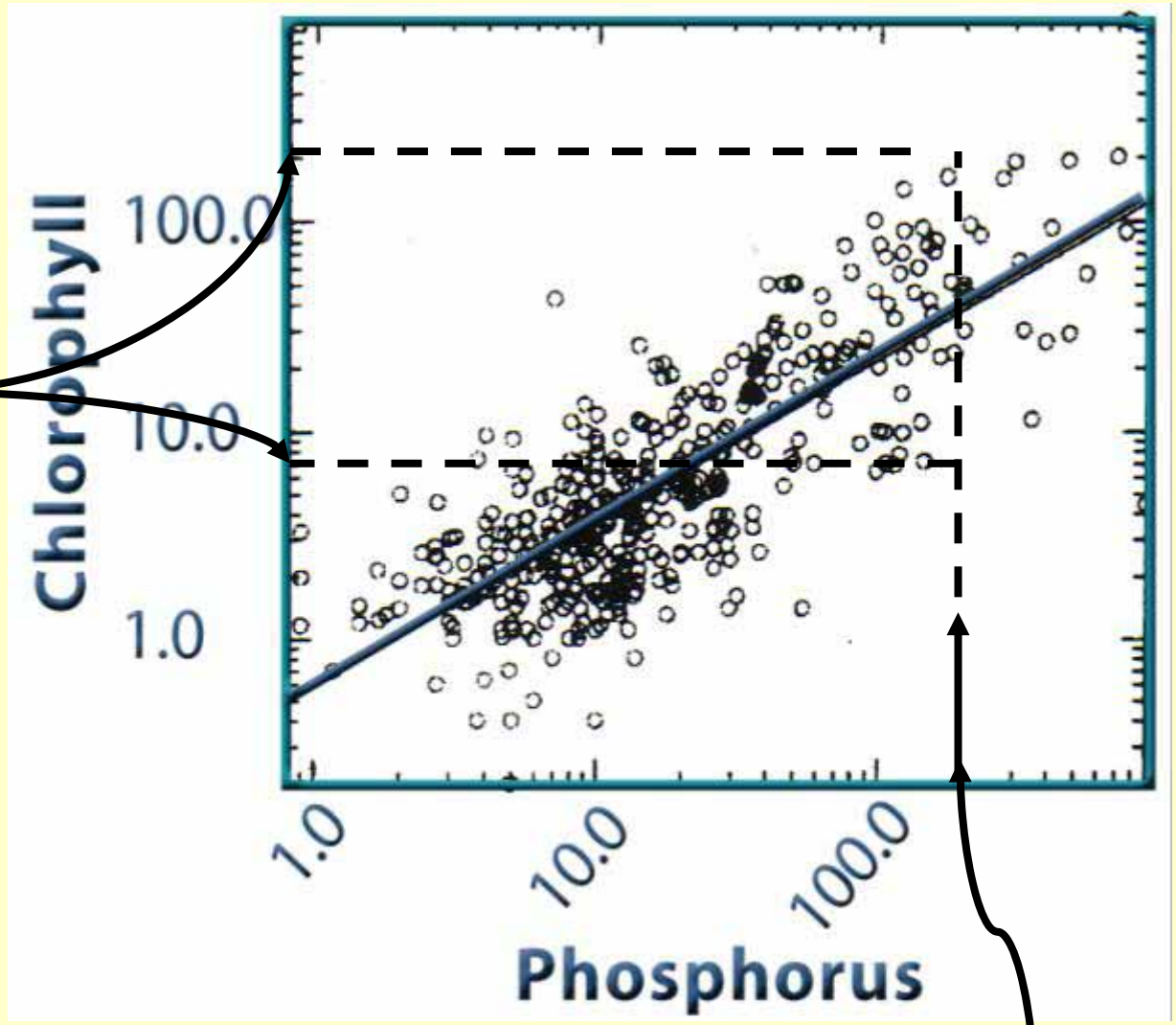
Biotic Interactions and Habitat

Paul Cunningham
Bureau of Fisheries Management


Photo Courtesy of MNDNR

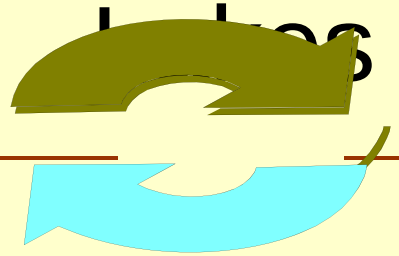
High inter-lake variability between Chlorophyll and TP

Chlorophyll
varies between ~
10 and 220 ug/l



For TP=200 ug/l

Stable States in Shallow Lakes

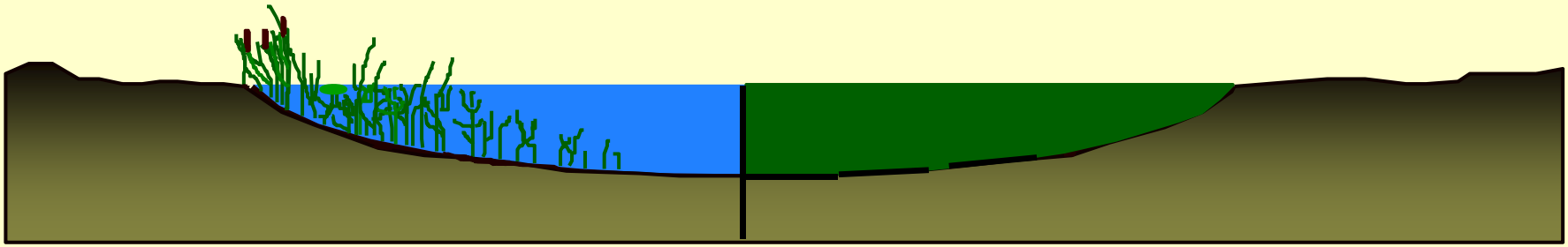


Clear State

- clear water
- low algal biomass
- high macrophyte biomass
- Piscivores dominate

Turbid State

- murky water
- high algal biomass
- sparse macrophytes
- Planktivores/benthivores dominate



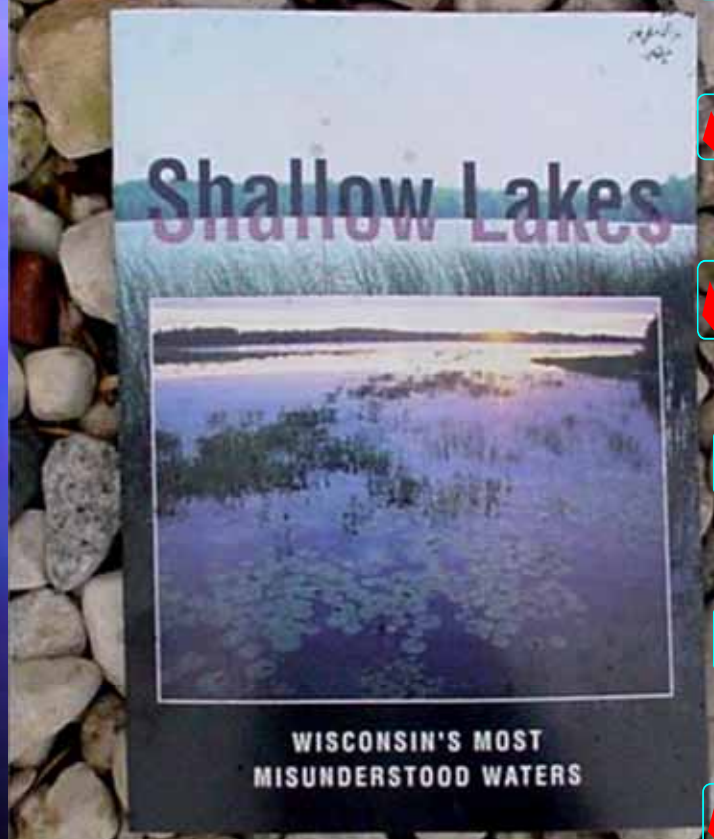
Shallow Lakes

WISCONSIN'S MOST
MISUNDERSTOOD WATERS

SHALLOW LAKES

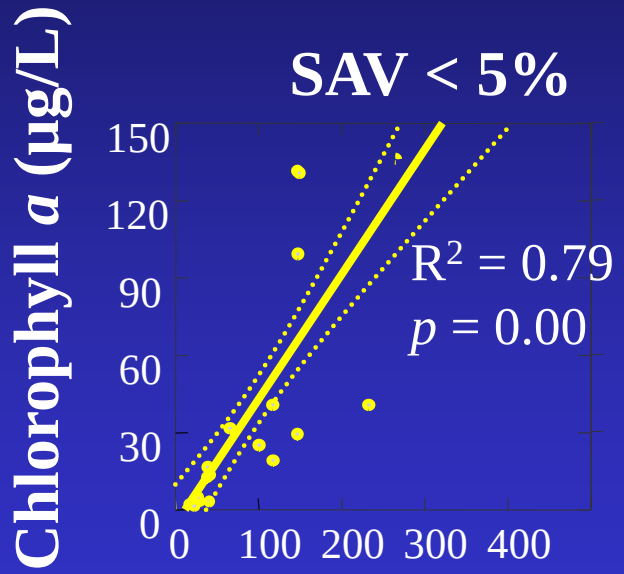
HOPE FOR MINNESOTA'S TROUBLED WATERS

SHALLOW LAKE : NON-STRATIFIED,< 7 m DEEP, > 4 ha



- **> One third of WI lake acres, > 300k ac**
- **WI's largest , Winnebago @ 137,708 ac**
- **Large littoral zone area(>50%criteria)**
- **Aquatic plants = Heart of ecosystem**
- **Exist in turbid or clear water state**
- **Water column stays mixed**
- **User expectations often unrealistic**

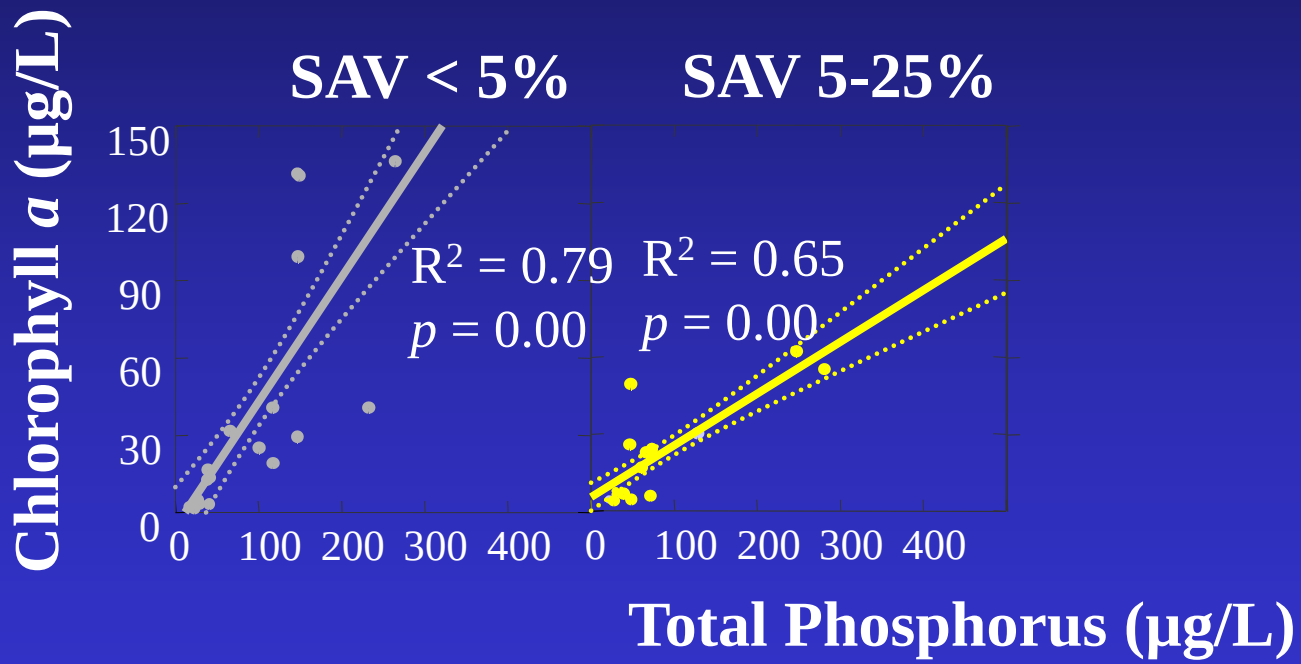
Effect of SAV on the chlorophyll and TP relationship



Total Phosphorus (µg/L)

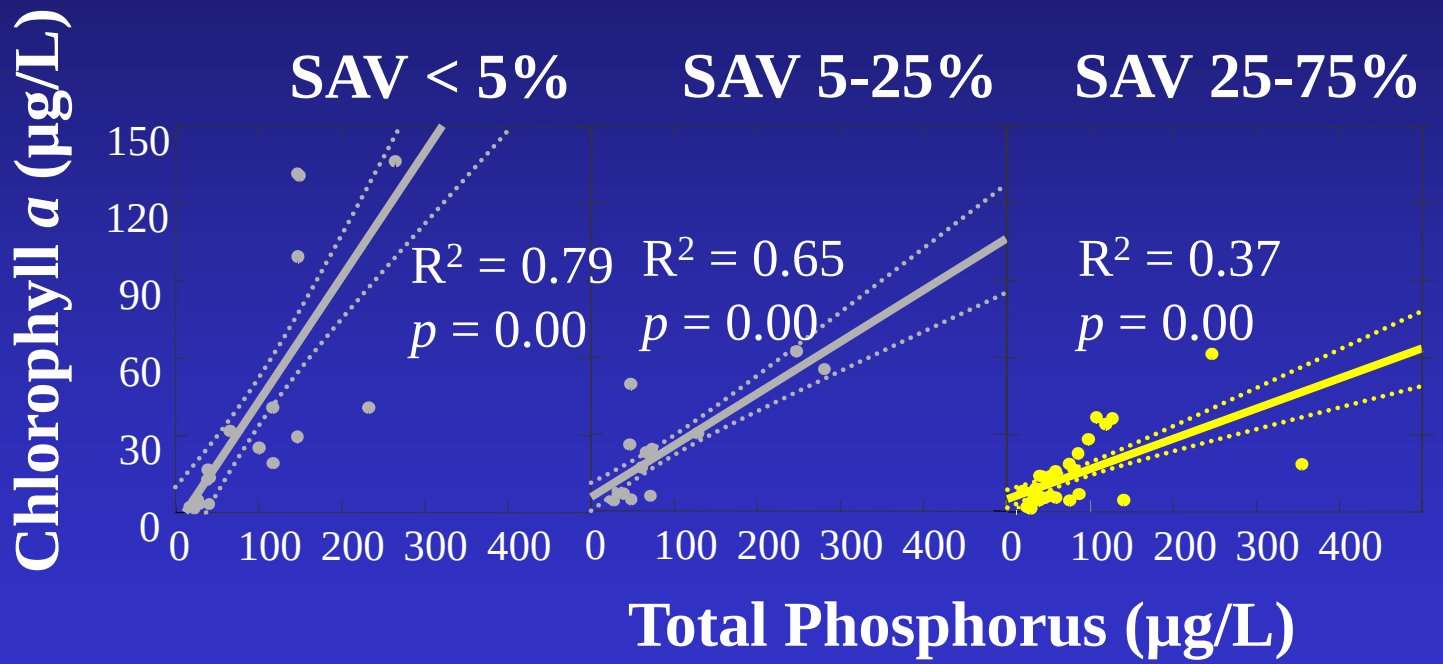
Bayley et. al. 2007

Effect of SAV on the chlorophyll and TP relationship



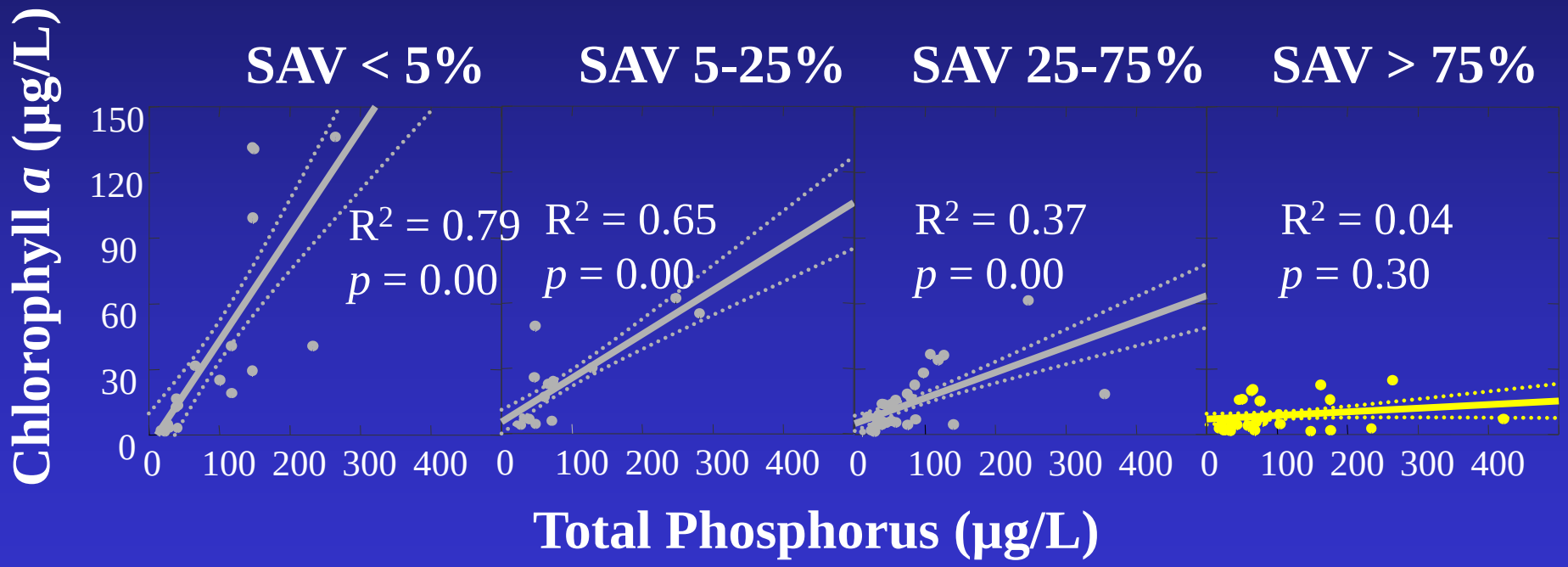
Bayley et. al. 2007

Effect of SAV on the chlorophyll and TP relationship



Bayley et. al. 2007

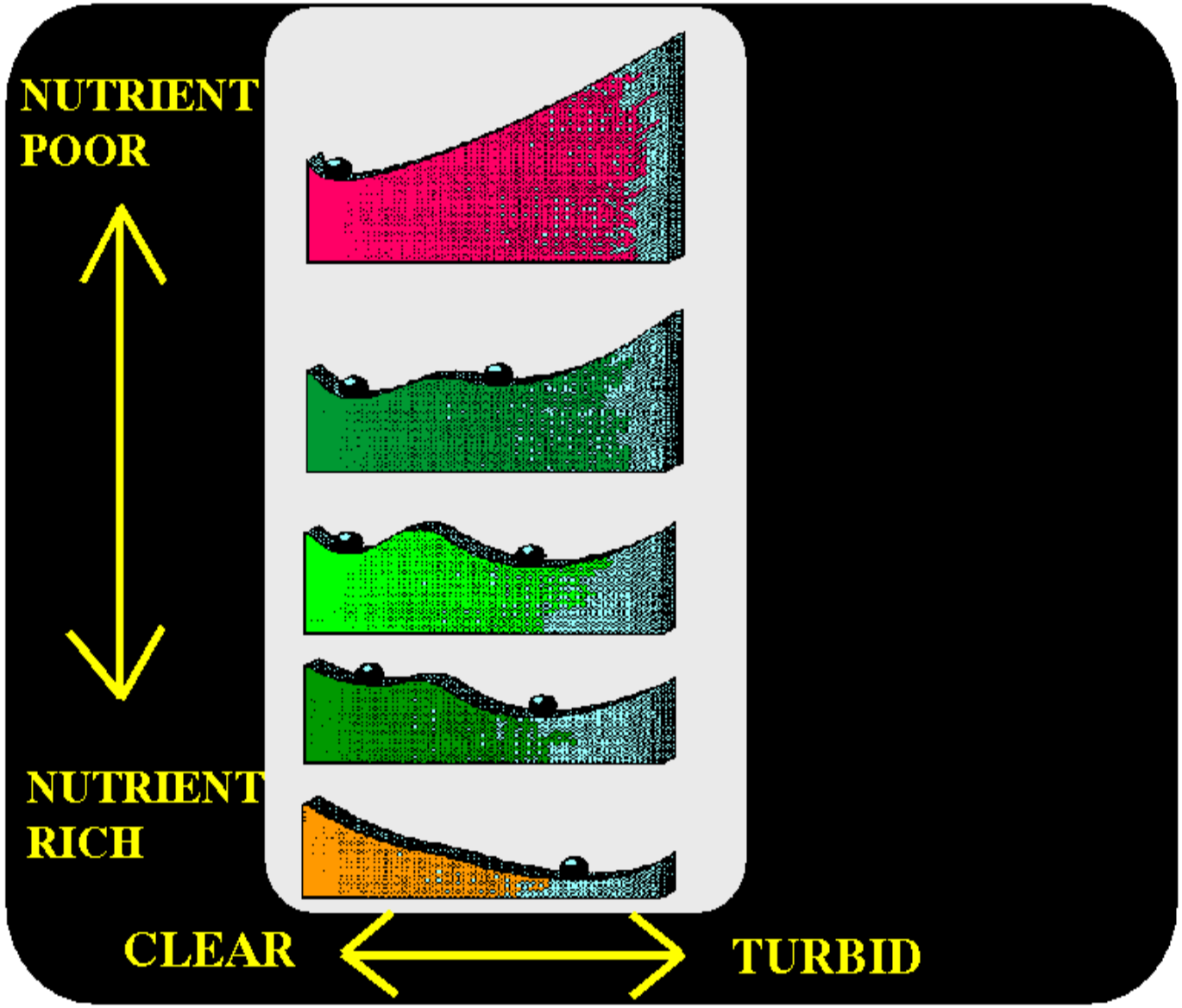
Effect of SAV on the chlorophyll and TP relationship



Bayley et. al. 2007

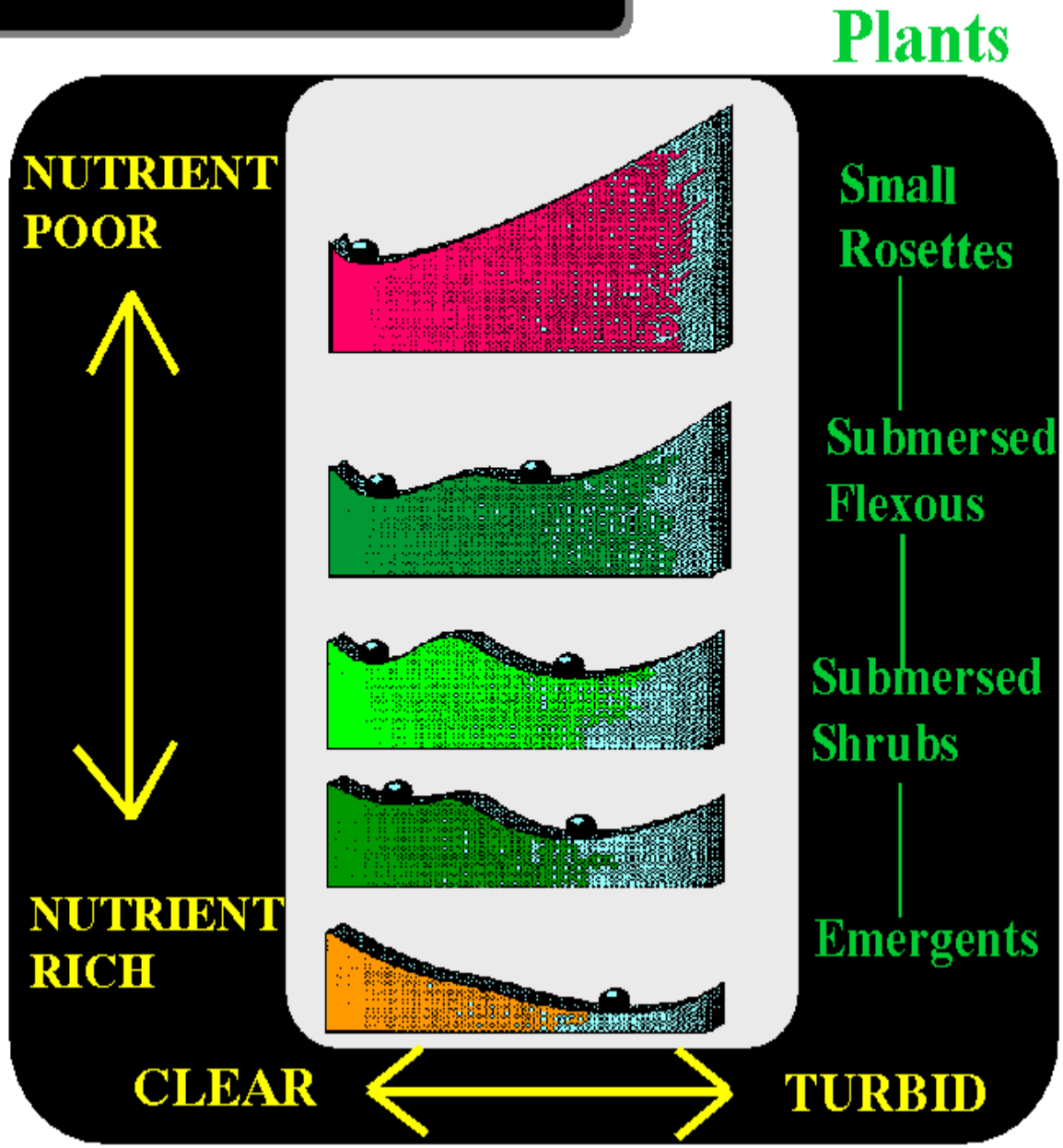
Shallow Lake Ecology

(From Scheffer et al. 1993)



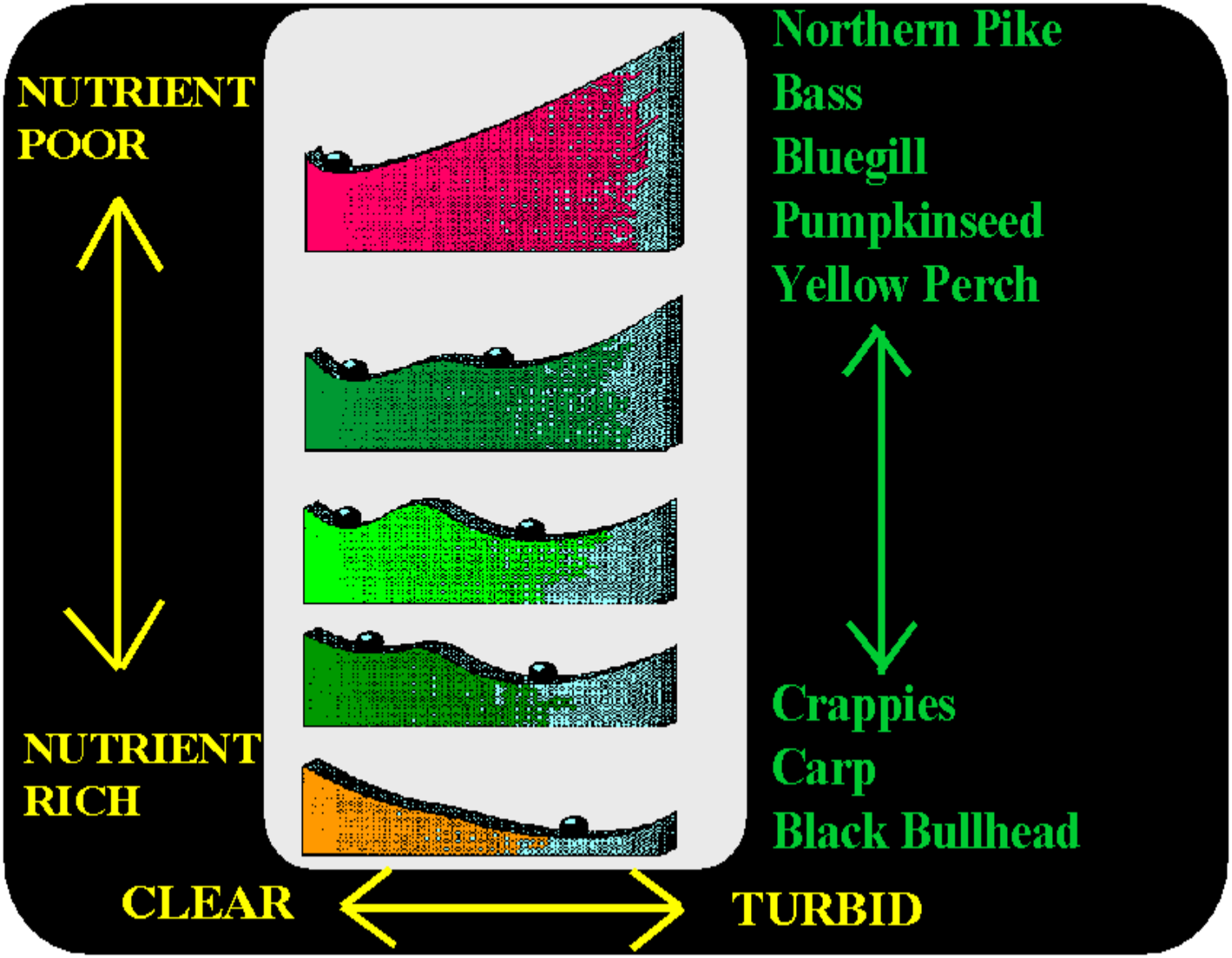
Shallow Lake Ecology

(From Scheffer et al. 1993)



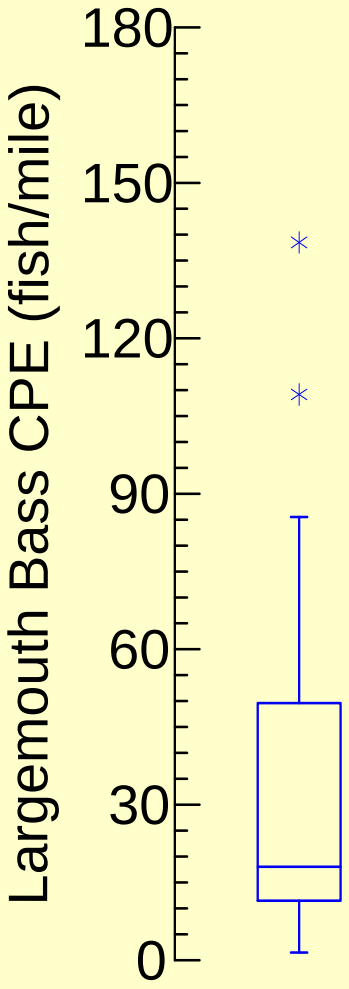
Shallow Lake Ecology

(From Scheffer et al. 1993)

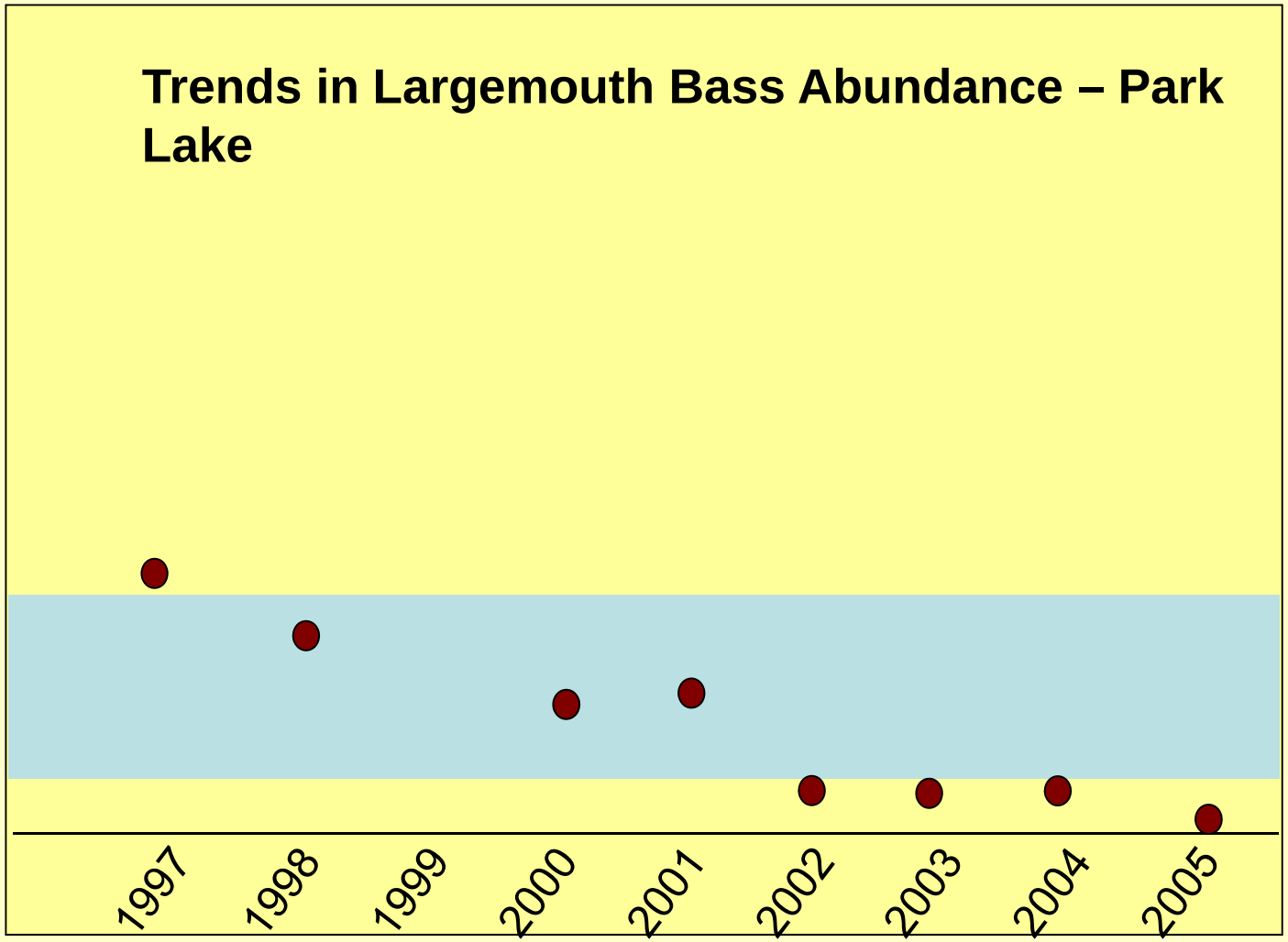


Fish Community: Assessment by Analogy

Inter-quartile ranges are benchmarks for quick evaluations of survey data. Catch rates within the inter-quartiles = **normal** for Class 3 lakes. Catch rates outside the inter-quartiles = **unusual**.



Fall Electrofishing Surveys; 46 Lakes



Clear-water State

Turbid-water State

Piscivores

Planktivores/Benthivores

Zooplankton grazing

Algae biomass

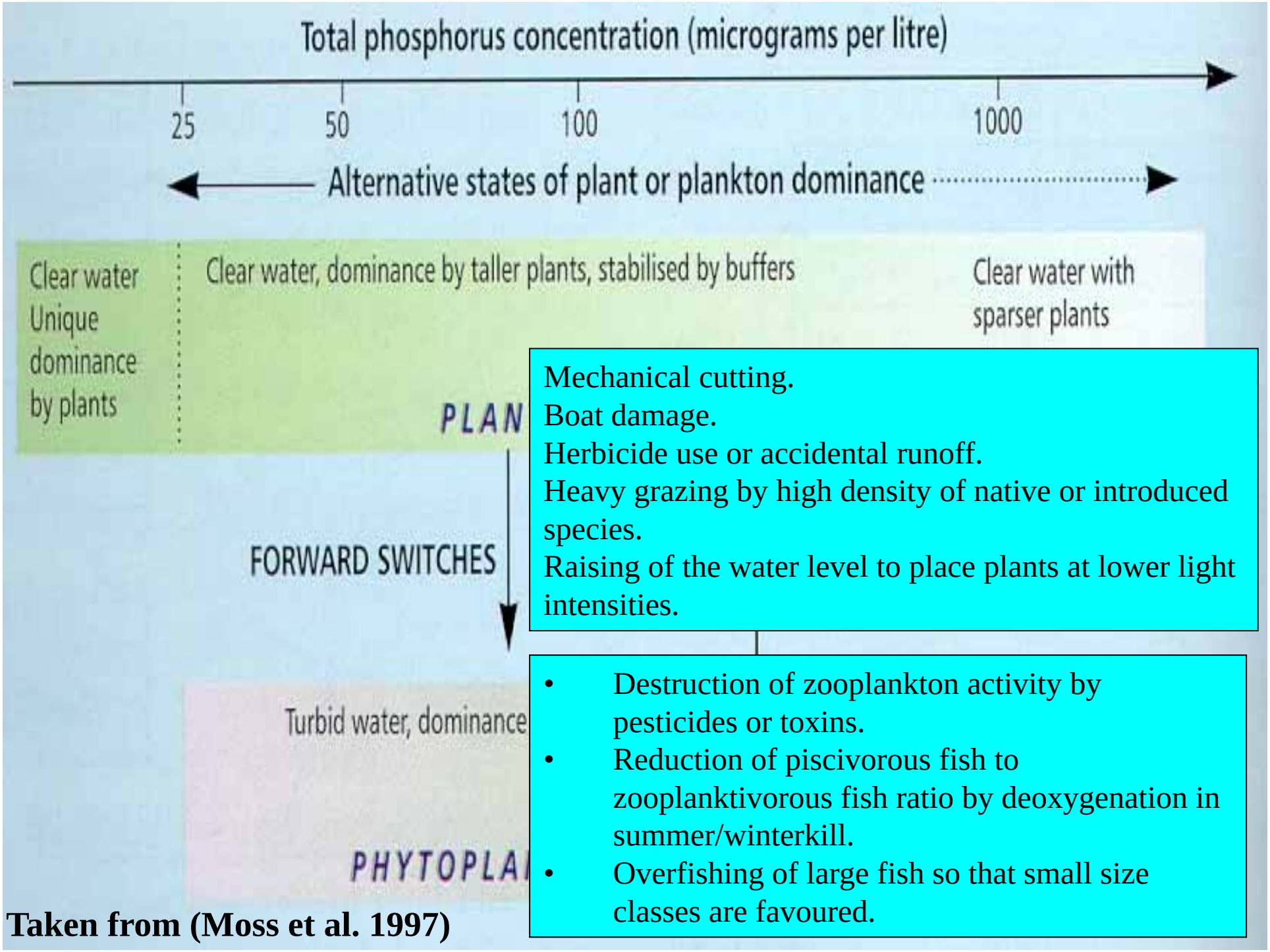
Aquatic plant biomass

Sediment Resuspension

N. Hansel-Welch & M.B. Butler, 199

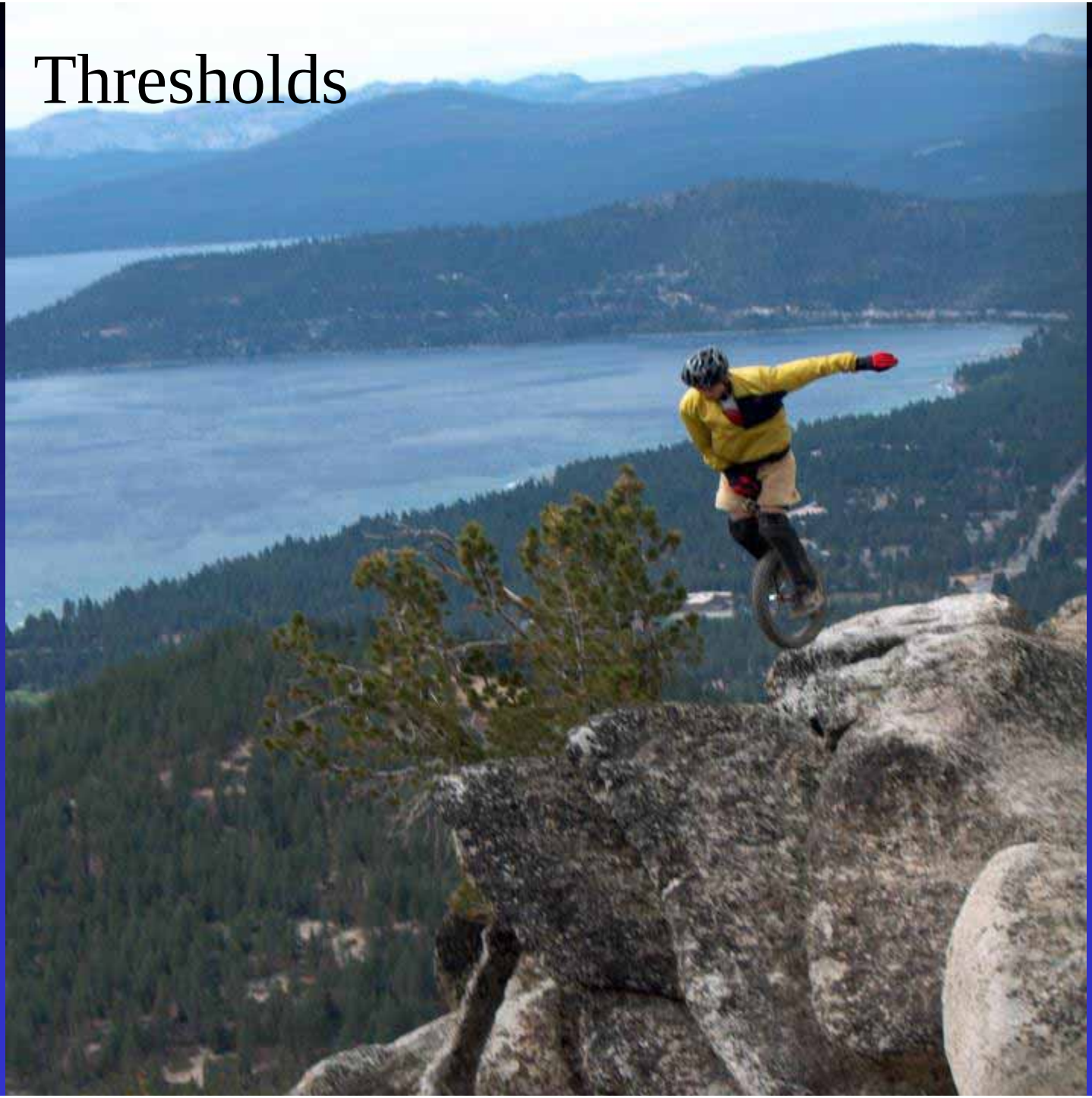
Cladocerans, or water fleas "vacuum" the algae from lake water. When they are abundant, the water is more clear.

If conditions are unfavorable, i.e. zooplanktivorous fish like bluegill are abundant, refuge absent, the lake water remains turbid from algae.

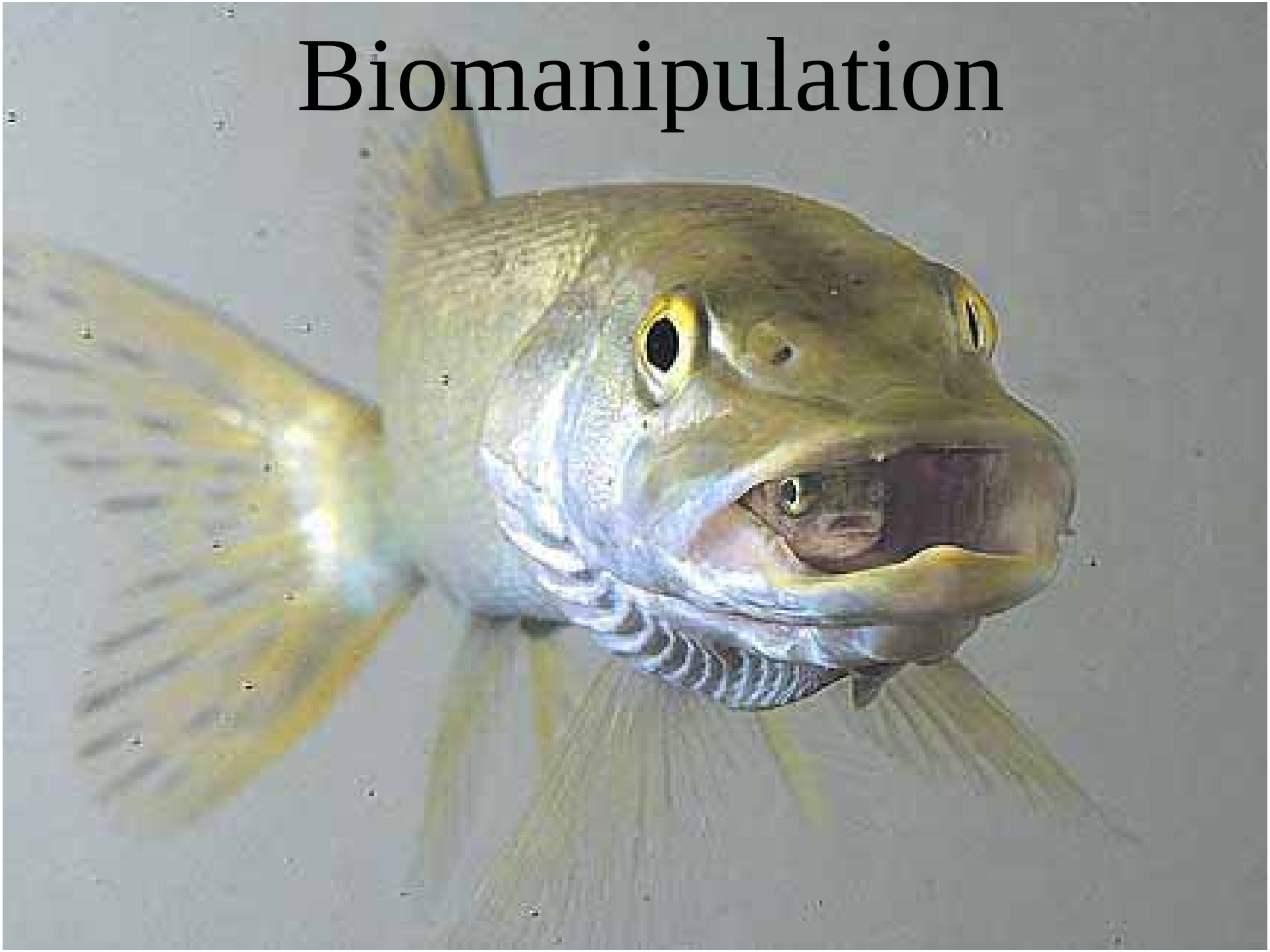


Taken from (Moss et al. 1997)

Thresholds



Biomanipulation



Big Muskego Lake -- Chlorophyll A

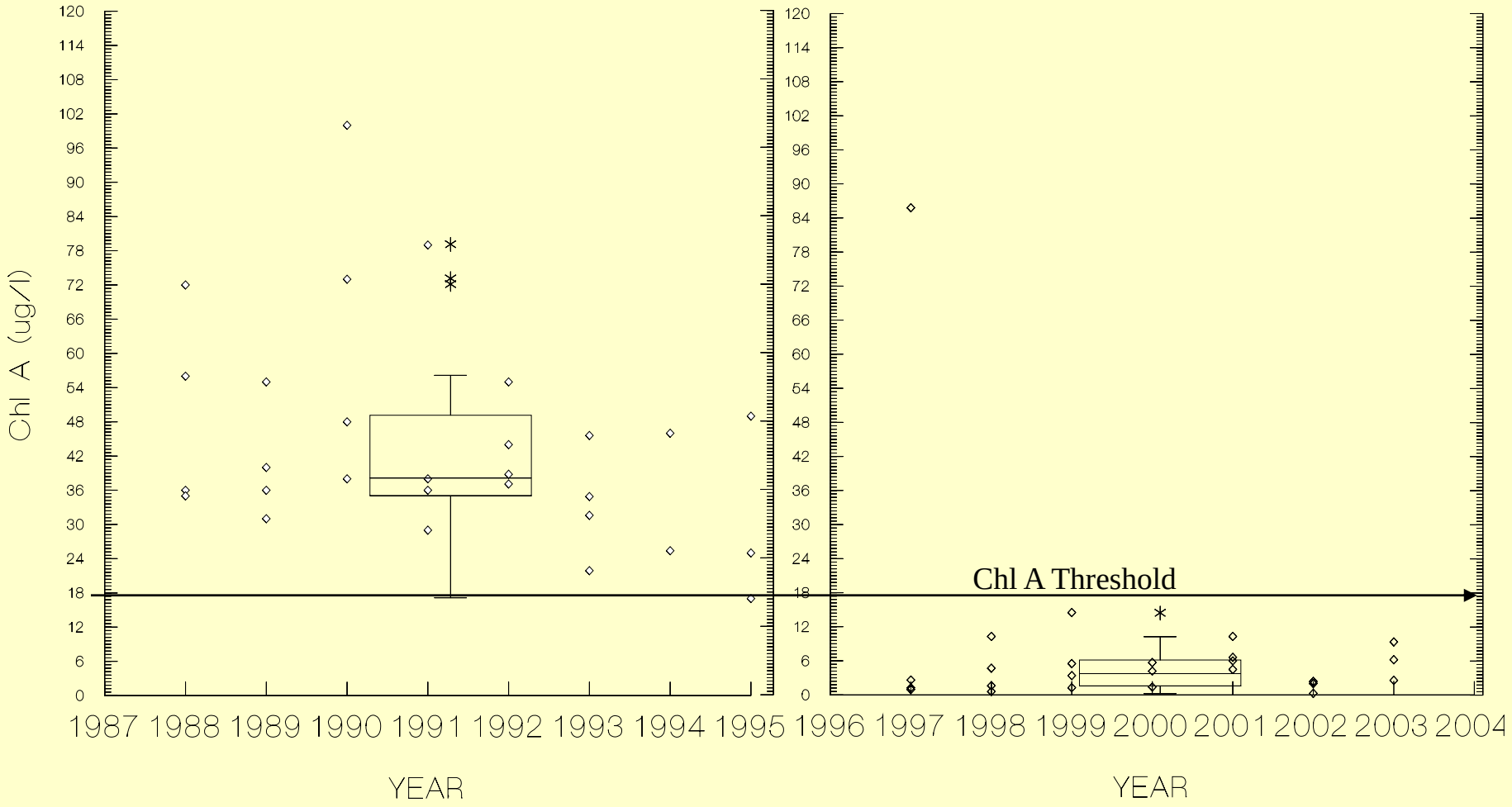
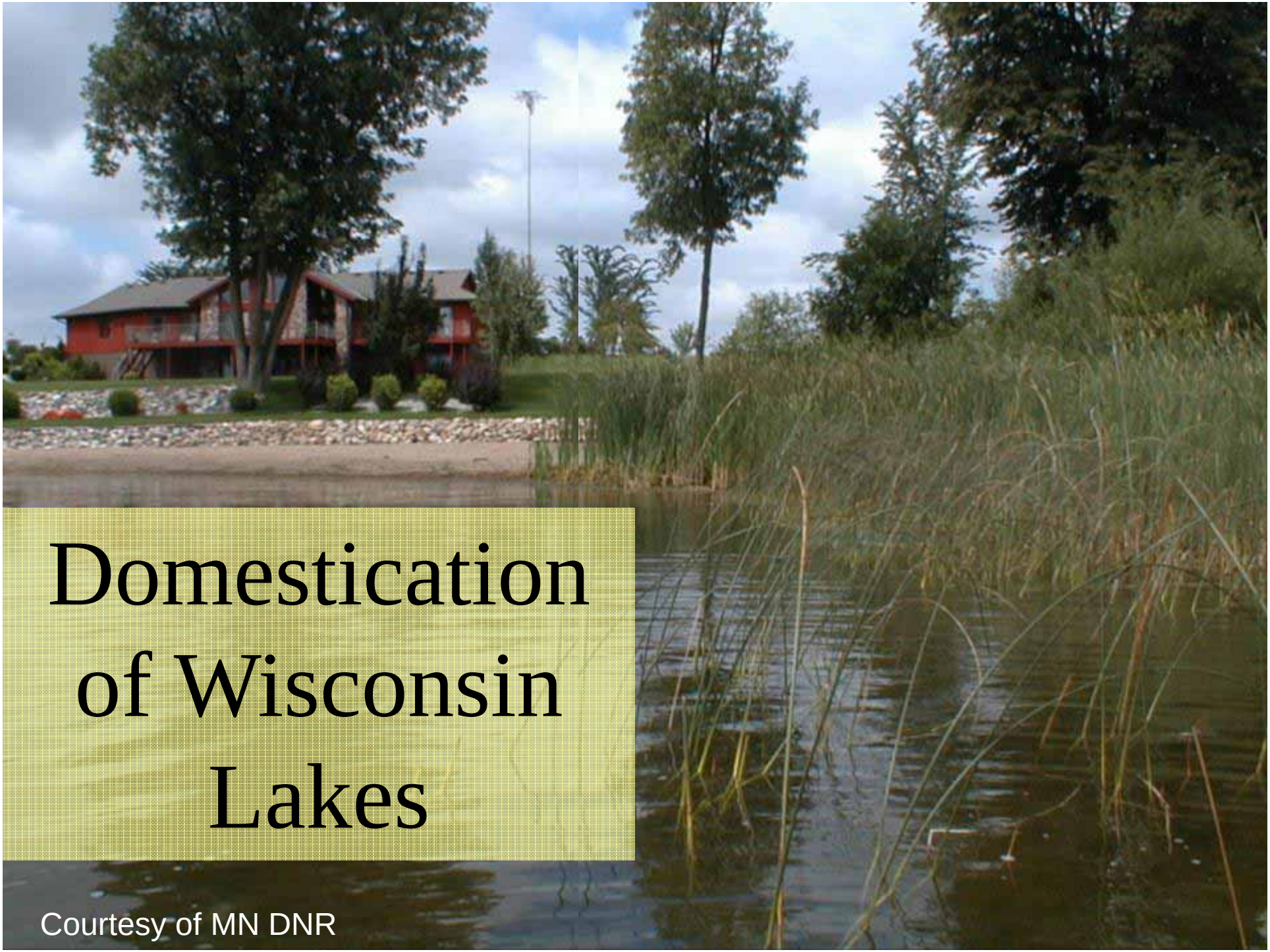


Photo: Mike DeVries, The Capital Times, 5 July 2007

Bioturbation

Nearshore Fish and Wildlife Habitat: Human Impacts, Obvious Remedies, Difficult Choices

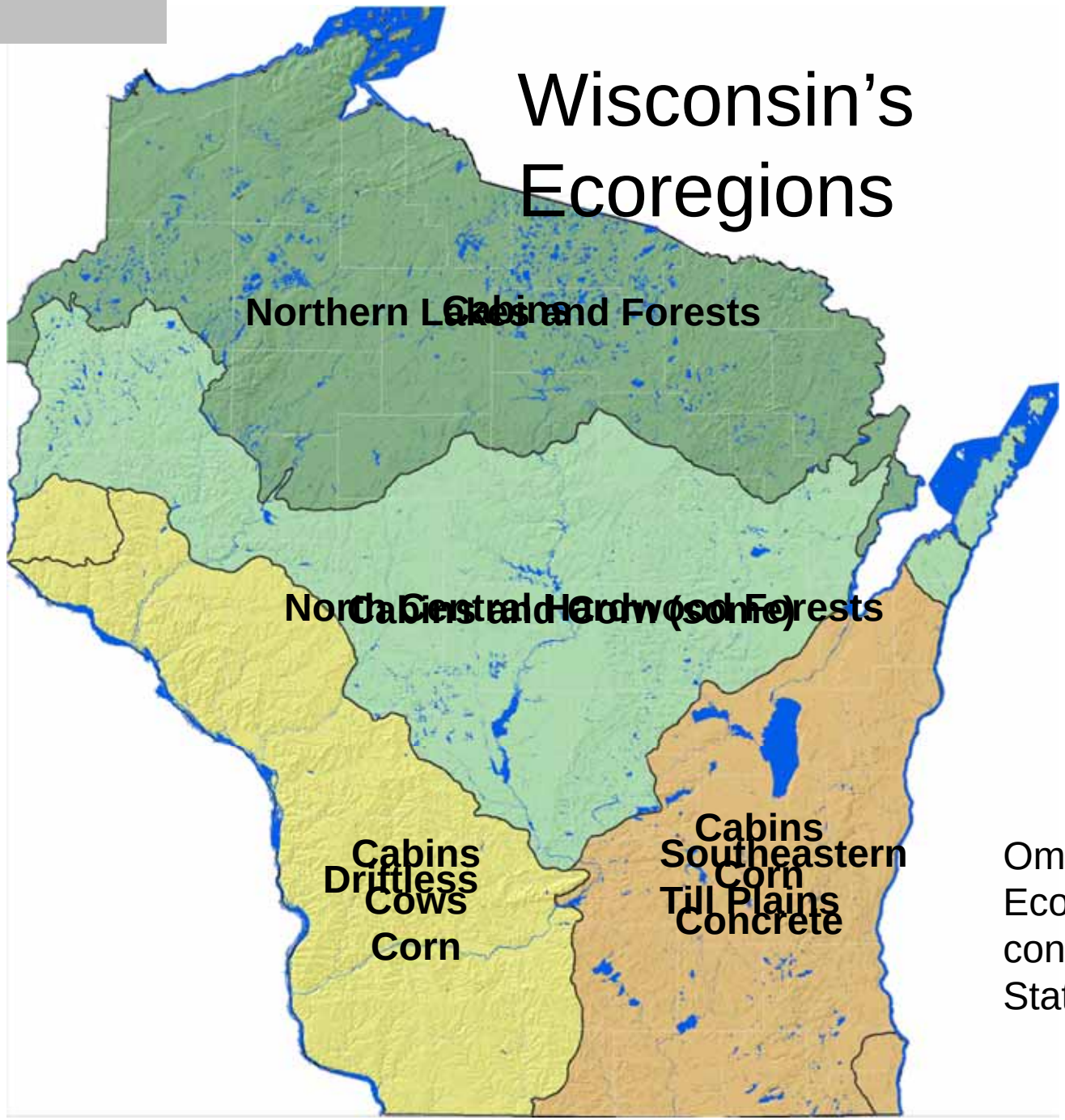
Paul Cunningham
Bureau of Fisheries Management



Domestication of Wisconsin Lakes

Courtesy of MN DNR

Wisconsin's Ecoregions



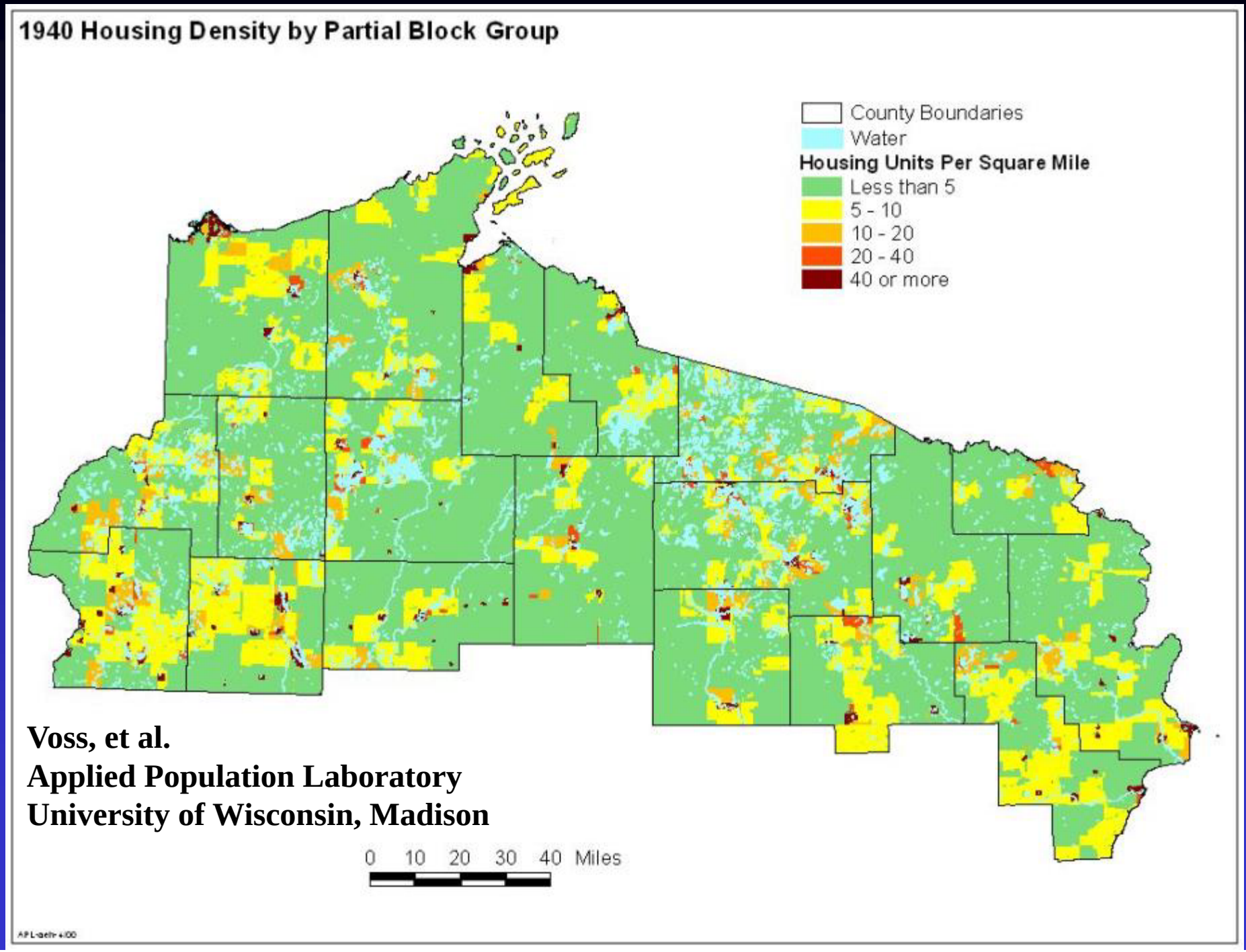
Omernik, J.M. 1987. Ecoregions of the conterminous United States.

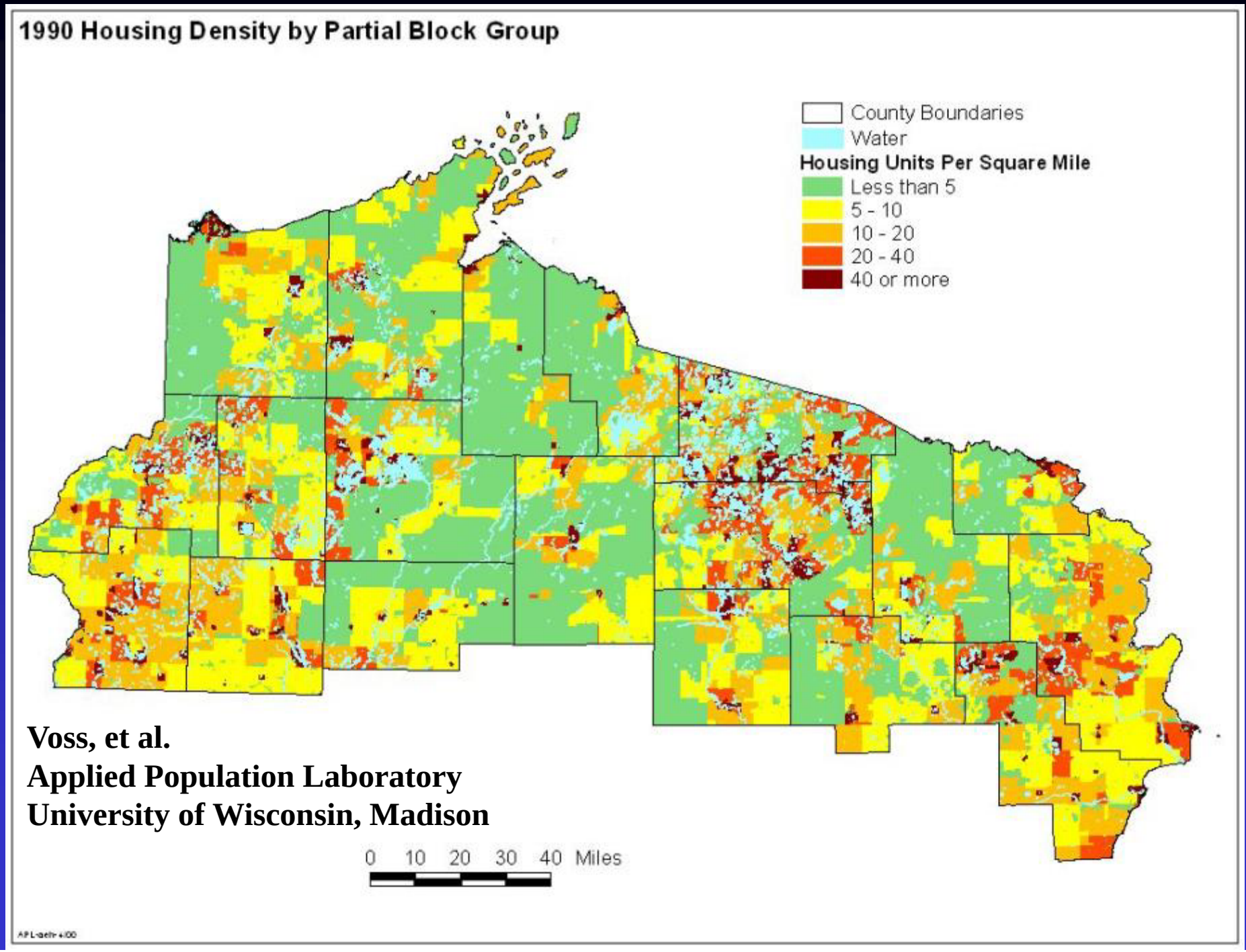
Essential Habitat

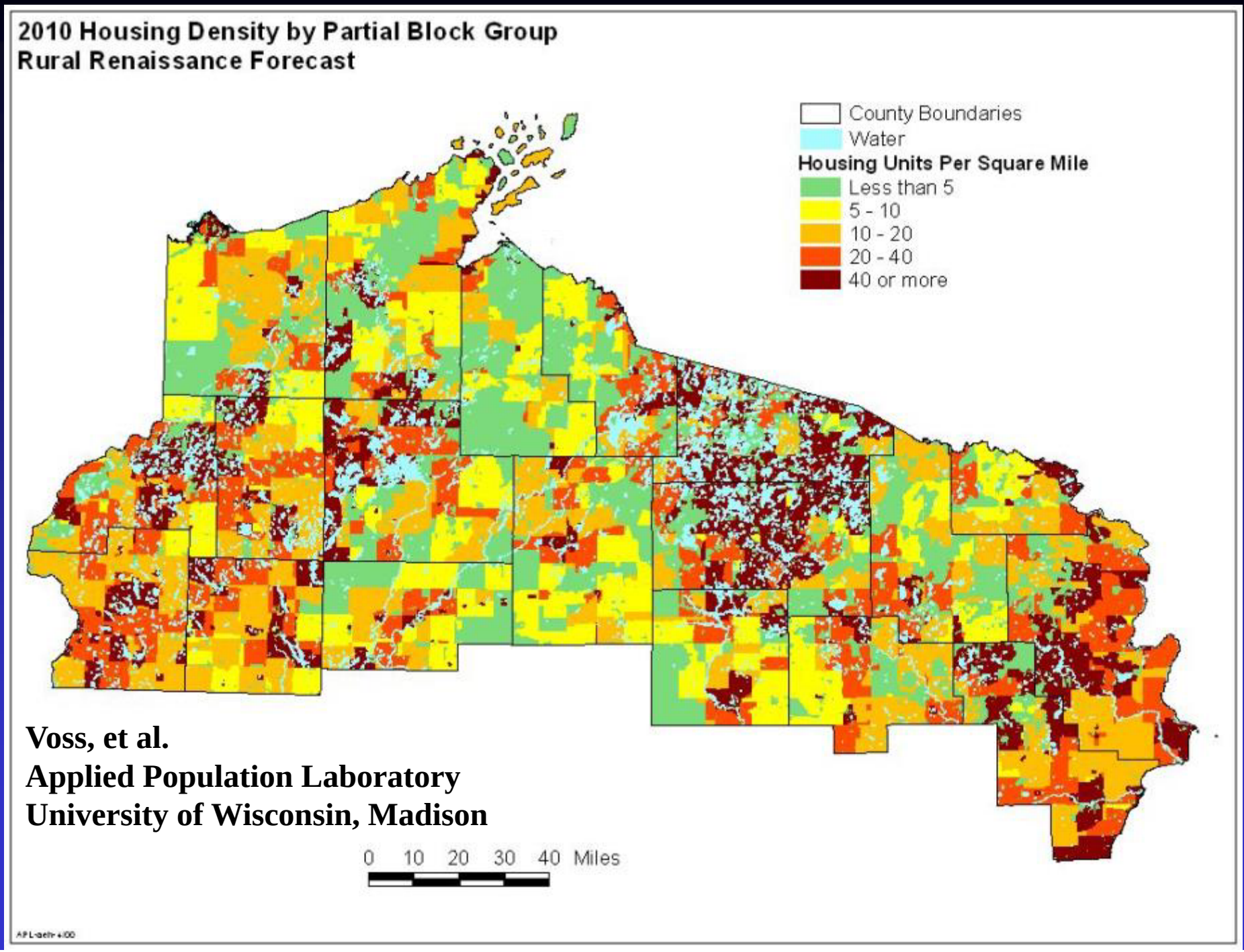
- Littoral zone
- Tributary areas
- Adjacent shoreland

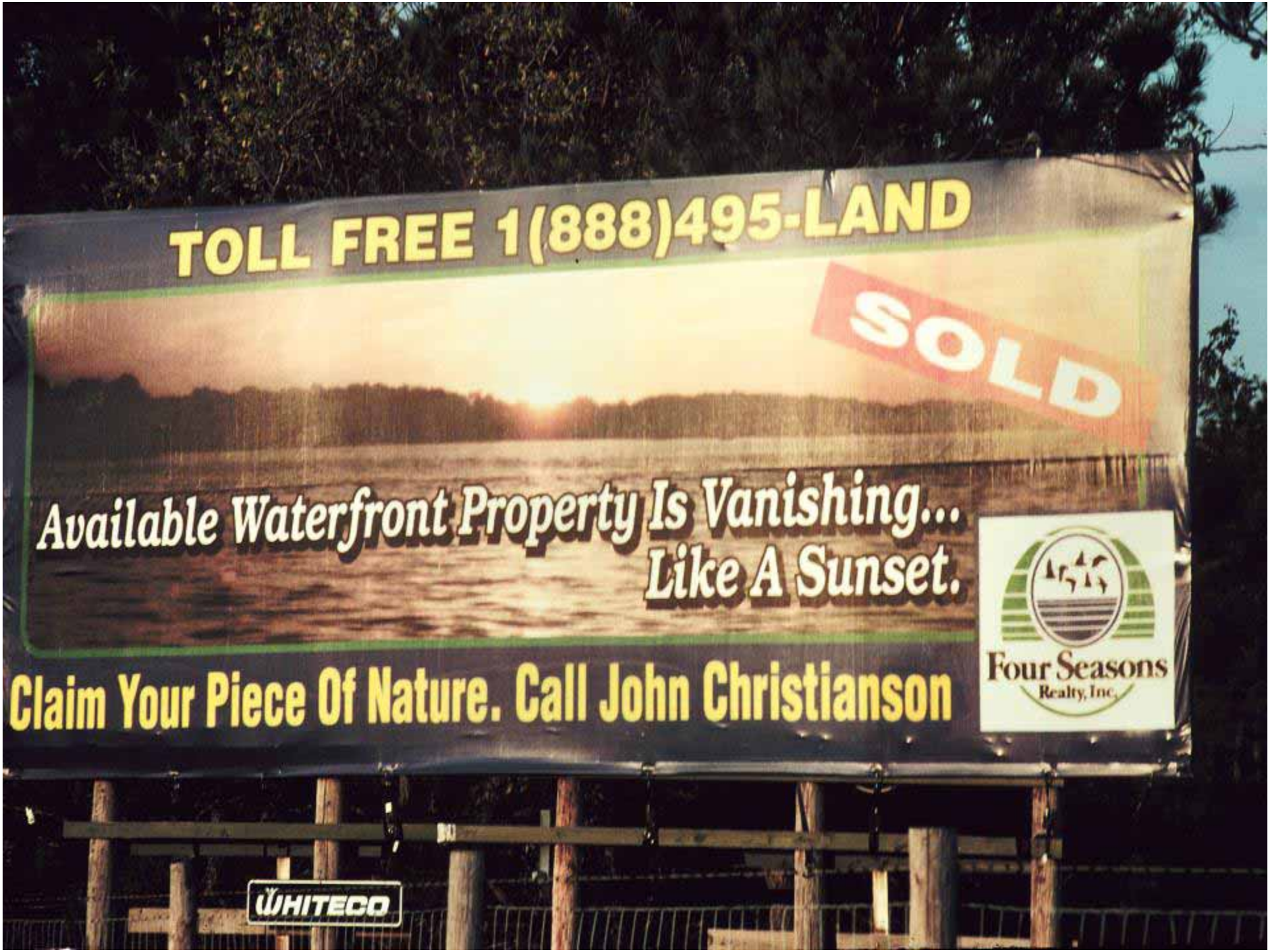
Features of Littoral Zone Habitat

- Vegetation
- Substrate
- Woody Cover
- Overhanging Bank Cover
- Depth and Depth Gradients


1940 Housing Density by Partial Block Group
County Boundaries
Water
Housing Units Per Square Mile
Less than 5
5 - 10
10 - 20
20 - 40
40 or more
Voss, et al.
Applied Population Laboratory
University of Wisconsin, Madison
0 10 20 30 40 Miles


1990 Housing Density by Partial Block Group
County Boundaries
Water
Housing Units Per Square Mile
Less than 5
5 - 10
10 - 20
20 - 40
40 or more
Voss, et al.
Applied Population Laboratory
University of Wisconsin, Madison
0 10 20 30 40 Miles


2010 Housing Density by Partial Block Group
Rural Renaissance Forecast
County Boundaries
Water
Housing Units Per Square Mile
Less than 5
5 - 10
10 - 20
20 - 40
40 or more
Voss, et al.
Applied Population Laboratory
University of Wisconsin, Madison
0 10 20 30 40 Miles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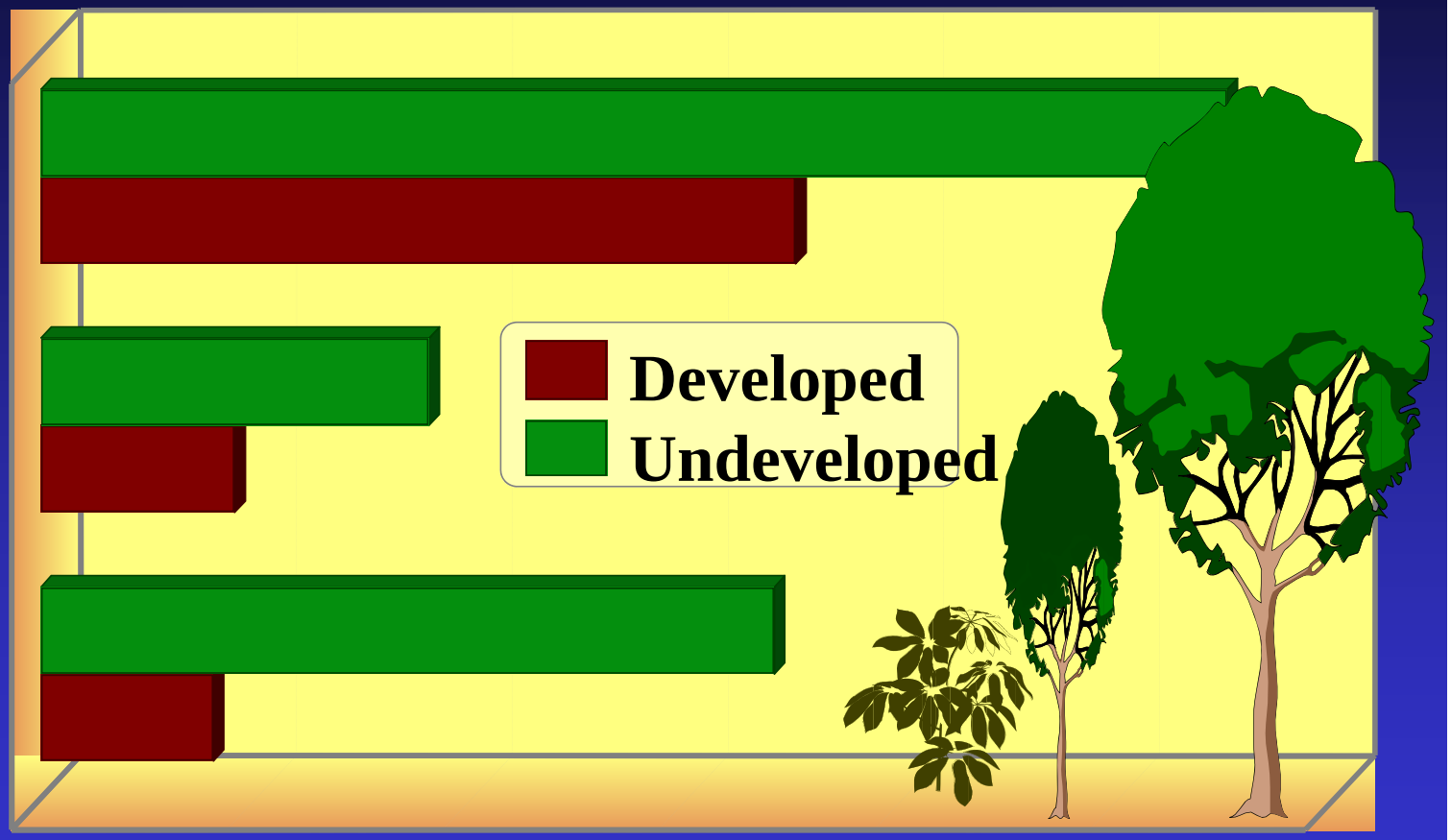
Comparisons of Undeveloped and Developed Shorelands, Northern Wisconsin

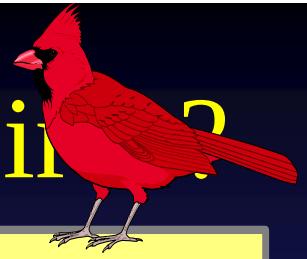
Joan Elias & Mike Meyer

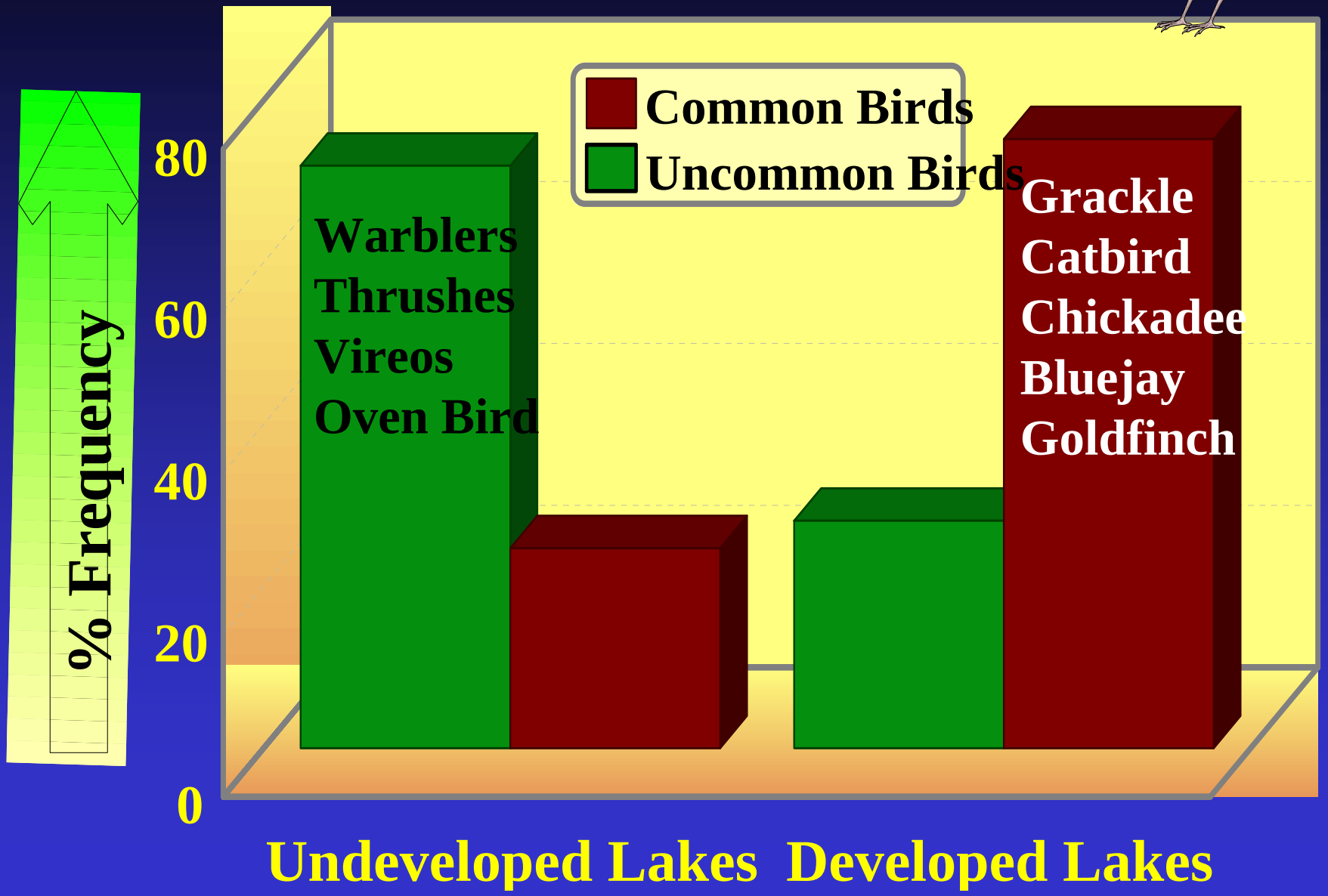
What's Happened To Shoreland Plants?

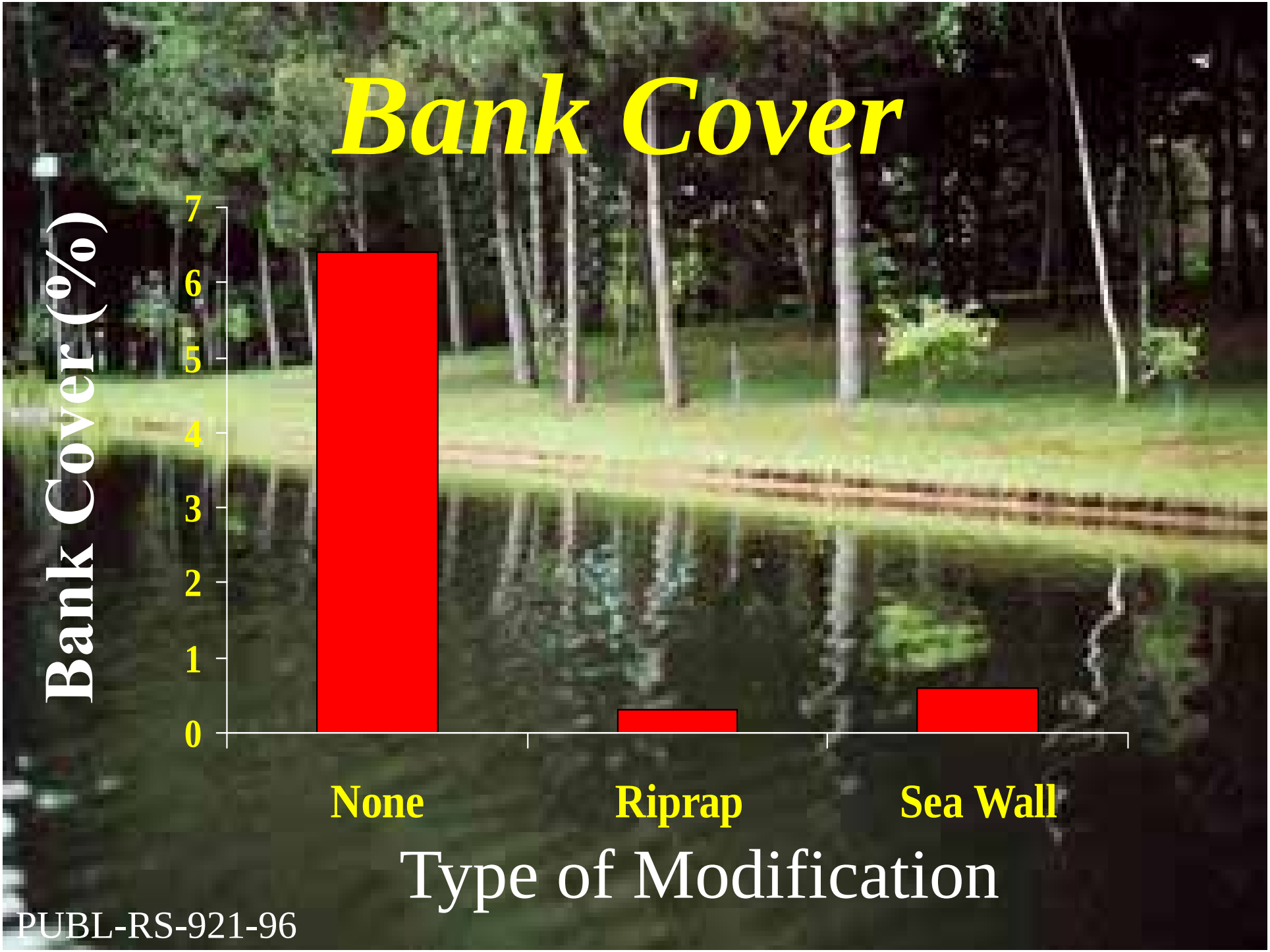


Elias and Meyer,

What's Happened To Songbi[illegible]?






Bank Cover
Bank Cover (%)
7
6
5
4
3
2
1
0
None
Riprap
Sea Wall
Type of Modification
PUBL-RS-921-96

Consequences of Lakeshore Development on Emergent and Floating-Leaf Vegetation Abundance

Radomski and Goeman, 2001

Minnesota Department of Natural Resources

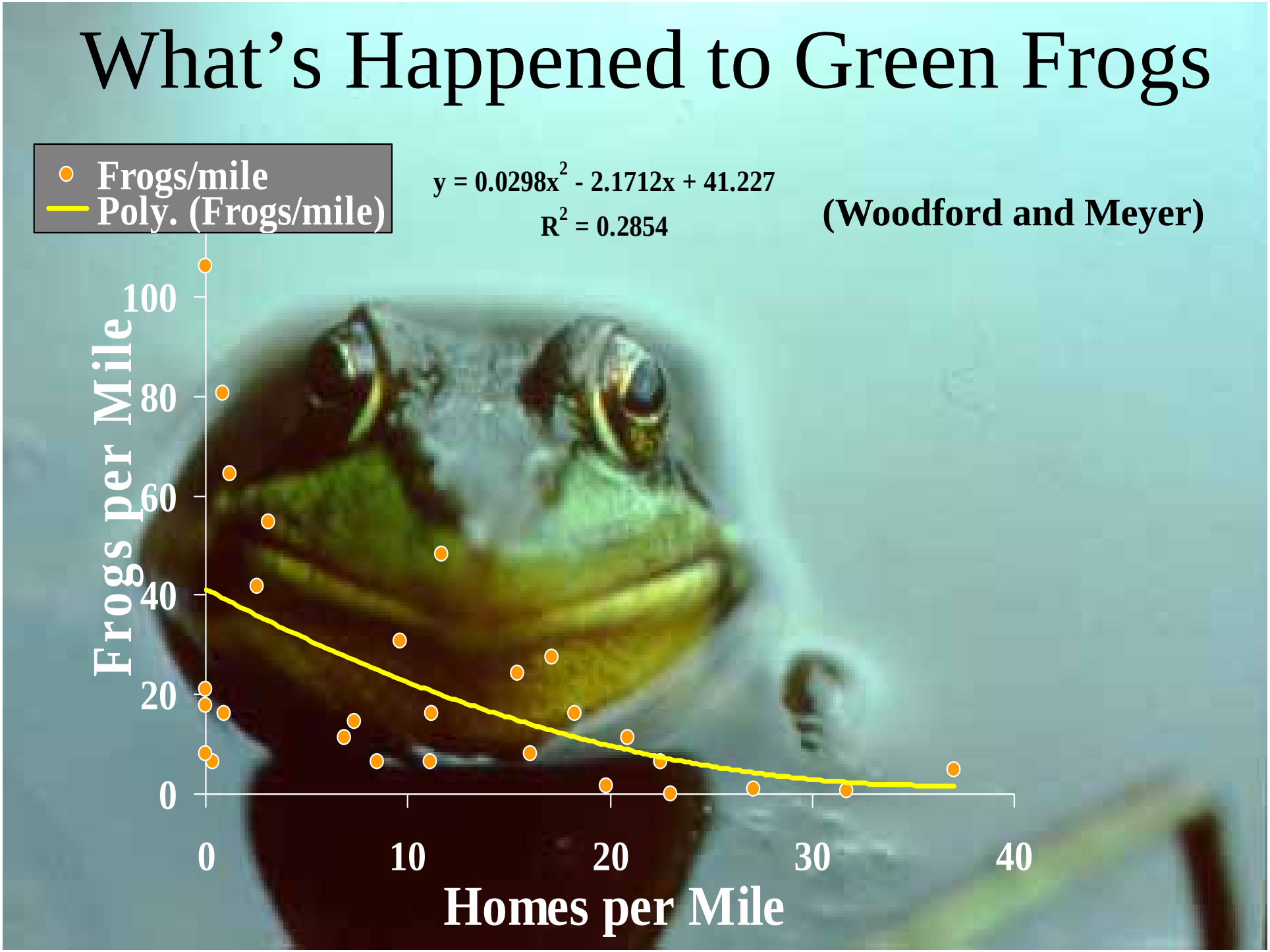
Consequences of Lakeshore Development on Emergent and Floating-Leaf Vegetation Abundance

- Developed shores had less aquatic vegetation
- For each lake lot, 2/3rds of the emergent and floating-leaf vegetation was lost
- Minnesota has lost 20-28% of

Radomski and Goeman, 2001

Minnesota Department of Natural Resources

What's Happened to Green Frogs

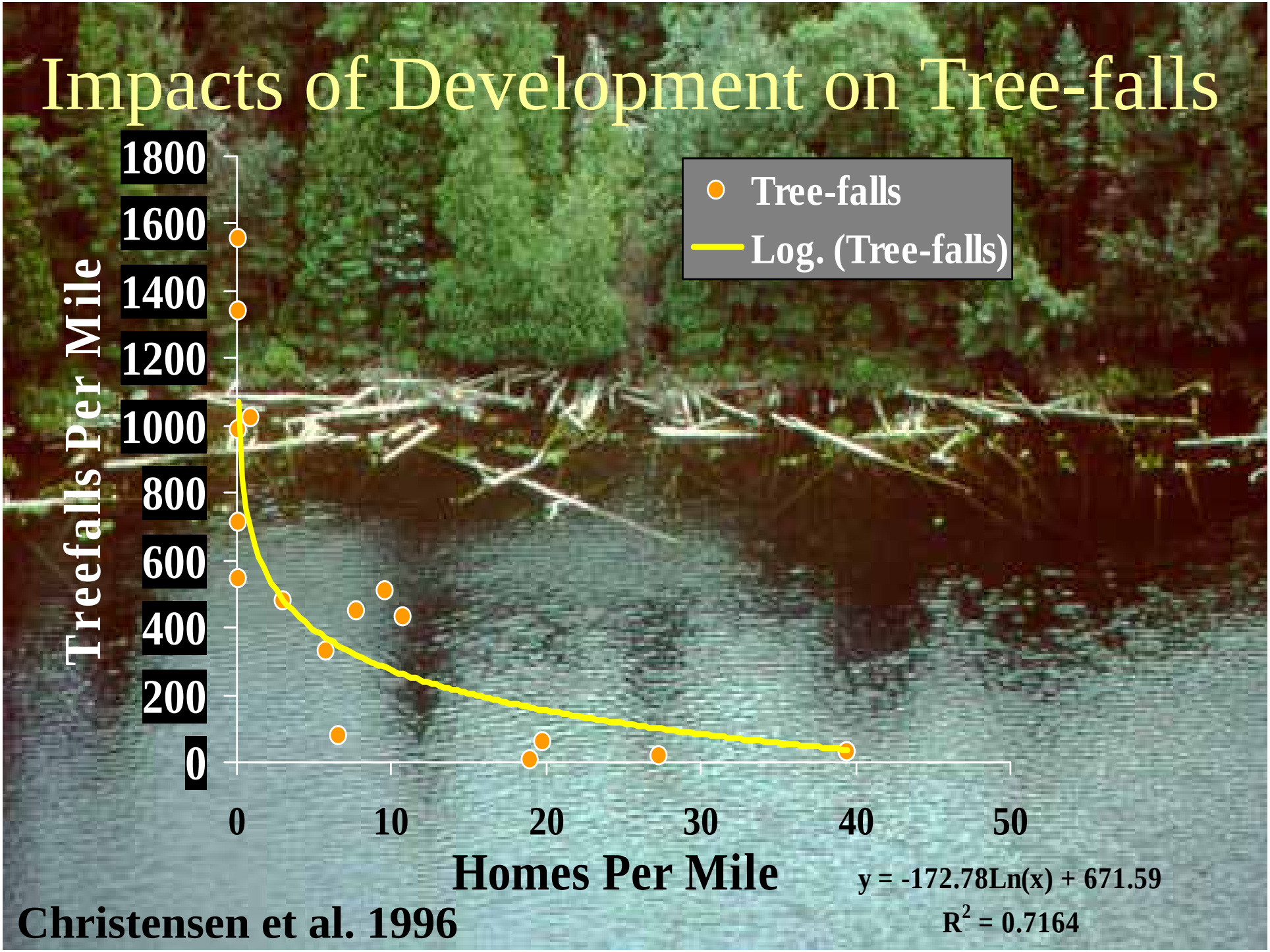


Impacts of Lakeshore Development on Tree-falls in North Temperate Lakes

Christensen et al. 199

University of Wisconsin
Center for Limnology

Impacts of Development on Tree-falls



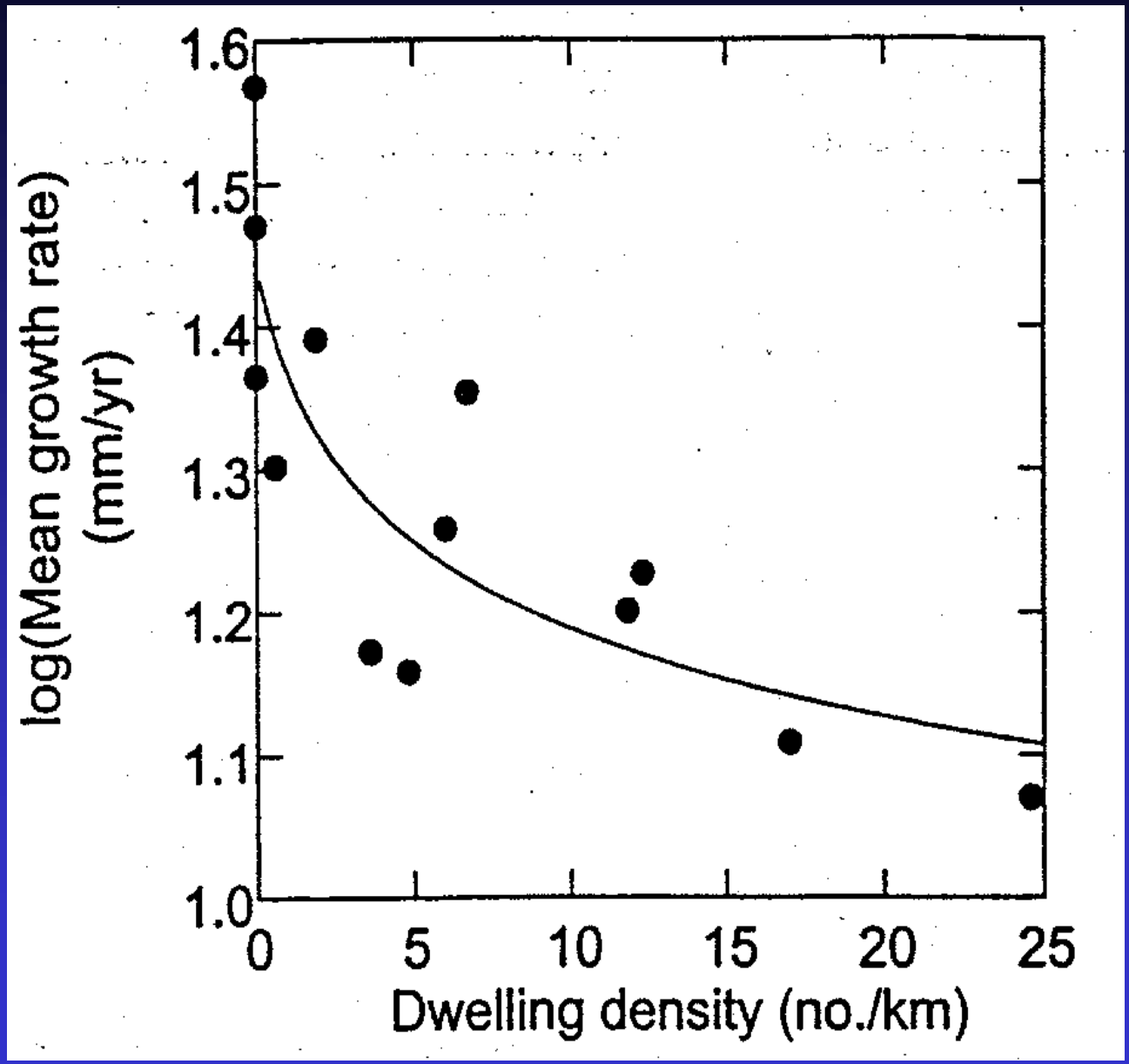
Christensen et al. 1996

Development Impacts on Fish Growth and Production

Schindler et al. 2000

University of Wisconsin
Center for Limnology

Development Impacts on Bluegill Growth



Schindler et al. 2000

Fish grow ~3X faster in lakes with lots of woody habitat

log Growth Rate (mm/yr)

Undeveloped

Low Development

High Development

Undeveloped

Low Development

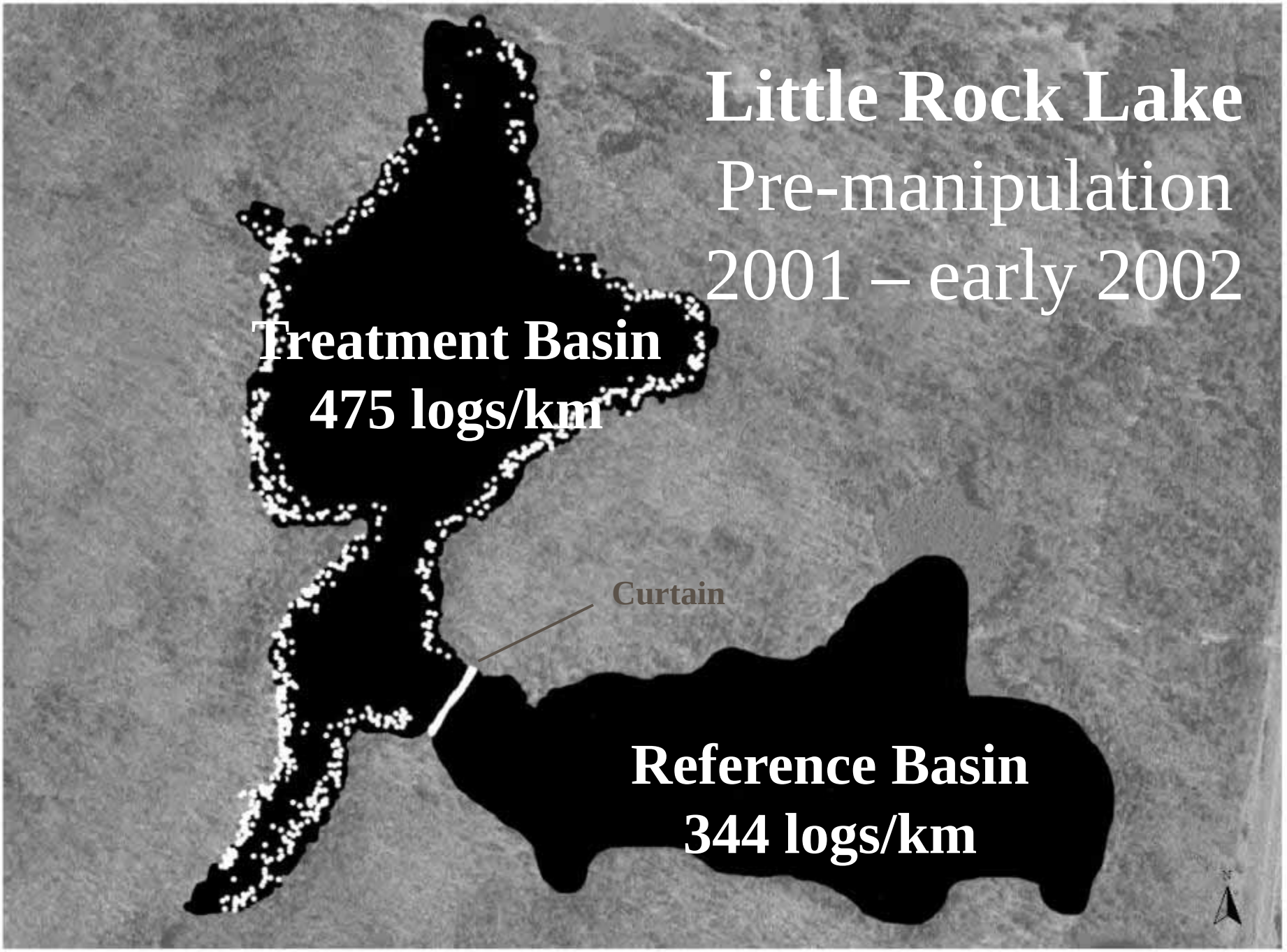
High Development

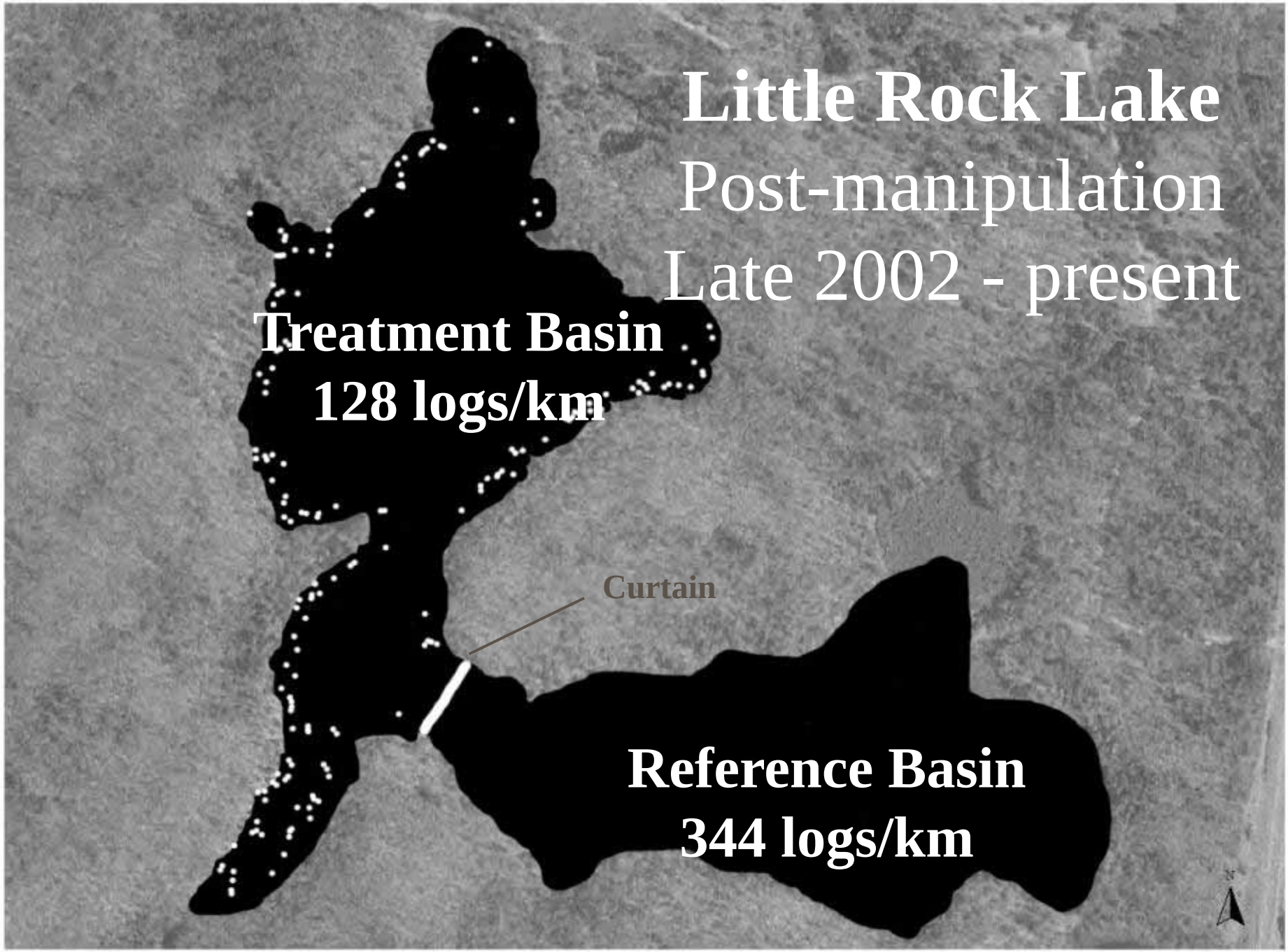
Woody Habitat (no./km)

From Schindler et al. 2000

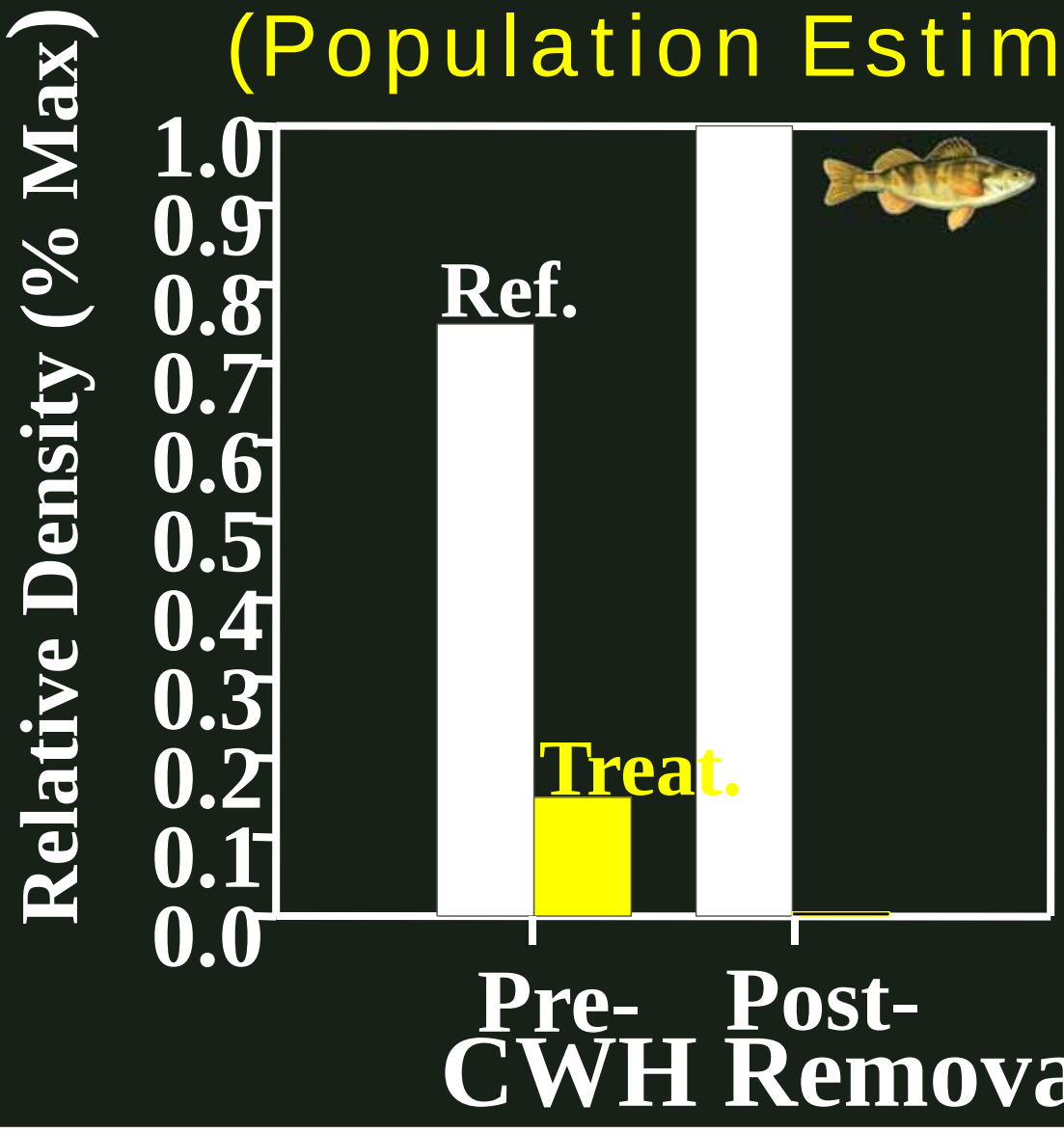
Fish Community Responses to a Whole-lake Removal of Coarse Woody Habitat

Greg G. Sass, James F. Kitchell, and Stephen R. Carpenter
Center for Limnology
University of Wisconsin - Madison


Little Rock Lake
Pre-manipulation
2001 – early 2002
Treatment Basin
475 logs/km
Curtain
Reference Basin
344 logs/km


Little Rock Lake
Post-manipulation
Late 2002 - present
Treatment Basin
128 logs/km
Curtain
Reference Basin
344 logs/km

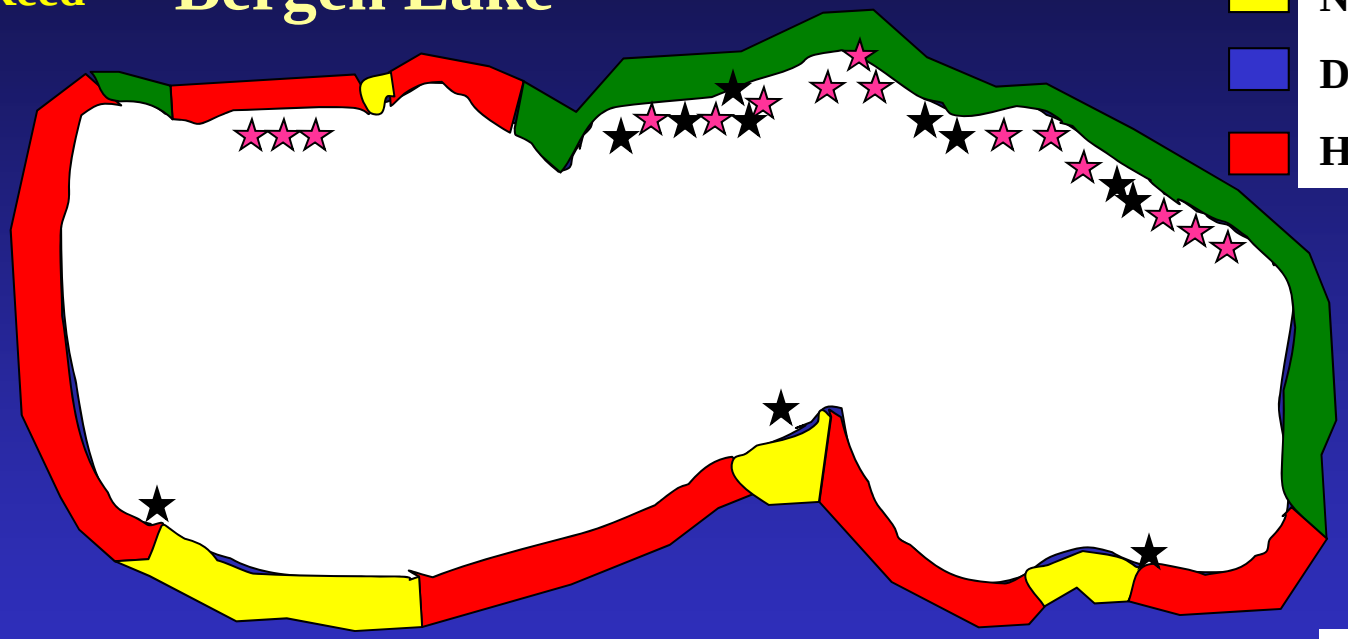
Yellow Perch Abundance (Population Estimate)



Development Effects on Nest Site Selection by Largemouth Bass and Black Crappie

Jeffrey Reed

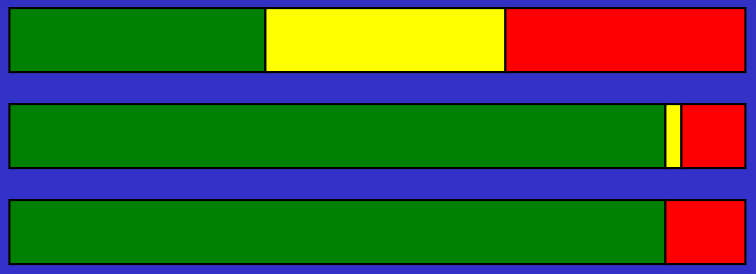
Bergen Lake



- Undeveloped
- No Dwelling
- Dwelling
- Heavily Developed

★ LMB Nest

☆ BLC Nest



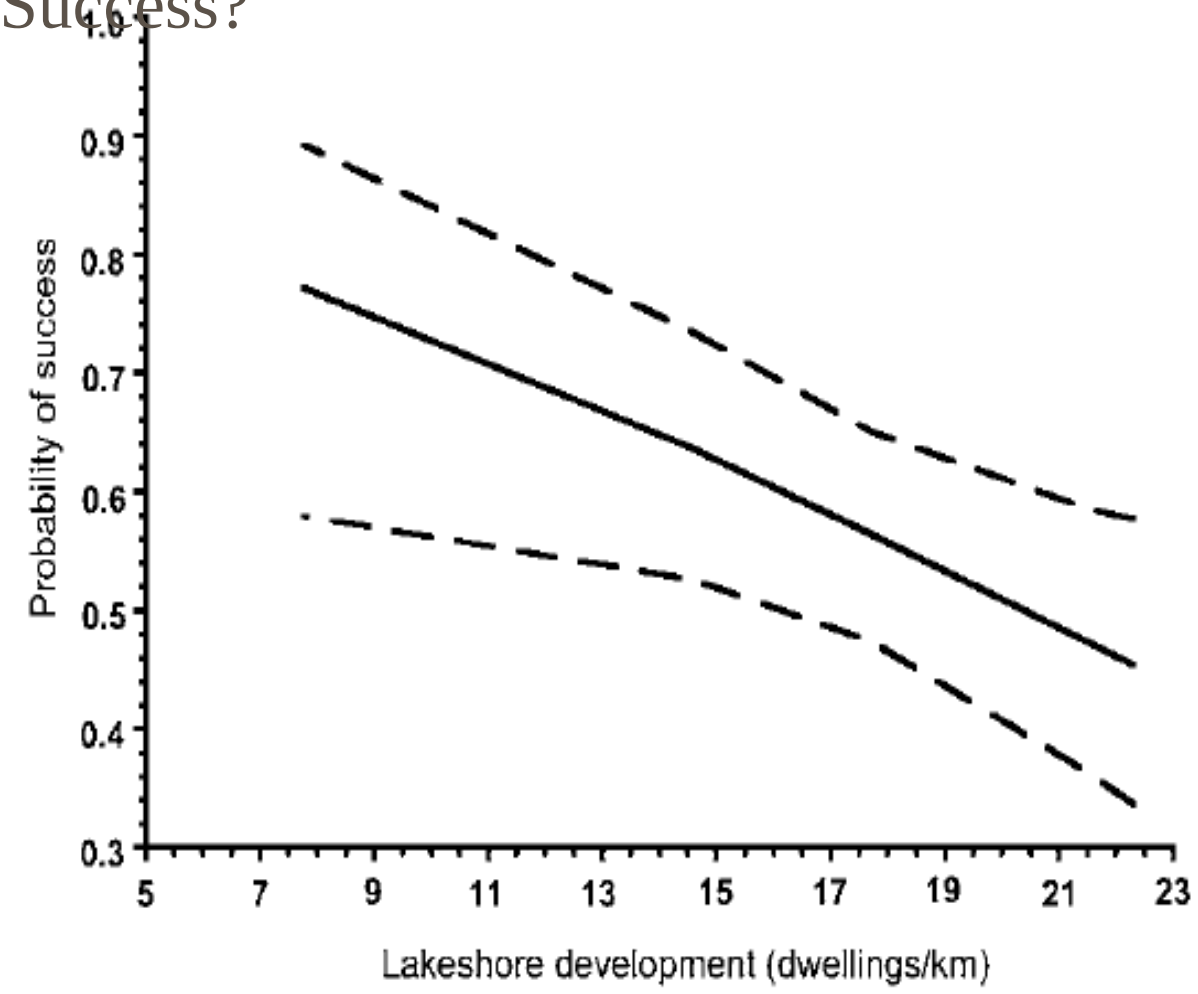
Available Habitat

Largemouth Bass Habitat Selection

Black Crappie Habitat Selection

TYLER WAGNER, AARON K. JUBAR, AND MARY T. BREMIGAN

Can Habitat Alteration and Spring Angling Explain Largemouth Bass Nest Success?

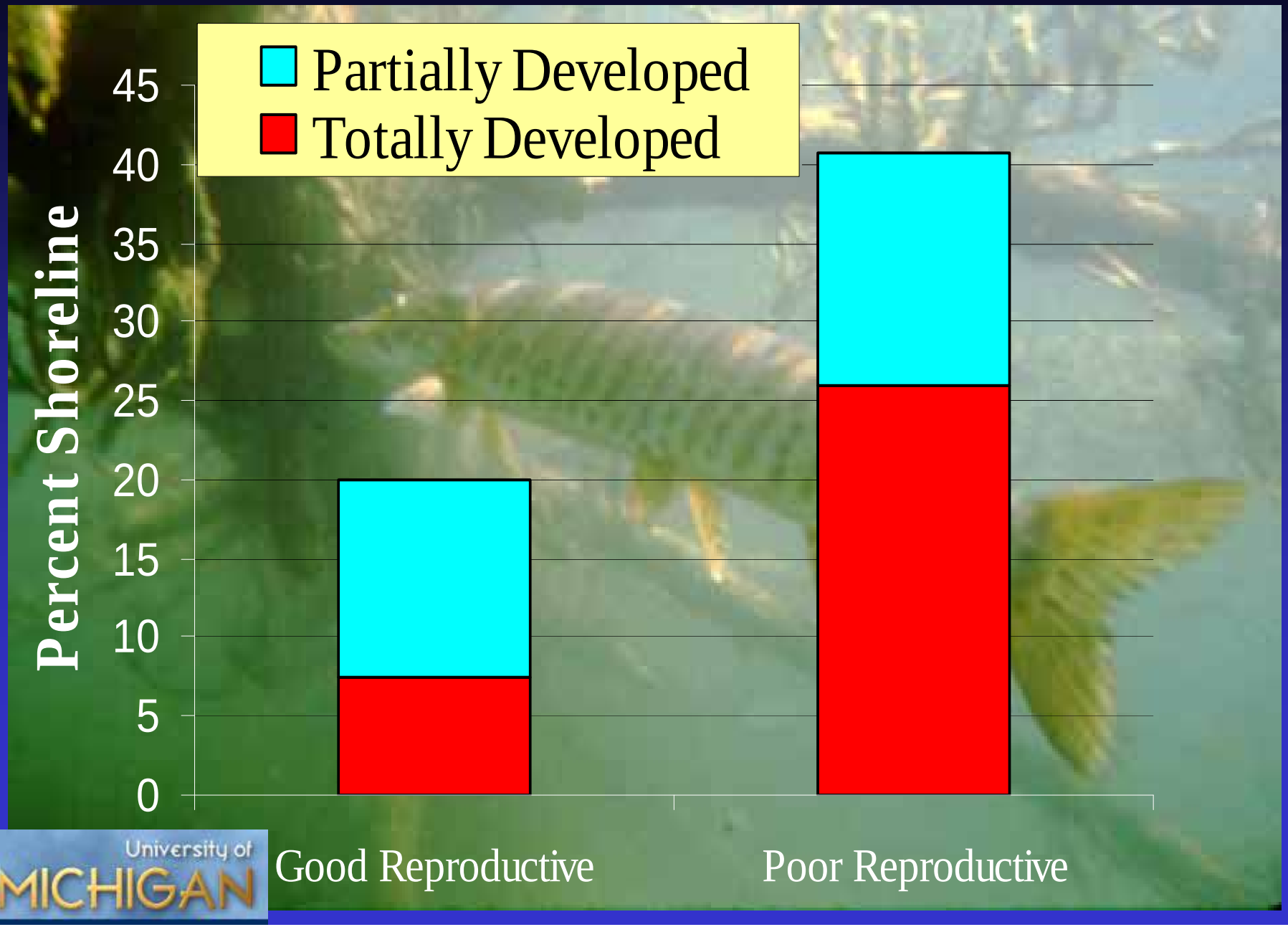


Lake Characteristics Influencing Spawning Success of Muskellunge

Rust et al.,

University of MICHIGAN

Lake Characteristics Influencing Muskellunge Reproduction

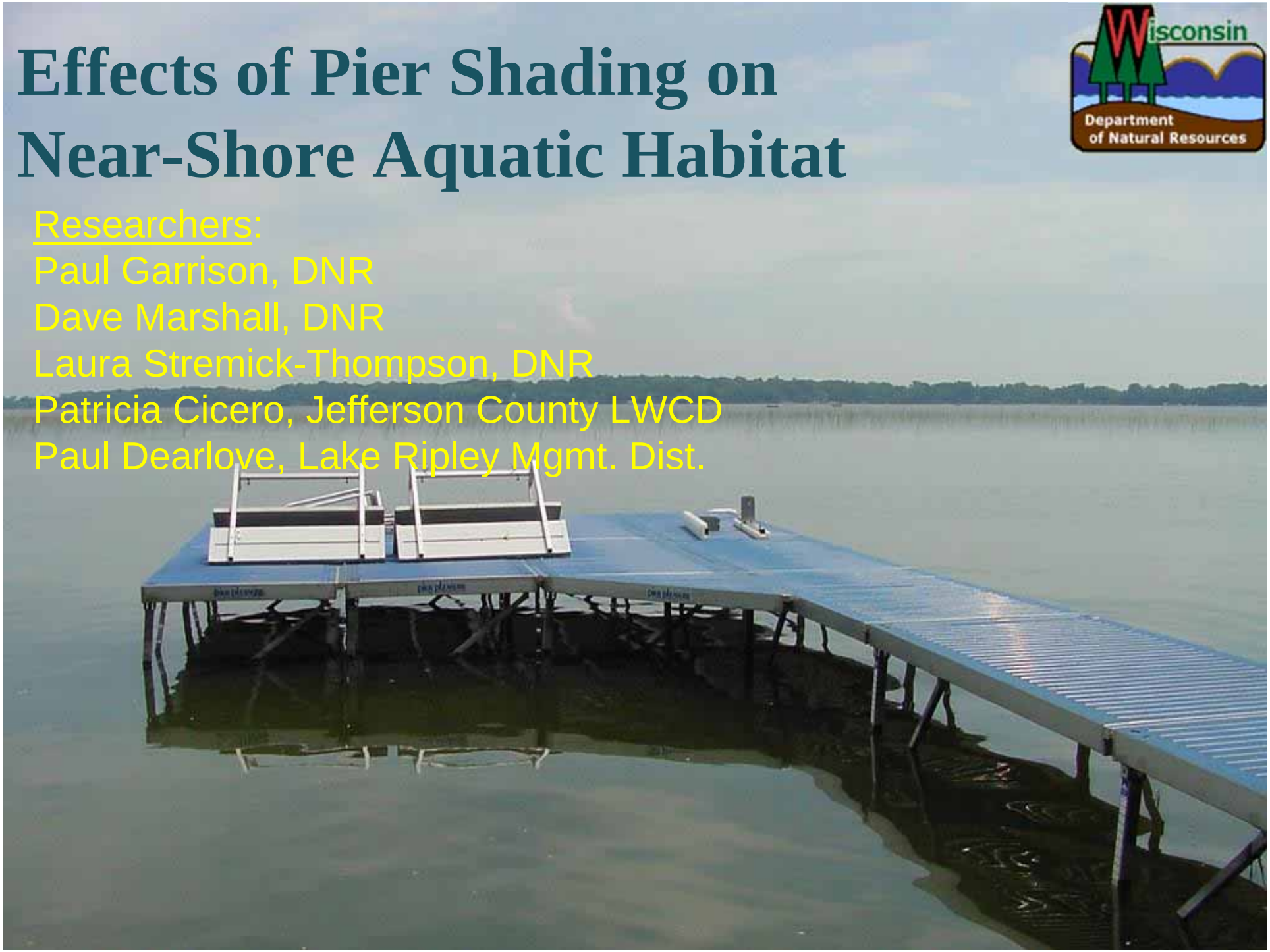


University of MICHIGAN

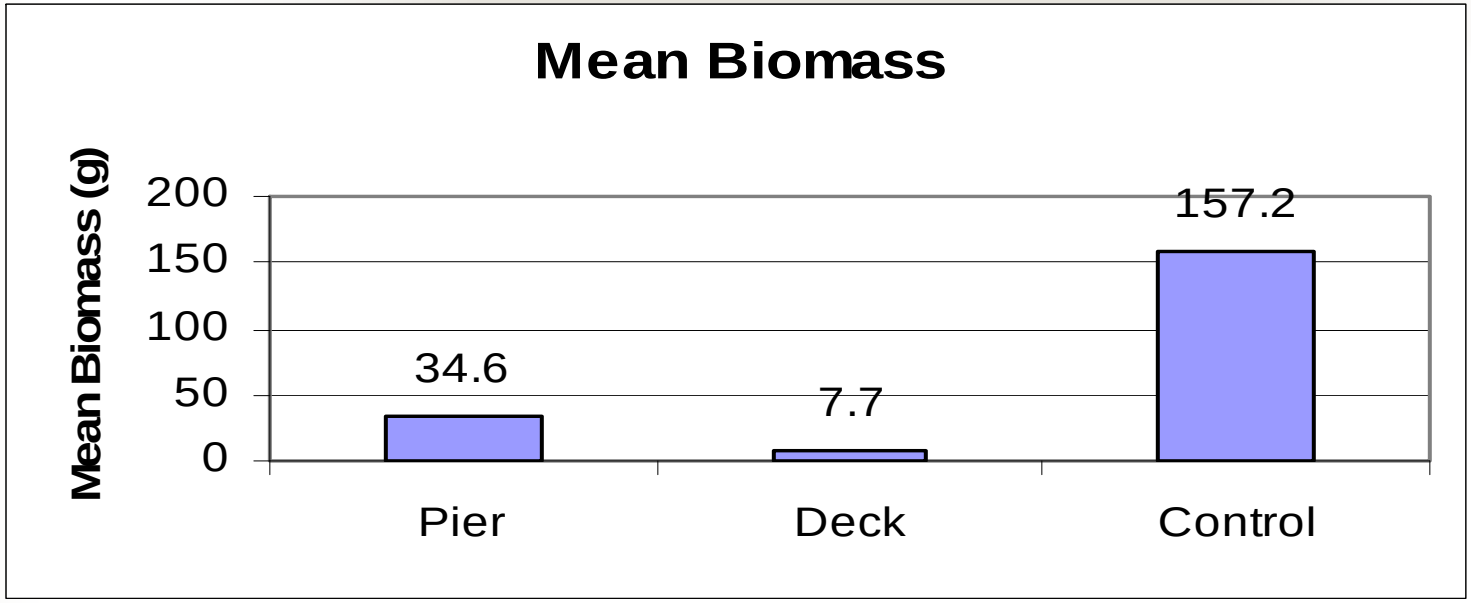

Improve Water Clarity
Fish and Wildlife Habitat
Hold Sediments
Nutrient Cycling
Invertebrates
Aesthetics

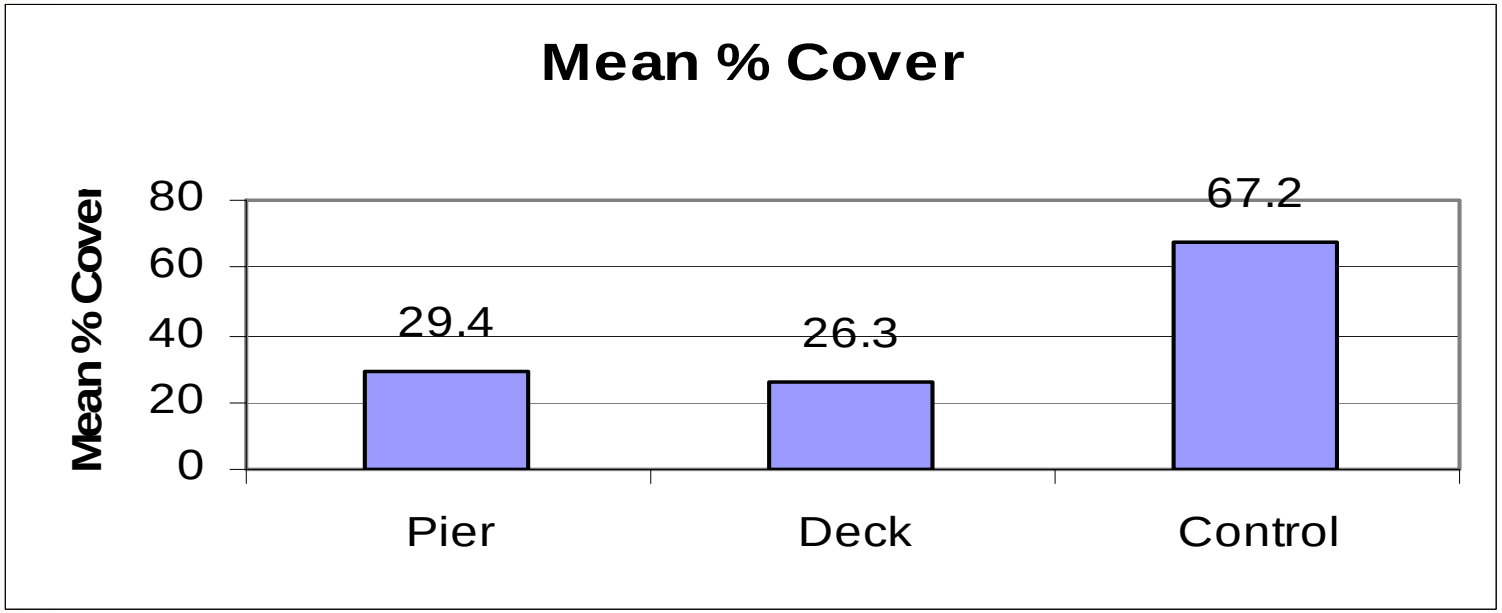
Effects of Pier Shading on Near-Shore Aquatic Habitat

Researchers:
Paul Garrison, DNR
Dave Marshall, DNR
Laura Stremick-Thompson, DNR
Patricia Cicero, Jefferson County LWCD
Paul Dearlove, Lake Ripley Mgmt. Dist.

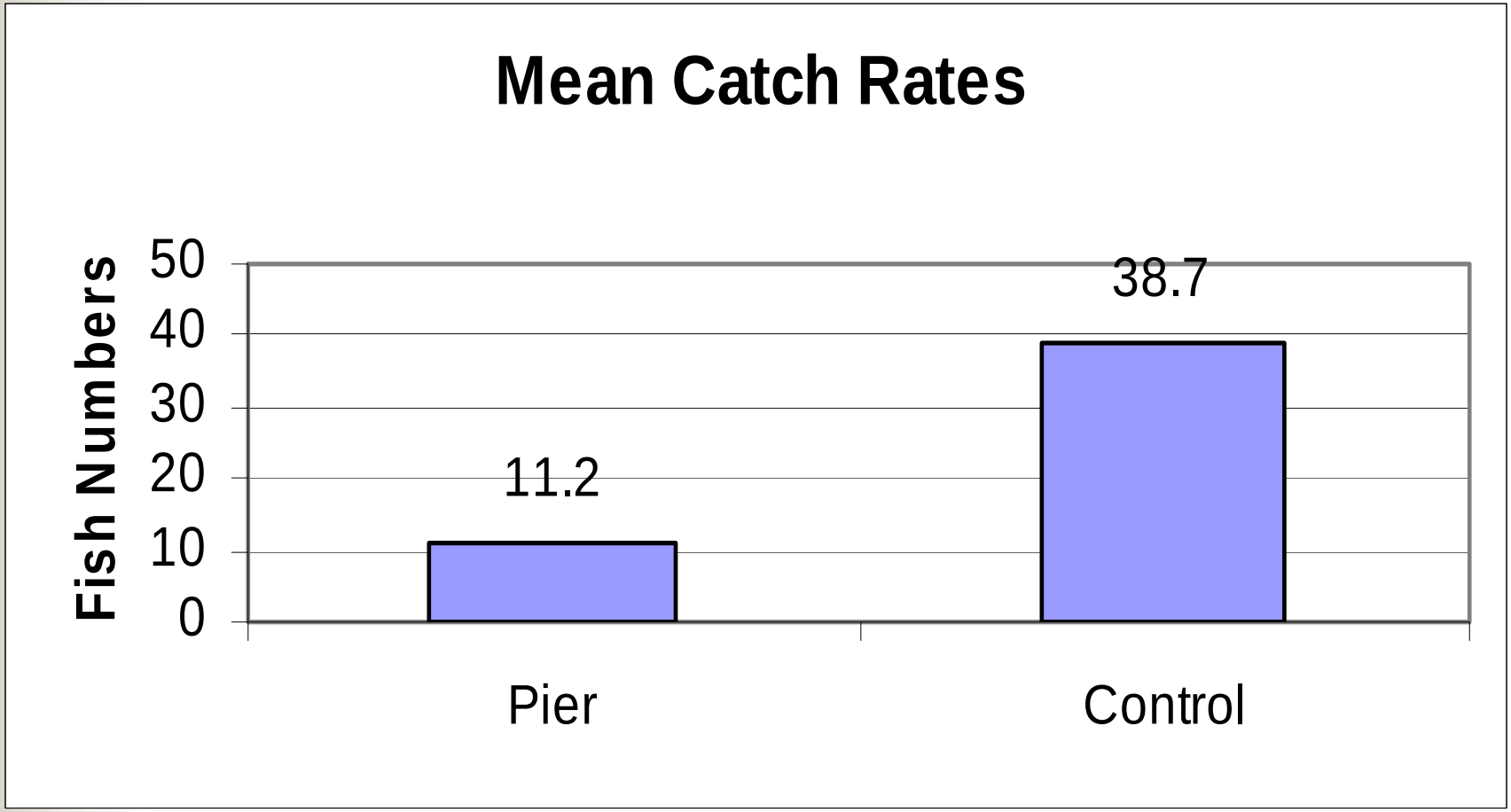


Ecological Effects of Piers on Aquatic Plants





Ecological Effects of Piers on Fish



Habitat Changes With Lakeshore Development

Shrub layer at lake-forest edge

Bank cover

Snag trees

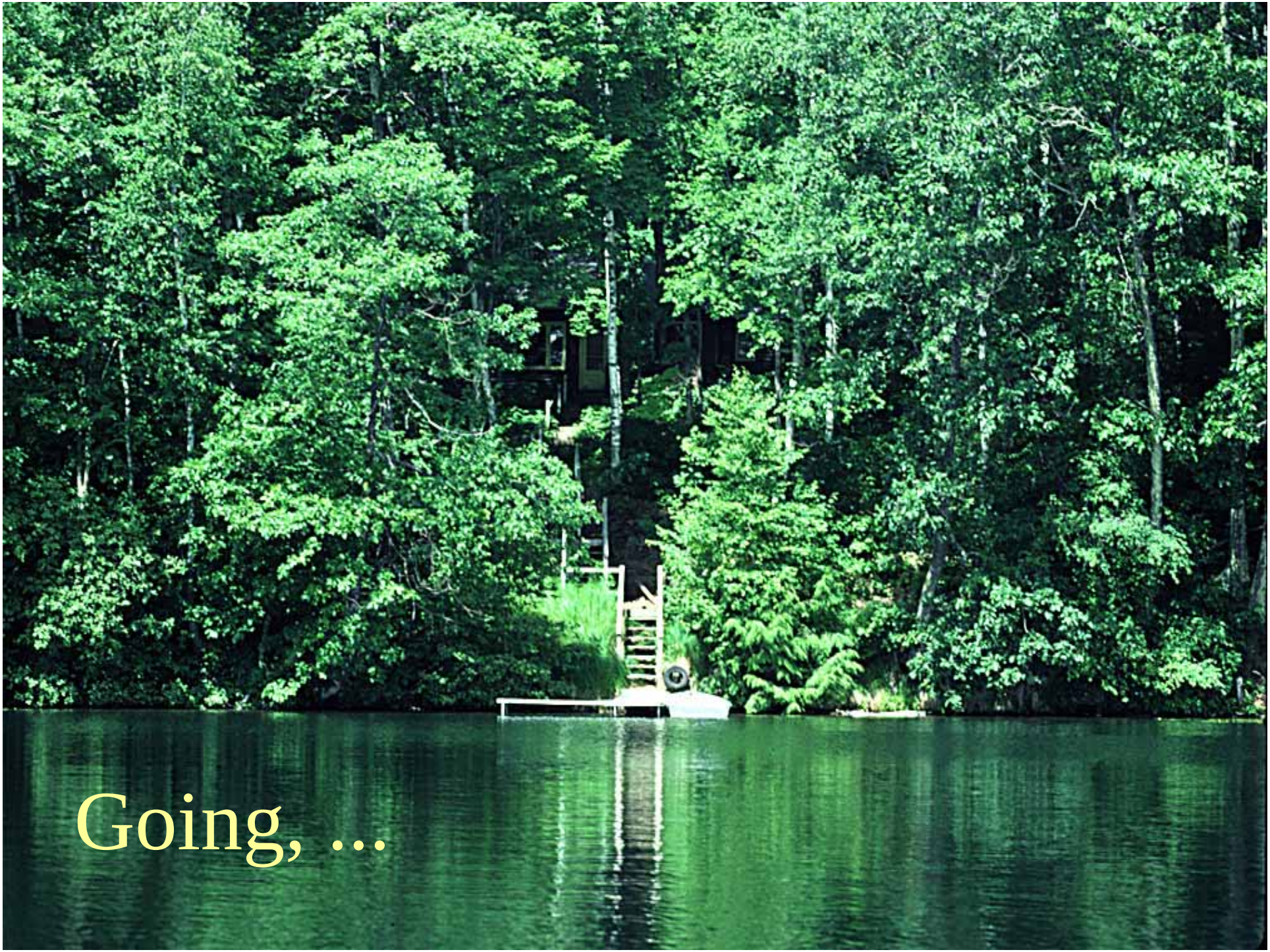
Woody cover & tree-falls in the nearshore

Subcanopy layers at lake-forest edge

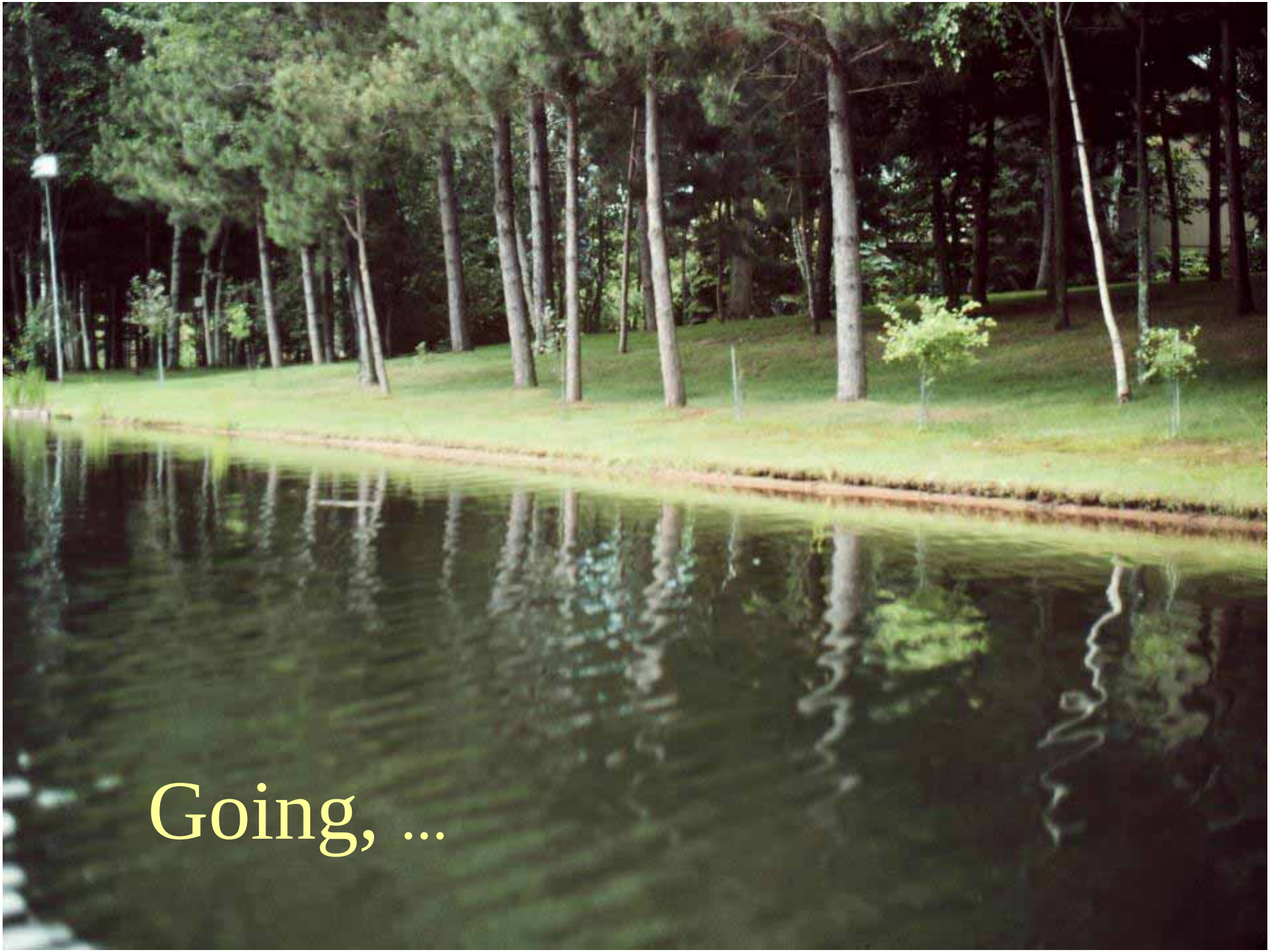
Emergent and floating leafed plants

Water Quality


Natural Shoreline
Habitat...

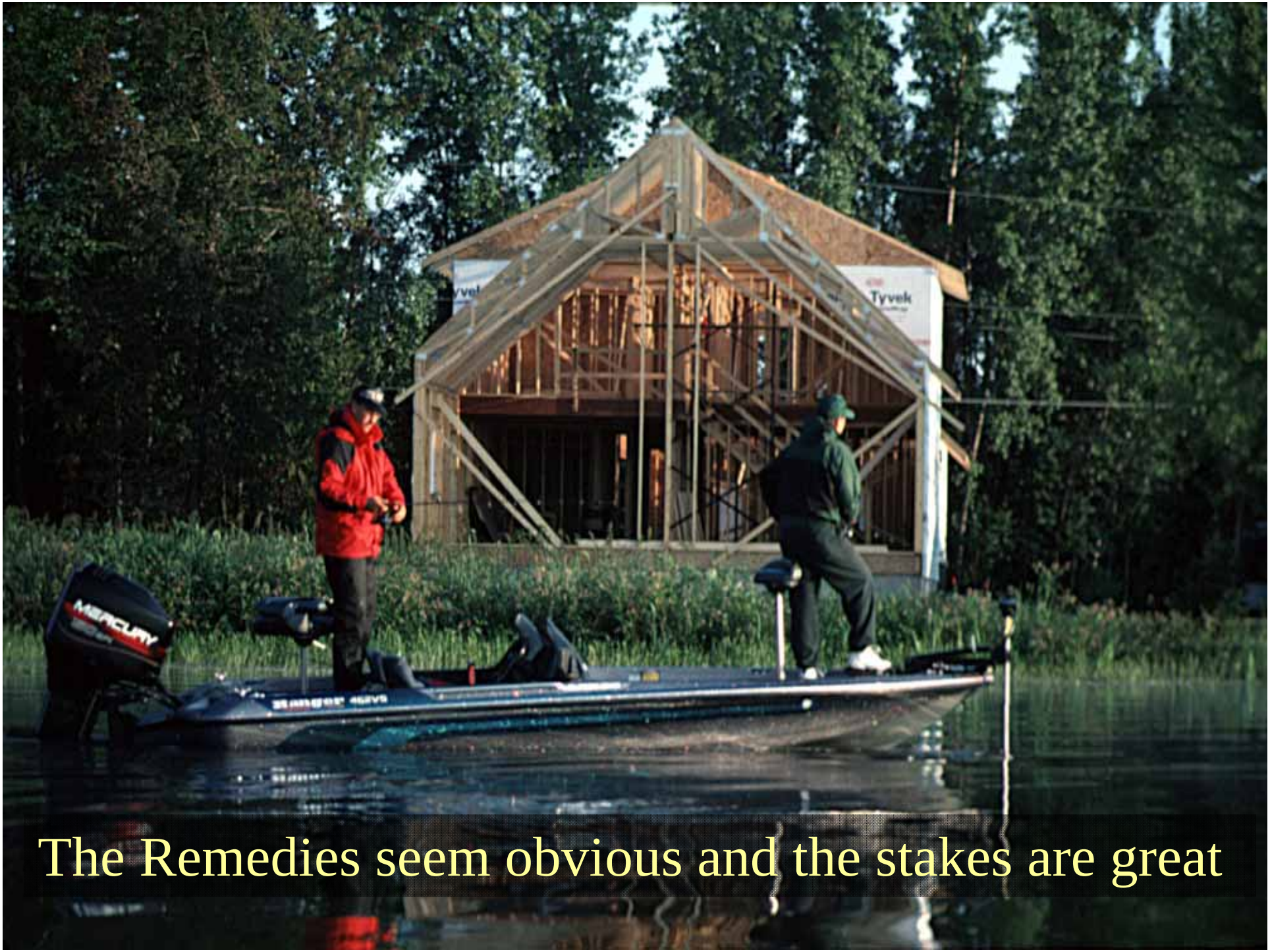

Going, ...


Going, ...

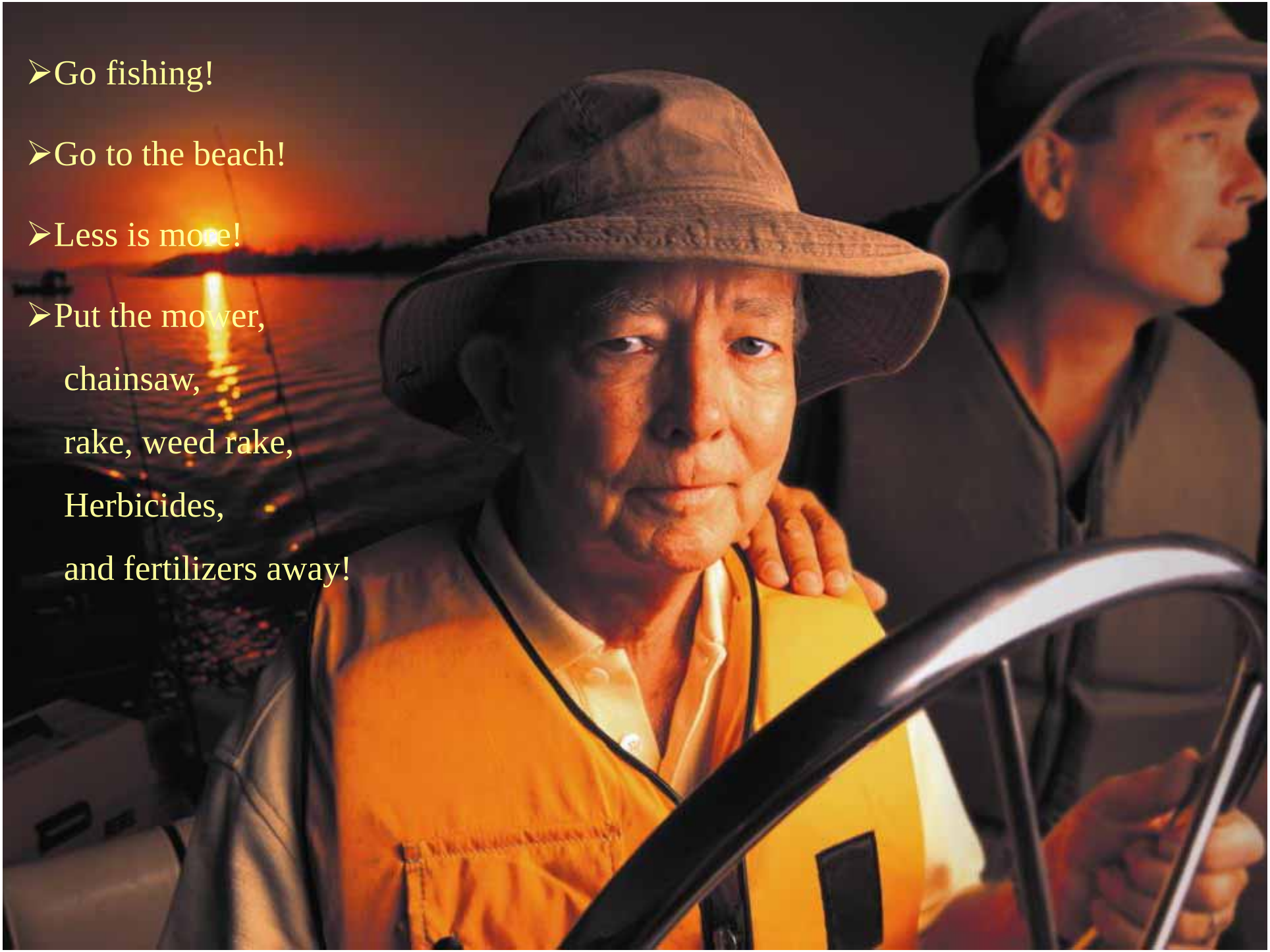

Going, ...


Gone…….


Well it Doesn't Have
to Be That Way!



The Remedies seem obvious and the stakes are great


➢Go fishing!
➢Go to the beach!
➢Less is more!
➢Put the mower,
chainsaw,
rake, weed rake,
Herbicides,
and fertilizers away!