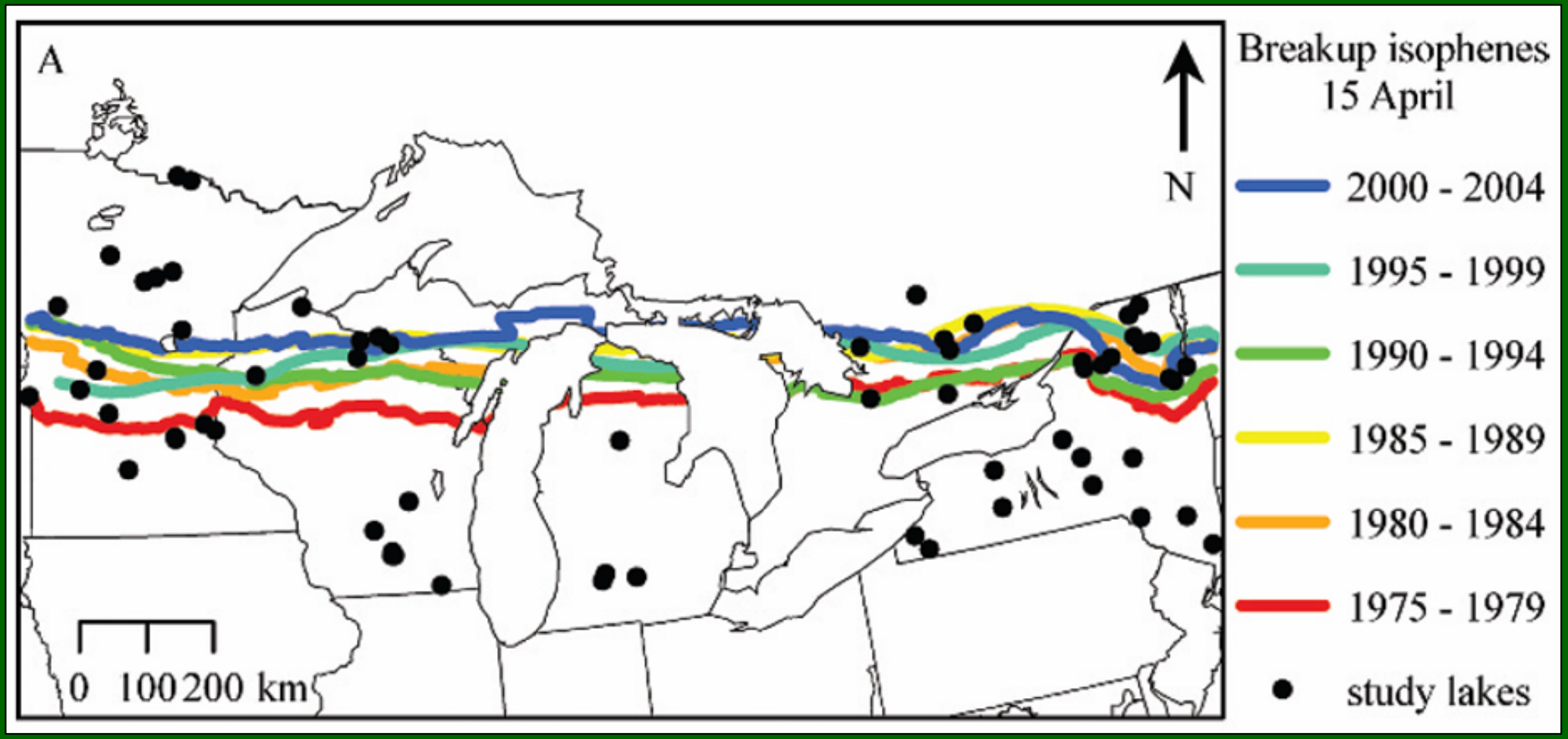


Ice Duration Has Declined:

- 3.4 days/decade since 1857
- 14.7 days/decade since 1975

(Howk, F. 2009. Changes in ice cover at Bayfield, Wisconsin. Journal of Great Lakes Research 35(1):159-162)

The April 15 Ice Out Line is Moving Northward



Jenson, Benson, Magnuson et al., 2007

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Climate Change Projections for the Great Lakes

- Warmer, drier summers
- Warmer winters
- Shorter cold season
- More winter precipitation as rain
- Warmer water
- Less ice
- Later freeze-up, earlier ice-out
- More evaporation from lakes
- Lower lake levels
- Irregular, higher intensity storms
- More flooding, esp. in spring

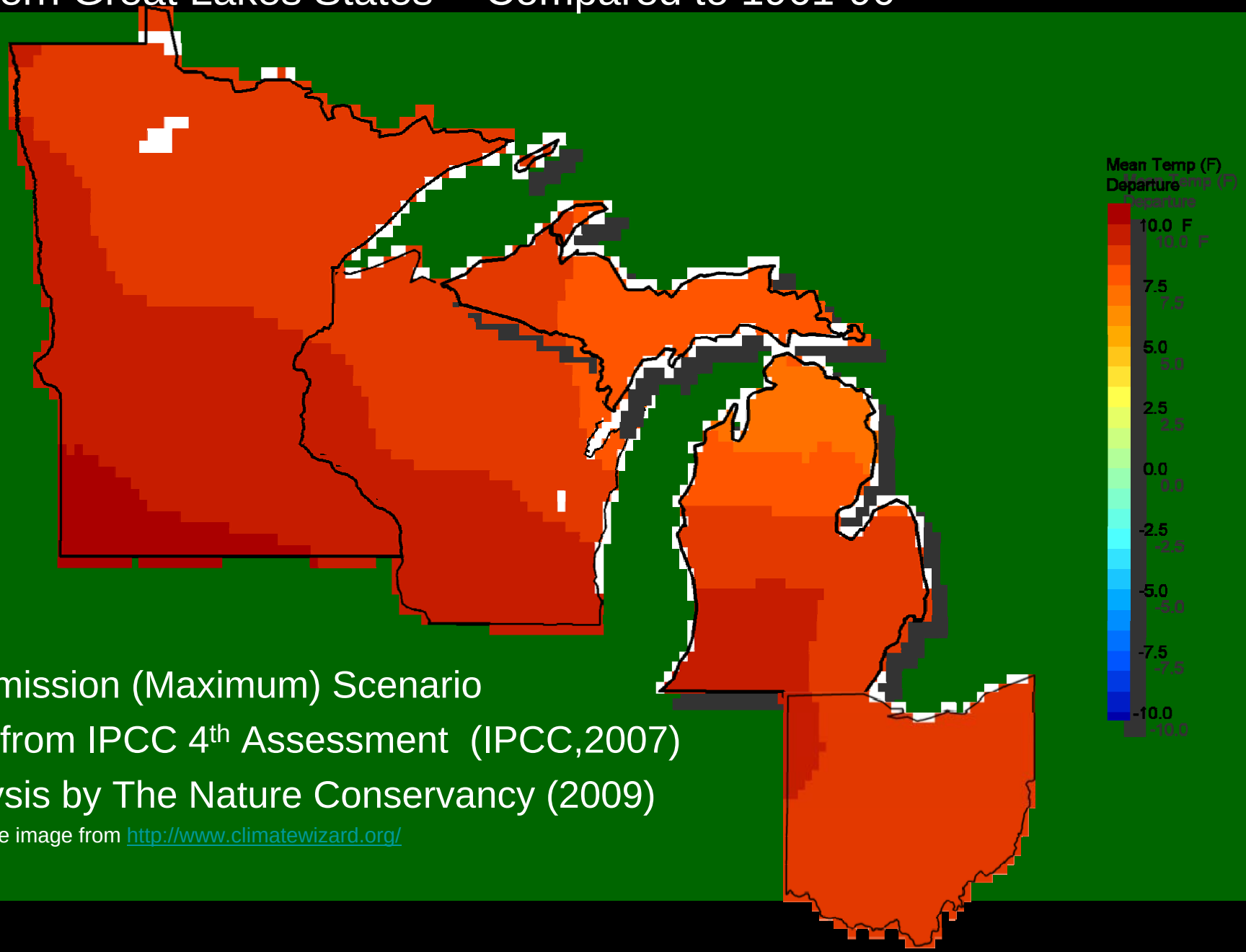
Outer Island, Apostle Islands National Lakeshore

Climate Change Projections for the Great Lakes

• Warmer, drier summers	(IPCC, 2001)
• Warmer winters	(IPCC, 2001)
• Shorter cold season	(International Joint Commission, 2003)
• More winter precipitation as rain	(Wuebbles and Hayhoe, 2004)
• Warmer water	(Lehman, 2002)
• Less ice	(International Joint Commission, 2003)
• Later freeze-up, earlier ice-out	(International Joint Commission, 2003)
• More evaporation from lakes	(Nat'l Assessment Synthesis Team, 2000)
• Lower lake levels	(Nat'l Assessment Synthesis Team, 2000)
• Irregular, higher intensity storms	(International Joint Commission, 2003)
• More flooding, esp. in spring	(Kling et. al, 2003)

Change in Annual Temperature by 2100

Western Great Lakes States -- Compared to 1961-90



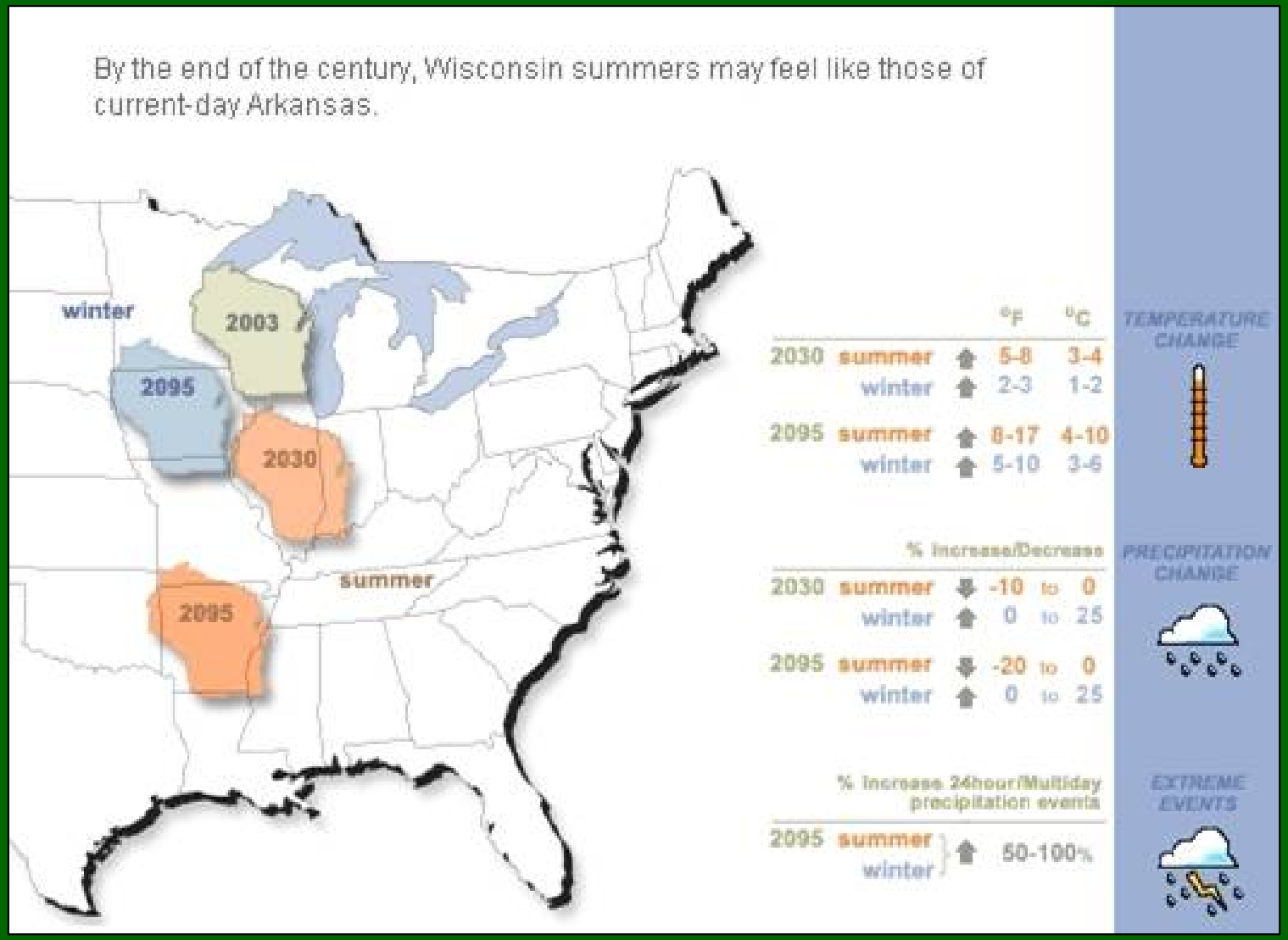
A2 Emission (Maximum) Scenario

Data from IPCC 4th Assessment (IPCC,2007)

Analysis by The Nature Conservancy (2009)

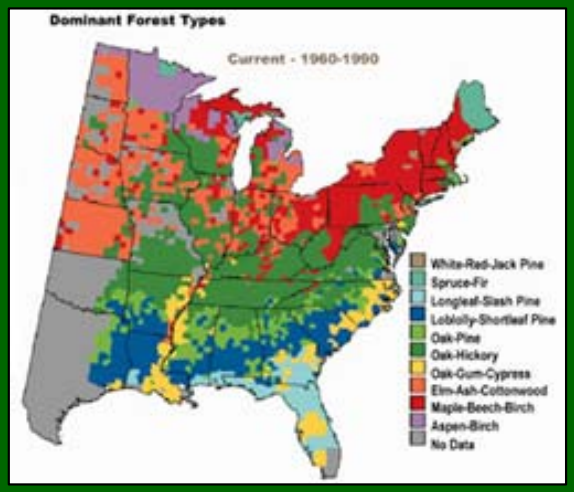
Composite image from http://www.climatewizard.org/

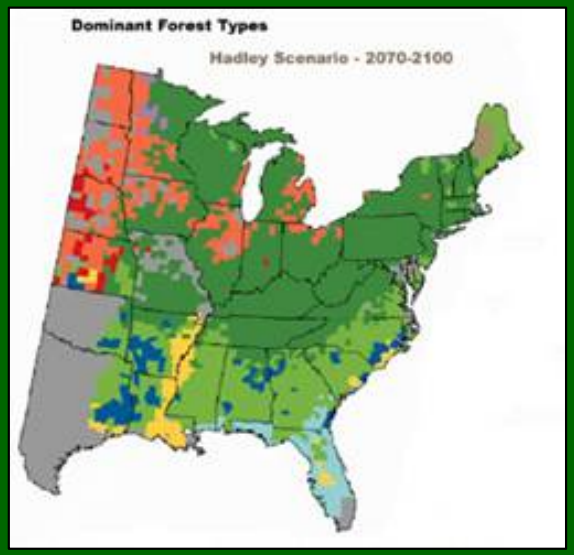
Climates Will Migrate South



From http://www.ucsusa.org/greatlakes/glimpactmigrating.html

Projected Ecological Impacts





- Spruce, hemlock, and fir forests will shrink. (Union of Concerned Scientists, 2003)
- Birch forests are likely to be replaced by oak/hickory and oak/pine forests. (National Assessment Synthesis Team, 2000)
- Fire frequency will increase. (He, Mladenoff, and Gustafson, 2002)
- Cold water fish species such as lake trout, brook trout, and whitefish may decline dramatically while warmer water species will expand their ranges. (Union of Concerned Scientists, 2003)

➢ Habitats and ecosystem function will be disrupted.

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Responding to Climate Change

- Mitigation
  - Reducing greenhouse gas emissions and overall environmental impact
- Adaptation
  - Adjusting human or natural systems in response to climate change to reduce adverse impacts *(it doesn't mean accepting climate change, but it does mean dealing with it!)*
- Communication
  - Leading by example and telling the story

Why Do We Need to Adapt?

One Example: Low Water Levels in Lake Superior

- Recreational infrastructure: fixed docks will be too high, ramps will need to be extended, more navigational hazards will be exposed.
- Commercial shipping: locks and berths will be too shallow. Ships will have to carry less to float higher. ($$)
- Ephemeral wetlands (e.g. the Kakagon Sloughs south of the Apostle Islands), hugely important biological areas, may dry up, affecting wild rice beds, fisheries, and possibly tribal communities.

Why Do We Need to Adapt?

One Example: Low Water Levels in Lake Superior

Bad River wild rice harvest cancelled

By Chad Dally
Thursday, August 09th, 2007 10:35:05 AM

THE DAILY PRESS Online
NORTHERN WISCONSIN'S MORNING NEWSPAPER
ashlandwi.com - one city - one address

Leah Gibala/Submitted Photo
Bad River tribal members Donald Corbine and his son, Justin, harvest wild rice in the Kakagon Slough in August, 2006.

The fears of many Bad River tribal members have been realized: For the first time in history, there will be no harvest of wild rice this year within tribal boundaries.

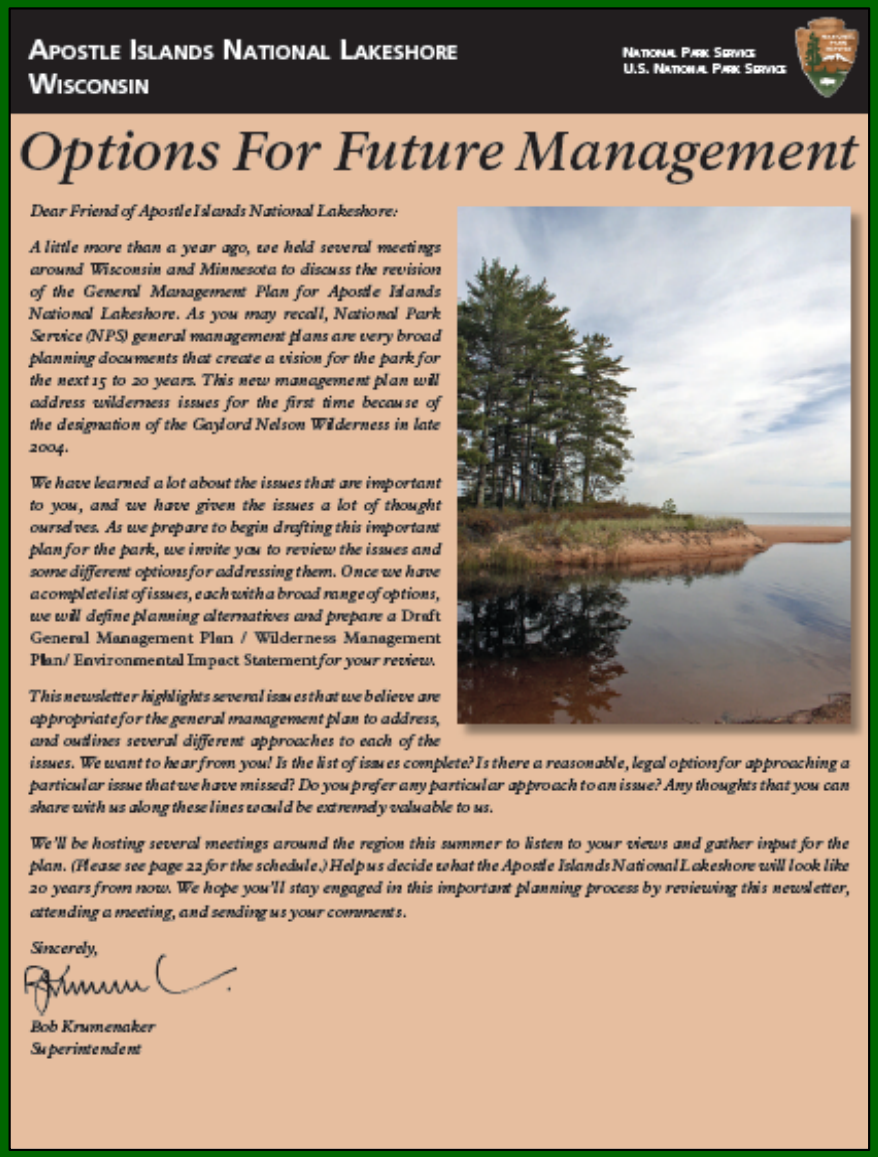
The Bad River Tribal Council announced on Wednesday that, due to extremely low water levels, a one-year hiatus is in place for rice beds in the 12,000-acre Kakagon, Bad River and Bad River Slough complexes, as well on Honest John Lake and the Sand Cut Sloughs off of Oak Point.

"This is something we have to do as a people," said Matt O'Claire, a game warden with Bad River's Natural Resources Department (NRD). "...It's something that we share with everybody, but we also talk about looking ahead seven generations and the need to protect it for our children and grandchildren."

- Ephemeral <u>wetlands</u> (e.g. the Kakagon Sloughs south of the Apostle Islands), hugely important biological areas, may dry up, affecting wild rice beds, fisheries, and possibly tribal communities.

Adapting Facilities and Infrastructure

Planning for Change



APOSTLE ISLANDS NATIONAL LAKESHORE
WISCONSIN

NATIONAL PARK SERVICE
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Options For Future Management

Dear Friend of Apostle Islands National Lakeshore:

A little more than a year ago, we held several meetings around Wisconsin and Minnesota to discuss the revision of the General Management Plan for Apostle Islands National Lakeshore. As you may recall, National Park Service (NPS) general management plans are very broad planning documents that create a vision for the park for the next 15 to 20 years. This new management plan will address wilderness issues for the first time because of the designation of the Gaylord Nelson Wilderness in late 2004.

We have learned a lot about the issues that are important to you, and we have given the issues a lot of thought ourselves. As we prepare to begin drafting this important plan for the park, we invite you to review the issues and some different options for addressing them. Once we have a complete list of issues, each with a broad range of options, we will define planning alternatives and prepare a Draft General Management Plan / Wilderness Management Plan/ Environmental Impact Statement *for your review.*

This newsletter highlights several issues that we believe are appropriate for the general management plan to address, and outlines several different approaches to each of the issues. We want to hear from you! Is the list of issues complete? Is there a reasonable, legal option for approaching a particular issue that we have missed? Do you prefer any particular approach to an issue? Any thoughts that you can share with us along these lines would be extremely valuable to us.

We'll be hosting several meetings around the region this summer to listen to your views and gather input for the plan. (Please see page 22 for the schedule.) Help us decide what the Apostle Islands National Lakeshore will look like 20 years from now. We hope you'll stay engaged in this important planning process by reviewing this newsletter, attending a meeting, and sending us your comments.

Sincerely,

Bob Krumenaker
Superintendent

Adapting Facilities and Infrastructure

Planning for Changing Lake Levels

Adapting to Ecological Change

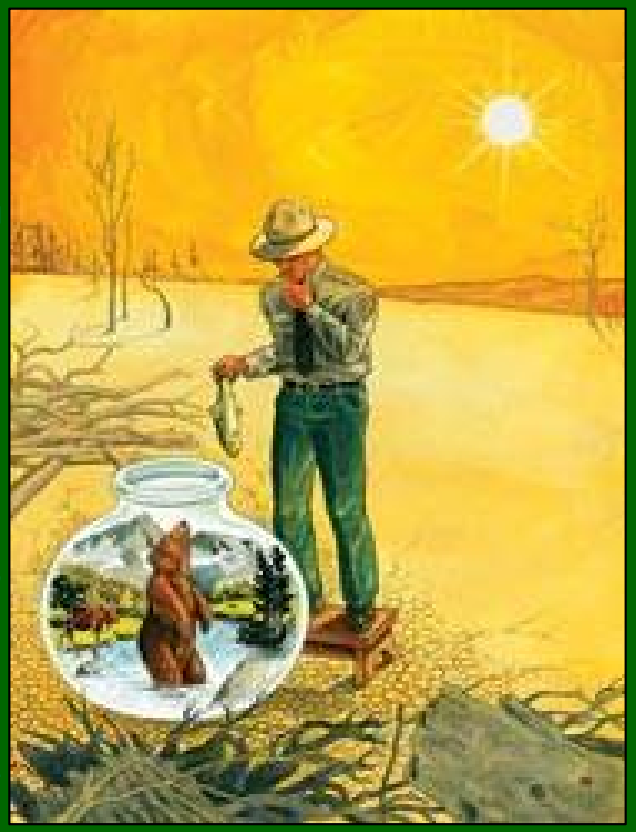
Two Choices

- Intervene by moving species and manipulating habitats
- Increase resilience

Adaptation by Ecological Intervention

Some Difficult Questions

http://www.hcn.org/servlets/hcn.Article?article_id=17481



Graphic By John Kastner
From High Country News 2/4/2008

- Do we know the implications of moving species to new habitats?
- Do we know how to do it successfully?
- Should we create refugia in new habitats?
- If so, what's the impact on the "receiving" area"?
- A valued, at-risk species in one area may look like an invasive species in another…
- Who decides?
- We may not yet know the *right* answers – but we may be able to quickly identify some *wrong* ones!

Adaptation by Increasing Ecosystem Resiliency

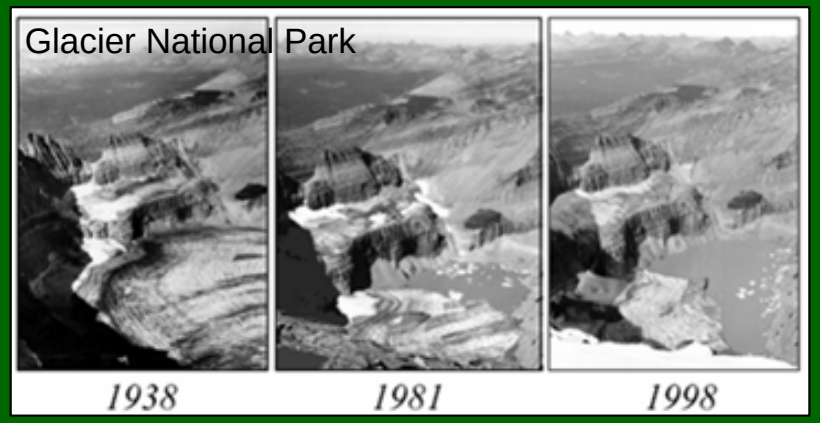
We Know This Is a Good Idea - What Does it Mean for the Great Lakes?

- Identifying the most vulnerable places and systems
  - Floodplains, wetlands, coastal areas, others
- Identifying the most intact systems (biological reservoirs)
  - Parks, forests, greenways, wetlands
- Increasing protection for both and assuring corridors for natural migration
- Reducing known stressors and restoration of damaged areas
  - Pollution, contaminants, erosion, habitat fragmentation
  - Controlling invasive species and preventing new invasions

Most Importantly: Change the Paradigm

Putting the Pieces Together

- Climate change is not simply an environmental issue
- We need to consider changes to:
  - Human health and safety
  - Facilities and infrastructure
  - Quality of life
  - Economic livelihoods
  - Communities, both human and natural
- Adaptation is essential
- *"Climate change adaptation is aimed at treating symptoms early so that they don't get worse, and so nature can eventually recover as we bring greenhouse gas emissions into check."* — Jonathan Hoekstra, The Nature Conservancy



From http://www.climatewizard.org/

We've Got Some Work To Do…

QUESTIONS? FOR MORE INFORMATION

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Lake Superior and the Apostle Islands From … Home