Citizen Science & Wisconsin's Wildlife Response to Climate Change

by
Mike Meyer
Wisconsin Department of Natural Resources

WISCONSIN INITIATIVE ON CLIMATE CHANGE IMPACTS

Wisconsin Initiative on Climate Change Impacts: Wildlife Working Group

Michael W. Meyer

Karl J. Martin

Co-Chairs

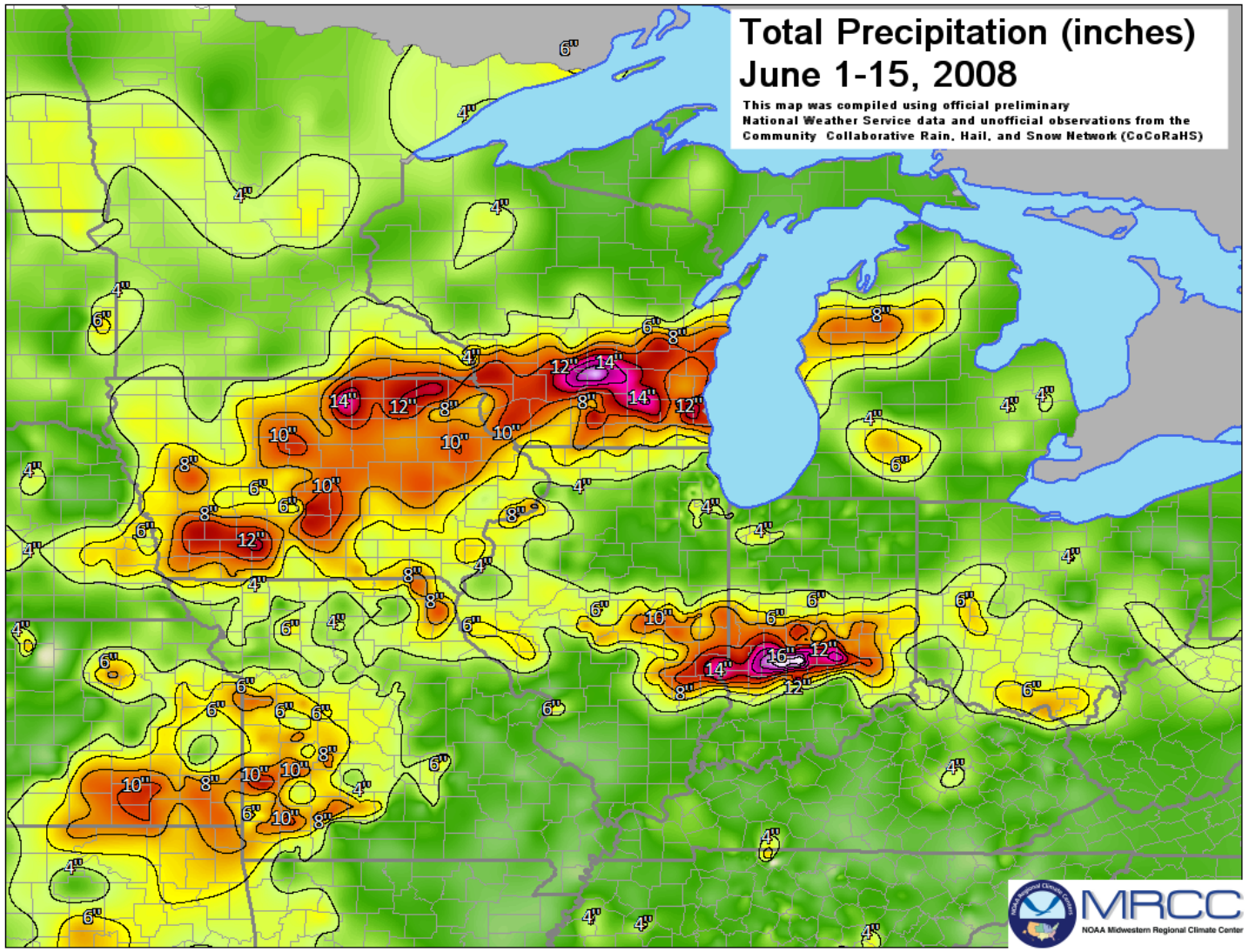
WICCI Wildlife Working Group Objectives

- Identify potential risks and vulnerabilities pertinent to Wisconsin wildlife
- Summarize existing information on climate change impacts to Wisconsin wildlife
- Identify data and research needed to assess future impacts on Wisconsin wildlife
- Recommend adaptation strategies to wildlife & conservation managers/policy makers

Research Investigating Climate Change Impacts on Wisconsin Aquatic Wildlife Resources

Can Citizen Scientists Assist?

Disparity between North and South?



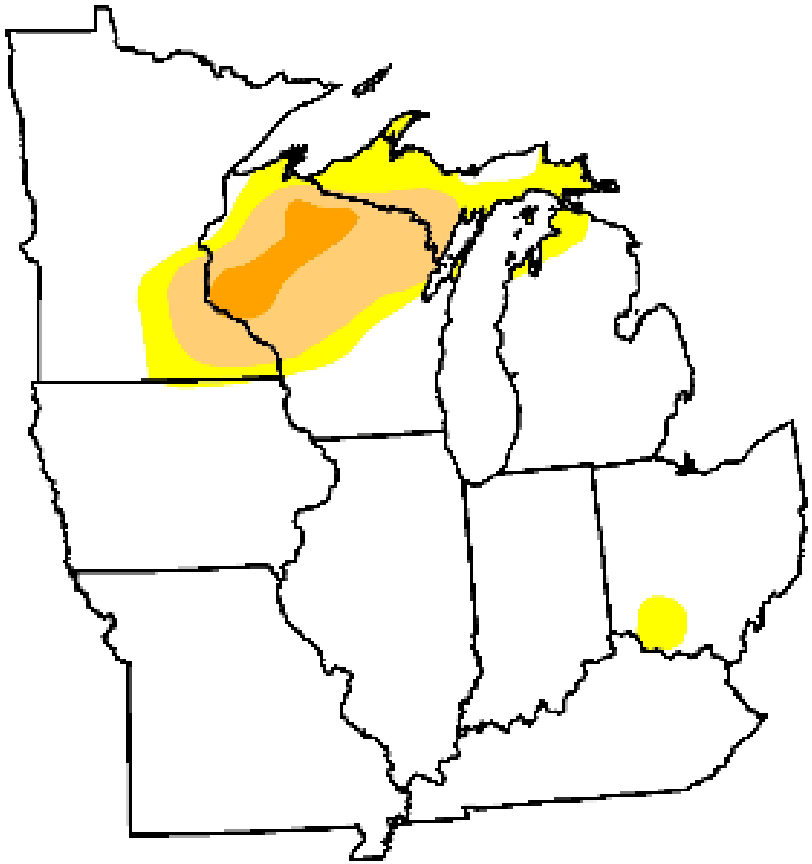
U.S. Drought Monitor

Midwest

May 5, 2009
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	85.9	14.1	8.1	1.7	0.0	0.0
Last Week (04/28/2009 map)	85.5	14.5	8.1	1.7	0.0	0.0
3 Months Ago (02/10/2009 map)	83.0	17.0	9.8	3.9	0.0	0.0
Start of Calendar Year (01/06/2009 map)	72.8	27.2	15.3	3.4	0.0	0.0
Start of Water Year (10/07/2008 map)	54.9	45.1	22.7	3.4	0.0	0.0
One Year Ago (05/06/2008 map)	96.9	3.1	0.0	0.0	0.0	0.0



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements

http://drought.unl.edu/dm

Released Thursday, May 7, 2009

Author: Laura Edwards, Western Regional Climate Center

Droughts and increased evaporation leads to lower lake levels affecting:

- Recreation
- Property values
- Ecosystems

Especially in regions with increased groundwater pumping

Potential effects of climate change on inland glacial lakes and breeding common loons in Wisconsin

John F. Walker1, Randall J. Hunt1, Kevin P. Kenow2, Michael Meyer3 and Lauren E. Hay4

1. USGS, Middleton, WI
2. USGS, LaCrosse, WI
3. WDNR, Rhinelander, WI
4. USGS, Denver CO

FUNDING 2008-2010 - Wisconsin Focus on Energy, Research Grants: Environmental and Economic Research and Development Program Research Program

21st Century Climate Change Projections for Wisconsin

(From Michael Notara, Bracing for Impact Presentation 04 March 09)

Warming of 6-10°F

Longer growing season

Fewer cold surges; More heat waves

Diminishing lake / river ice

Shorter snow season; More frequent freezing rain events

Increase in spring precipitation; Possible decrease during summer

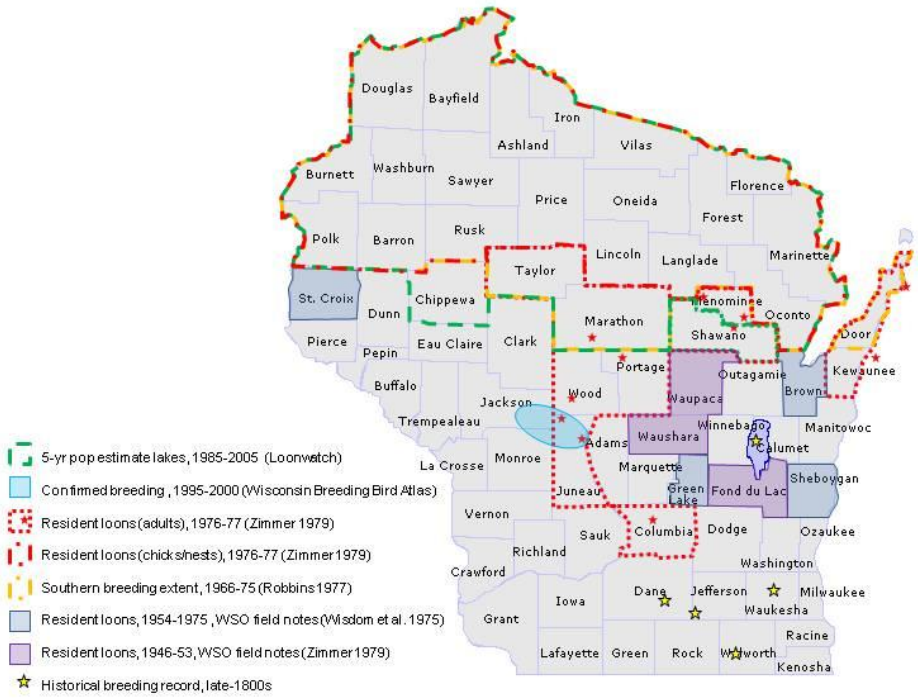
More extreme precipitation events, but not much of a change in annual precipitation

Will changing temperatures and precipitation alter hydrology of northern Wisconsin lakes?

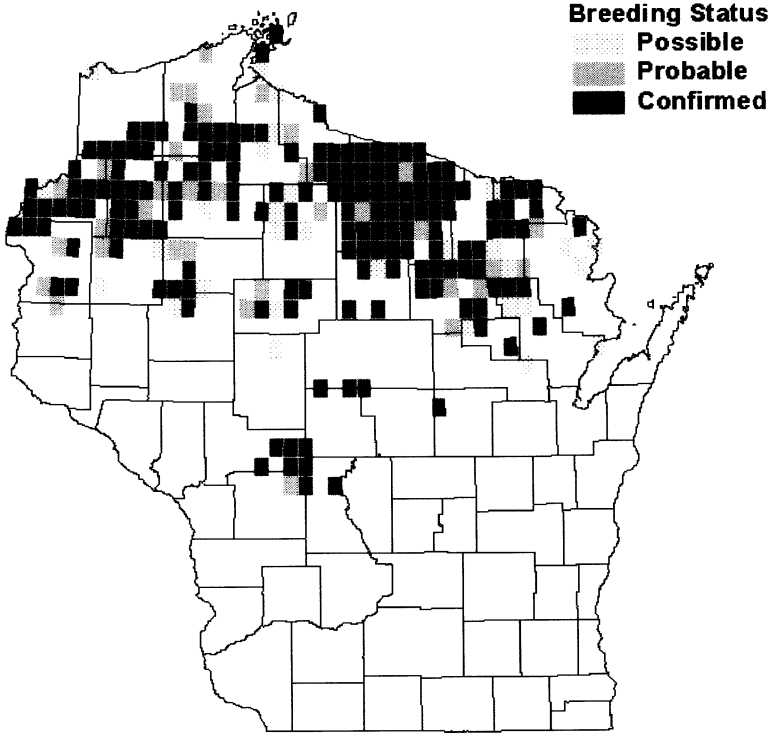
Negatives: Poorer water quality, more nuisance exotics

Eurasian watermilfoil

Historical accounts and current WBBA Atlas show WI common loon breeding distribution has already shifted north



Common Loon Map and Data



Max Breeding Status	# Quads	# Priority Blocks	# Total Blocks
Confirmed	162	99	228
Probable	34	40	59
Possible	30	26	93
Species Total	**226**	**165**	**380**
Total in Atlas	1132	1041	3853
Species Percentage	**19.96**	**15.85**	**9.86**

Species Total is the sum of all quads/priority blocks/total blocks the species was recorded in with at least a Possible breeding status. Total in Atlas is the number of quads/priority blocks/total blocks in the atlas with data (regardless of species). Species Percentage is the Species Total quads/priority blocks/total blocks divided by the Total in Atlas quads/priority blocks/total blocks.

Wisconsin Loons More Likely Found on Lakes with Good Water Clarity

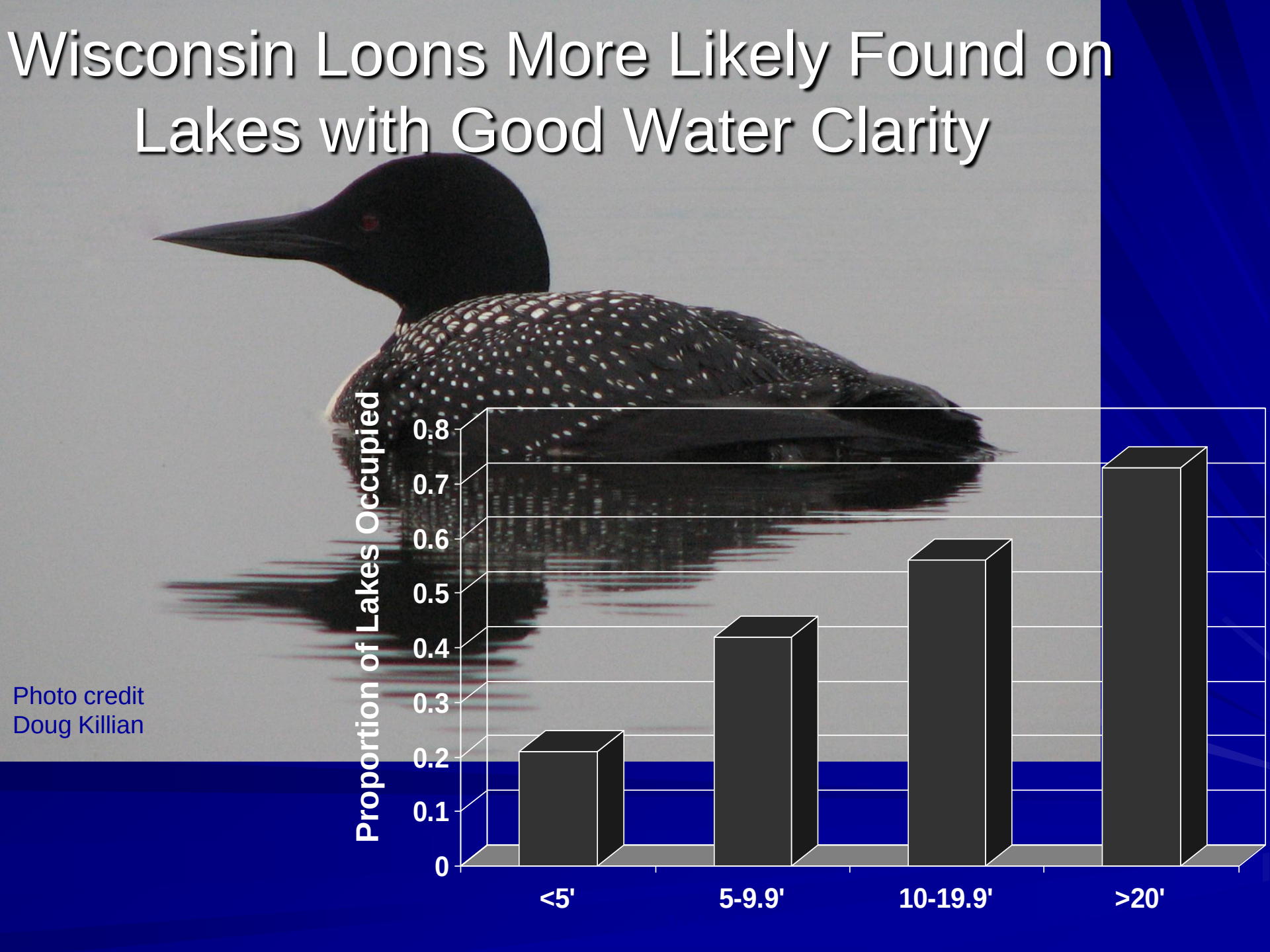
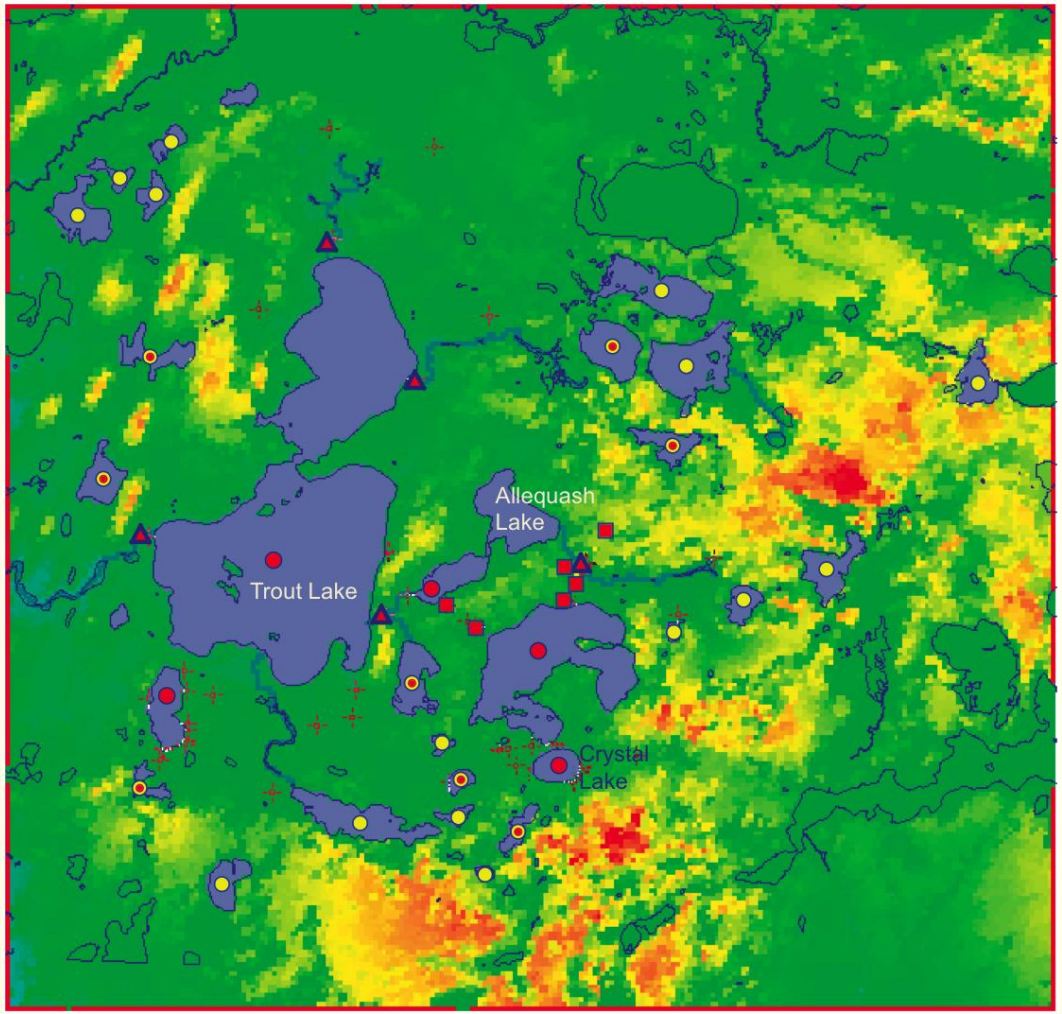


Photo credit
Doug Killian

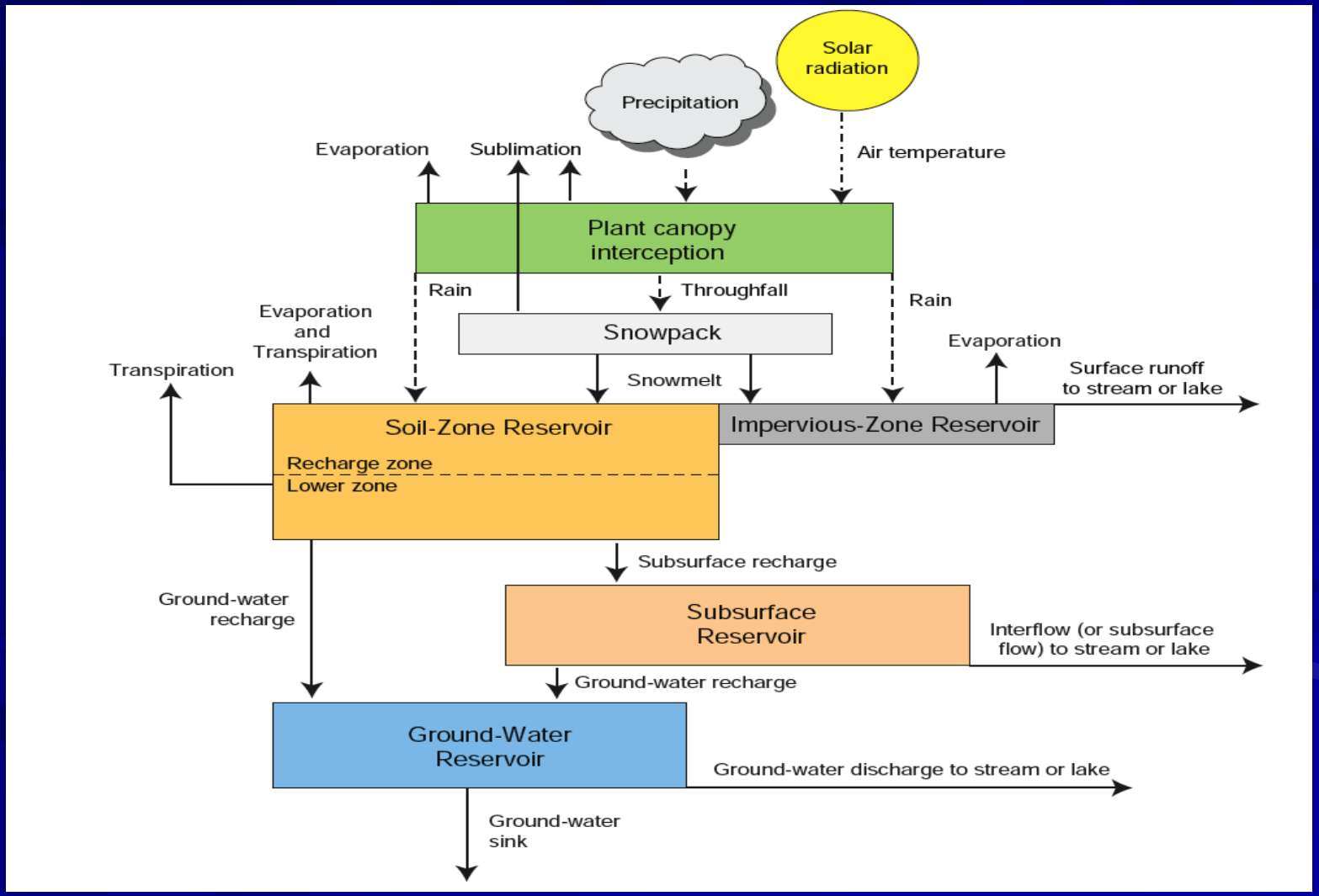
Trout Lake Watershed, Vilas County, Wisconsin



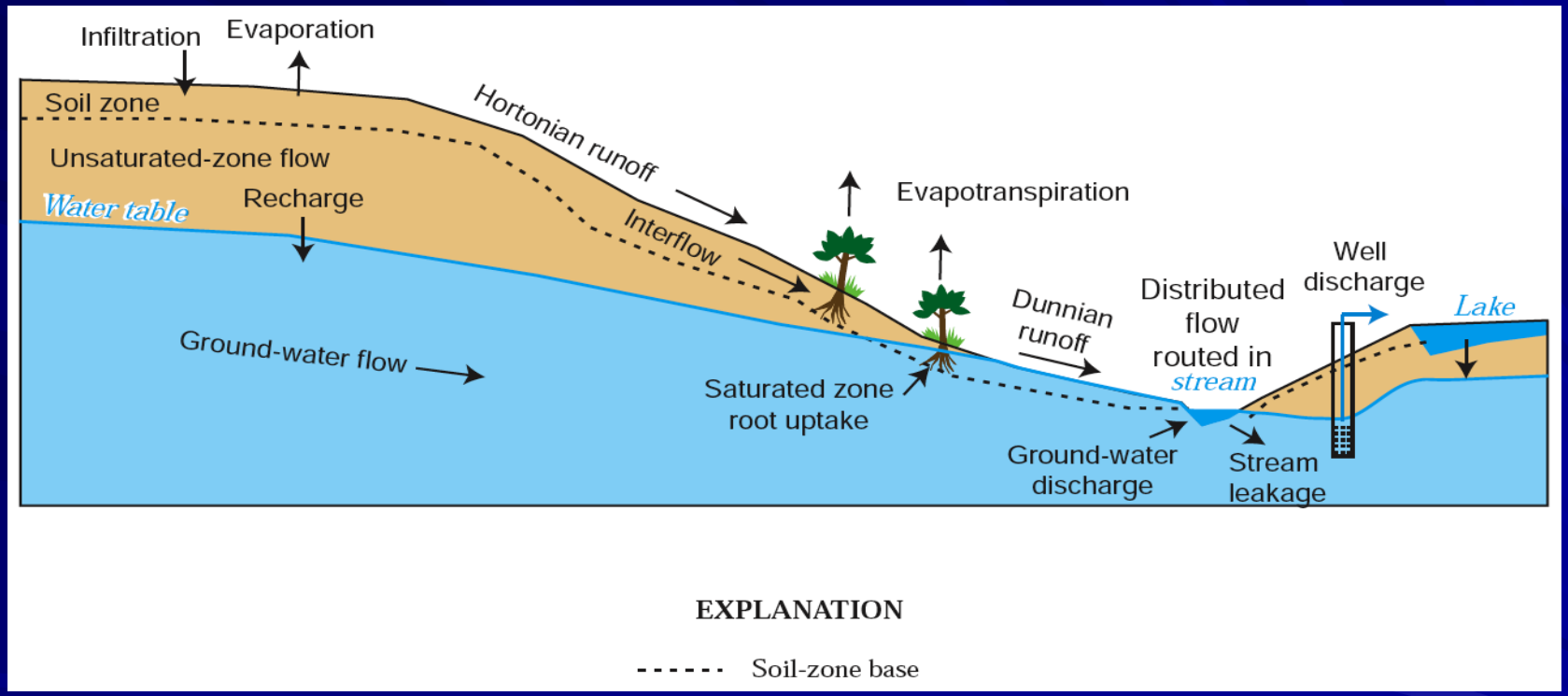
Explanation

- Well with high-frequency data
- Well with discrete data
- Lake with bi-weekly data
- Lake with single water-level target
- Lake with single water-level and flux targets
- Stream gage with high-frequency data

The USGS GSFLOW model (Markstrom et al., 2008) will predict watershed surface water hydrology as a function of IPCC Climate Change Model predictions……



..... and coupled with the MODFLOW ground-water flow model will describe how water volume and solute concentrations delivered to lakes may change. Lake models will then predict how these changes will affect lake trophic status



Schematic diagram of the GSFLOW model showing ground-water modeling using MODFLOW. The surface- and ground-water processes are linked at the bottom of the soil-zone interface (after Markstrom et al., 2008).

We will describe how predicted changes in Trout Lake watershed hydrology and lake trophic status will affect future loon habitat quality in the face of climate change

Photo: Doug Killian

Photo: Doug Killian

Can Citizen Scientists Deliver? A Cost/Benefit Analysis of the Wisconsin Loon Citizen Science Project

Michael W. Meyer
Wisconsin DNR Science Services
Wildlife and Forestry Research
Rhinelander, WI 54501

Wisconsin Loon Mercury Risk Assessment Project

Wisconsin Department of Natural Resources
USGS UMESC, LaCrosse, WI
UW Wildlife Ecology– Madison
USEPA, Narragansett, RI

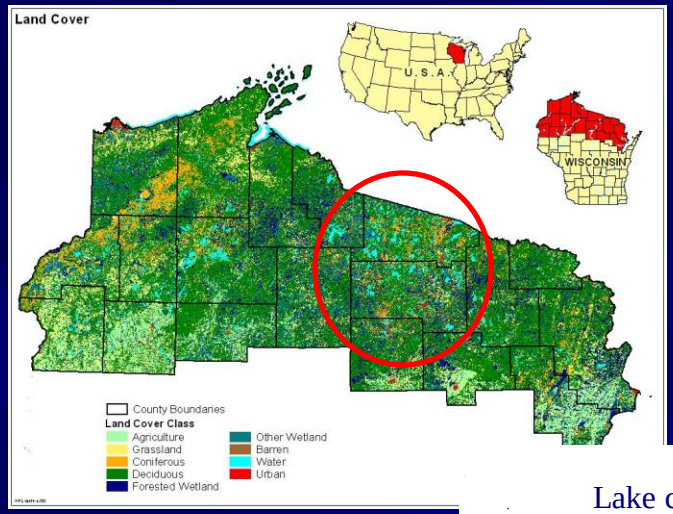
Photo credit: Doug Killian

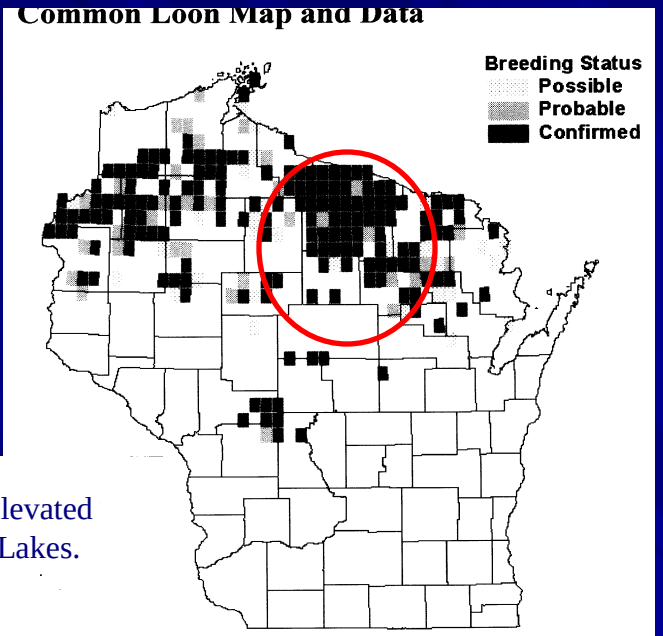
WISCONSIN DEPT. OF NATURAL RESOURCES

USGS

This research is funded by U.S. EPA - Science To Achieve Results (STAR) Program
Grant # R82-905

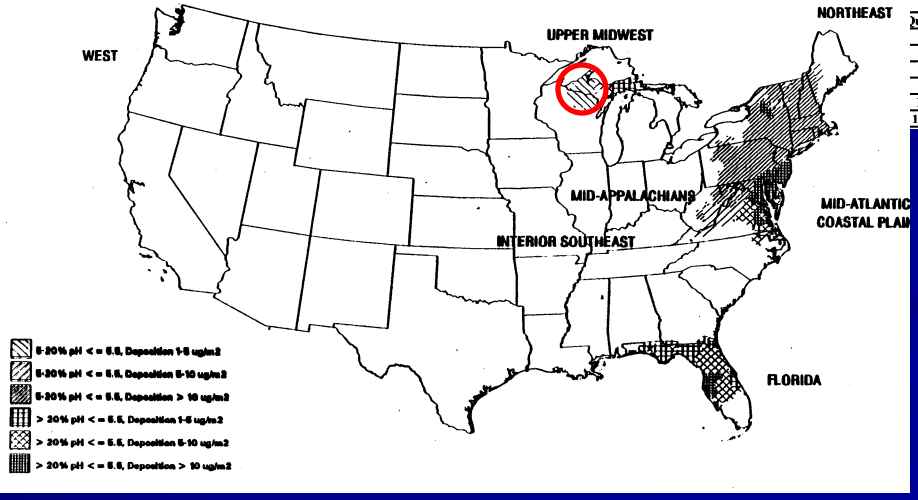
Risk Assessment Region





Lake chemistry and Hg deposition rates favor elevated MeHg in fish in some northcentral Wisconsin Lakes.

Figure ES-1
Surface Water and pH ≤ 5.5 and Anthropogenic Mercury Deposition

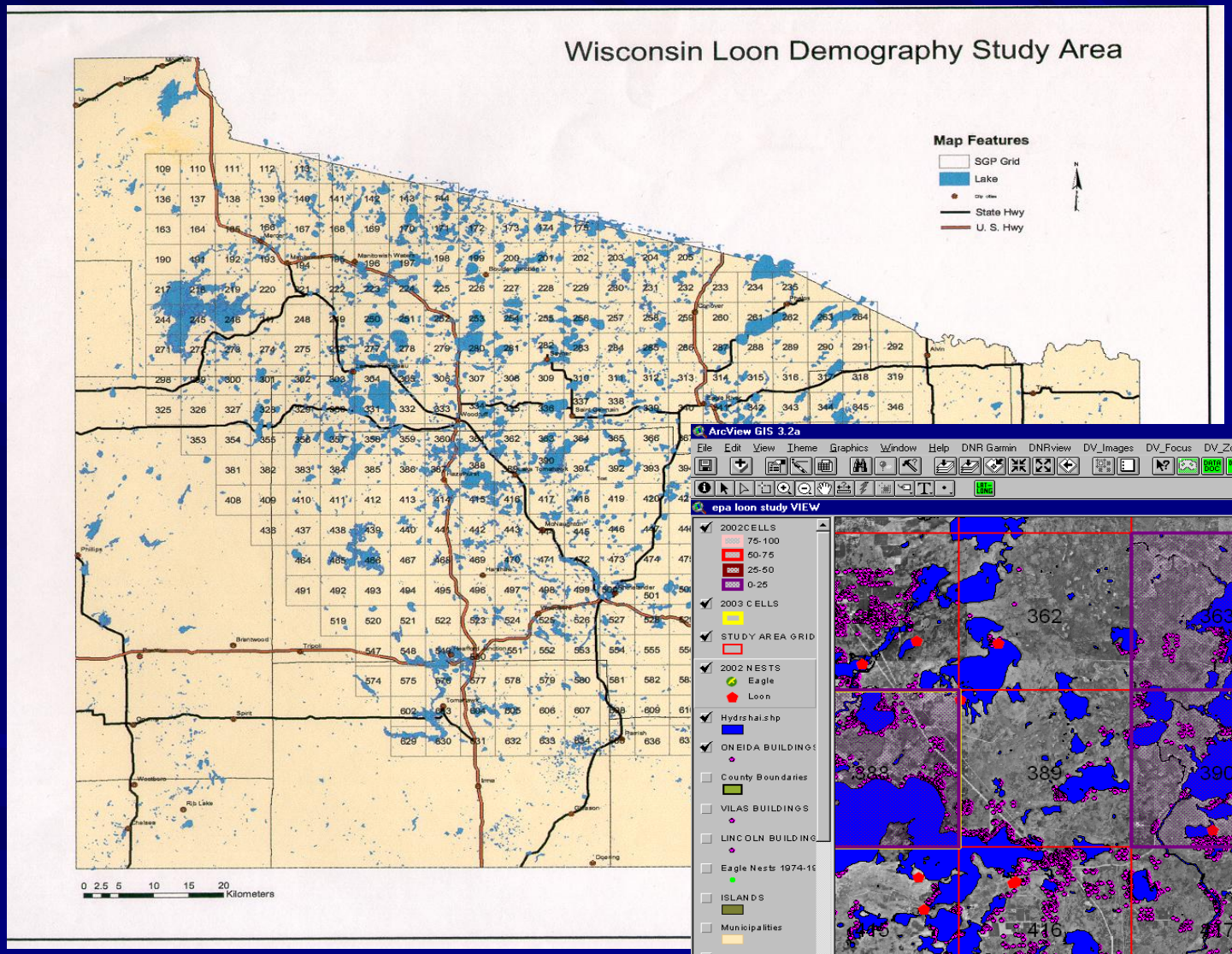


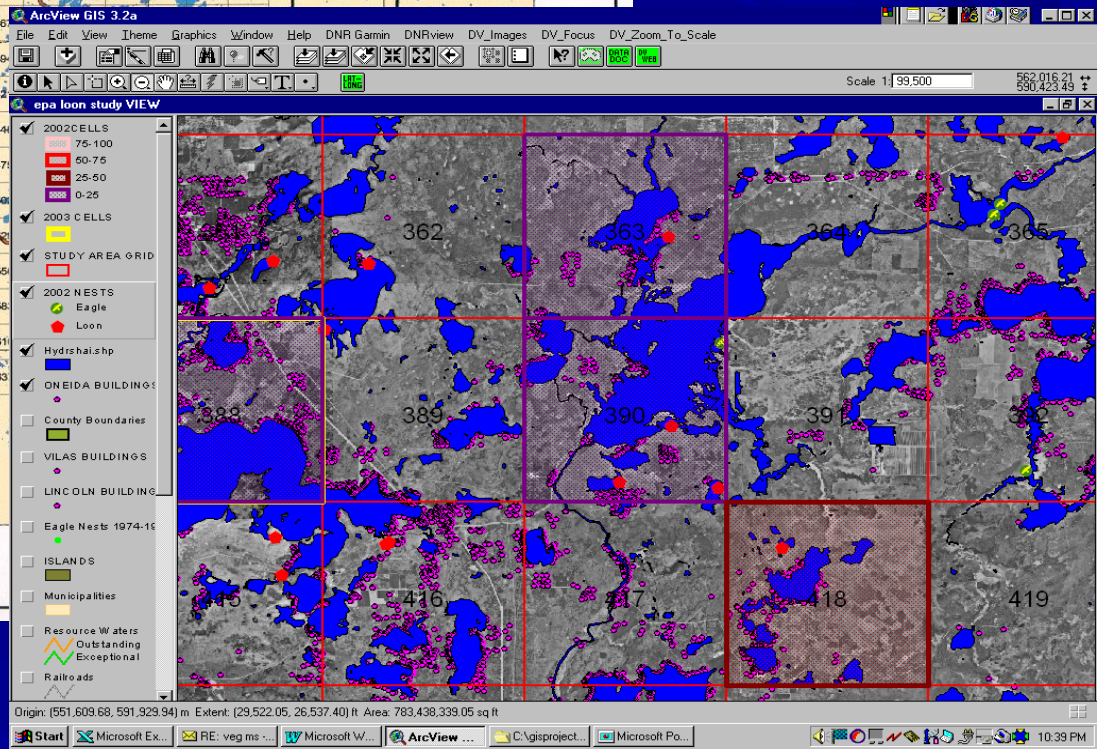
Quads	# Priority Blocks	# Total Blocks
162	99	228
34	40	59
30	26	93
226	**165**	**380**
1132	1041	3853
19.96	**15.85**	**9.86**

Species Total is the sum of all quads/priority blocks/total blocks the species was recorded in with at least a Possible breeding status. Total in Atlas is the number of quads/priority blocks/total blocks in the atlas with data (regardless of species). Species Percentage is the Species Total quads/priority blocks/total blocks divided by the Total in Atlas quads/priority blocks/total blocks.

Site/scale

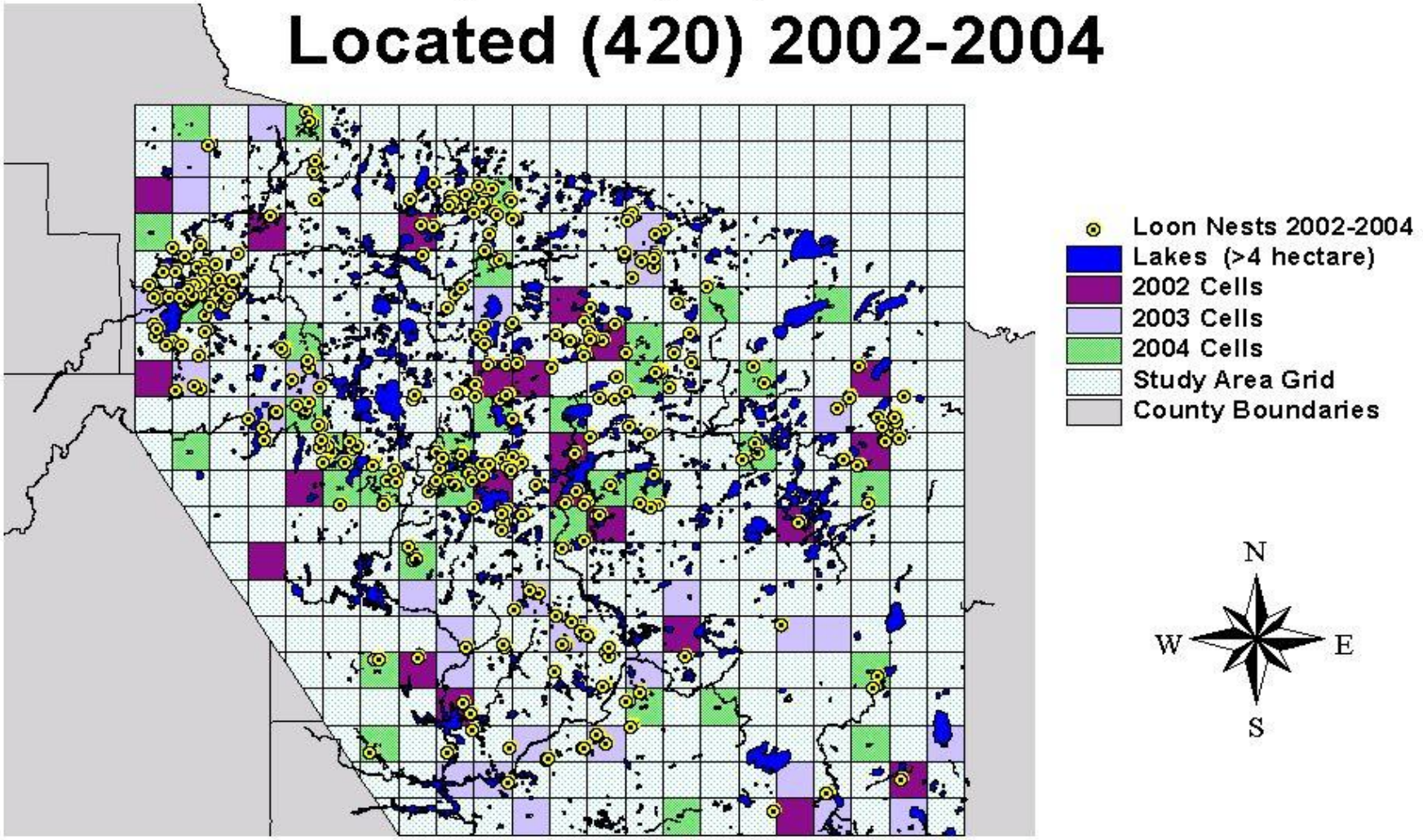
Objective 1) LOON POPULATION ESTIMATE





- Dual Frame Quadrat Sampling Technique. Haines and Pollock. 1998. *Environmental and Ecological Statistics* 5,245-256.

Cells Sampled (90) & Loon Nests Located (420) 2002-2004

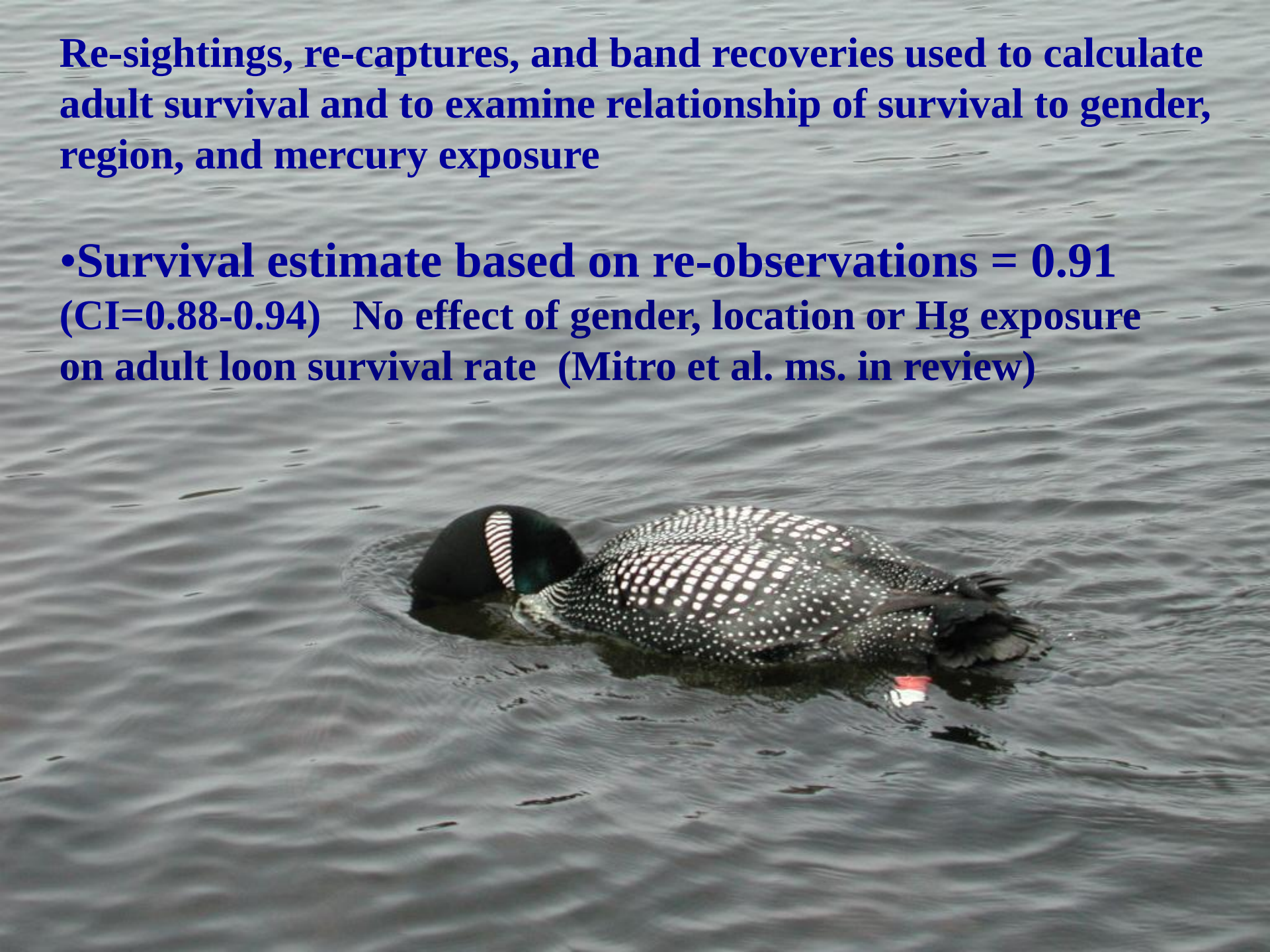



REAR
WS 5307 FK


MERCURY
HE GOOD MIKE'S
2005
THE BAD RECORD
Jeff
THE BREAKING
Terry
LOON CREW
LUCKY!
143 LOONS

Re-sightings, re-captures, and band recoveries used to calculate adult survival and to examine relationship of survival to gender, region, and mercury exposure

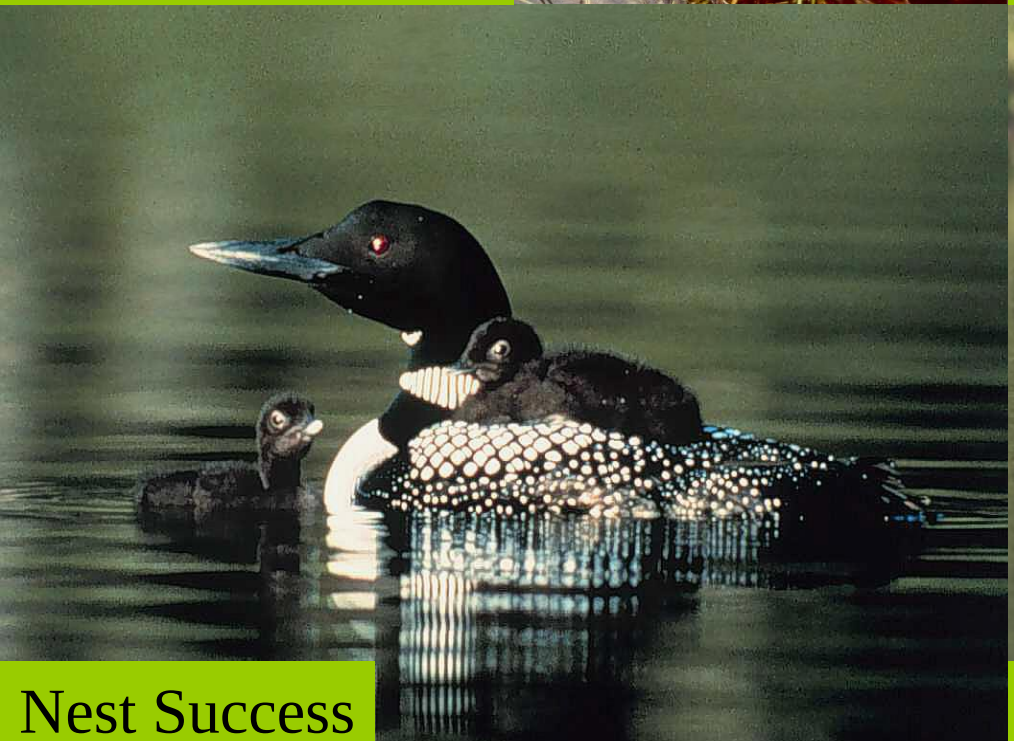
- **Survival estimate based on re-observations = 0.91 (CI=0.88-0.94) No effect of gender, location or Hg exposure on adult loon survival rate (Mitro et al. ms. in review)**



Fertility 2002-2004

Proportion nesting

Clutch size = 1.67



Nest Success

Chick Survival to Banding

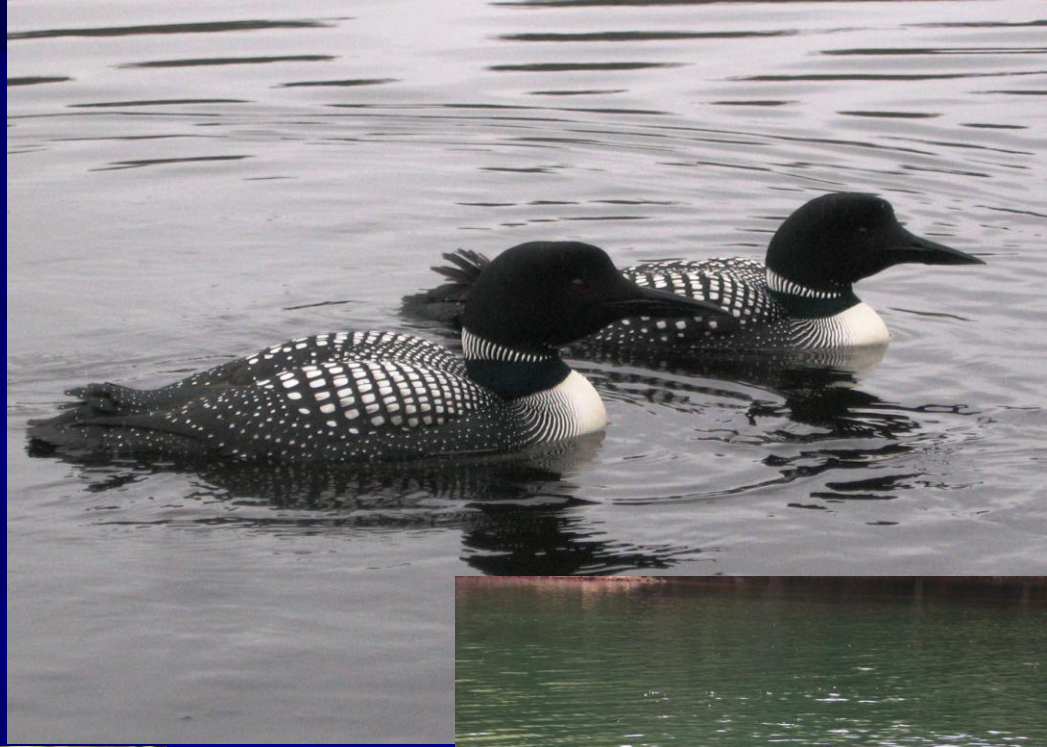
Mike Meyer, Doug Killian, Dennis Stockwell
WDNR Science Services
Rhinelander

WISCONSIN
DEPT. OF NATURAL RESOURCES

What Does a Loon Citizen Scientist Do?

- Collect loon population data necessary to update the Wisconsin Loon Population Model
- Identify critical loon nesting habitat for conservation and management
- Assist with loon banding and lake water chemistry projects.

Weekly lake surveys document presence of territorial adults and floaters, nest attempts, and chick survival



How is this accomplished?

- Loon Citizen Scientists will survey lake(s) from May – August, ideally once weekly
- During each survey, the number of adult loons present, the nesting status, and chick survival are recorded
- Once per year, identify returning adults by identifying color leg bands when present
- Assist project staff with night banding efforts in July and early August
- Fill in appropriate data sheets and return to Project Leaders at the end of the season

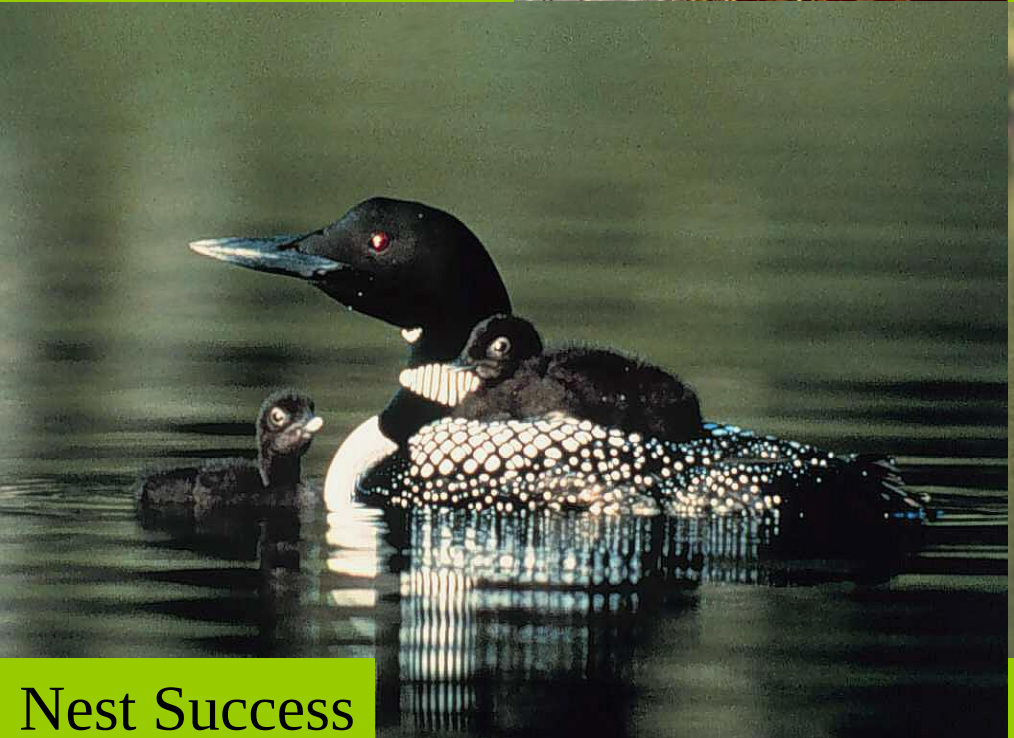
Adult Survival Rate – Re-observations of >1200 Wisconsin adult loons individually color-marked 1991 - 2008


08/06/2008

Nest Monitoring

Proportion nesting

Clutch size



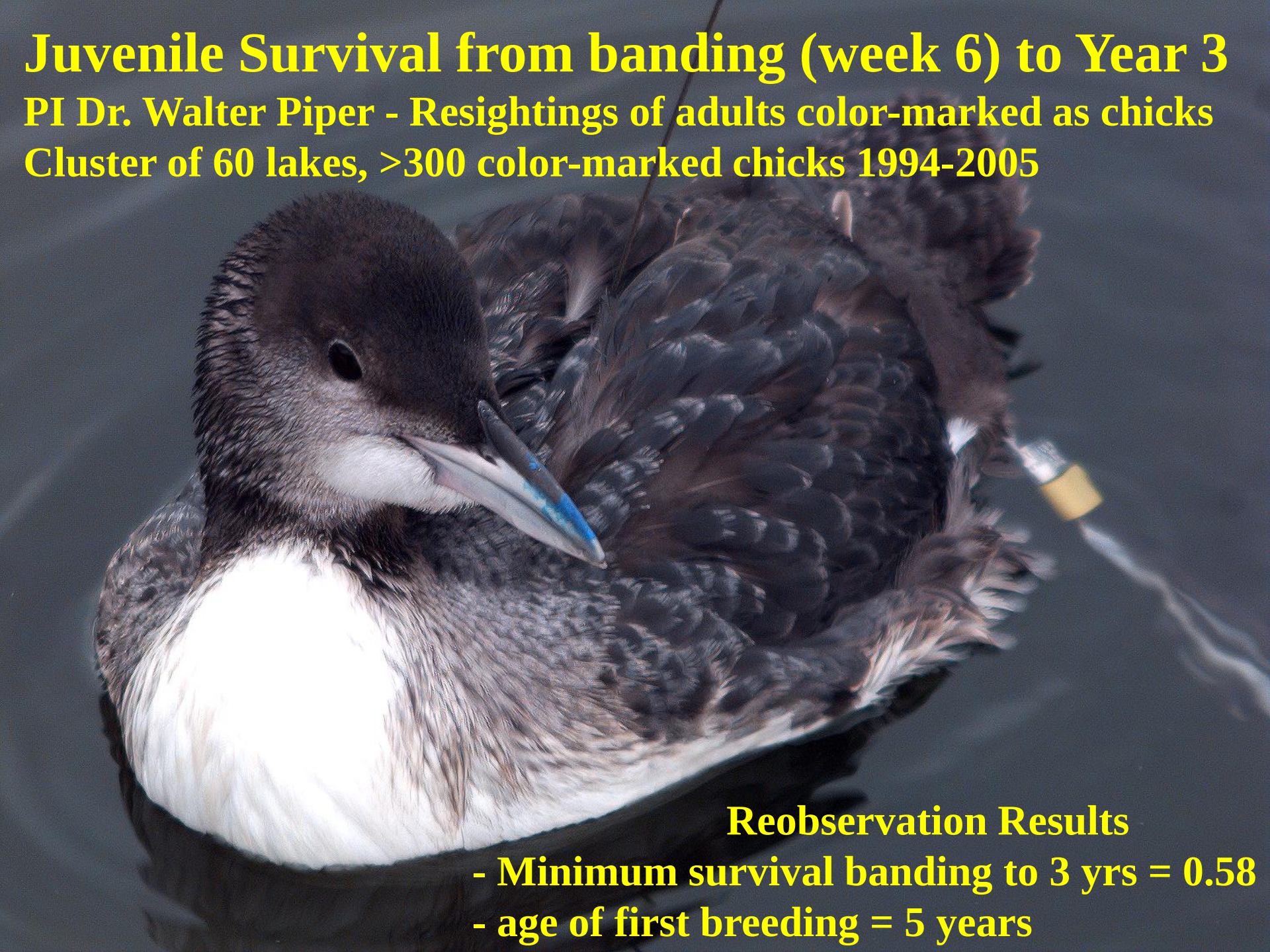
Nest Success

Chick Survival to Banding

Juvenile Survival from banding (week 6) to Year 3

PI Dr. Walter Piper - Resightings of adults color-marked as chicks

Cluster of 60 lakes, >300 color-marked chicks 1994-2005



Reobservation Results

- Minimum survival banding to 3 yrs = 0.58

- age of first breeding = 5 years

COMMON LOON 2 STAGE DETERMINISTIC PROJECTION MATRIX MODEL

MATLAB version 7, The Mathworks, Natick, MA, USA

$$A(\lambda) = \begin{Bmatrix} P_1 & F_2 \\ G_1 & P_2 \end{Bmatrix}$$

A(λ)= Population Annual Growth Rate

P_1=juvenile survival

P_2=adult survival

F_2=adult fertility

G_1=transition to adulthood

Volunteer Participation

Volunteer Sign up	Returned Forms 2007	Returned Forms 2008	Returned Forms 2009
2007 = 21	17	18	14
2008 = 58		29	17
2009 = 19			9
Total	17	47	40

Volunteer Results

	2008	2009
Volunteers forms received	47	40
Lakes Monitored	50	59
# weeks surveyed/volunteer	13	14
# band re-observation forms	25	N/A
# territorial pair	60	69
# pair nesting	55	61
# chicks hatched	46	55
# fledge	37	38

Random vs. Volunteer Results

	2002	2003	2004	Mean	2008	2009
Nesting Propensity	0.820	0.787	0.830	0.812	0.917	0.884
Hatched/pair	0.541	0.492	0.591	0.541	0.766	0.797
Fledged/pair	0.410	0.426	0.398	0.411	0.560	0.550
Chick Survival	0.758	0.867	0.833	0.819	0.801	0.790

Loon Citizen Scientist Accuracy 2008

(n=35 lakes)

- Band reobservations - <35%
- Territorial Pair presence/absence – 100%
- Proportion Nesting – 85%
- Nest outcome – 100%
- Chick hatching – 95%
- Chick survival – 100%

- Conclusion – Loon Citizen Scientists accurately identify territorial pair and nest outcome (fecundity); trained staff required to quantify adult re-observation rates (adult survival and juvenile recruitment)

Volunteer Sample Biases

- Volunteers primarily from lakes with a history of loon use
- Volunteer lakes larger than randomly selected lakes
- Volunteer lakes more productive (> % neutral pH) than random sample
- Fecundity rate 2008, 2009 higher than that measured 2002-2004 (random sample)

Cost/Benefit Analysis
WDNR LTE's

- Cost of monitoring fecundity weekly at 60 lakes using WDNR LTEs (USEPA study)
  - 1520 WDNR LTE hours (salary/FB = $22,800)
    - Weekly surveys, 30 lakes/LTE
    - May 1 – August 21 = 18 weeks
    - 80 hours = data entry
  - Travel
    - Vehicles (5000mi * 0.37mi) = $1,850
    - Boats/motor/trailers/canoes (gas & maintenance) - $1000
  - **Total = $25,650**

Cost/Benefit Analysis (cont.)

- Cost of monitoring fecundity weekly at 60 lakes using citizen scientists
  - 310 WDNR LTE hours (salary/FB = $4650)
    - 100 hours = 5 training workshops
    - 150 hours season prep – datasheet & newsletter mailings, maintenance of citizen science contact info/mailing list
    - 60 hours = data entry
  - Supplies, newsletter, mailings - $1500
  - Travel - $500
  - **Total - $6650**
  - **Net Savings $19,000**

Intangible Citizen Scientist Benefits

- Citizens participate in a State-of-the-Science Common Loon Conservation project
- Contribute data critical to natural resource policy making in northern Wisconsin
- Receive policy education via annual newsletters and spring training Workshops
- Become advocates for sound lake stewardship policies.

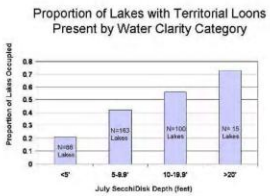
Volume 2, Issue 1
March 15, 2009

Red Eye News

New Research Grant Studies Climate Change Impact on Wisconsin Loons

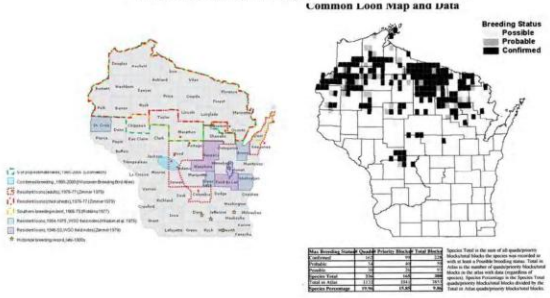
NORTHWOODS LOON PROTECTION PROGRAM

The Wisconsin Department of Natural Resources and partners at the US Geological Survey Water Center in Madison and the US Geological Survey Upper Midwest Environmental Science Center in La Crosse will begin a research study this summer to investigate whether predicted changes in Northern Wisconsin climate will result in reduced nest habitat quality of Common Loons. Loons typically select lakes for breeding that have good nesting habitat and relatively clear water. Previous work has shown that loons are less likely to be found on lakes as the secchi disk reading decline.



USGS Hydrologists John Walker and Randy Hunt will model the potential impacts of future climate conditions on lakes within the Trout Lake watershed in Vilas County. They will investigate whether changes in temperature and precipitation could lead to changes in lake water quality in the region. WDNR Research Scientist Mike Meyer and USGS Research Scientist Kevin Kenow will be heading up crews that will be documenting loon use of lakes within the watershed and at the southern extent of their breeding range—southern and central Wisconsin. Specifically, the research crews will be identifying which lake factors (such as water clarity) nesting loons are looking for when setting up breeding territories. They will then assess whether lake models predict these factors could change under future climate conditions, potentially reducing the amount of lakes suitable for loons in Wisconsin.

Historical accounts and current WBBA Atlas show WI common loon breeding distribution has shifted north



The Wisconsin breeding loon population has shifted north over the past 100 years, it is possible that reduced lake water quality is responsible for this range reduction.. Investigators will examine whether the water quality of southern lakes abandoned by breeding loons is lower than northern lakes currently used by nesting loons. By examining the current quality of lakes once used by loons but are no longer, learning what lake factors loons are currently selecting, and modeling the future condition of lakes in northern Wisconsin under a warming climate, scientists will assess how loons may fare as lake conditions change across the region. Funding for this research project was received from the Wisconsin Focus on Energy Program.

For more information, contact Mike Meyer at WDNR Rhinelander,

Michael.Meyer@Wisconsin.gov

Join Us – It's Fun!!

2007 = 17 volunteers
2008 = 66 volunteers
2009 = 75 volunteers

Ginger Gumm / Daniel Poleschook

Wisconsin
Frog and Toad Survey

Home

The Wisconsin Frog and Toad Survey (WFTS) is a citizen-based monit
program coordinated by the Wisconsin Department of Natural Resour
(WDNR), in cooperation with the U.S. Geological Survey (USGS) and
American Amphibian Monitoring Program (NAAMP).

The primary purpose of the WFTS is to determine the status, distribu
long-term population trends of Wisconsin's thirteen frog species. The
initiated in 1981 in response to known and suspected declines in seve
Wisconsin species, particularly northern leopard frogs (*Rana pipiens*),
cricket frogs (*Acris crepitans blanchardi*), pickerel frogs (*Rana palustr*
bullfrogs (*Rana catesbeiana*). The WFTS began annual statewide surv
and is now one of the longest running amphibian monitoring projects
America.

WFTS News

Survey Routes Available for 2010

Previous annual summaries
available online

Website Sponsors

Citizen Based Monitoring
Network of Wisconsin

Lake Phenology - Biota