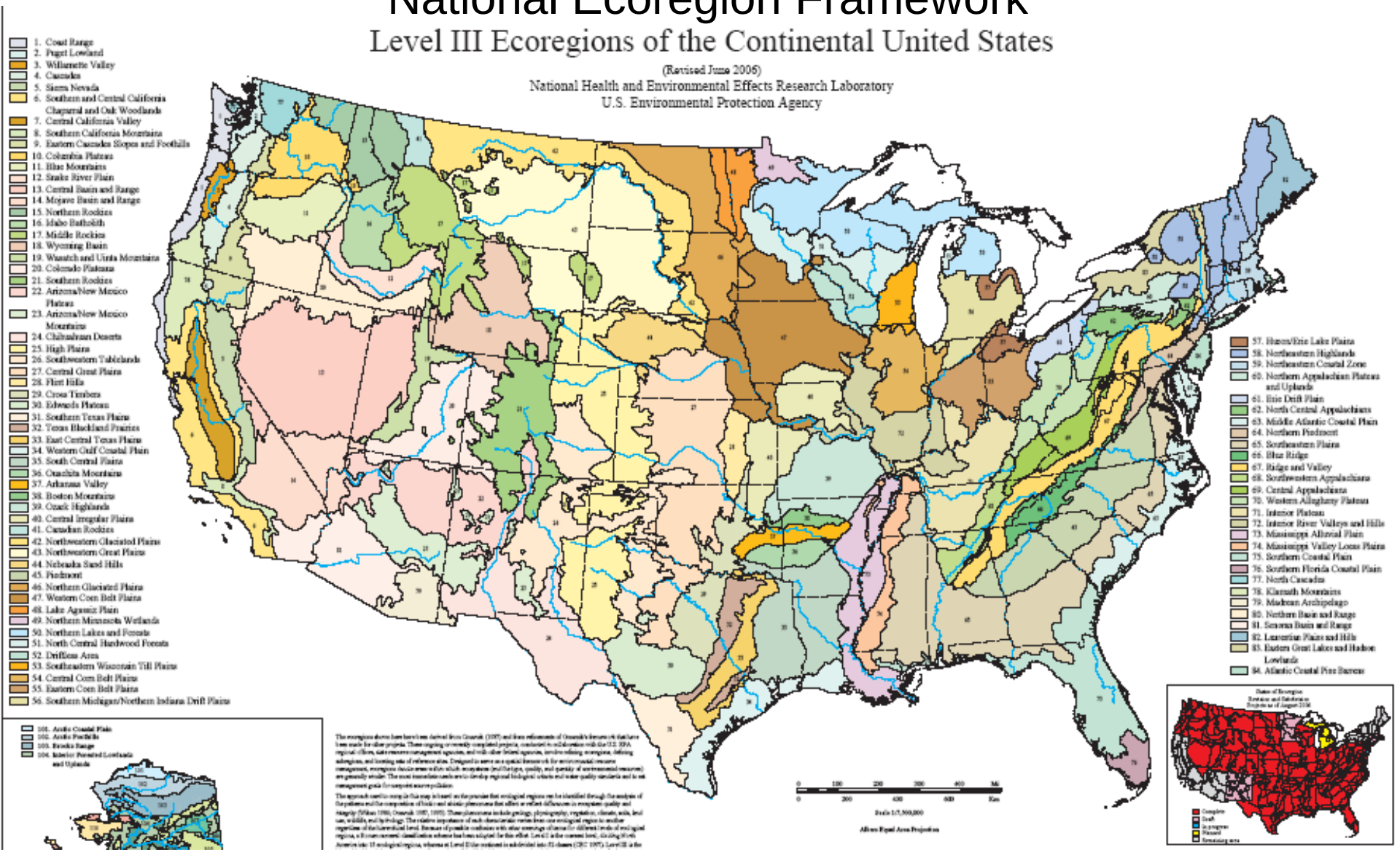
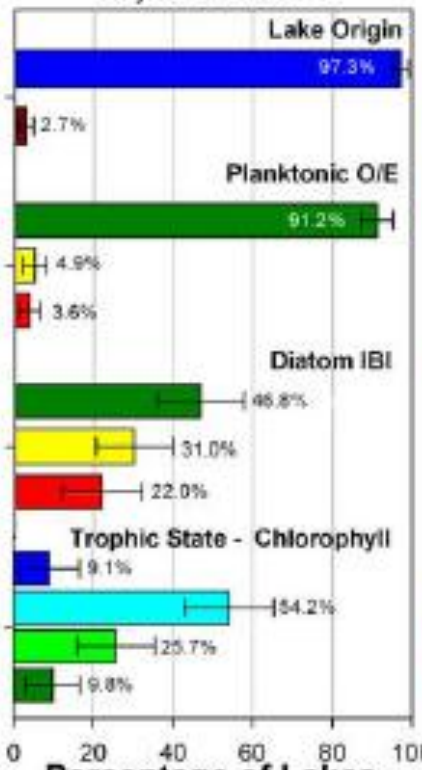
Nearshore Fish and Wildlife Habitat: Human Impacts, Obvious Remedies, Difficult Choices

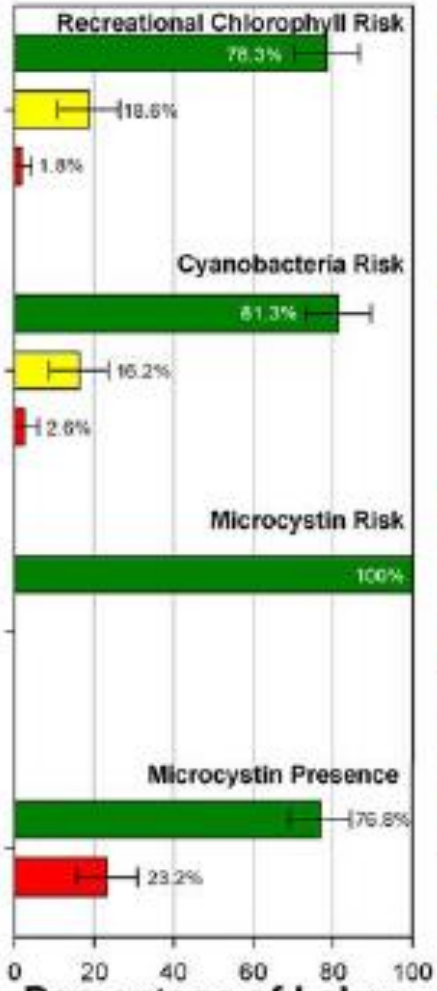
Paul Cunningham
Bureau of Fisheries Management

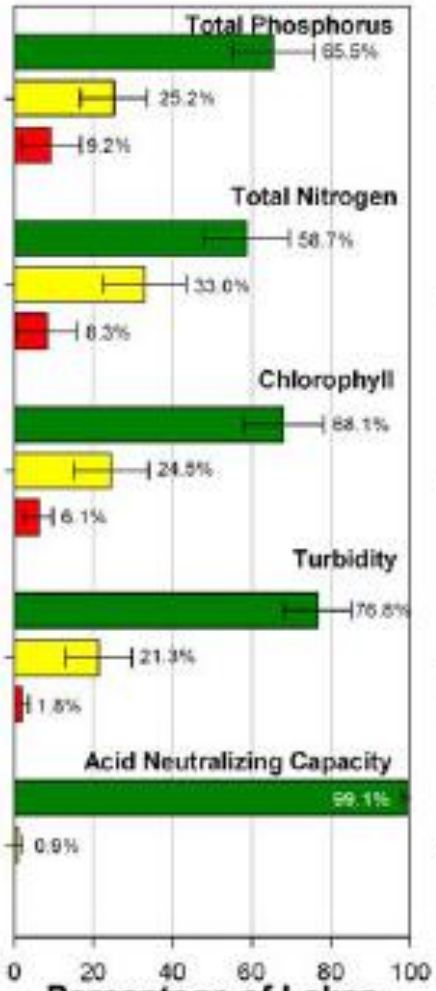
National Ecoregion Framework

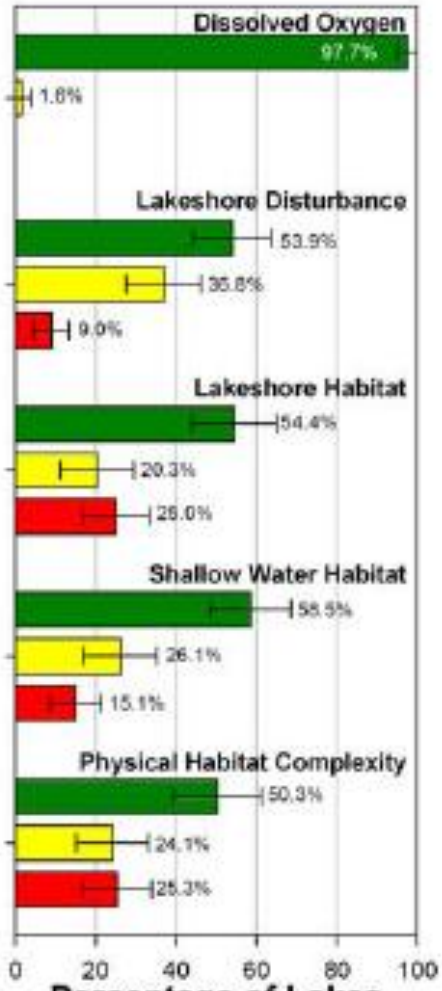


Upper Midwest
15,562 Lakes





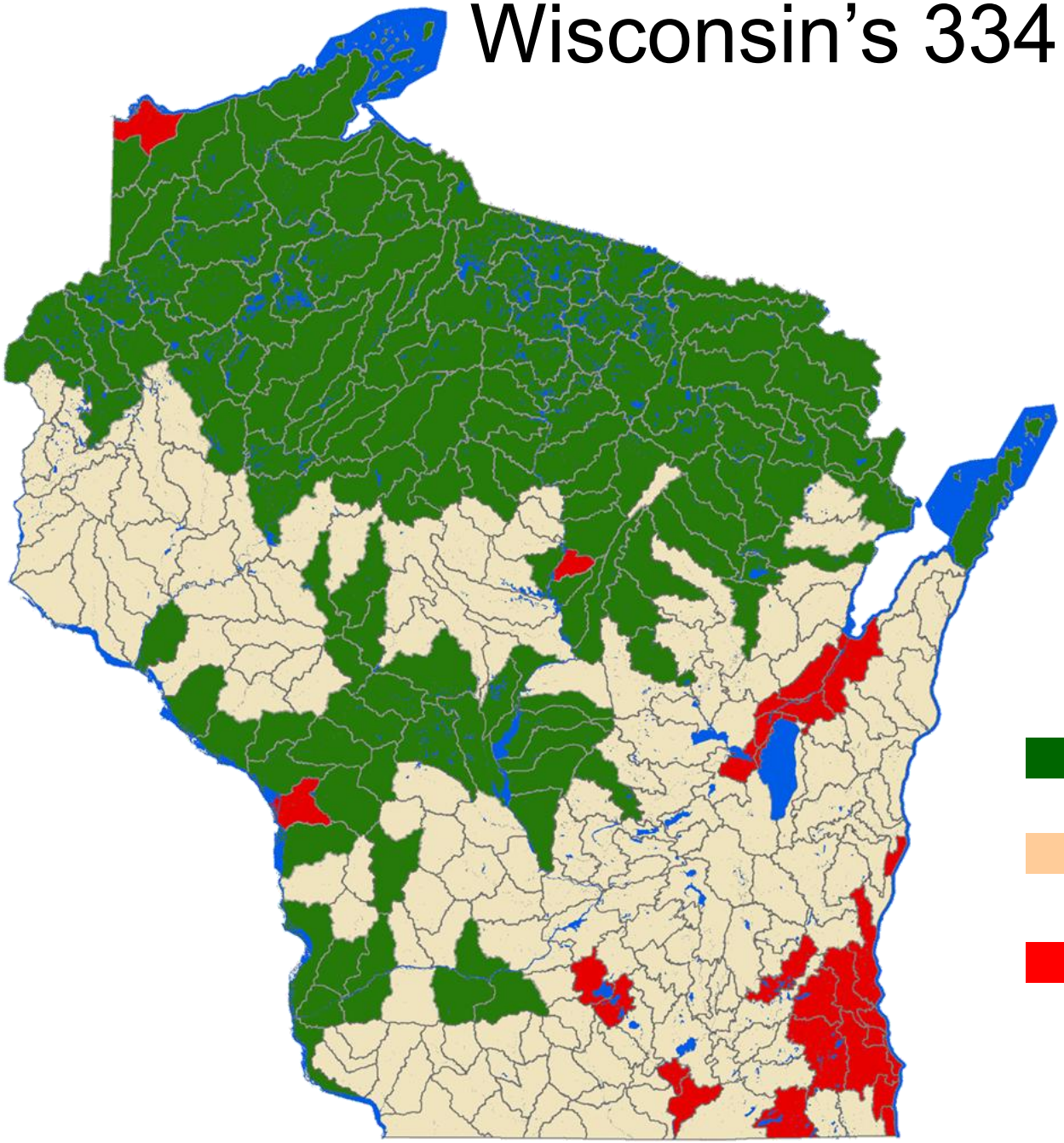




Wisconsin's Ecoregions

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

Wisconsin's 334 Watersheds

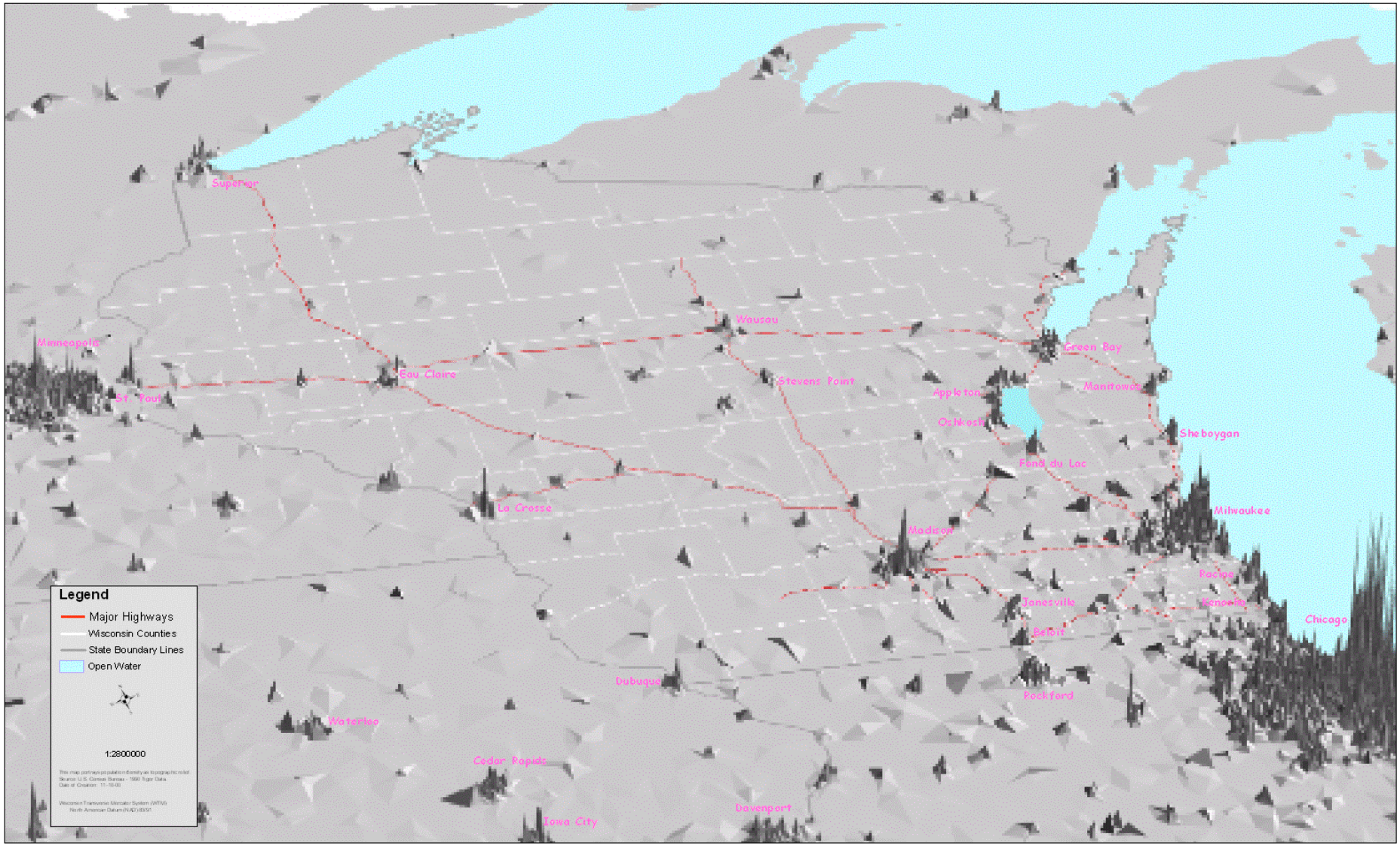


Forested, < 8% Urban and < 50 % Agriculture

Agriculture, > 50 Ag.

Urban, > 8% Urban.

A 3-dimensional view of population density, 1990.



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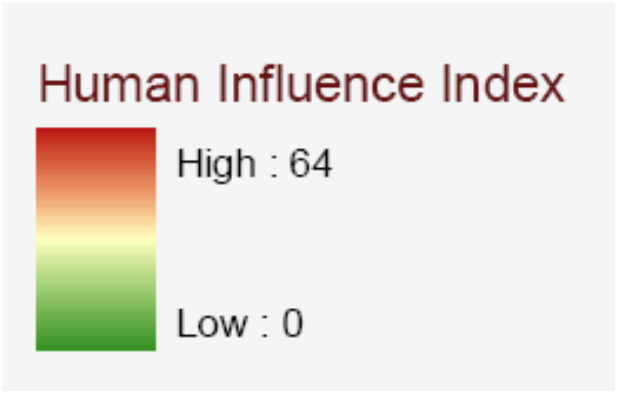
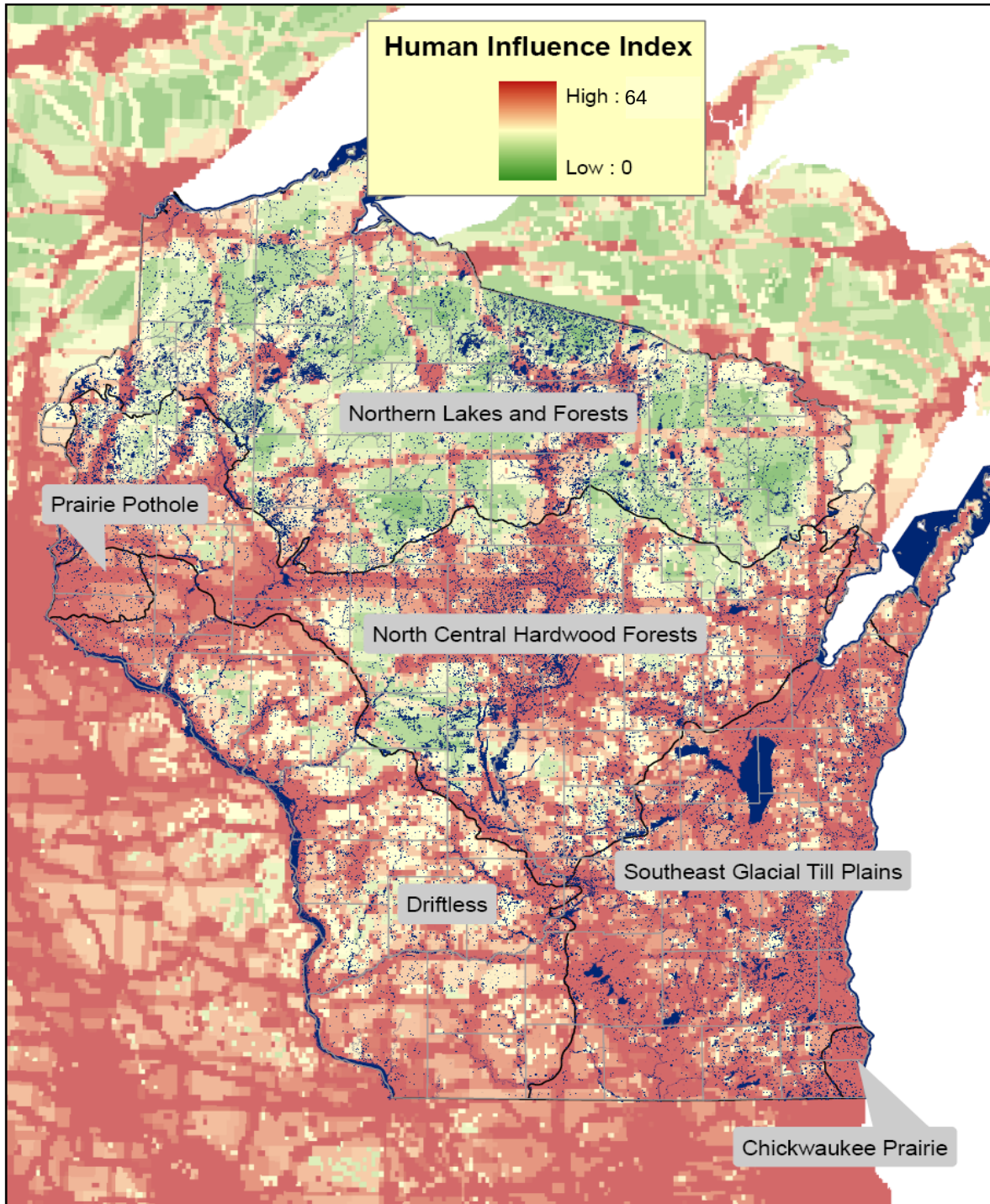
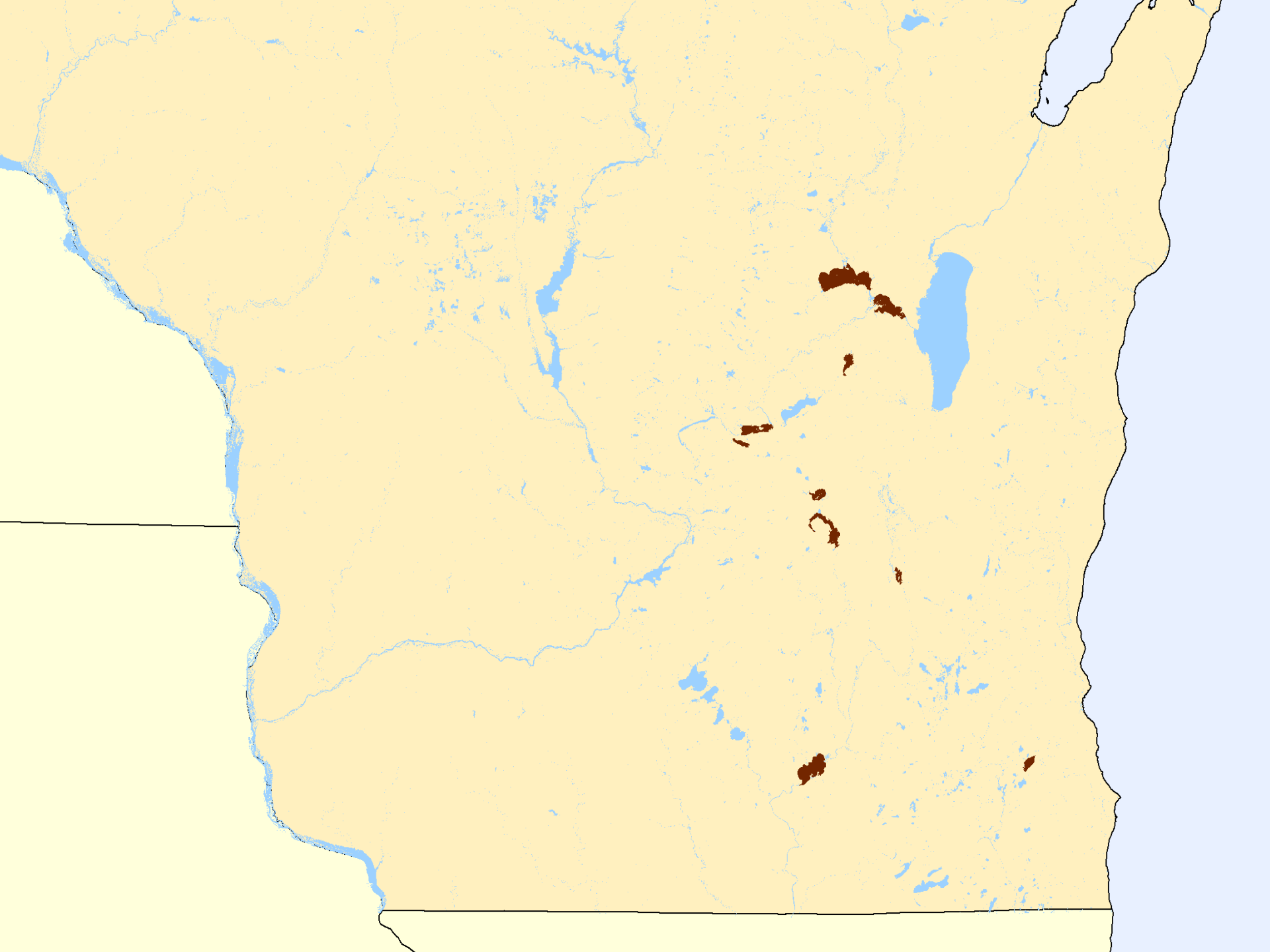


The Human Influence Index

The Human Influence Index (HII) is a measure of direct human influence on terrestrial ecosystems using the best available data sets on human settlement (population density, built-up areas), access (roads, railroads, navigable rivers, coastline), landscape transformation (land use/land cover) and electric power infrastructure (nighttime lights). HII values range from 0 to 64. Zero value represents no human influence and 64 represents maximum human influence possible using all 8 measures of human presence.

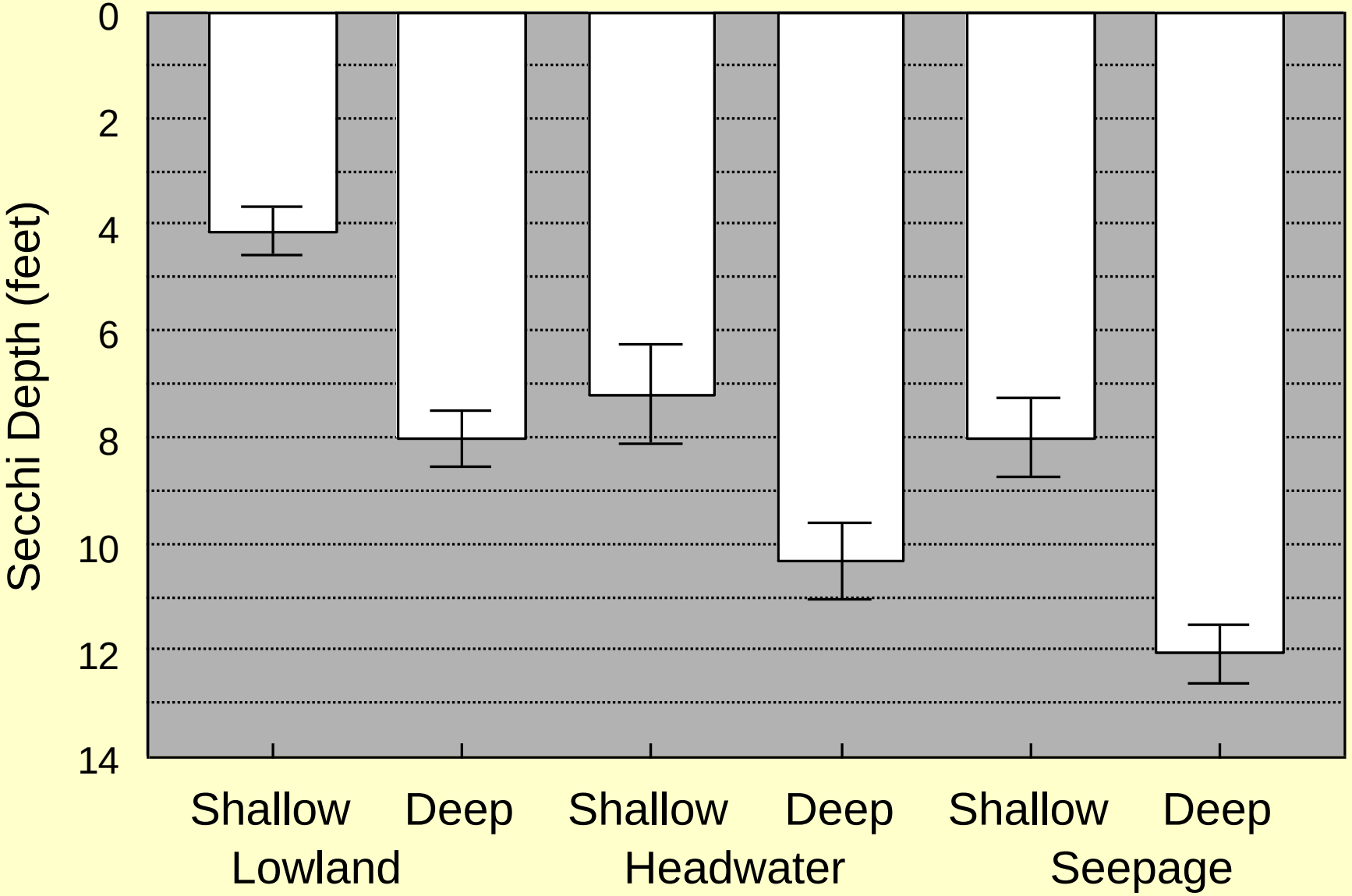




Context is Critical

Summer Secchi Depth

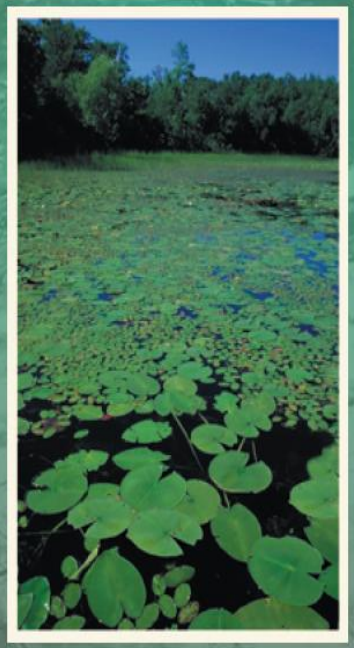
Mean and 95% Confidence Interval (n=920)



Shallow Lakes

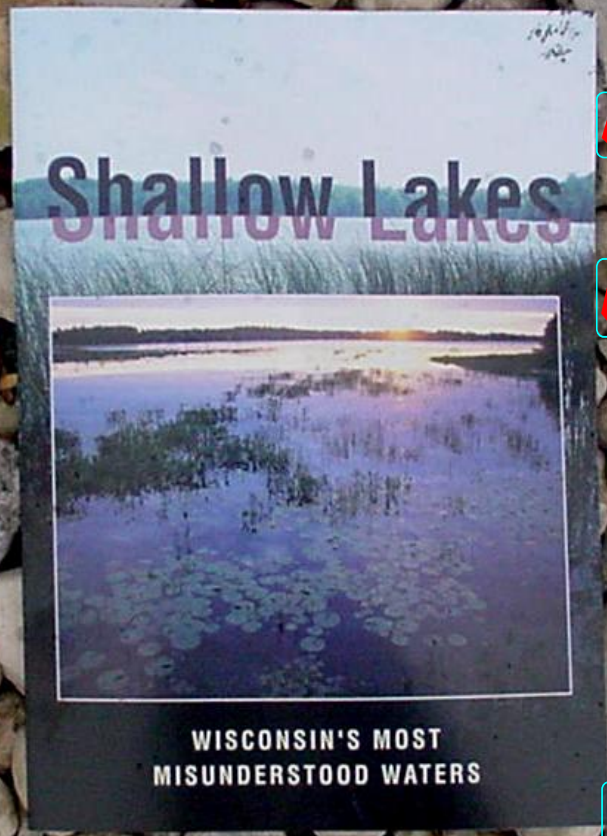
WISCONSIN'S MOST
MISUNDERSTOOD WATERS

Shallow LAKES



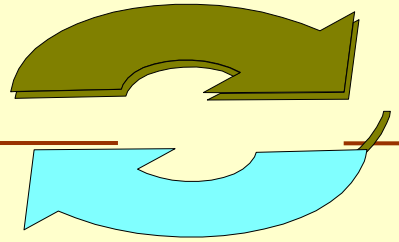
Hope for Minnesota's Troubled Waters

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**

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

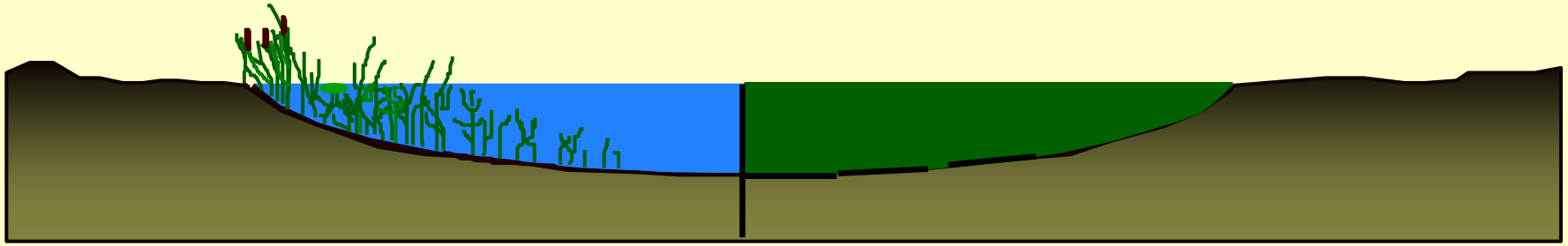
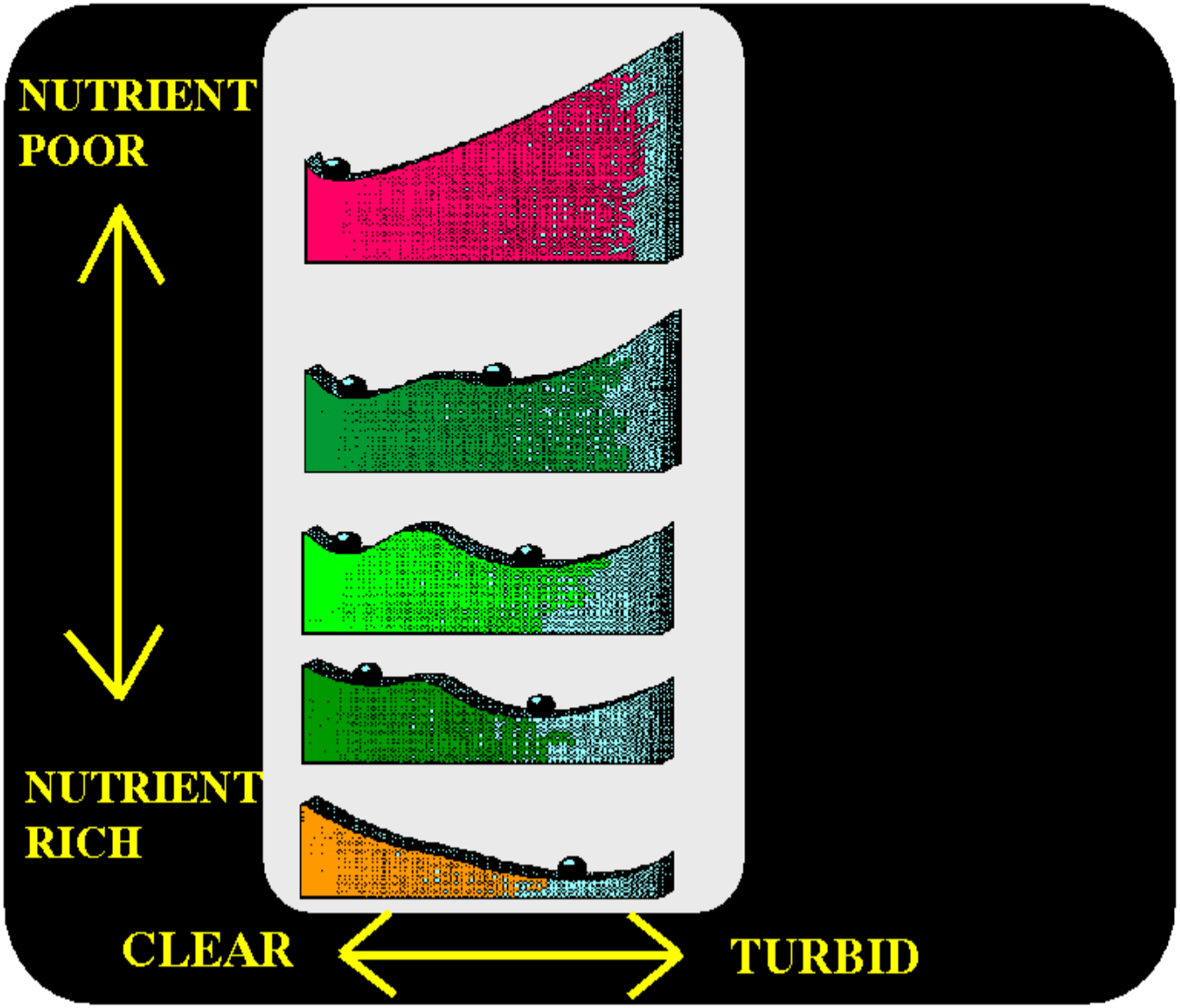



Photo Courtesy of MNDNR

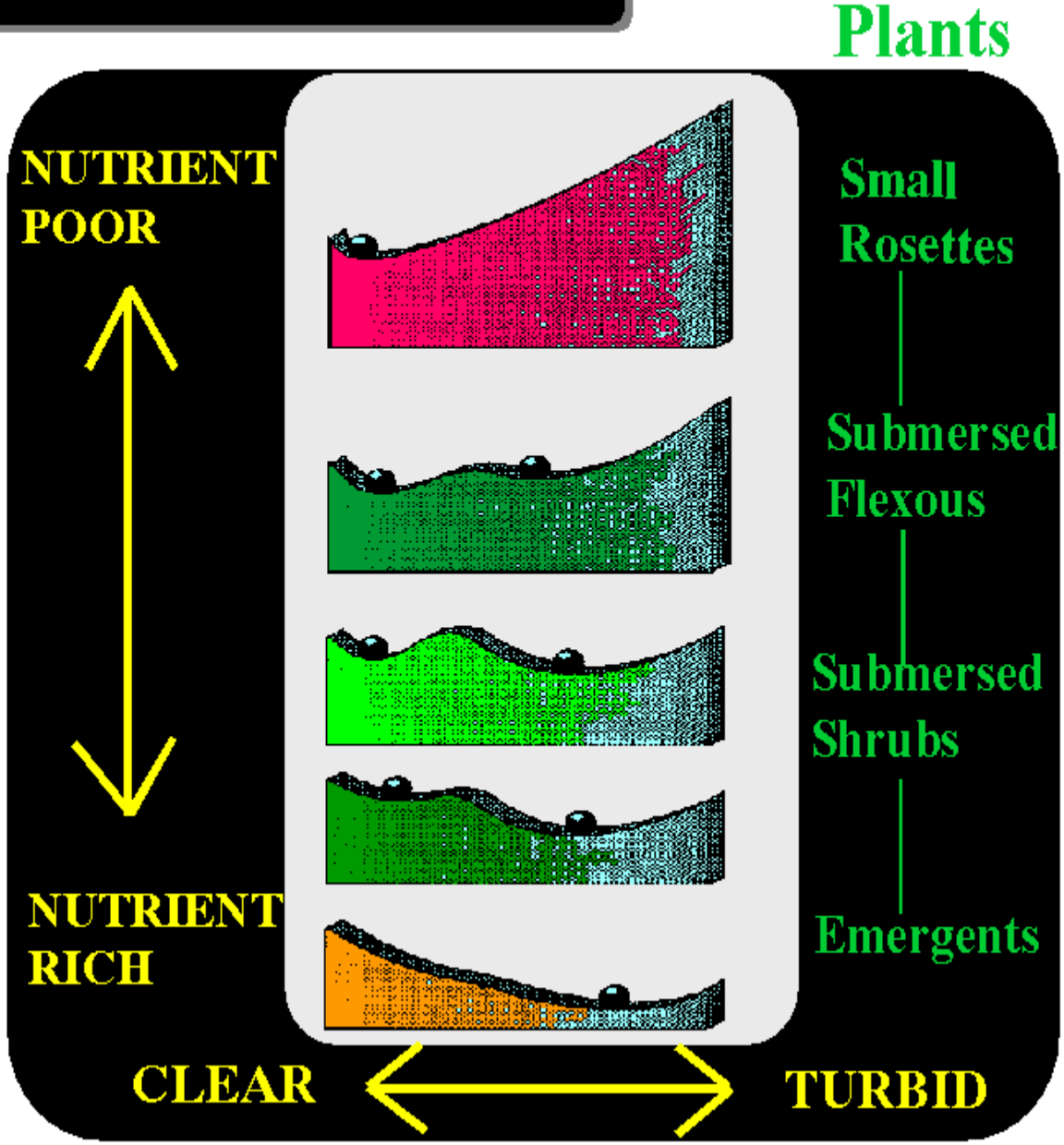
Shallow Lake Ecology

(From Scheffer et al. 1993)



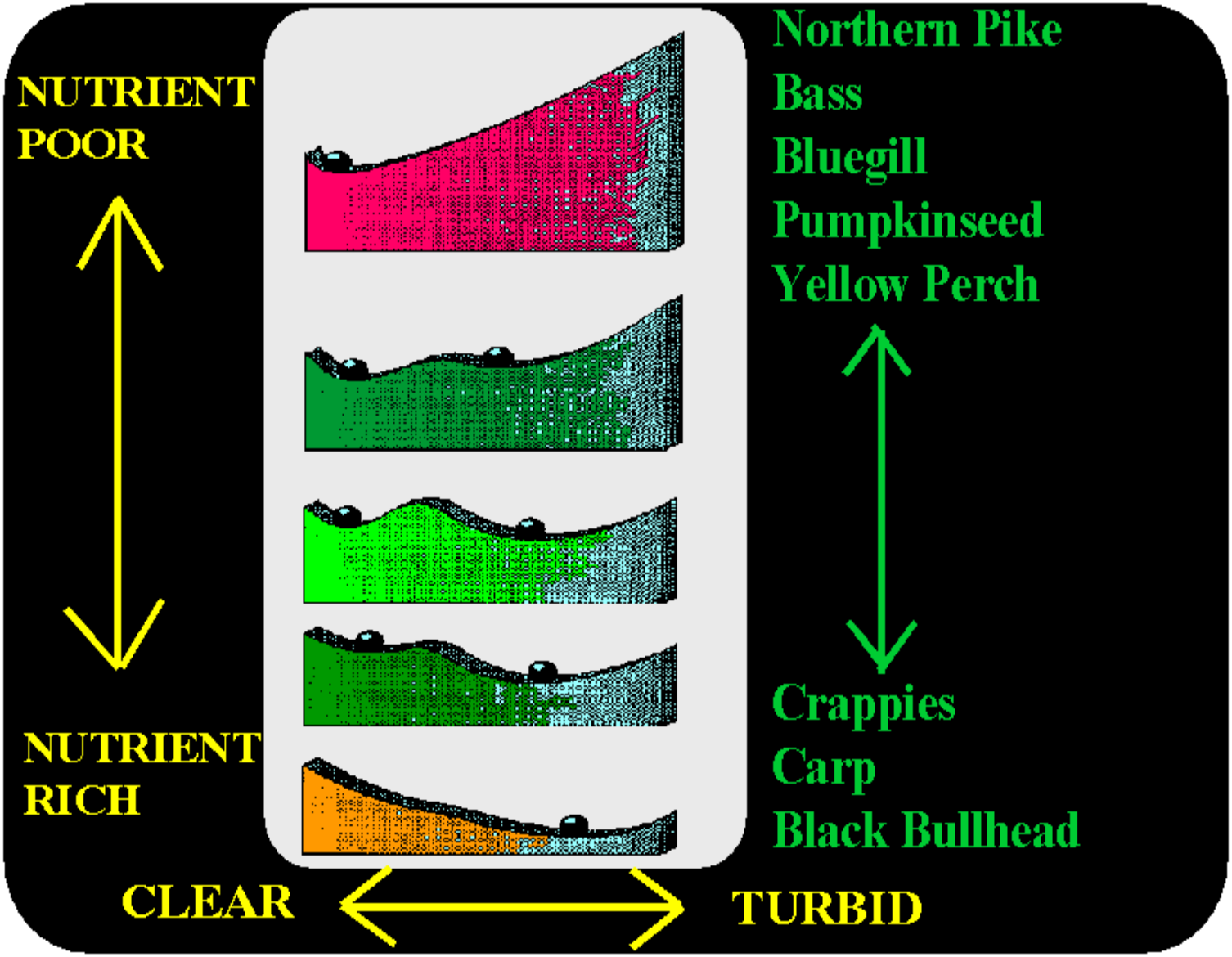
Shallow Lake Ecology

(From Scheffer et al. 1993)



Shallow Lake Ecology

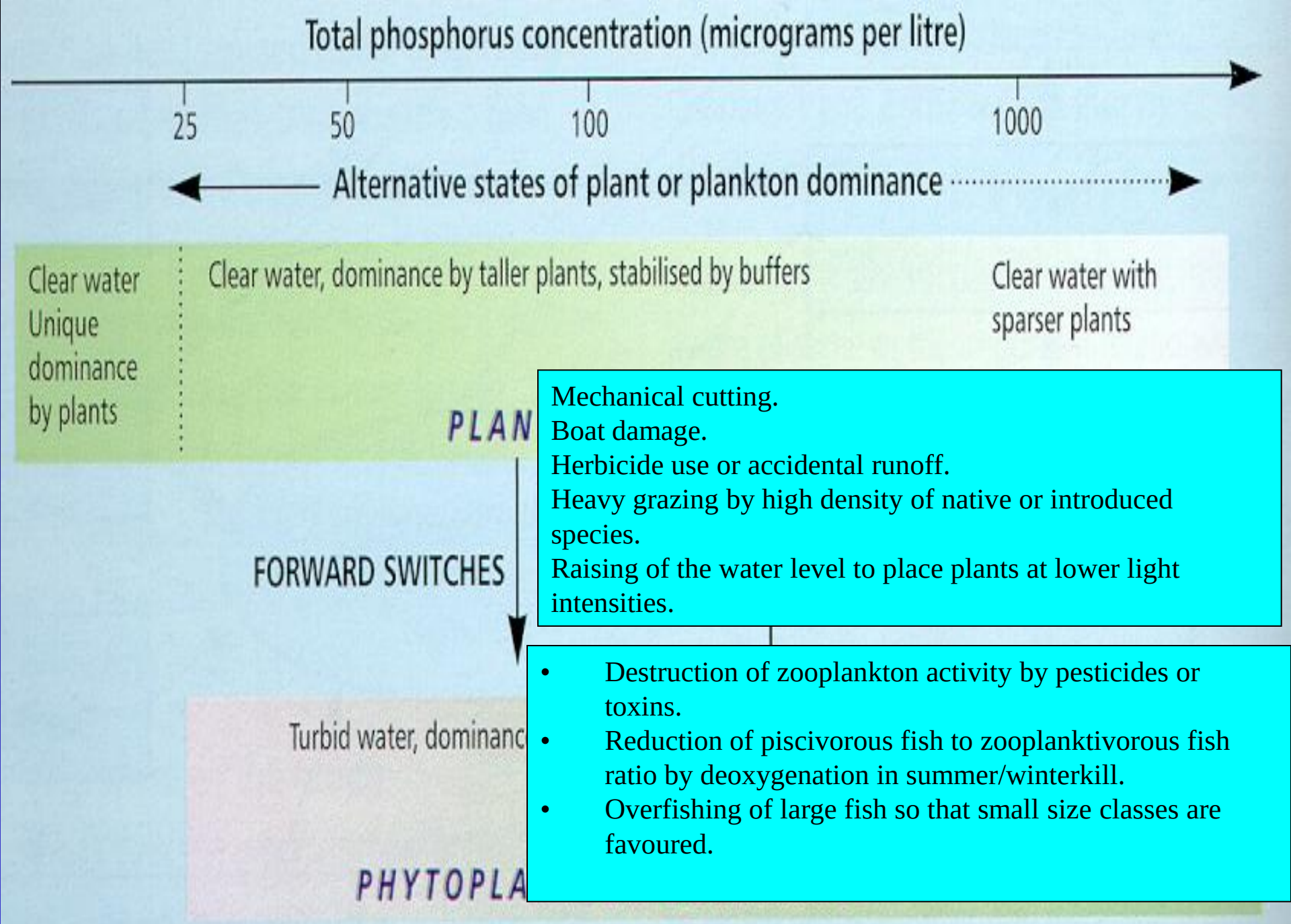
(From Scheffer et al. 1993)



Thresholds

Bioturbation

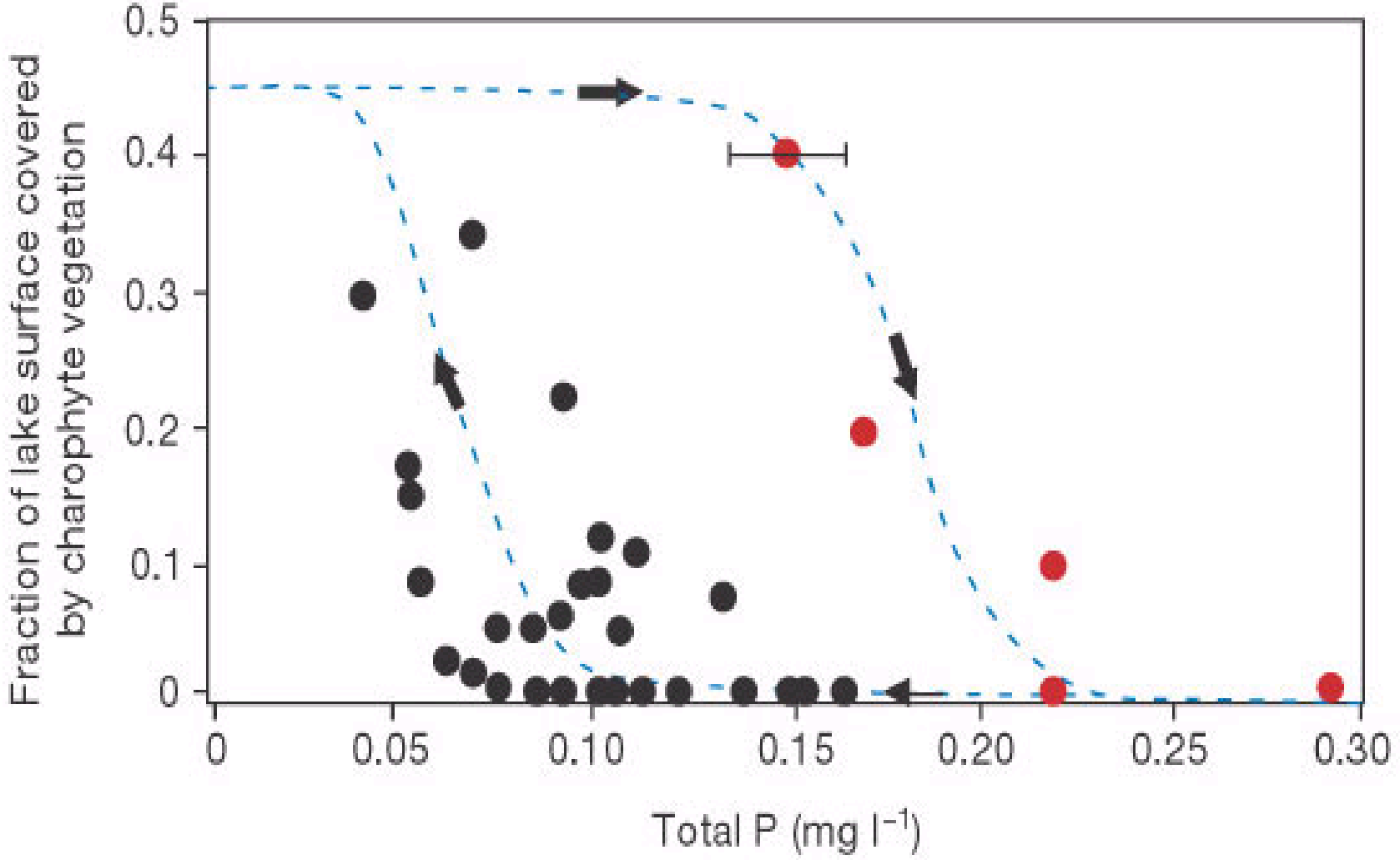
Photo: Mike DeVries, The Capital Times, 5 July 2007



Mechanical cutting.
Boat damage.
Herbicide use or accidental runoff.
Heavy grazing by high density of native or introduced species.
Raising of the water level to place plants at lower light intensities.

- Destruction of zooplankton activity by pesticides or toxins.
- Reduction of piscivorous fish to zooplanktivorous fish ratio by deoxygenation in summer/winterkill.
- Overfishing of large fish so that small size classes are favoured.

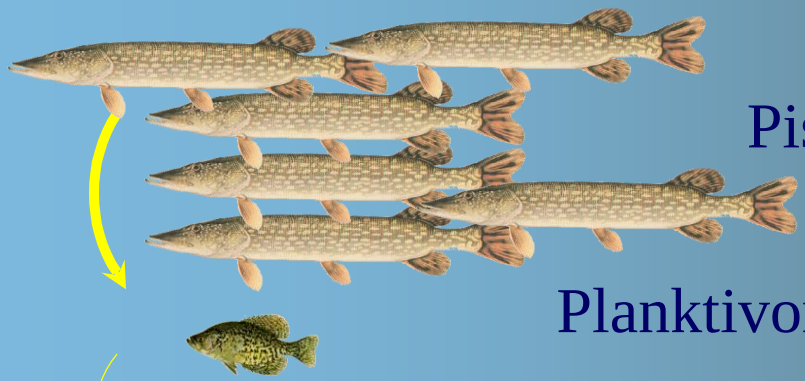
Taken from (Moss et al.



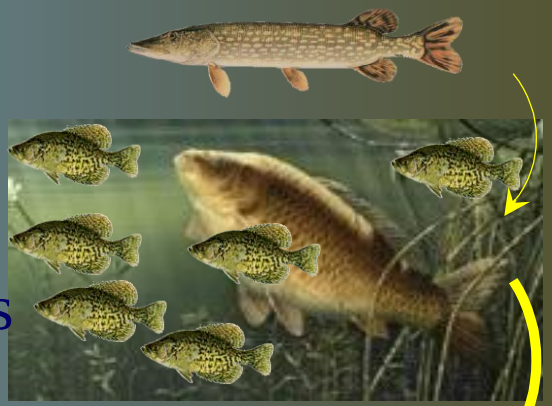
Hysteresis in the response of charophyte vegetation in the shallow Lake Veluwe to increase and subsequent decrease of the phosphorus concentration. Red dots represent years of the forward switch in the late 1960s and early 1970s. Black dots show the effect of gradual reduction of the nutrient loading leading eventually to the backward switch in the 1990s.

Clear-water State

Turbid-water State



Piscivores



Planktivores/Benthivores

Zooplankton grazing

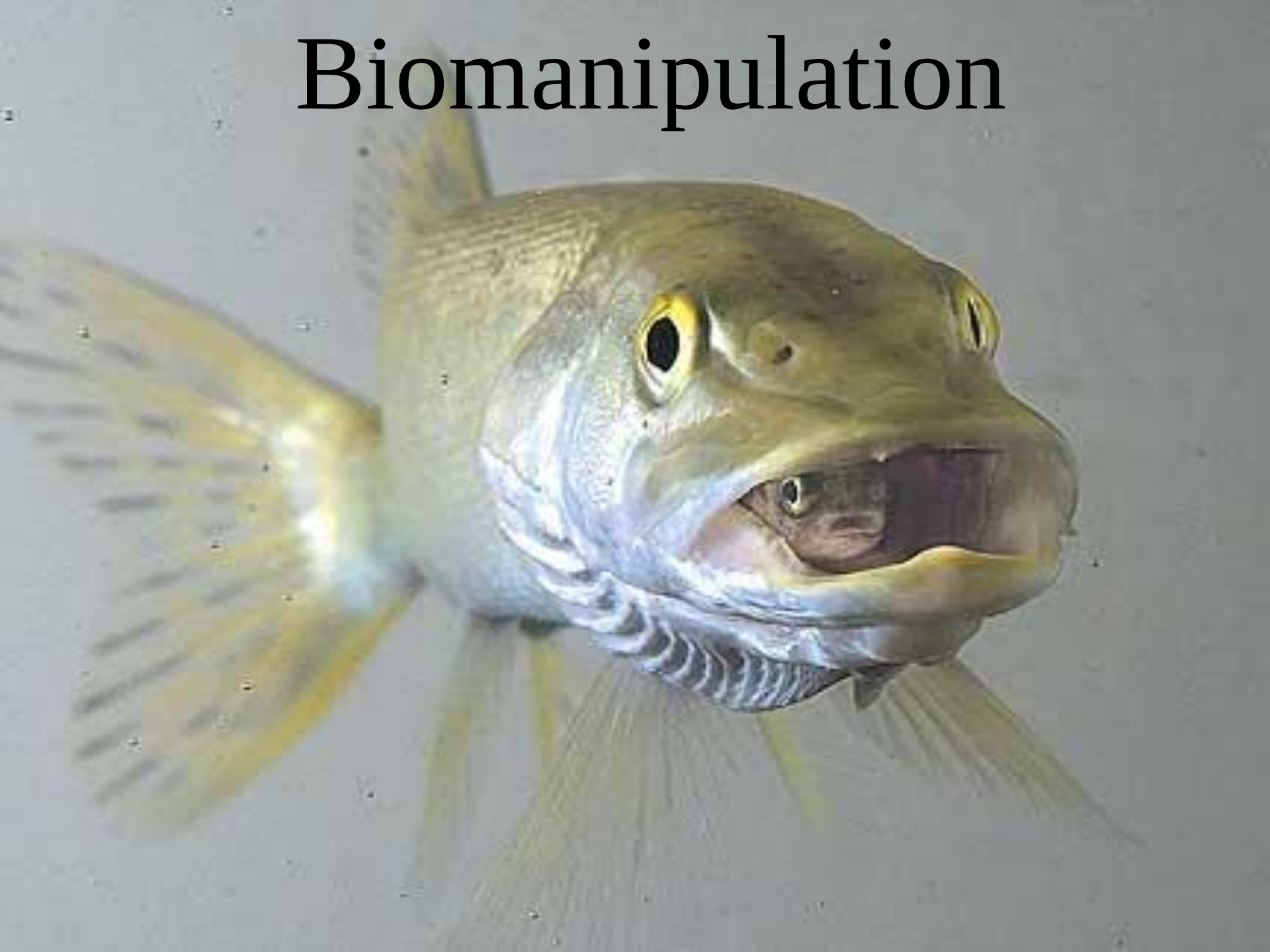
Algae biomass

Aquatic plant biomass

Sediment Resuspension

N. Hansel-Welch & M.B. Butler, 1997

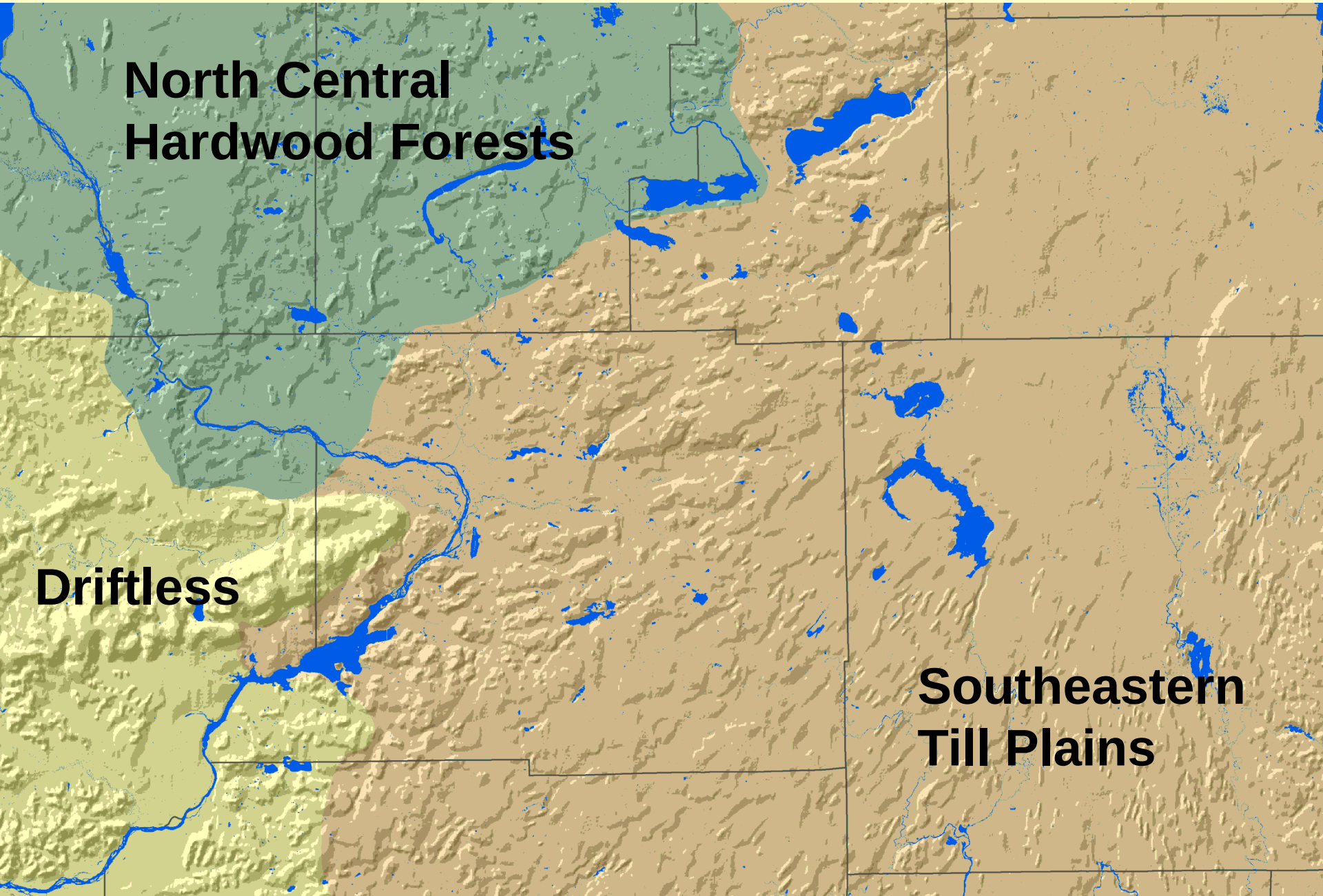
Biomanipulation

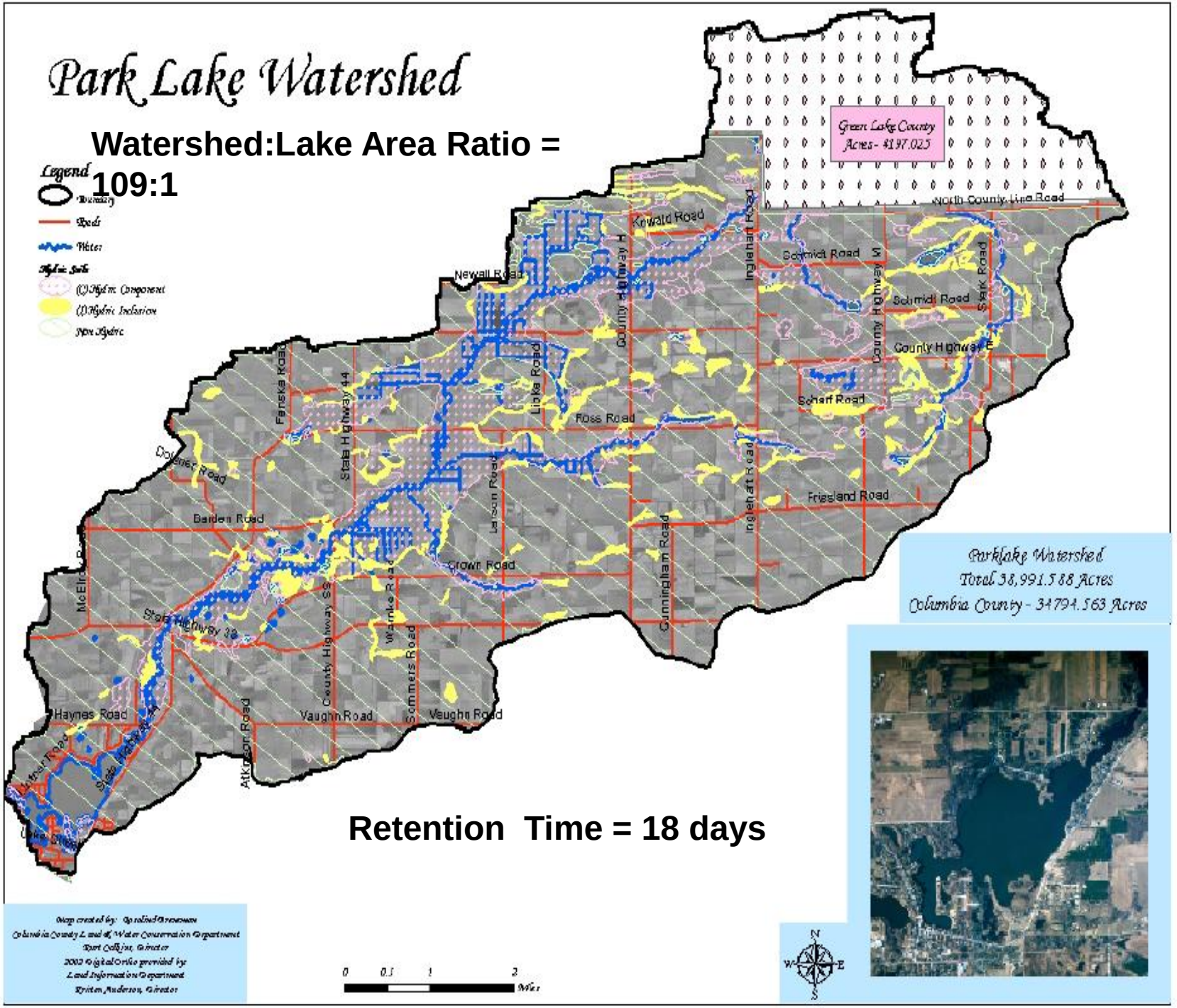


Cladocerans, or water fleas "vacuum" the algae from lake water. When they are abundant, the water is more clear.

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

Park Lake as an Example

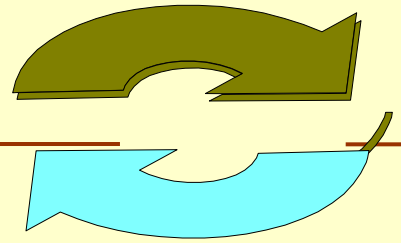



Park Lake Watershed
Watershed:Lake Area Ratio = 109:1
Legend
Boundary
Roads
Water
Hydric Soils
(C)Hydric Component
(I)Hydric Inclusion
Non Hydric
Green Lake County
Acres - 4197.025
North County Line Road
Knwald Road
Newall Road
Inglehart Road
Schmidt Road
County Highway H
County Highway W
Stark Road
County Highway E
Scharf Road
Ross Road
Larson Road
Linka Road
Farska Road
State Highway 44
Dolphey Road
Barden Road
Friesland Road
Cunningham Road
Crown Road
McElroy Road
State Highway 33
County Highway SS
Wanke Road
Sommers Road
Haynes Road
Vaughn Road
Atkinson Road
Parklake Watershed
Total 38,991.588 Acres
Columbia County - 34794.563 Acres
Retention Time = 18 days
0 0.5 1 2
Miles
N
W
E
S

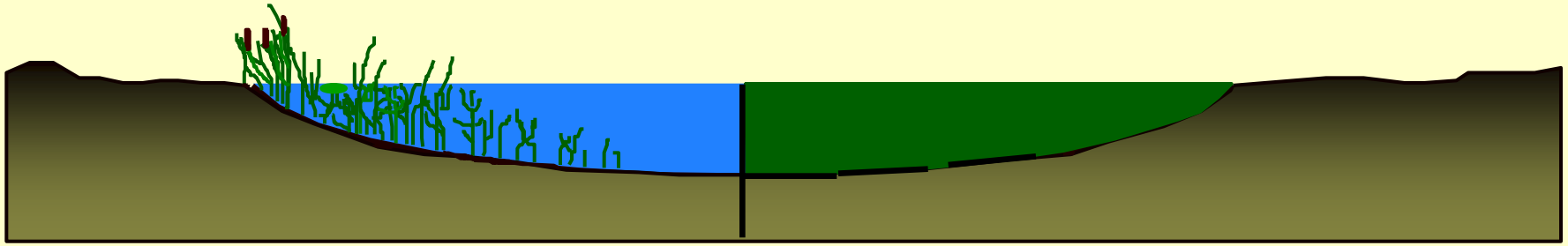
Park Lake as an Example

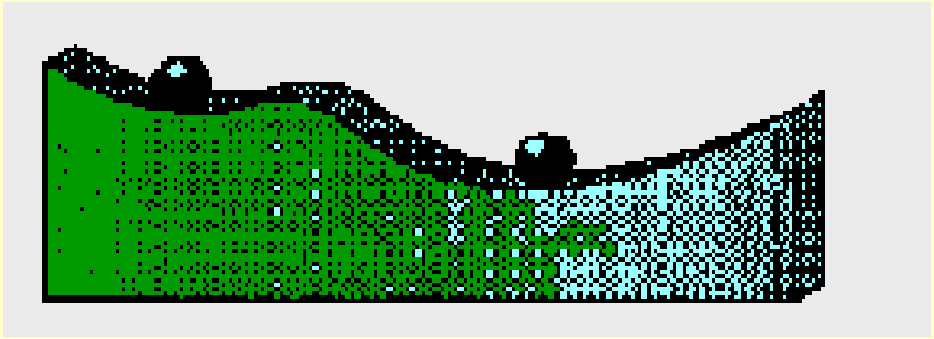
Park Lake

Clear State



Turbid State





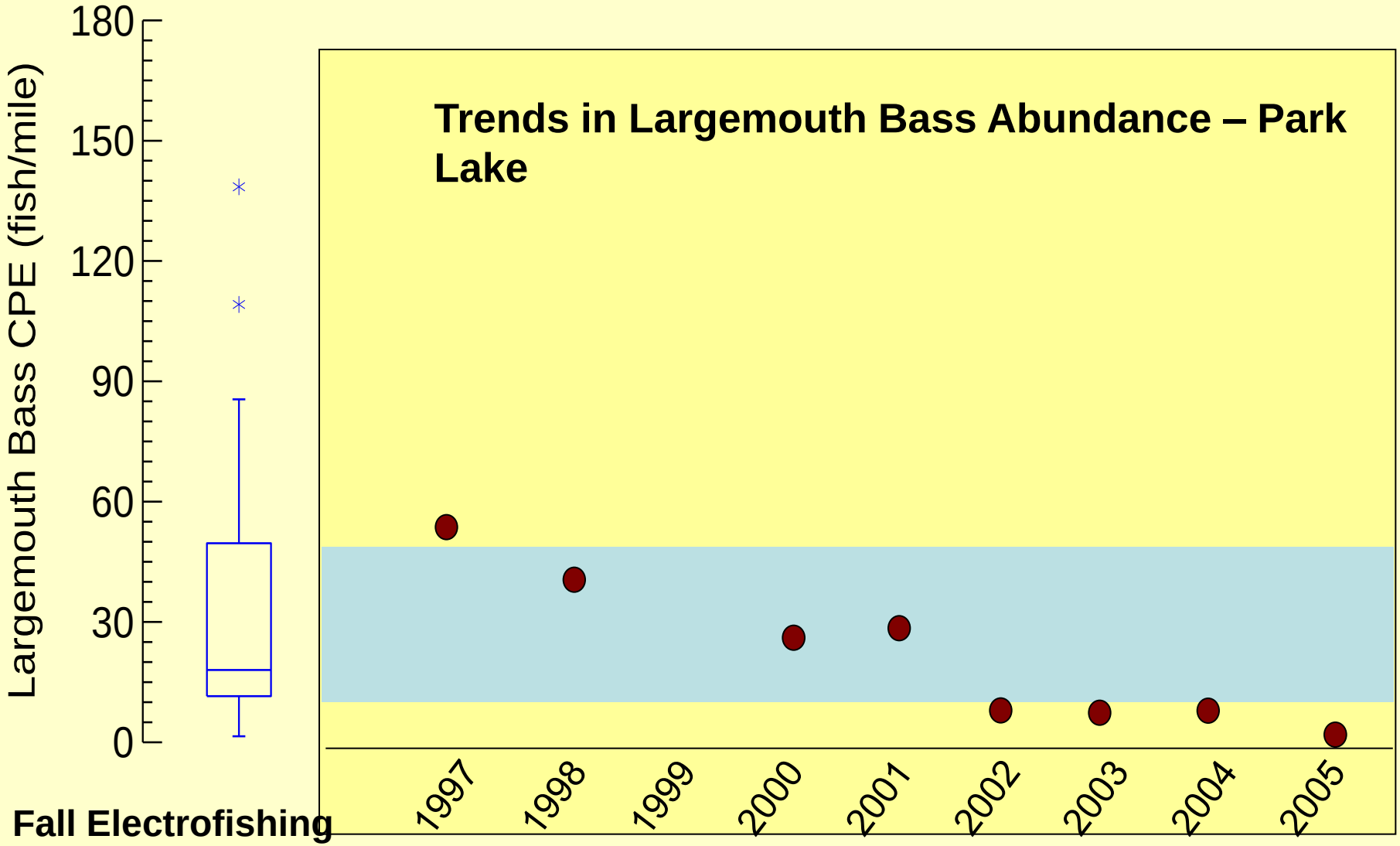
1978, SAV= 11 species

1998, SAV=10 species

2001, SAV=2 species

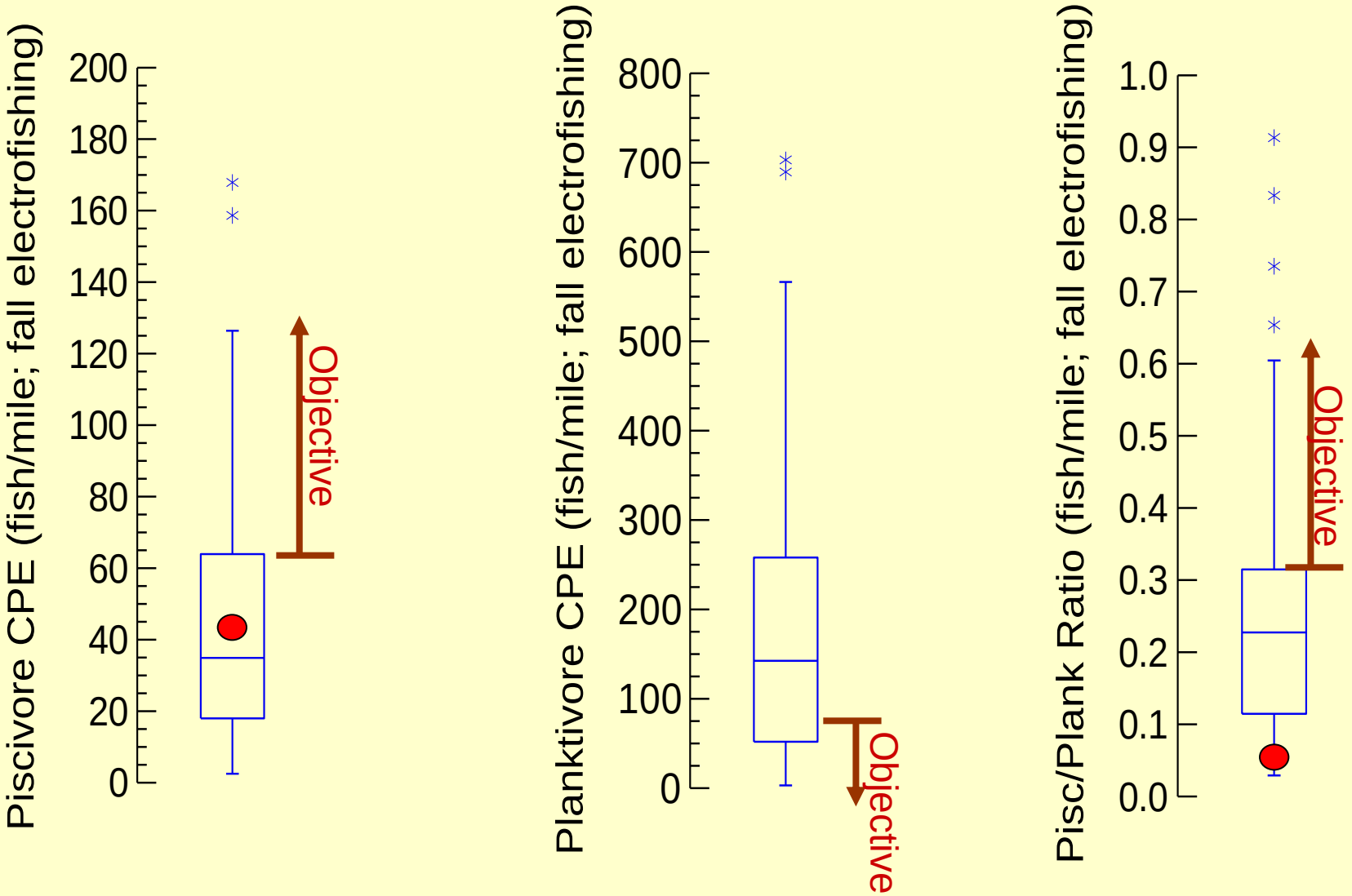
Fish Community: Assessment by Analogy

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**.



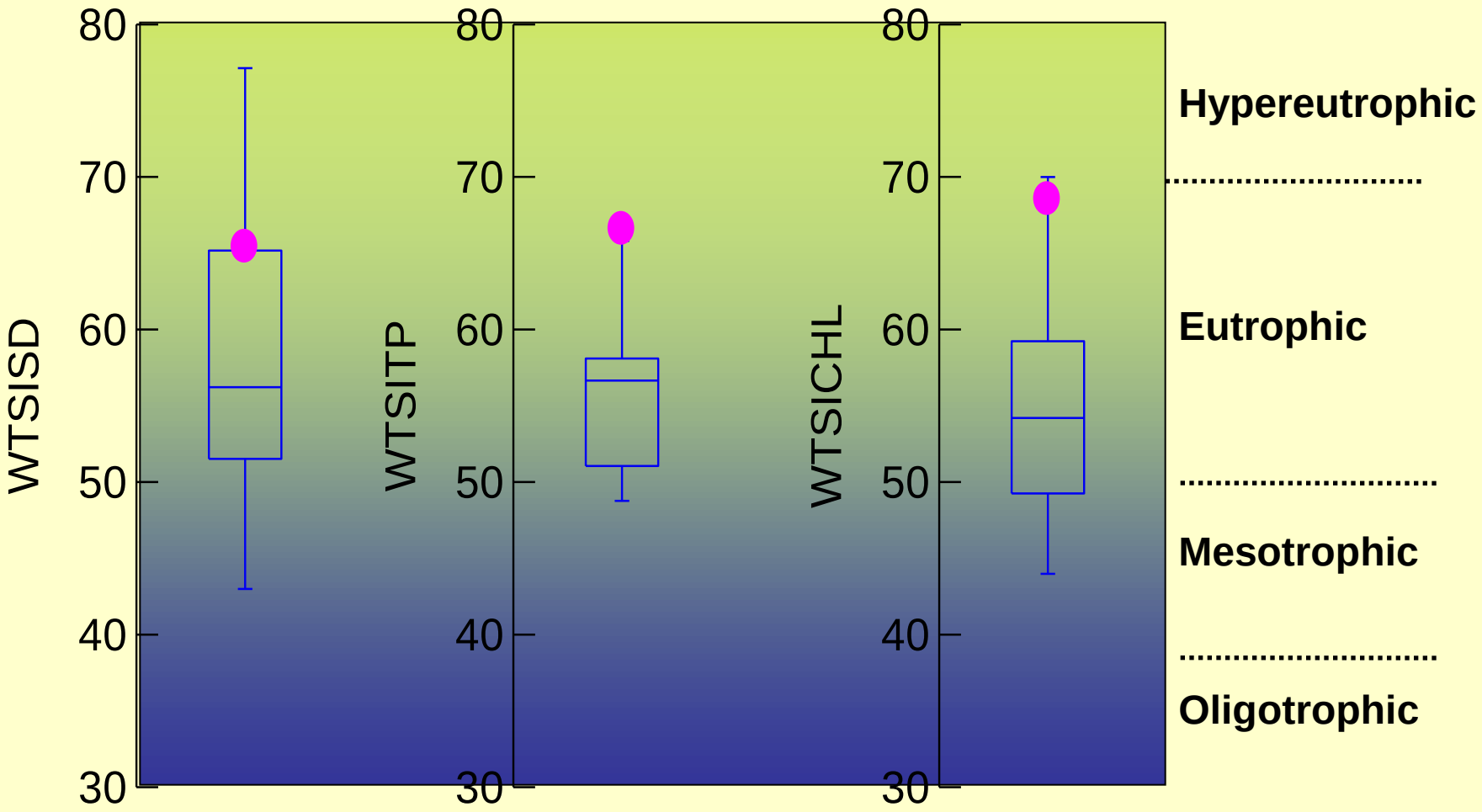
Fall Electrofishing Surveys; 46 Lakes

Fish Community Objectives: Biomanipulation of Park Lake



= Park Lake's Current Condition

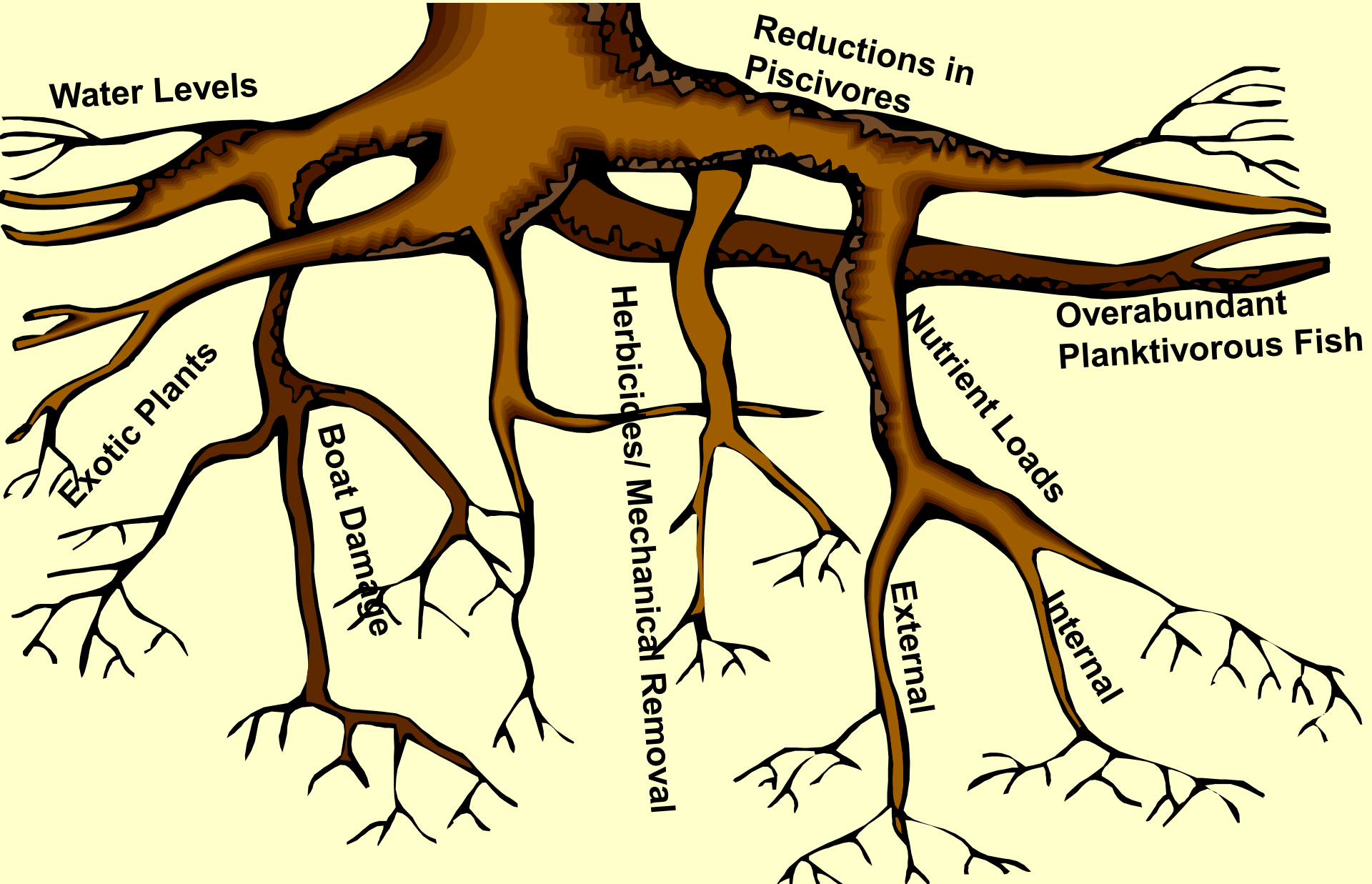
Example: Trophic State Indices



Box plots: Shallow lowland drainage lakes in Southern Wisconsin

2001-2004 (mean) Park Lake TSI values (summer)

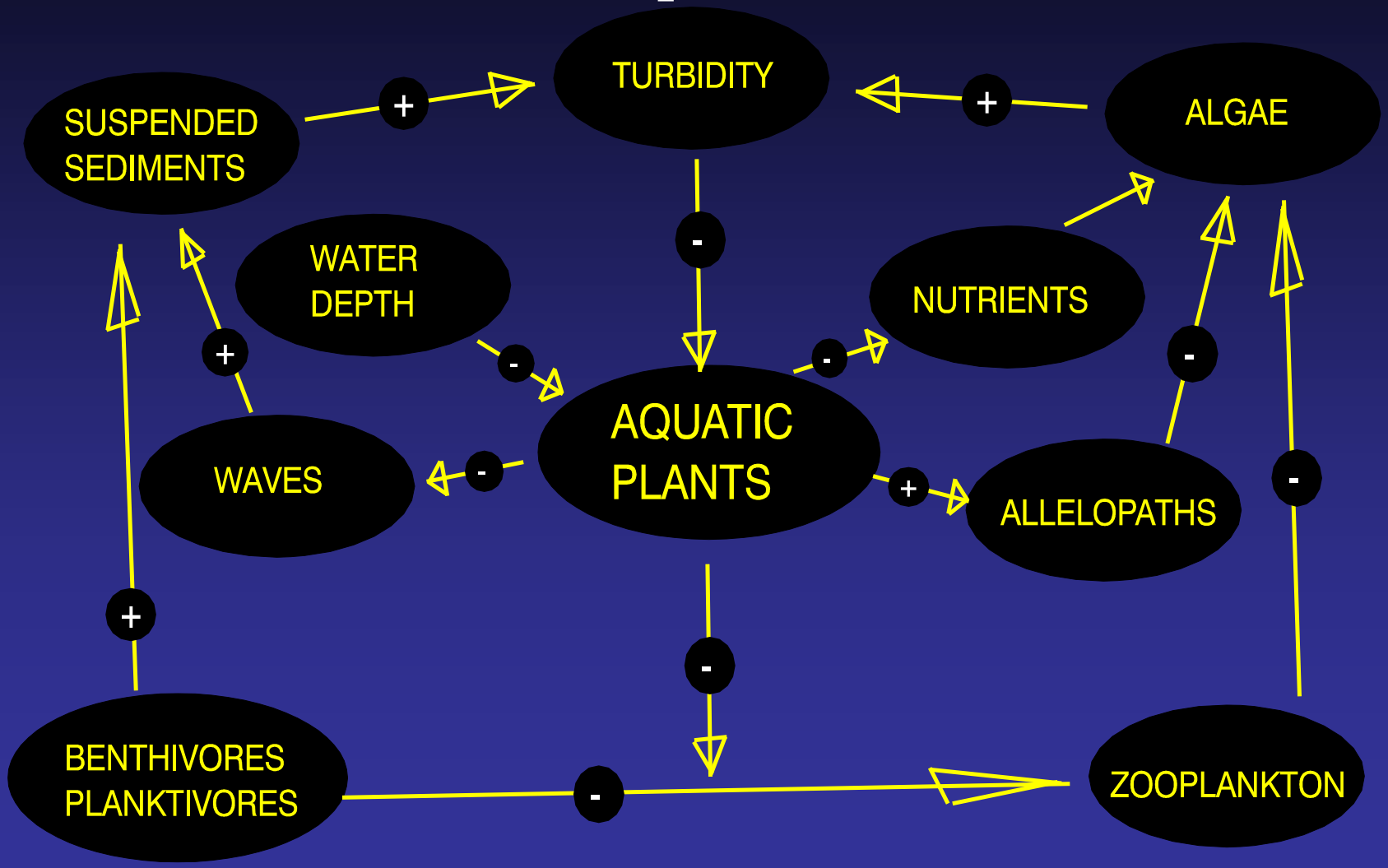
What is the root problem/cause of Park Lake's Degradation?



Shallow Lake Ecosystems

A Conceptual Model

(From Scheffer et al. 1993)



Shallow Lake Ecosystems

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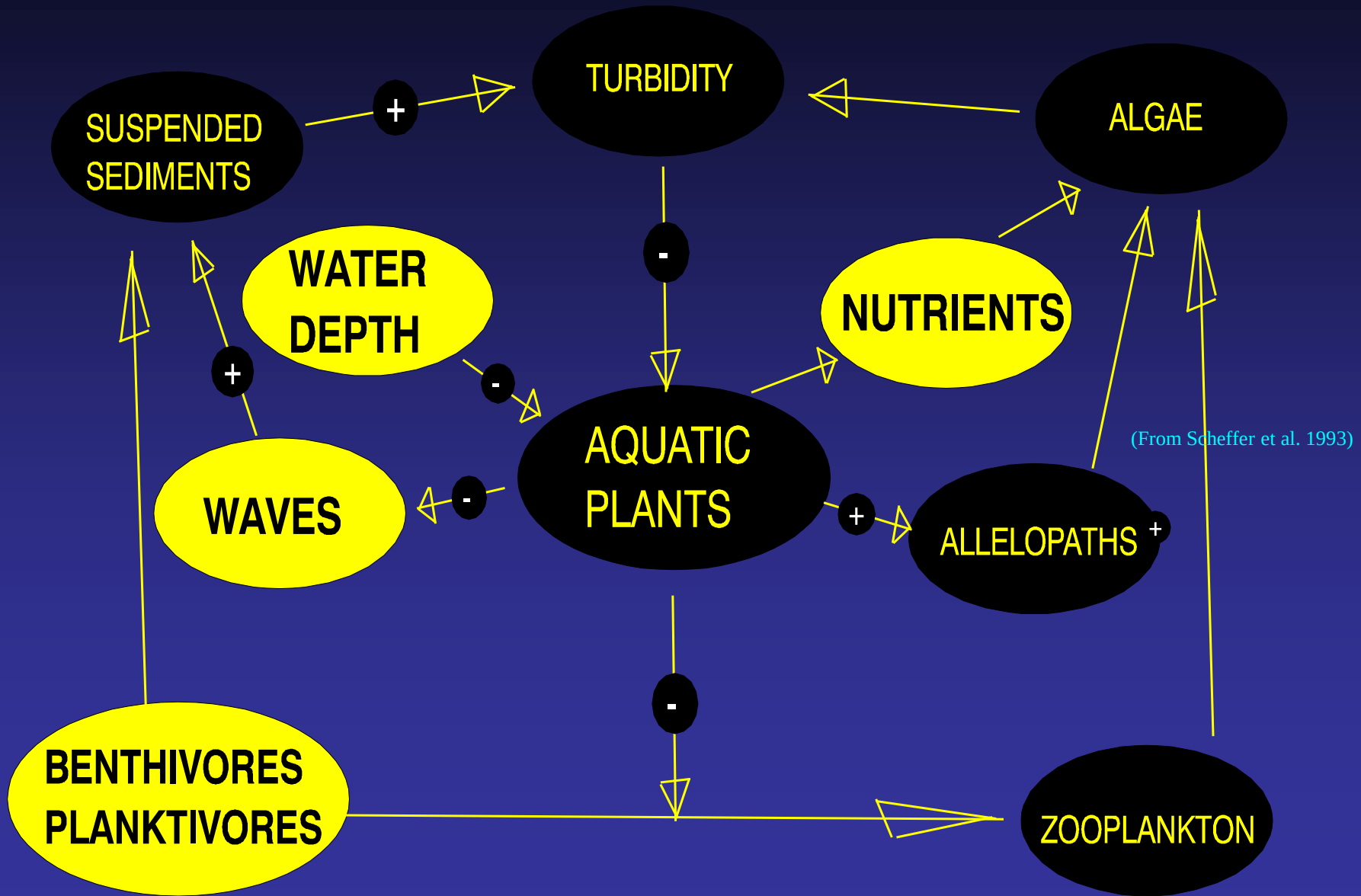
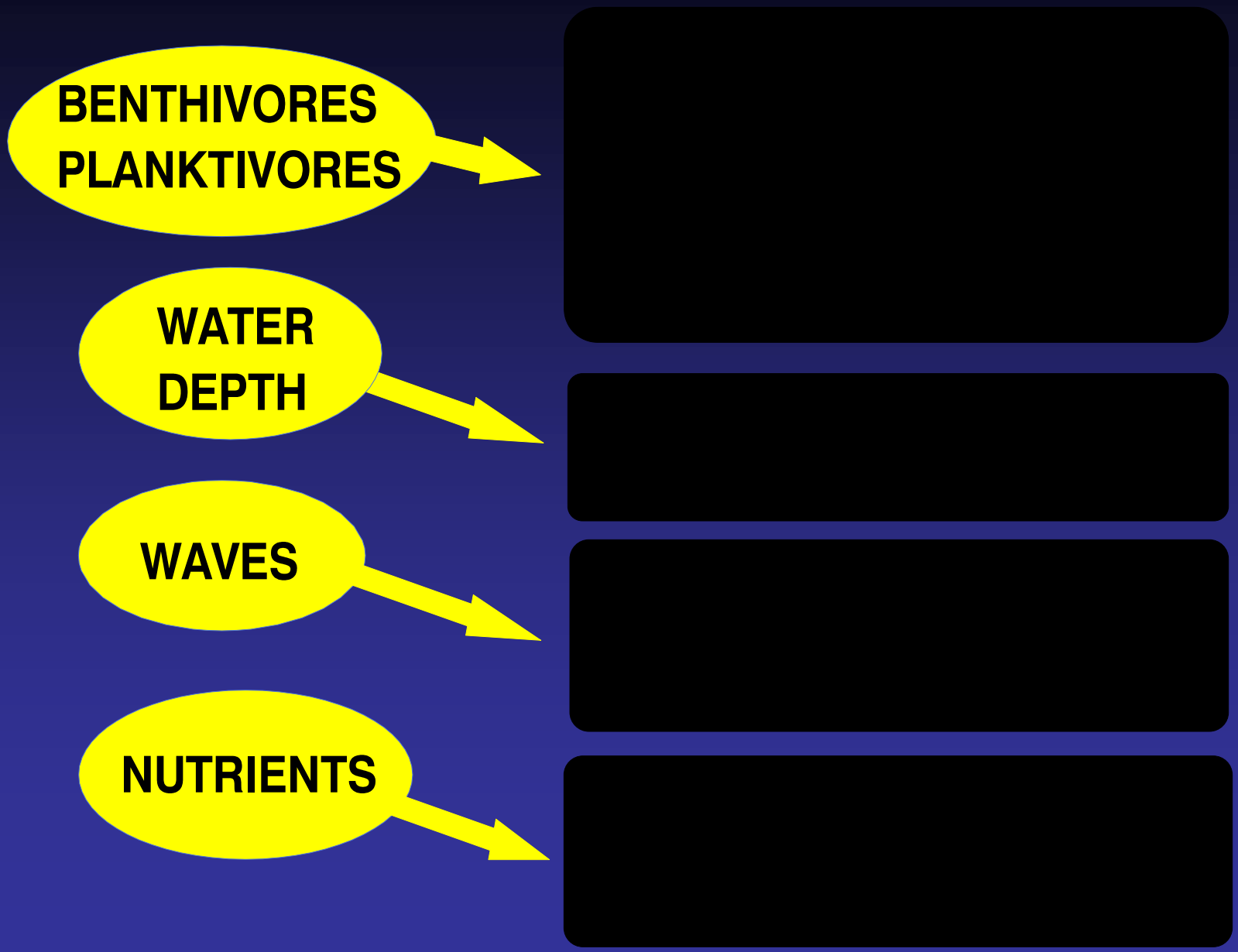


(From Scheffer et al. 1993)

Management Tools

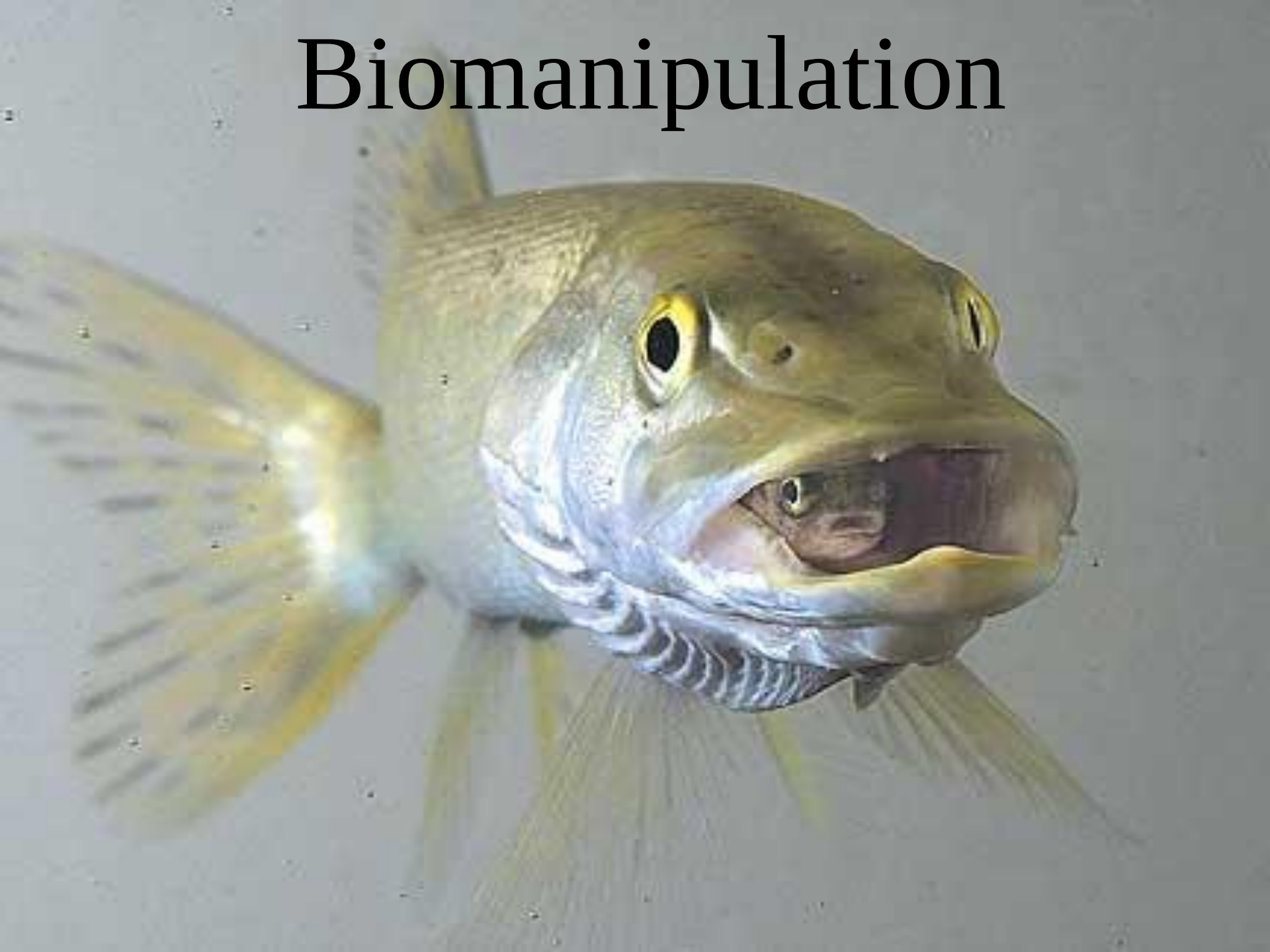


Management Tools

BENTHIVORES
PLANKTIVORES

SPOT TREATMENTS
CHEMICAL RECLAMATION
COMMERCIAL HARVEST
STOCK PISCIVORES
PROTECT PISCIVORES

Biomanipulation



(Commissioner Philo Hoy, 1876)

"When you can go with hook and line and bag ten pound specimens of that most desirable fish, the carp, then you will feel like thanking the men who have so persistently persevered in investigating every condition that can secure benefits so great."

(General Edwin E. Bryant, President of the Wisconsin Fisheries Commission, 1901)

" The greatest trouble we have in some of our lakes in Wisconsin is that the carp have got in there. I do not know of a fisherman in Wisconsin that would catch one if he could, and I never heard of one being eaten either by anybody in the circle of my acquaintance… Within a radius of five miles of Madison there are billions of carp. Every fisherman sees them, curses them, and refuses to catch them."

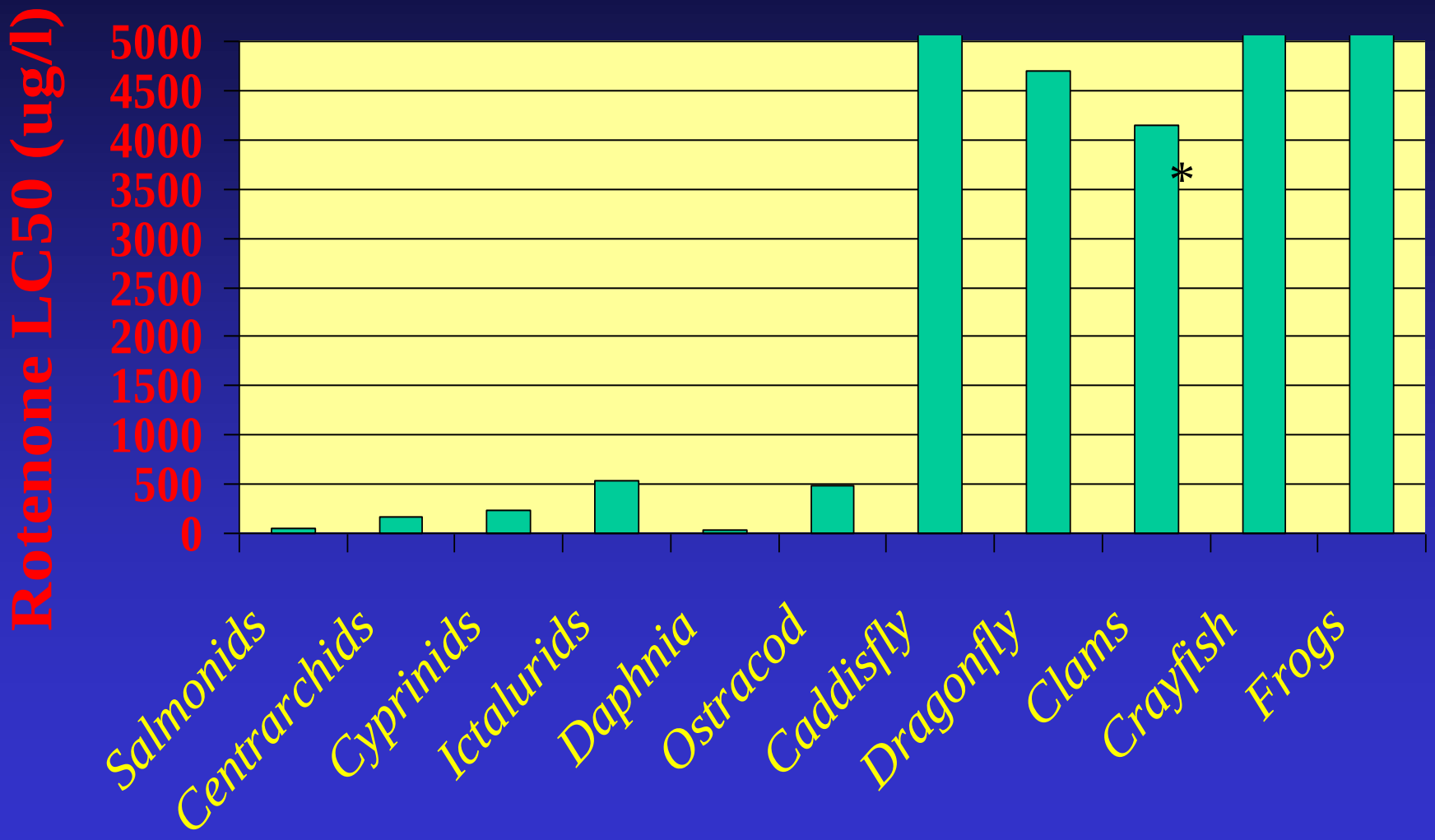
“Advances” in Fisheries Management

Hammering Carp


Contract
Removal

Rotenone

Toxicity of Rotenone Laboratory Tests; 24 hr LC_{50}



* 96 hour LC50

Fry Stocking

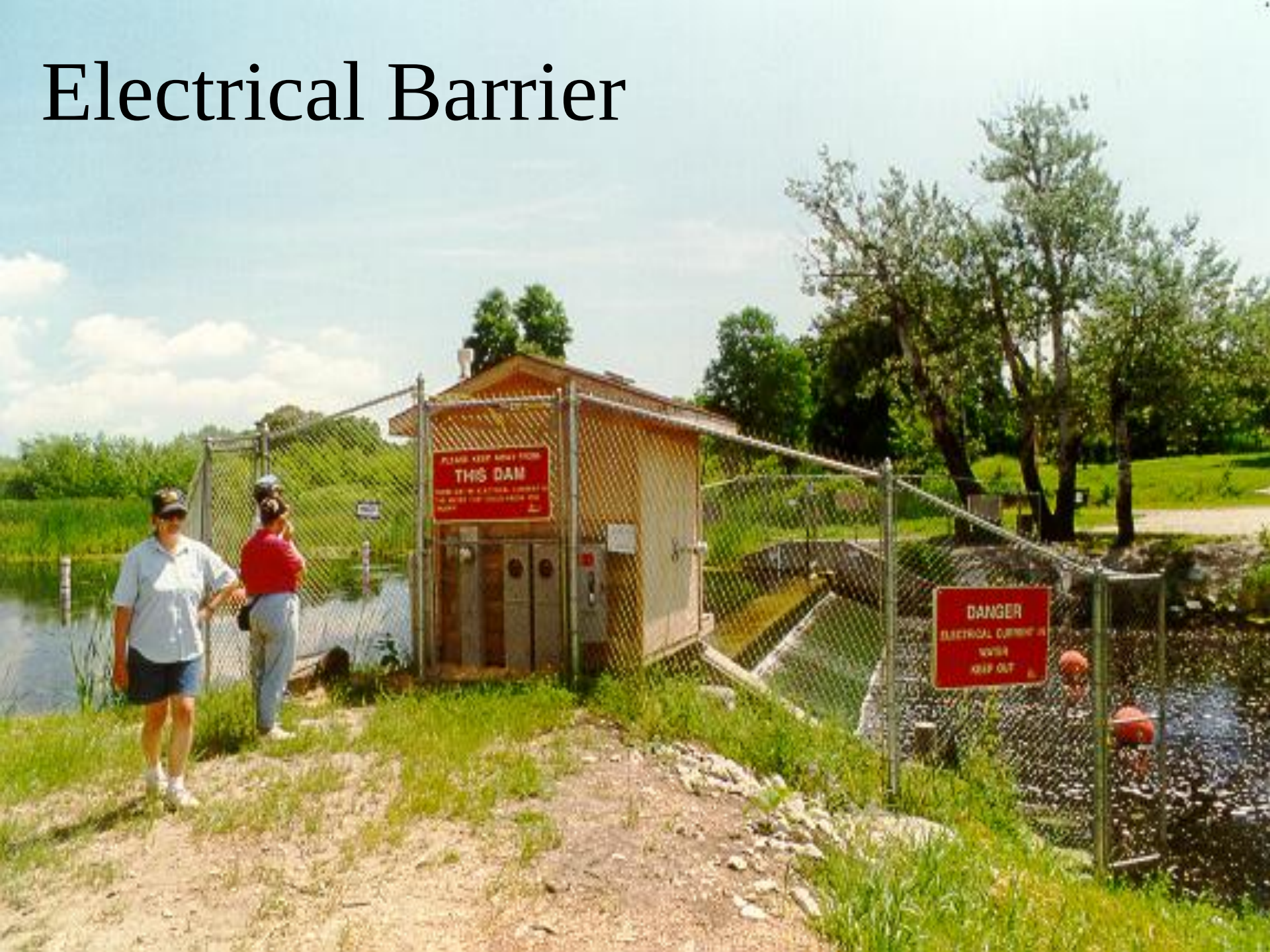

Fry Stocking

Aeration to Prevent Winterkill

Aeration - Refuge Area

Physical

Electrical Barrier



Management Tools

BENTHIVORES
PLANKTIVORES

PROTECT PISCIVORES
STOCK PISCIVORES
COMMERCIAL HARVEST
CHEMICAL RECLAMATION
SPOT TREATMENTS

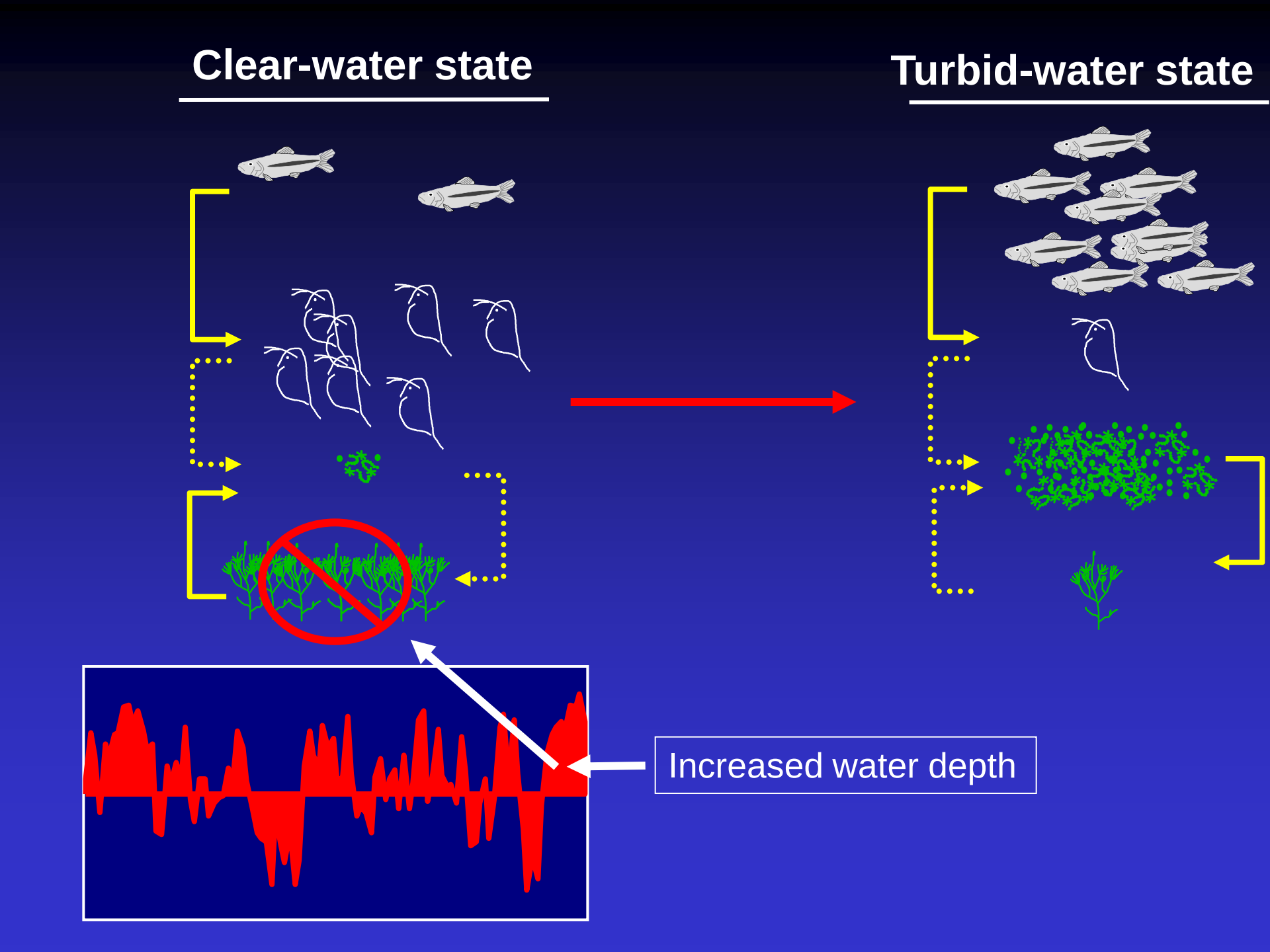
WATER DEPTH

LONG-TERM LEVELS
DRAWDOWN

WAVES

NUTRIENTS

HIGH WATER LEVELS DESTROY HABITAT

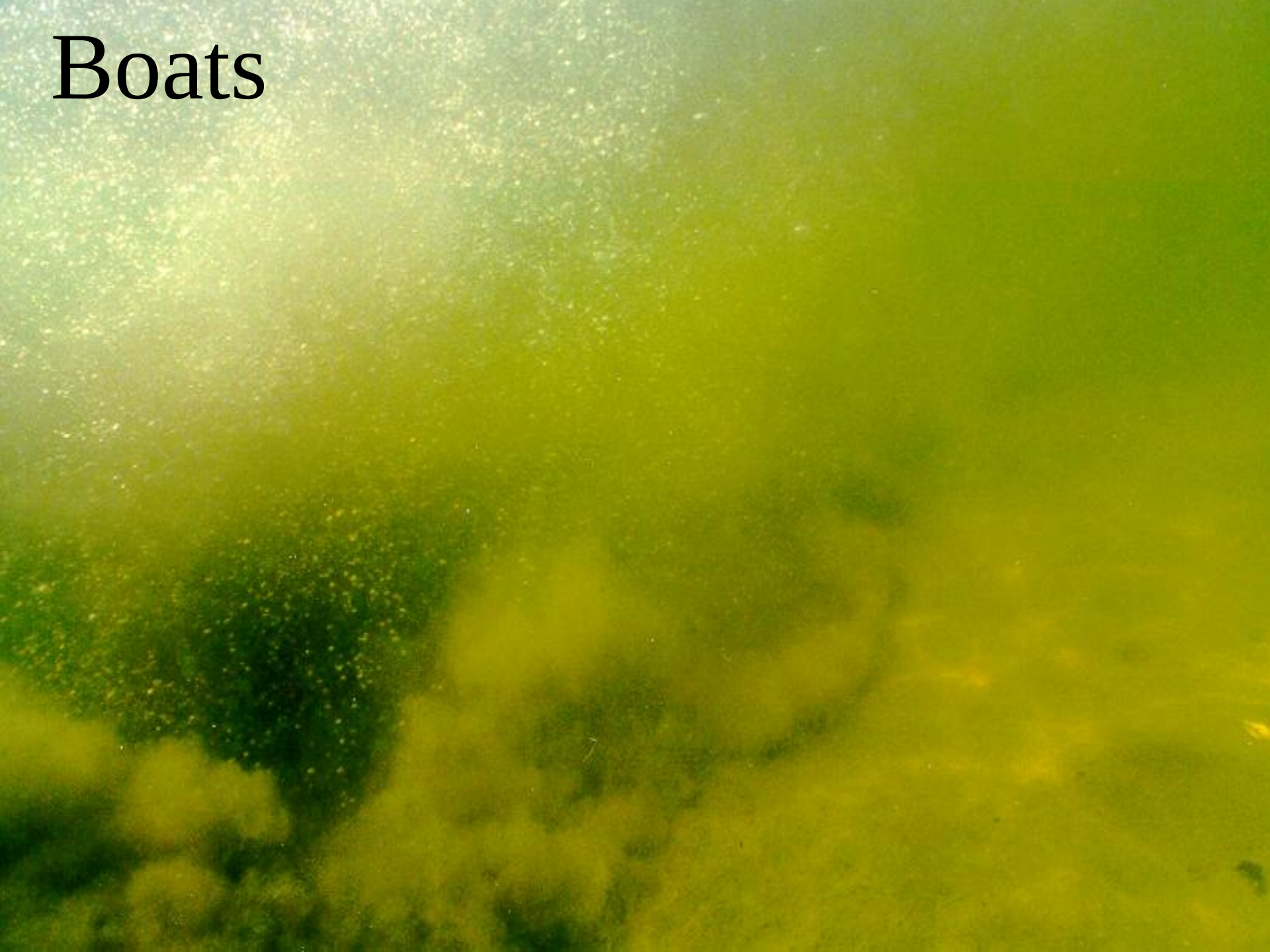

Clear-water state
Turbid-water state
Increased water depth

Management Tools

Boats


IF MOM ONLY KNEW

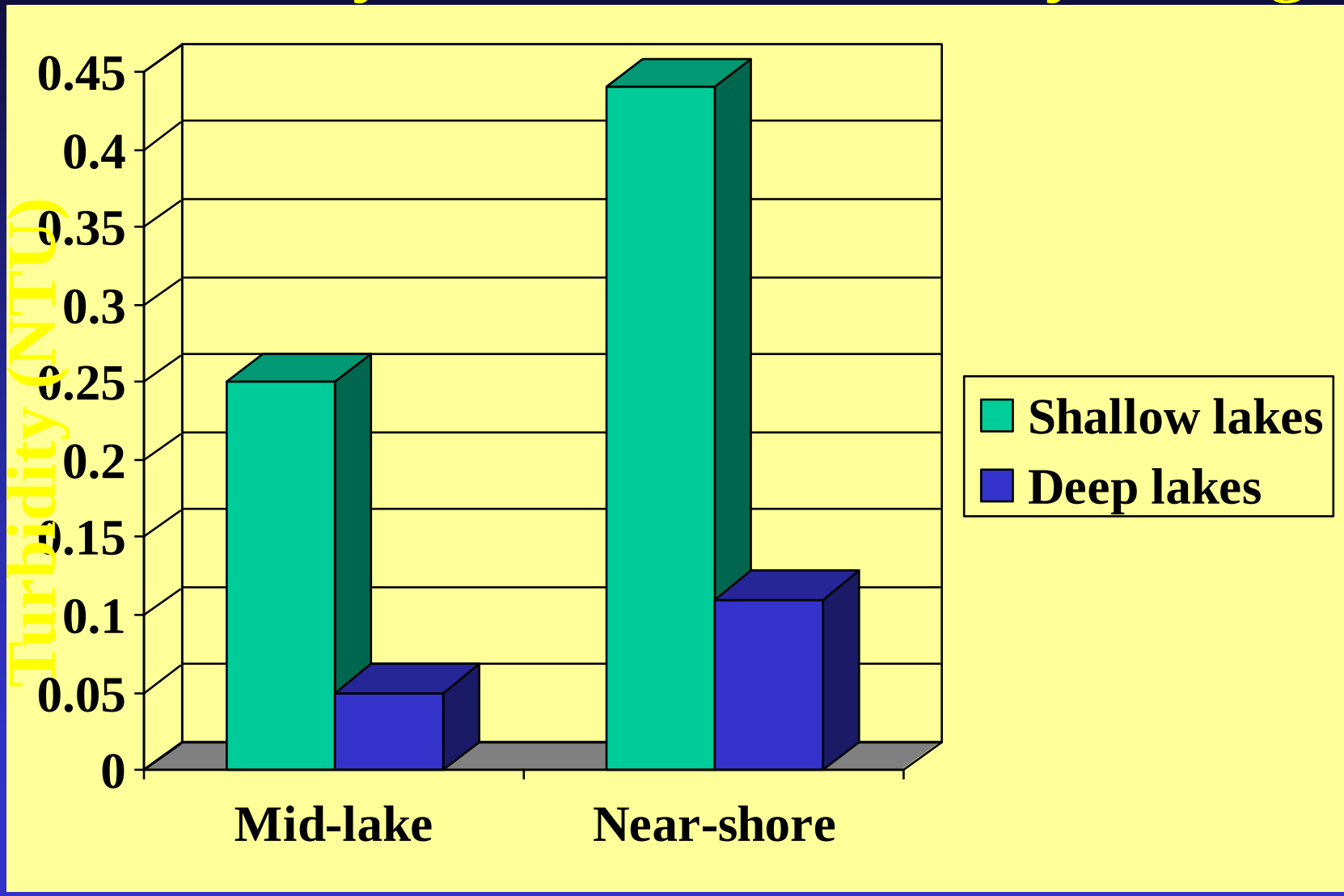
Boats



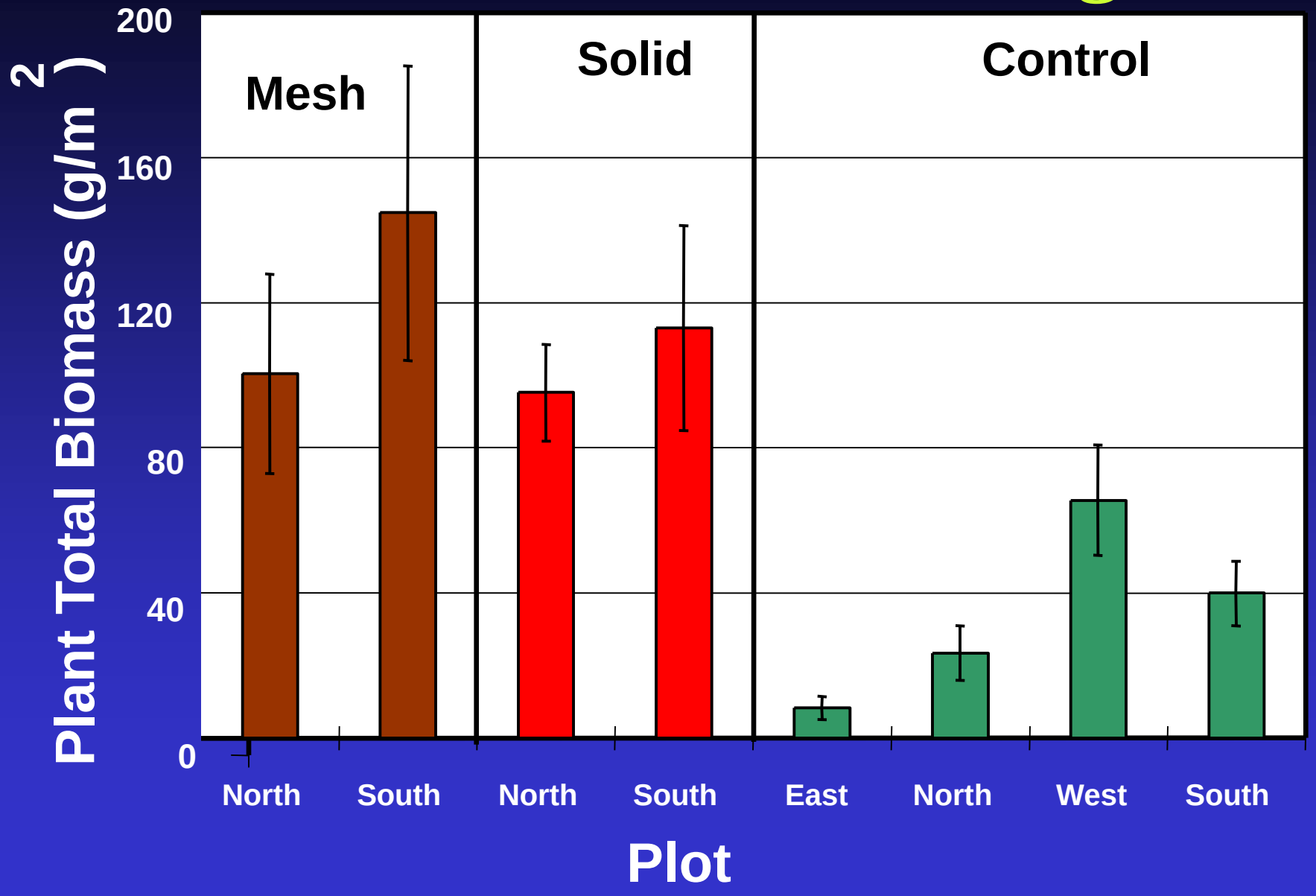

Boats

Boating

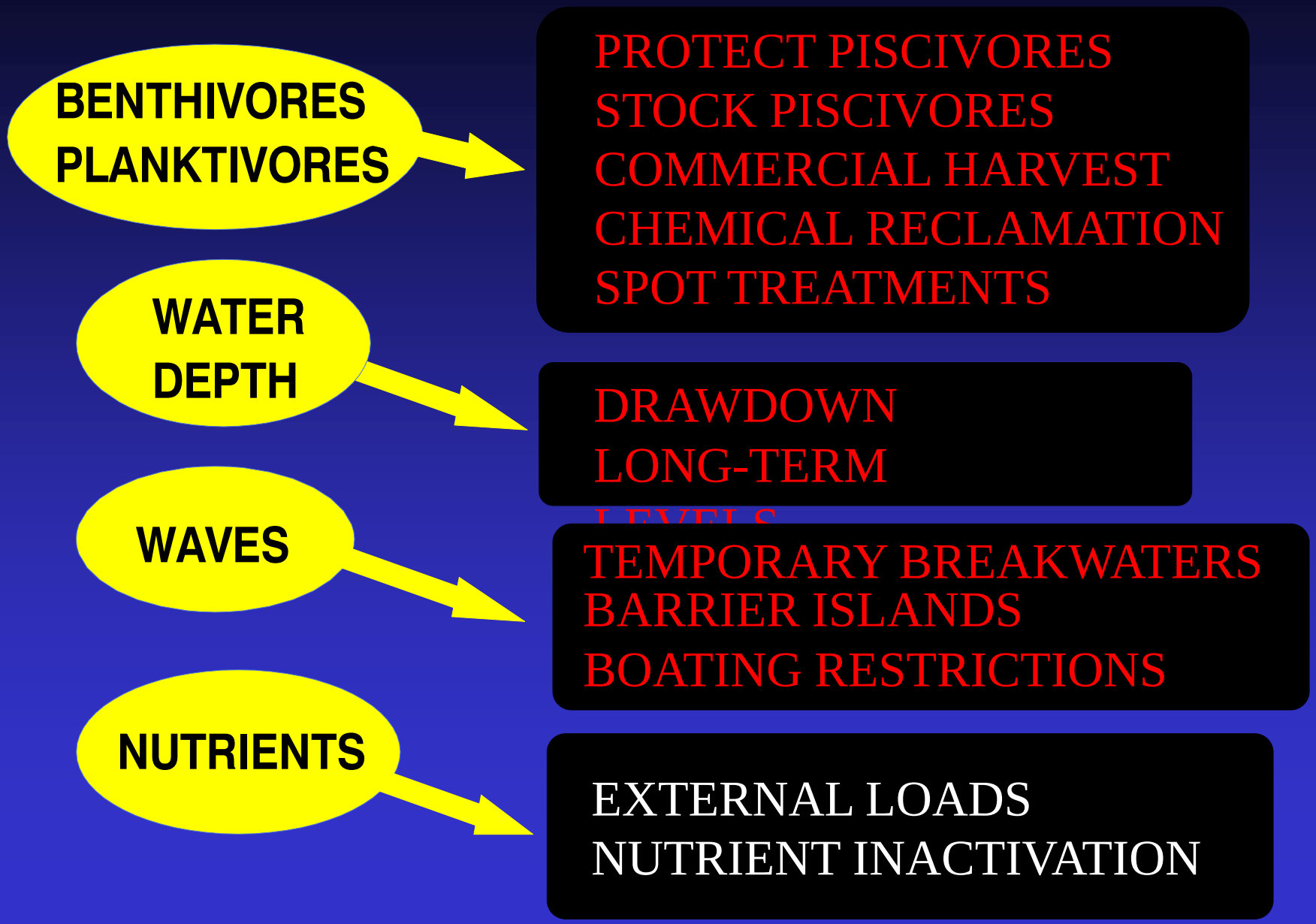
Weekday to Weekend Turbidity Change



Plant Growth - Boating



Management Tools

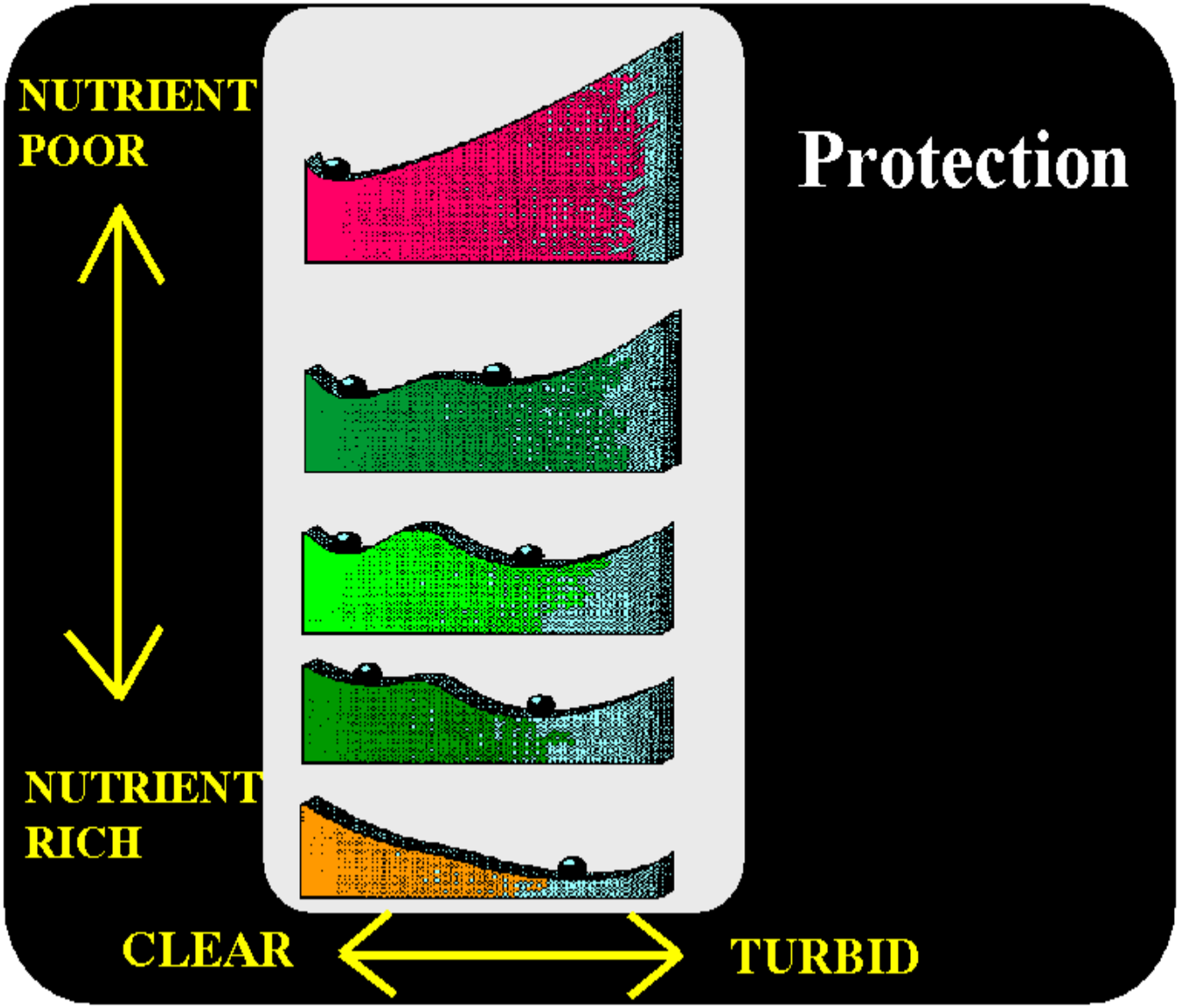


External Nutrient Loads

BMPs
Buffers
Settling basins
Flow diversion

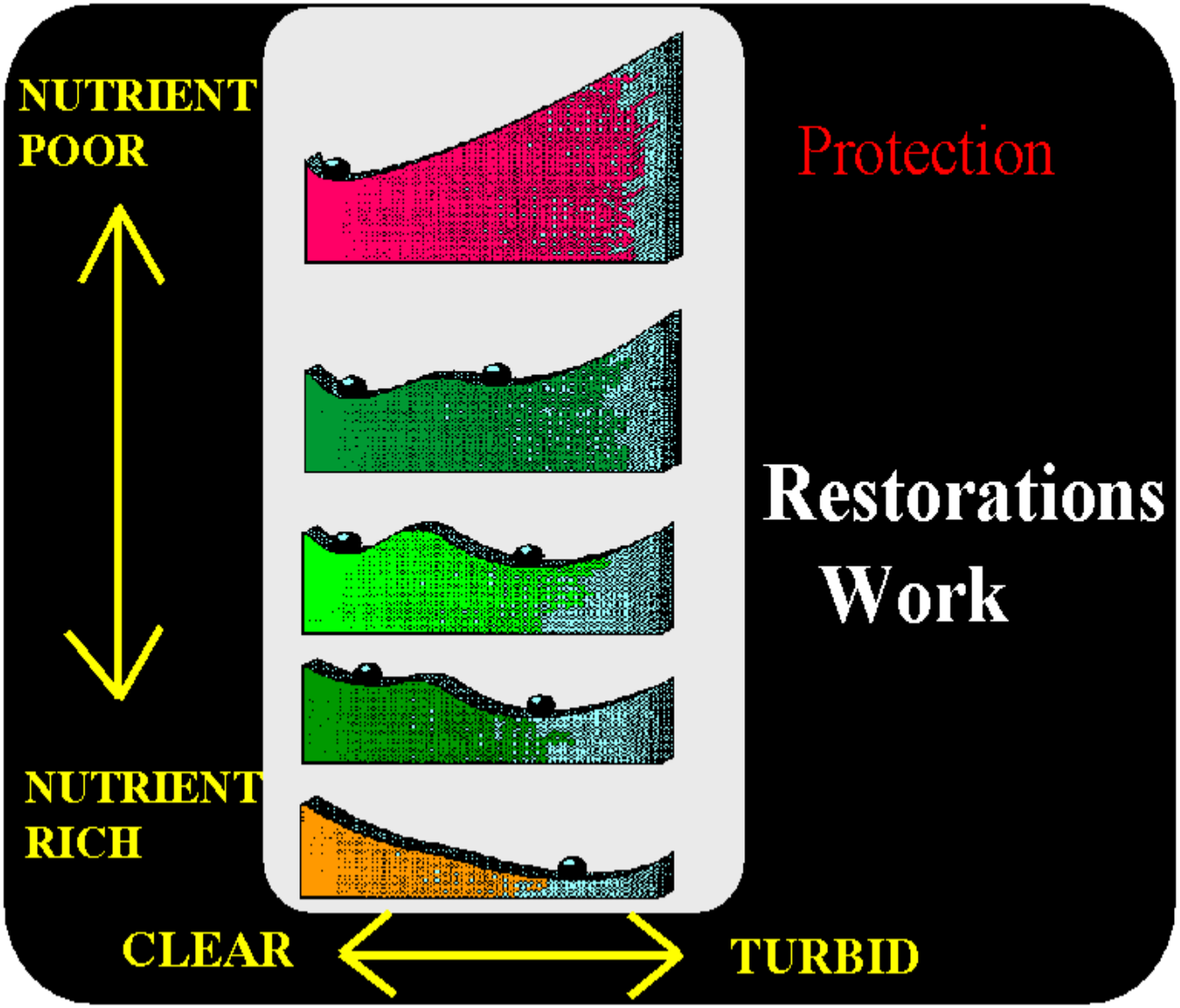
Shallow Lake Ecology

(From Scheffer et al. 1993)



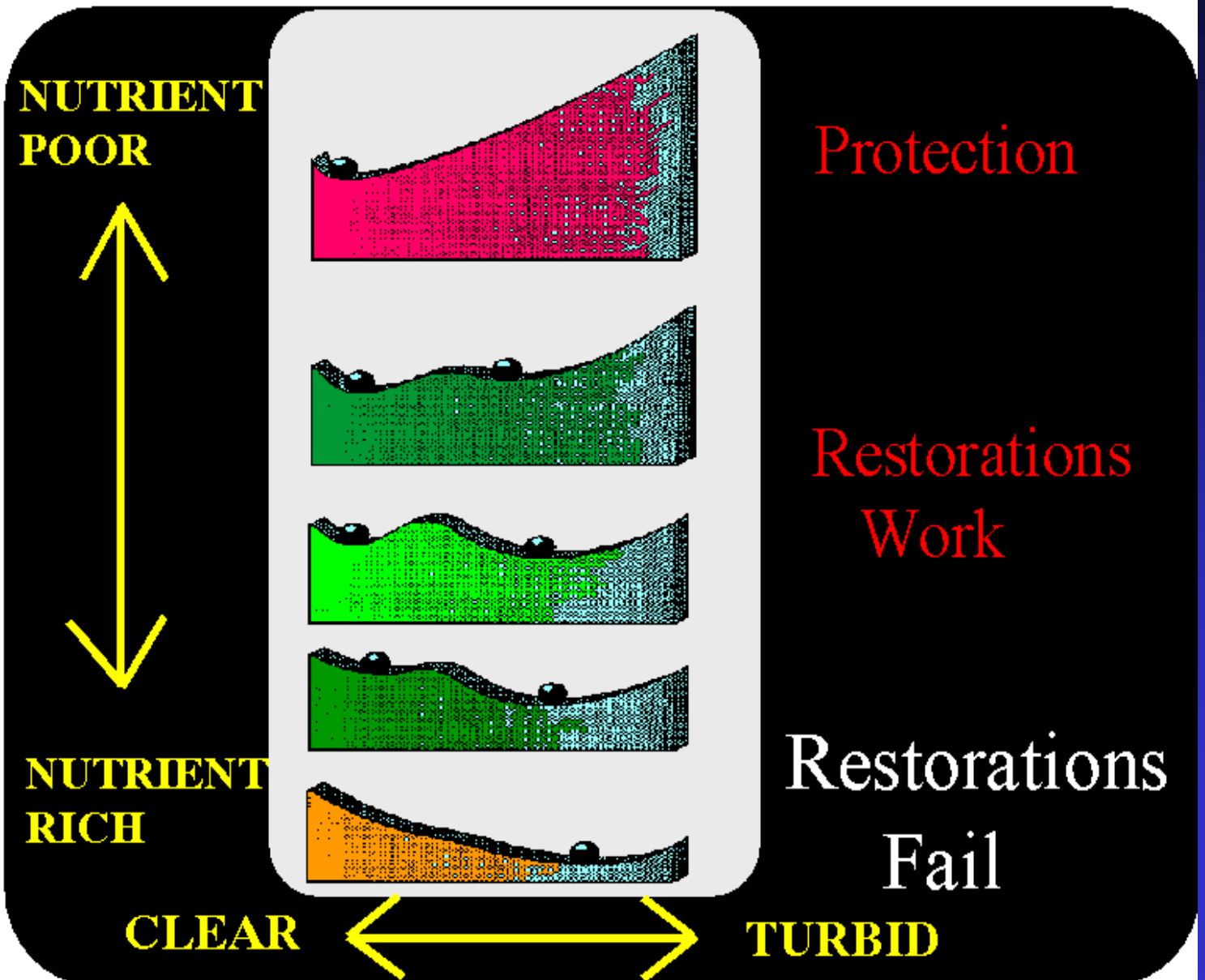
Shallow Lake Ecology

(From Scheffer et al. 1993)



Shallow Lake Ecology

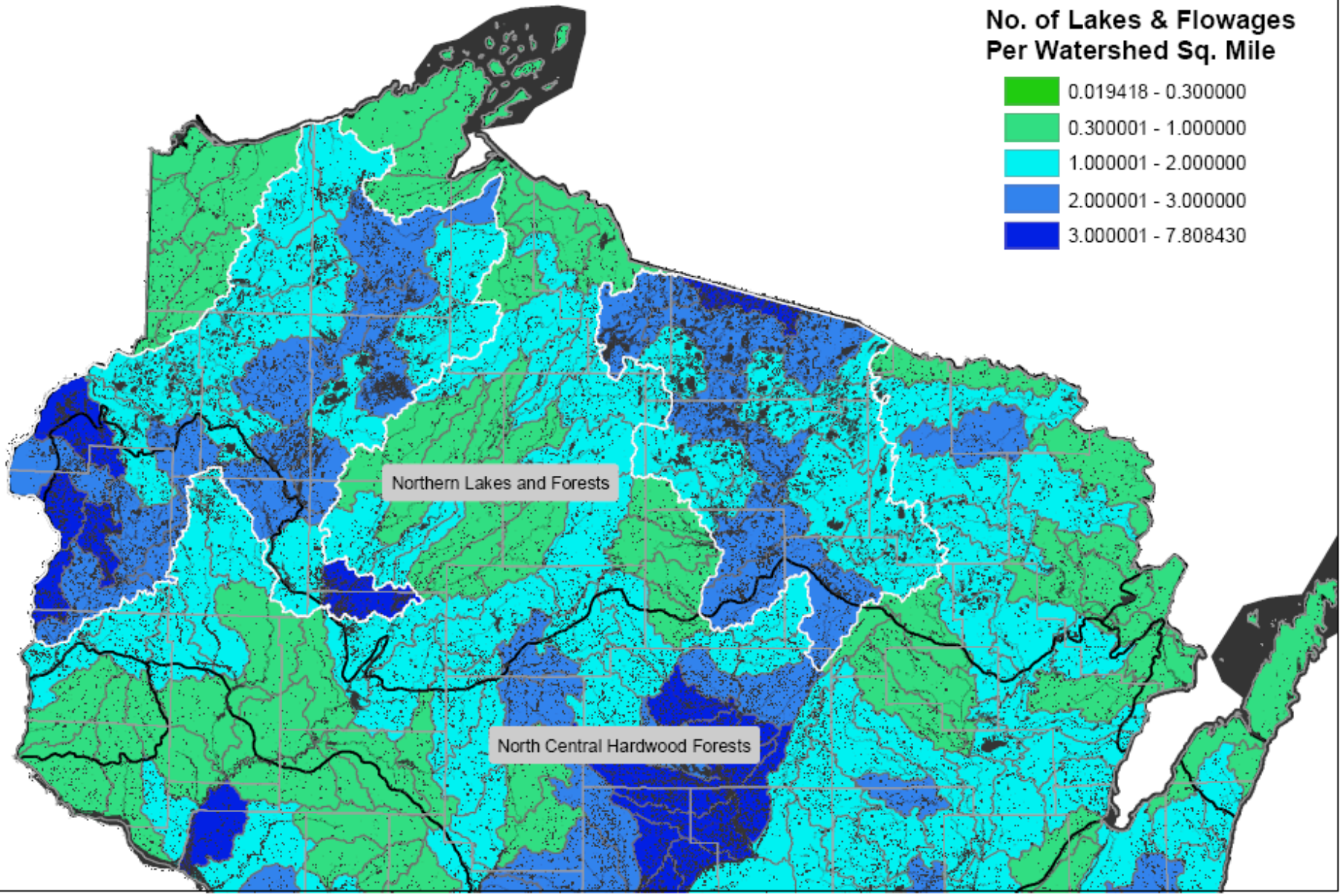
(From Scheffer et al. 1993)



Shallow Lake Ecology

(From Scheffer et al. 1993)

Level III Ecoregions and Watersheds of Wisconsin
Number of Lakes/Ponds/Flowages/Watershed Sq. Mile

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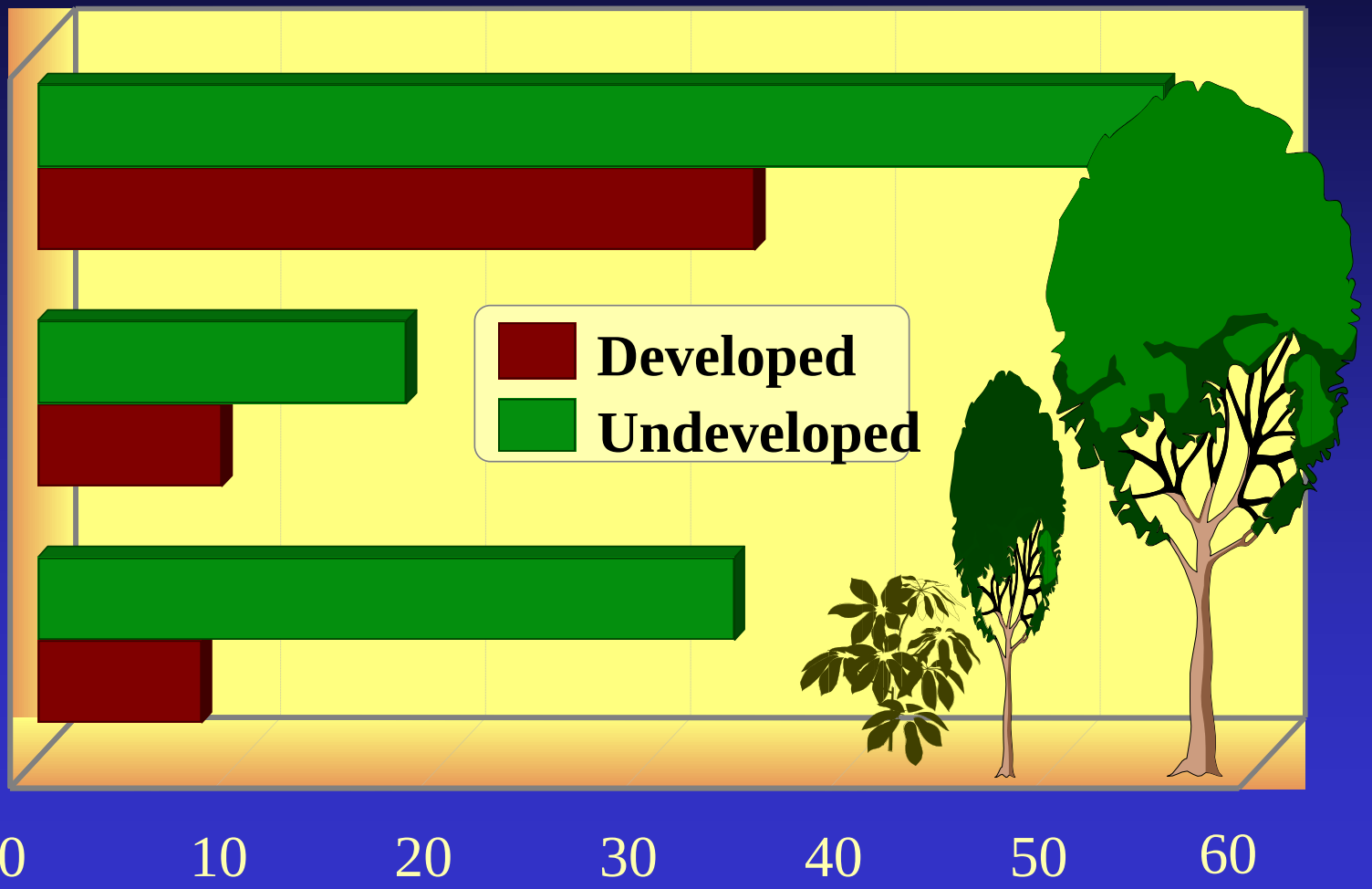
Domestication of Wisconsin Lakes

Courtesy of MN DNR

Comparisons of Undeveloped and Developed Shorelands, Northern Wisconsin

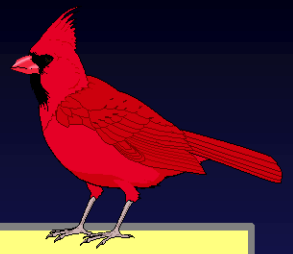
Joan Elias & Mike Meyer

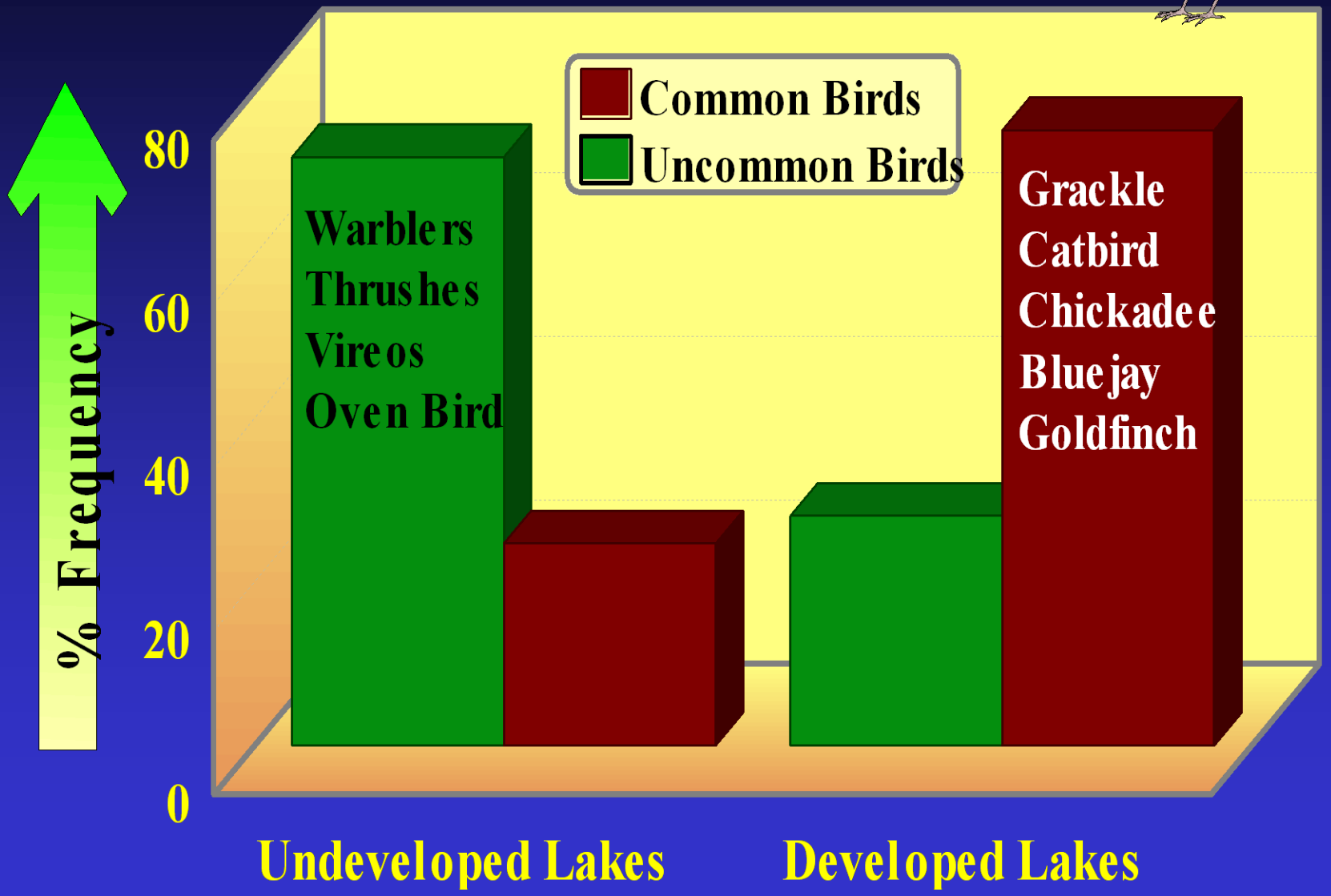
What's Happened To Shoreland Plan



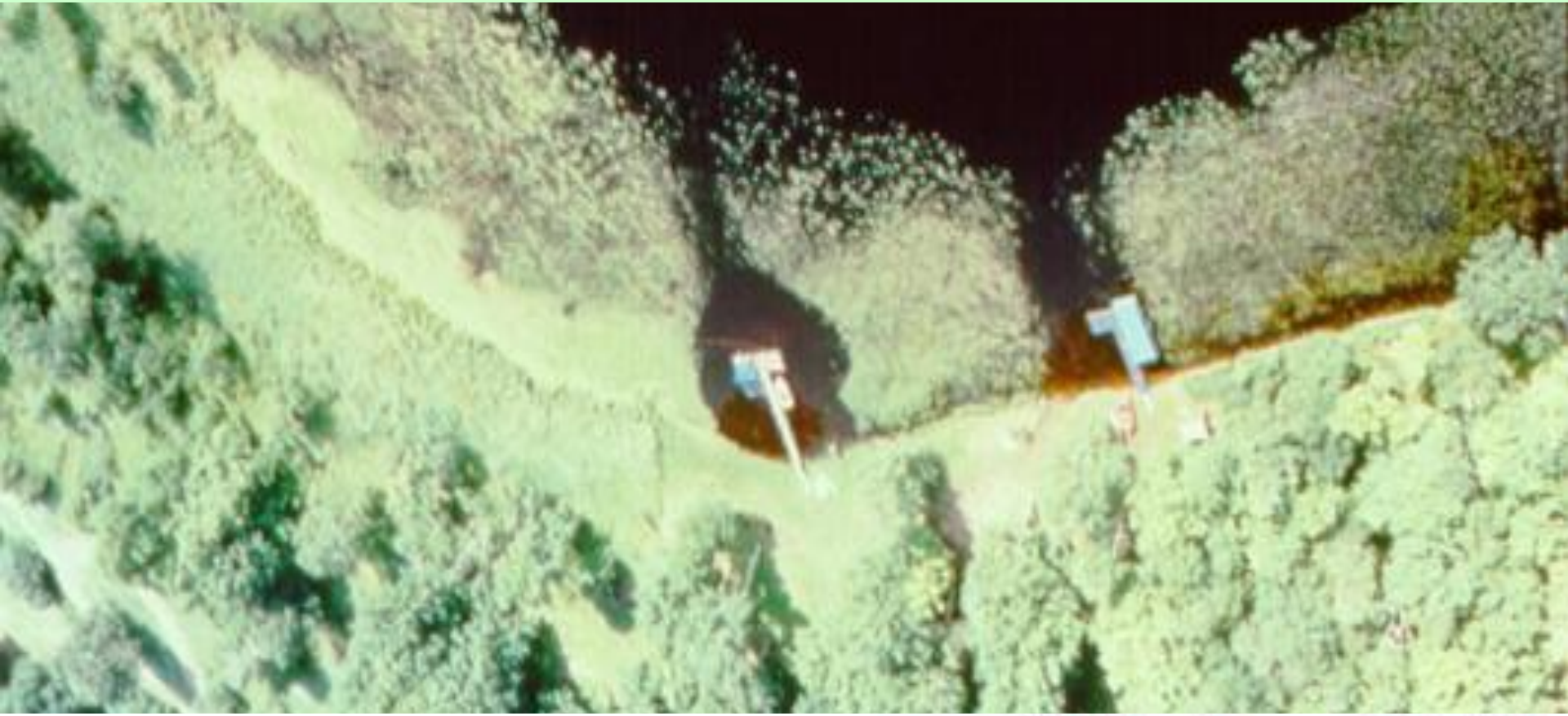
Elias and Meyer, in Prep.

What's Happened To Songbirds?





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



Radomski and Goeman, 2001

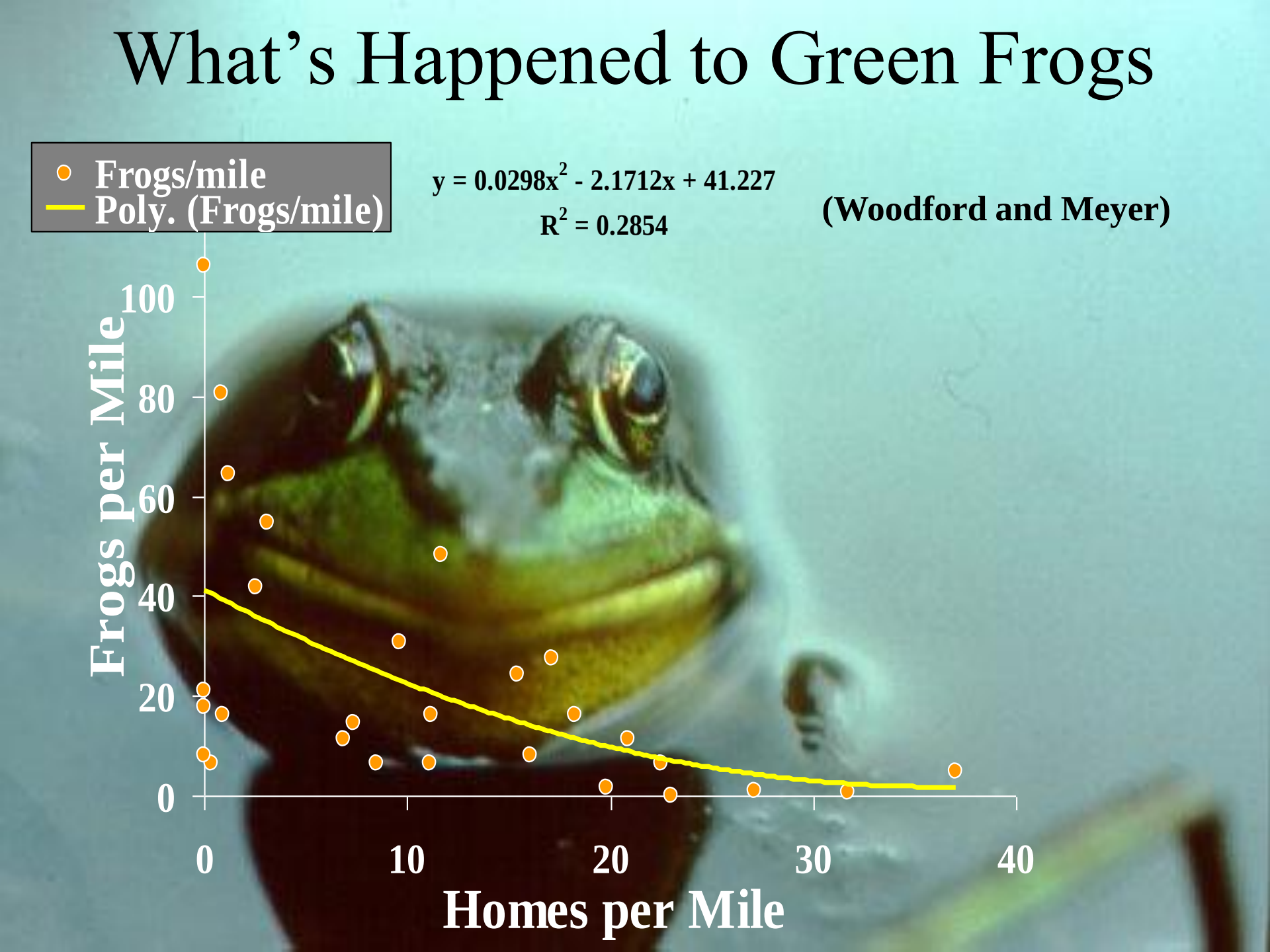
Minnesota Department of Natural Resources

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

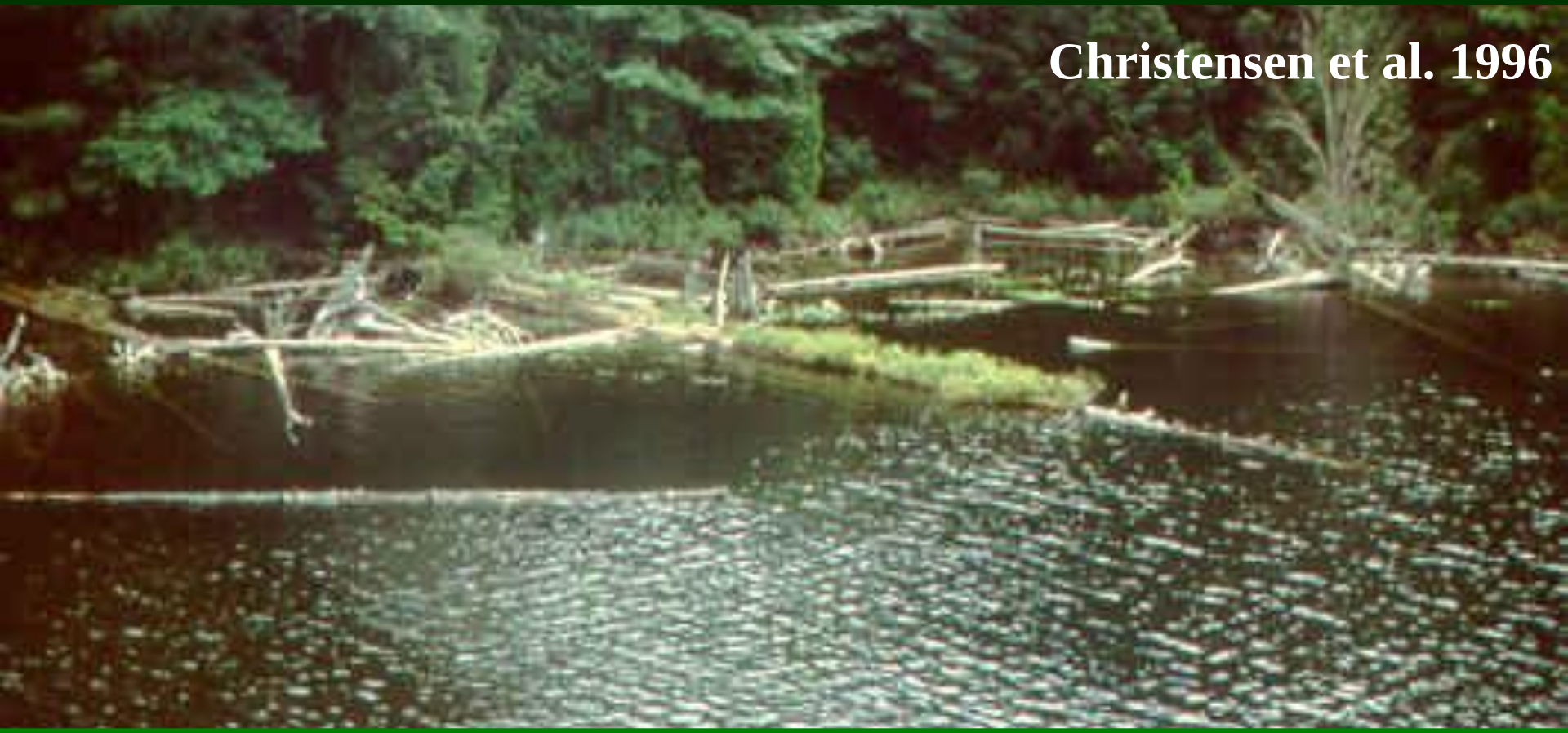
- Developed shores had less aquatic vegetation
- For each lake lot, 2/3rds of the emergent and floating-leaf vegetation was lost
- Minnesota has lost 20-28% of this vegetation

Radomski and Goeman, 2001

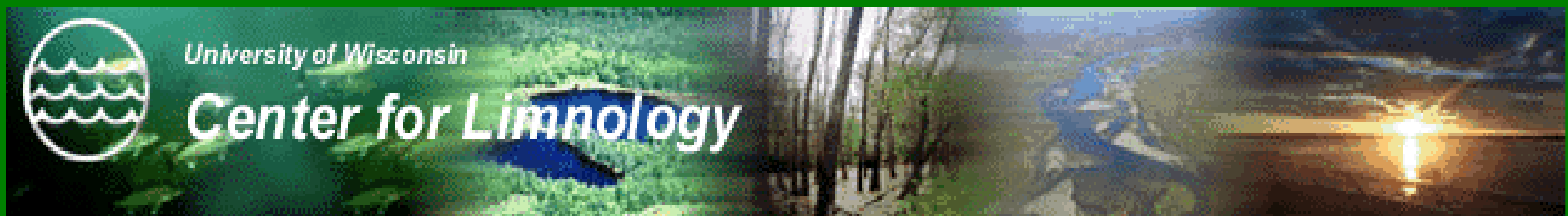
What's Happened to Green Frogs



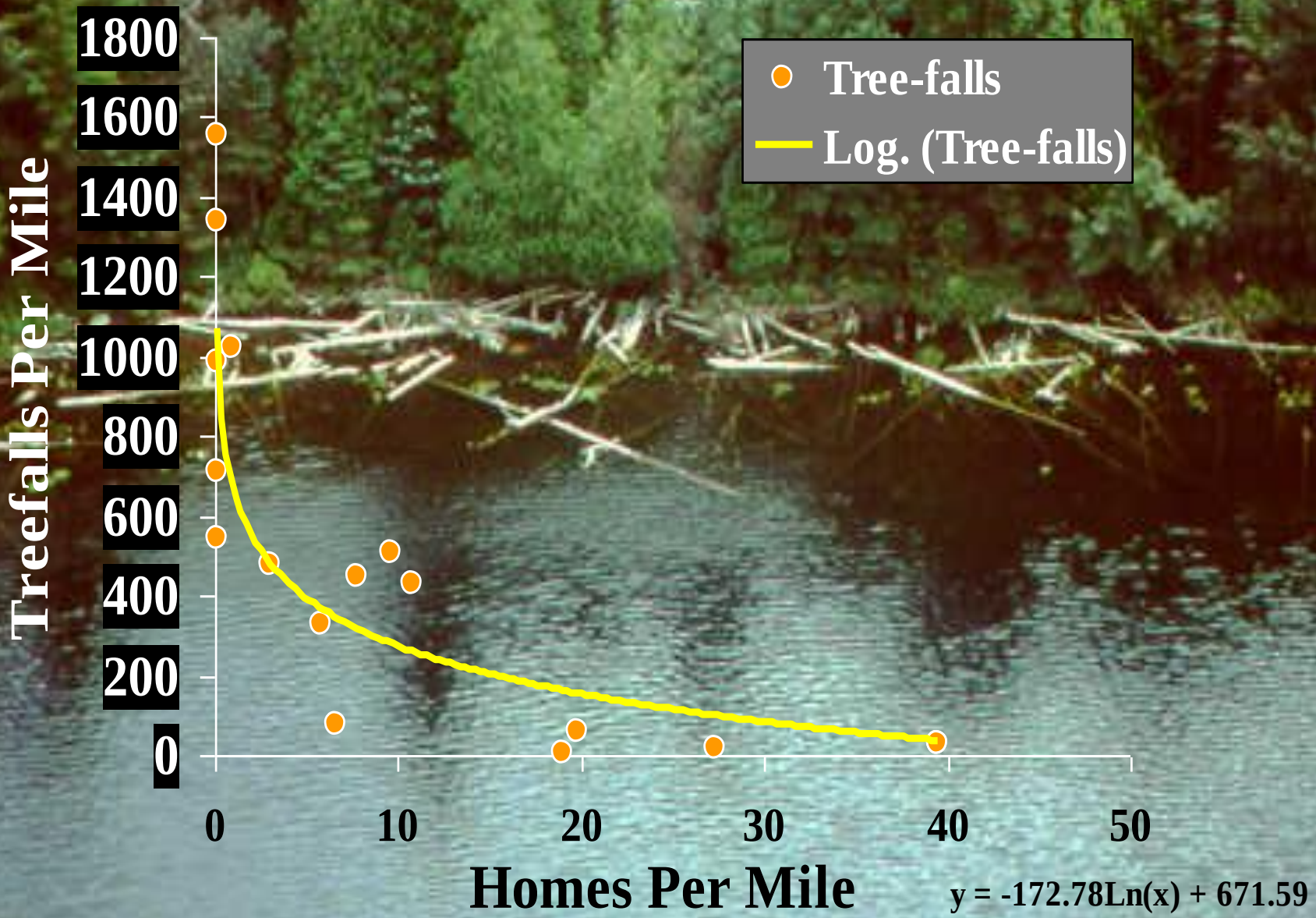
Impacts of Lakeshore Development on Tree-falls in North Temperate Lakes



Christensen et al. 1996



Impacts of Development on Tree-falls



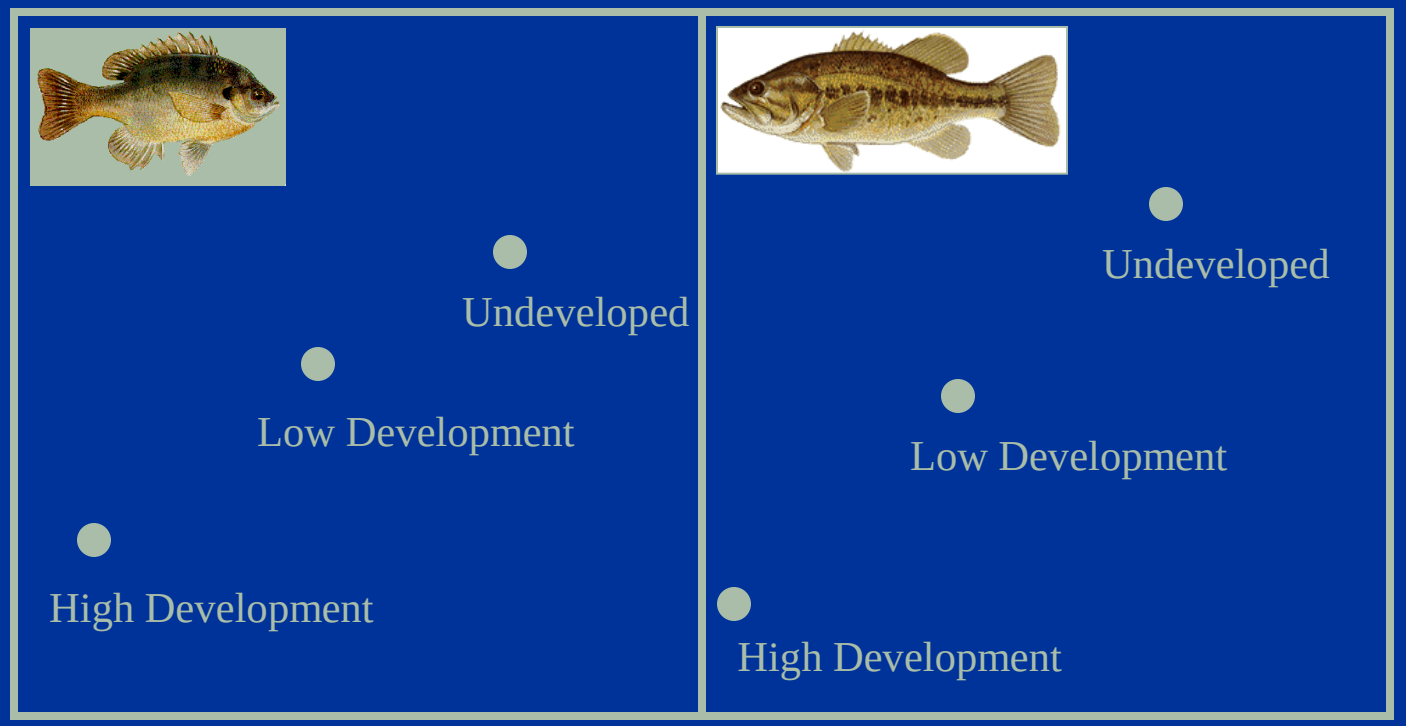
Christensen et al. 1996

Development Impacts on Fish Growth and Production

Schindler et al. 2000

University of Wisconsin
Center for Limnology

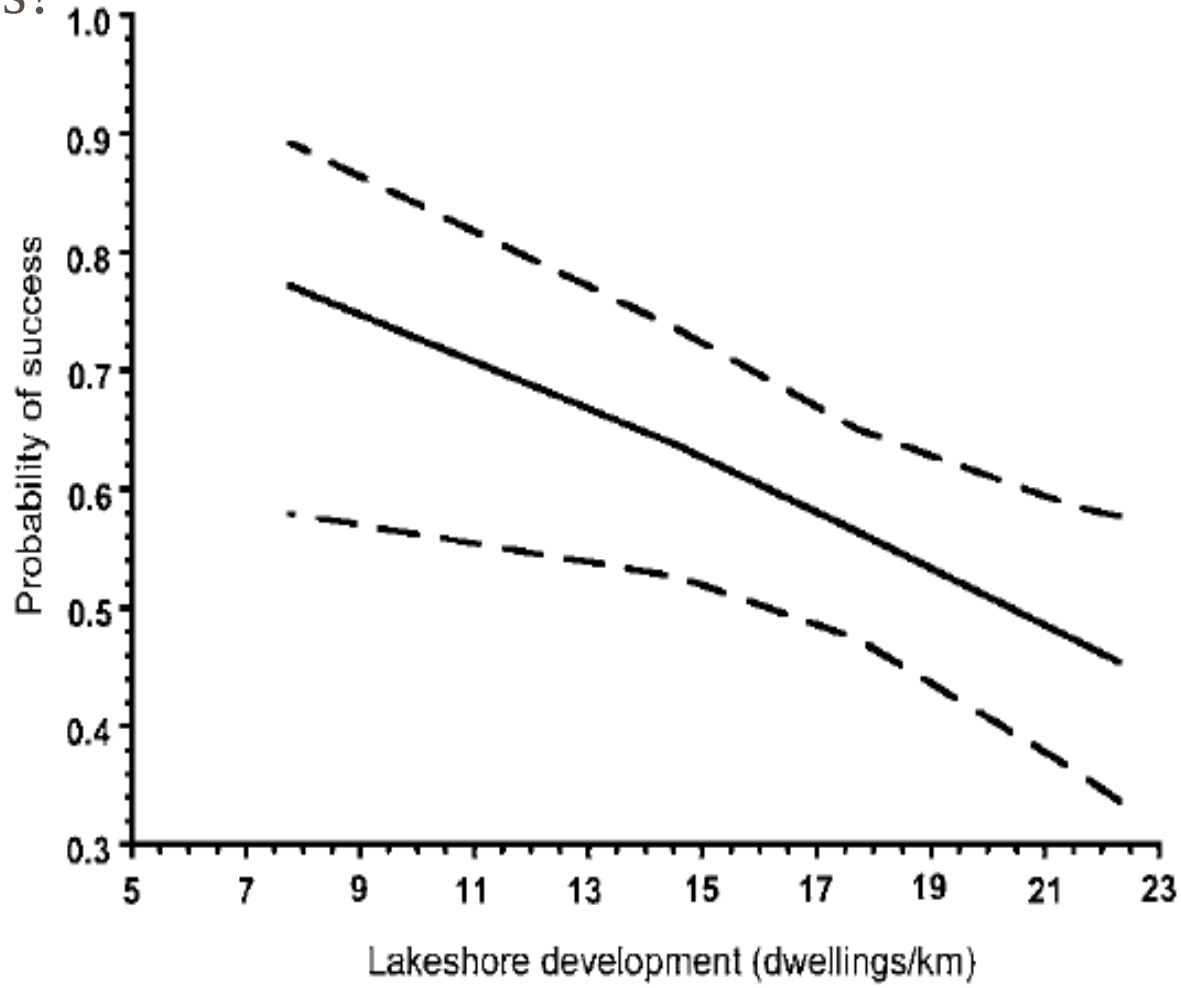
Fish grow ~3X faster in lakes with lots of woody habitat



From Schindler et al. 2000

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

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

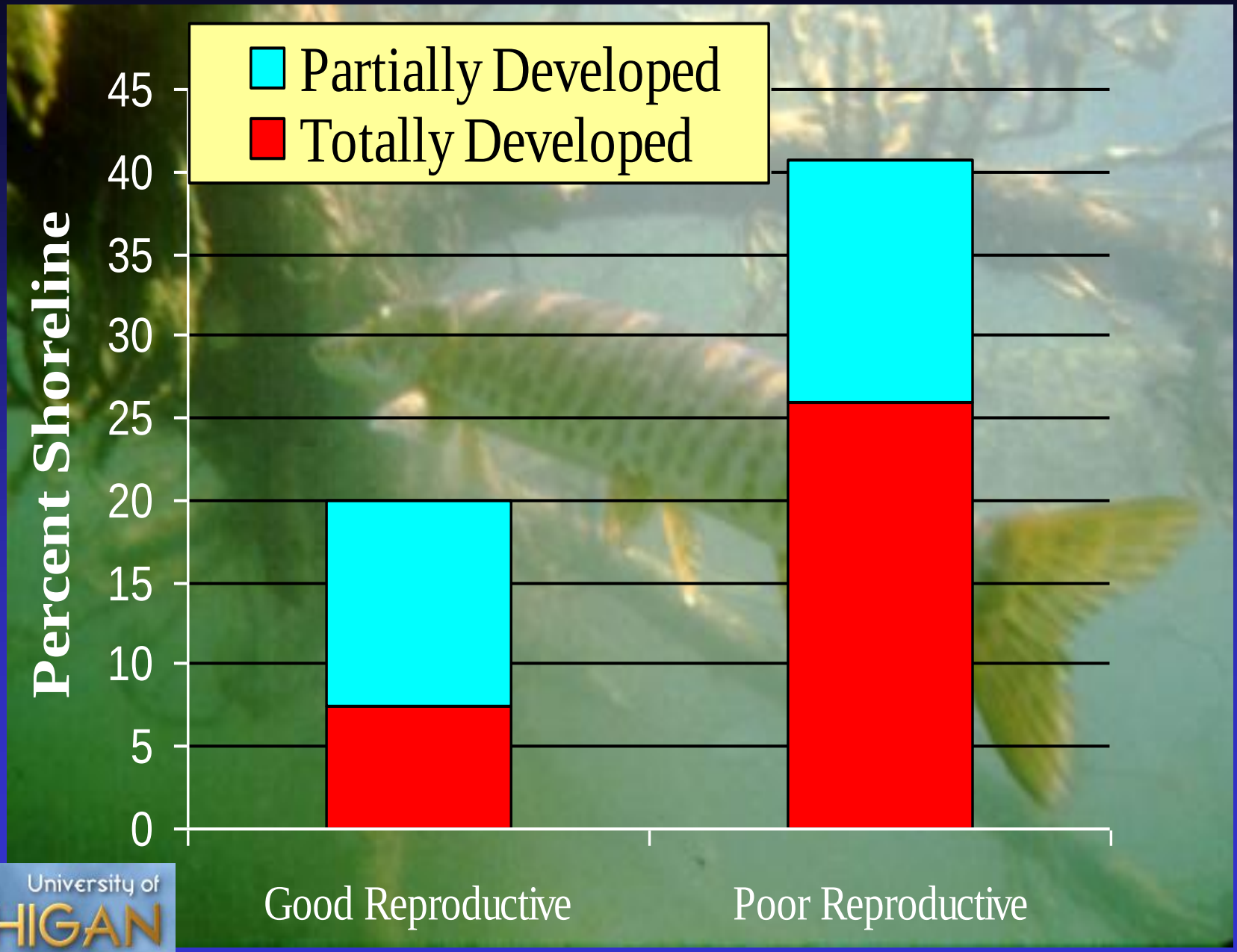


Lake Characteristics Influencing Spawning Success of Muskellunge

Rust et al.,

University of MICHIGAN

Lake Characteristics Influencing Muskellunge Reproduction



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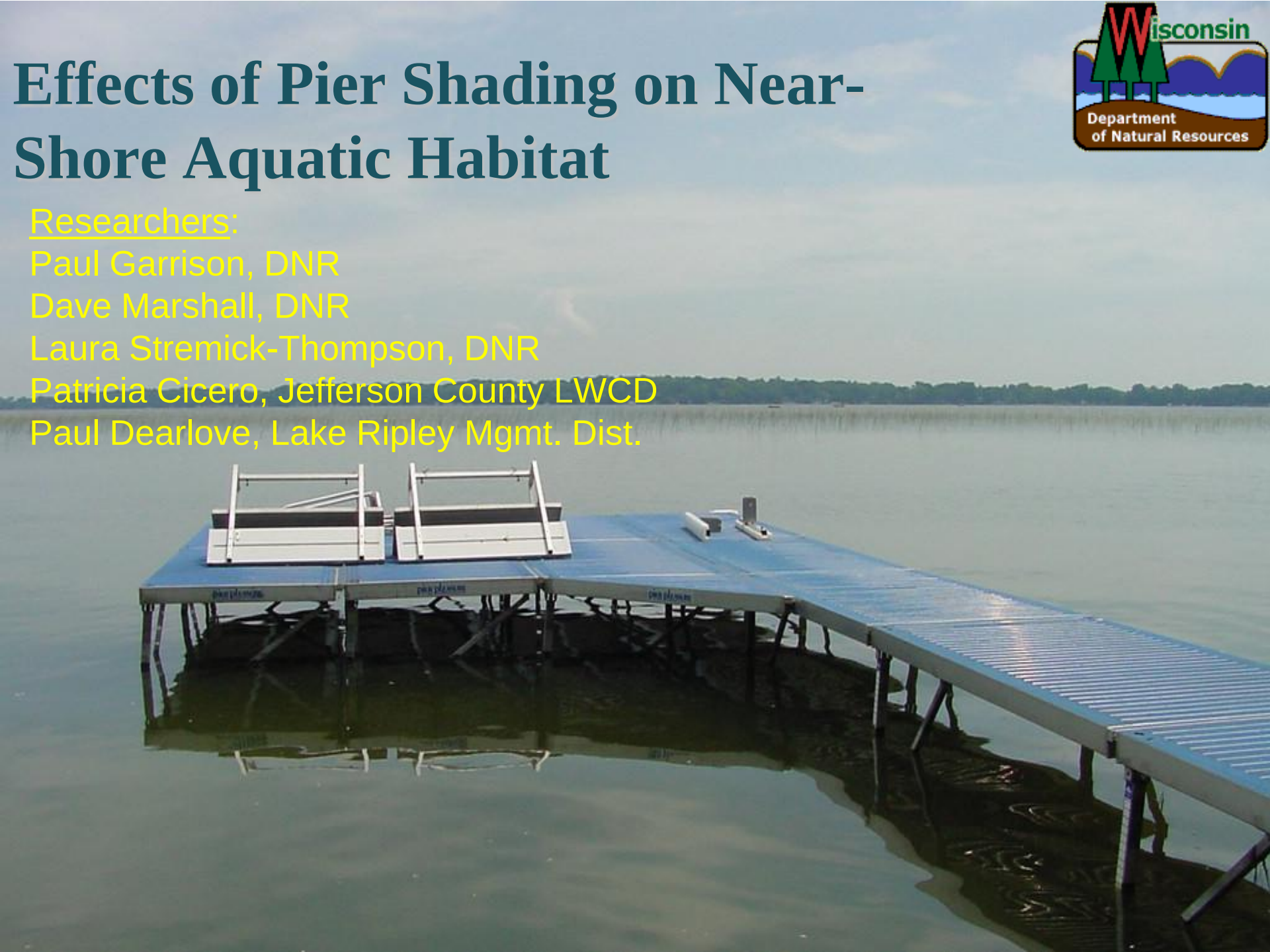
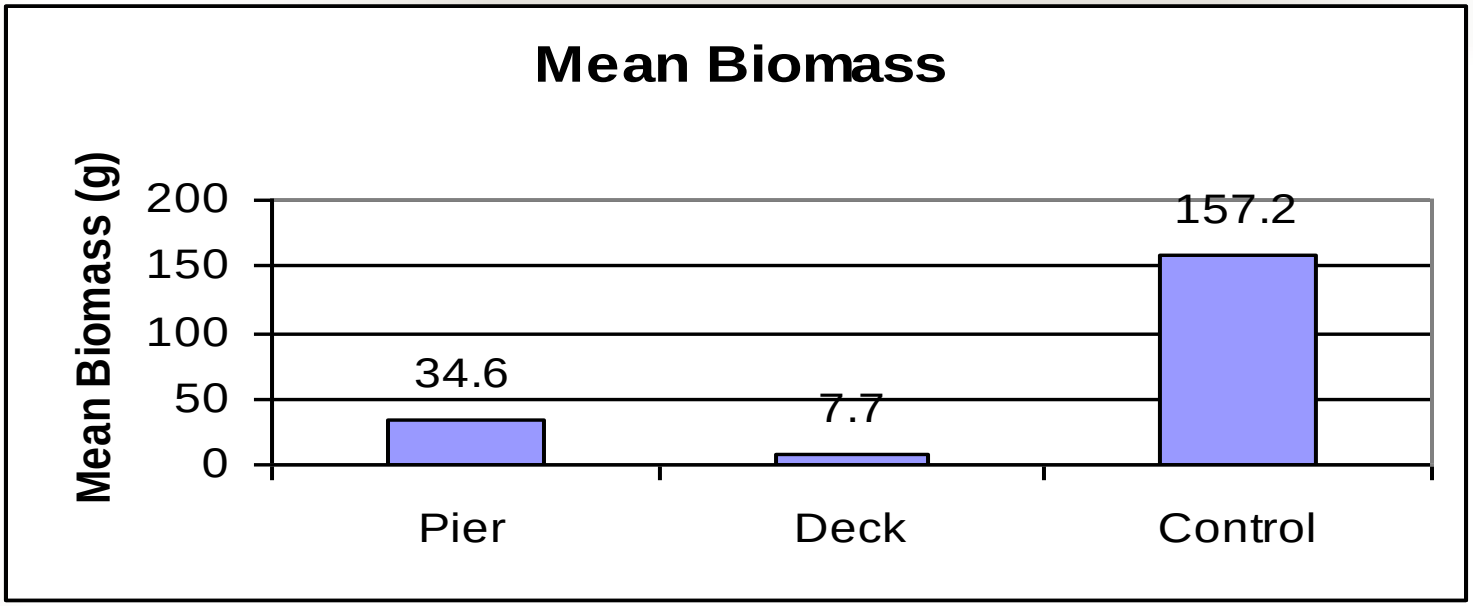
Improve Water Clarity
Fish and Wildlife Habitat
Hold Sediments
Nutrient Cycling
Invertebrates
Aesthetics

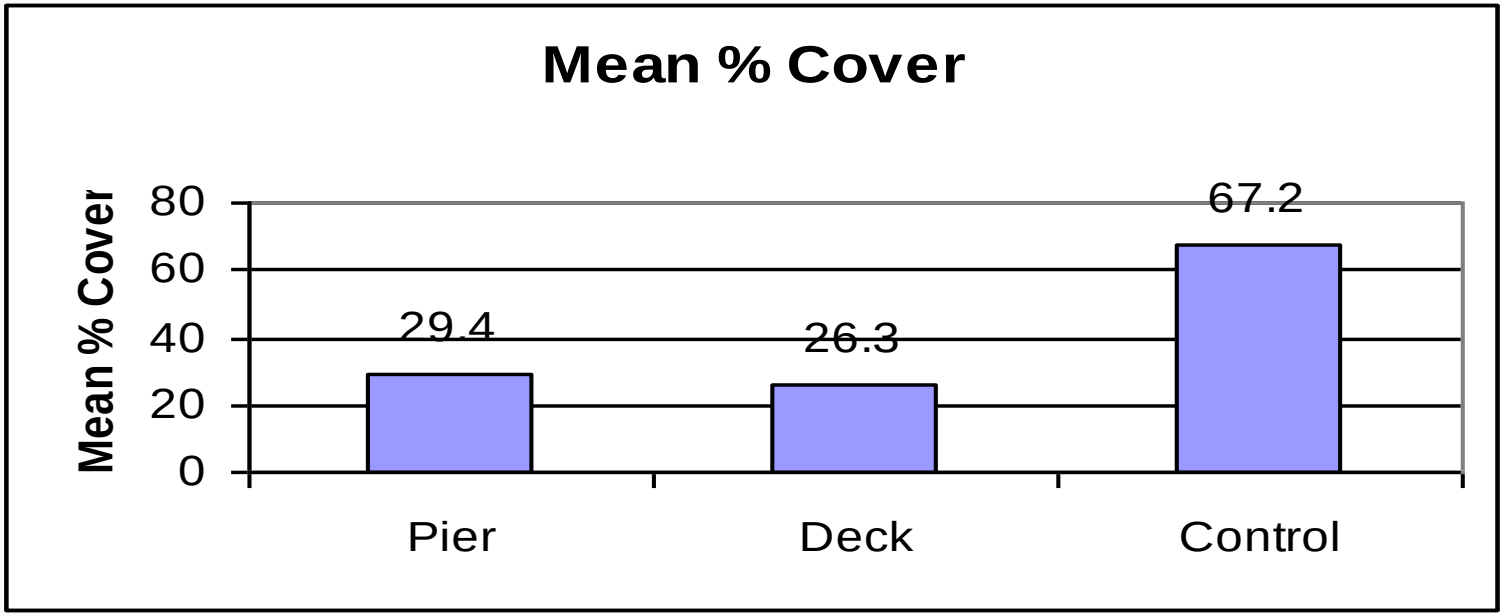
Effects of Pier Shading on Near-Shore Aquatic Habitat

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

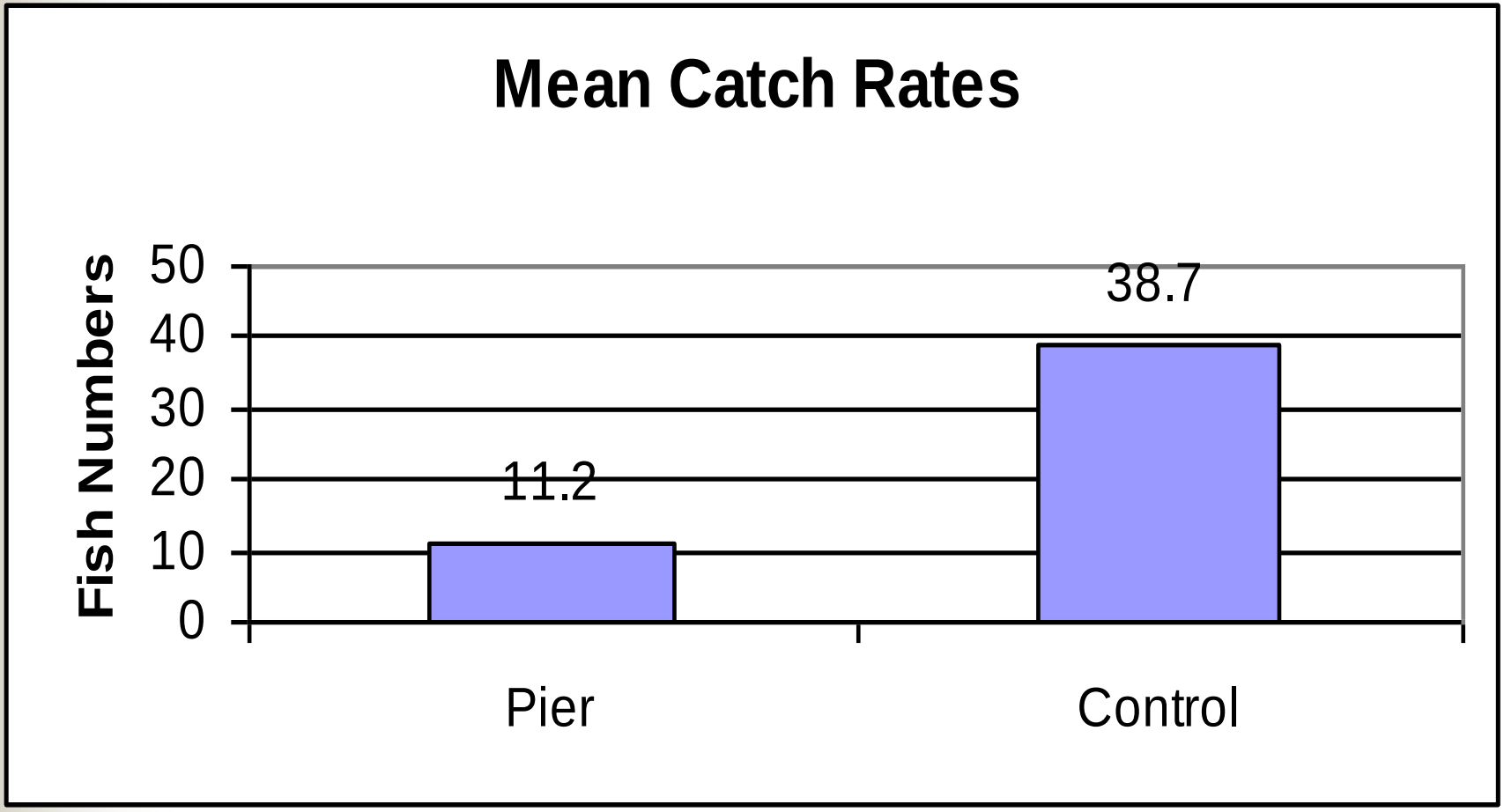


Ecological Effects of Piers on Aquatic Plants

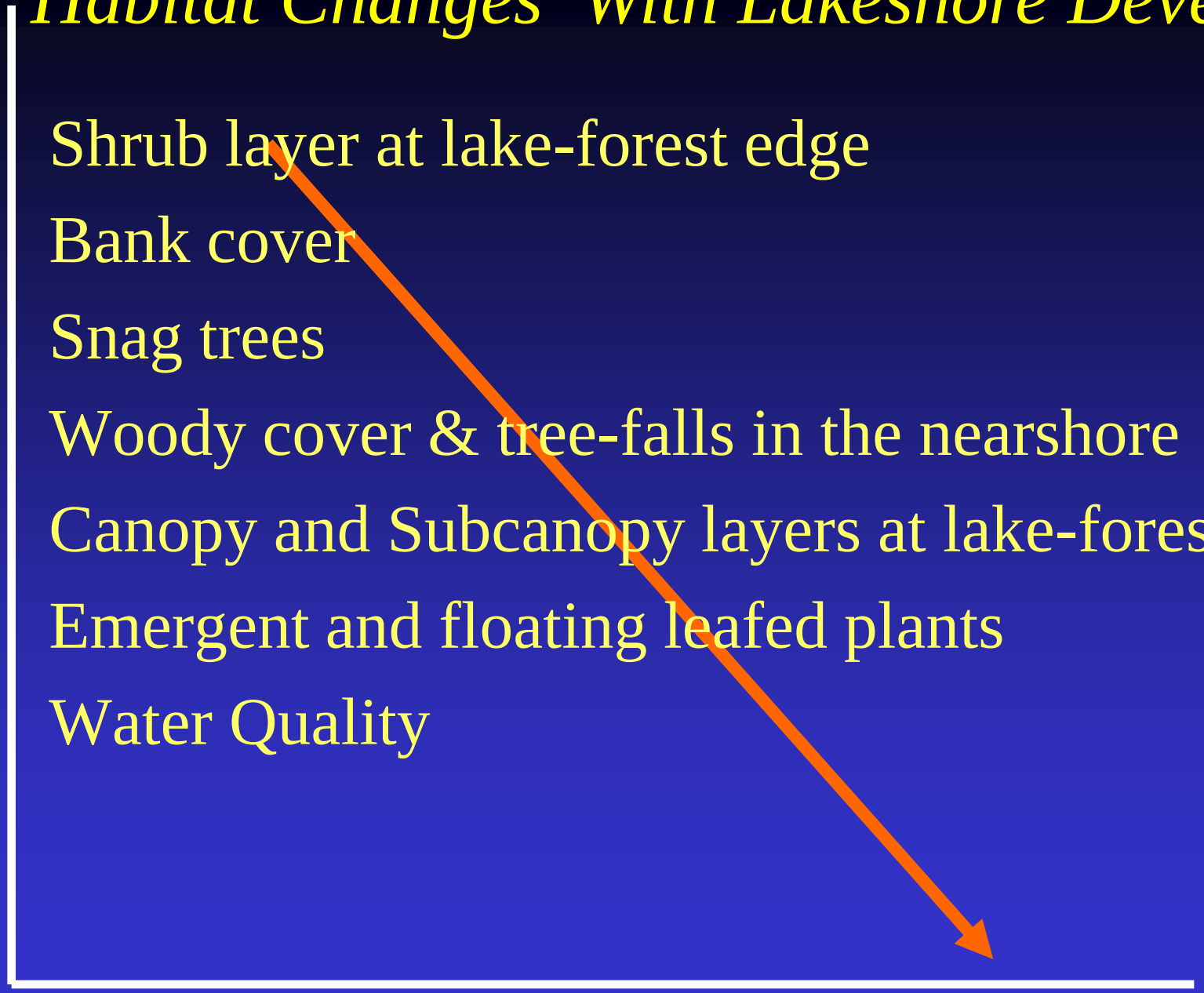


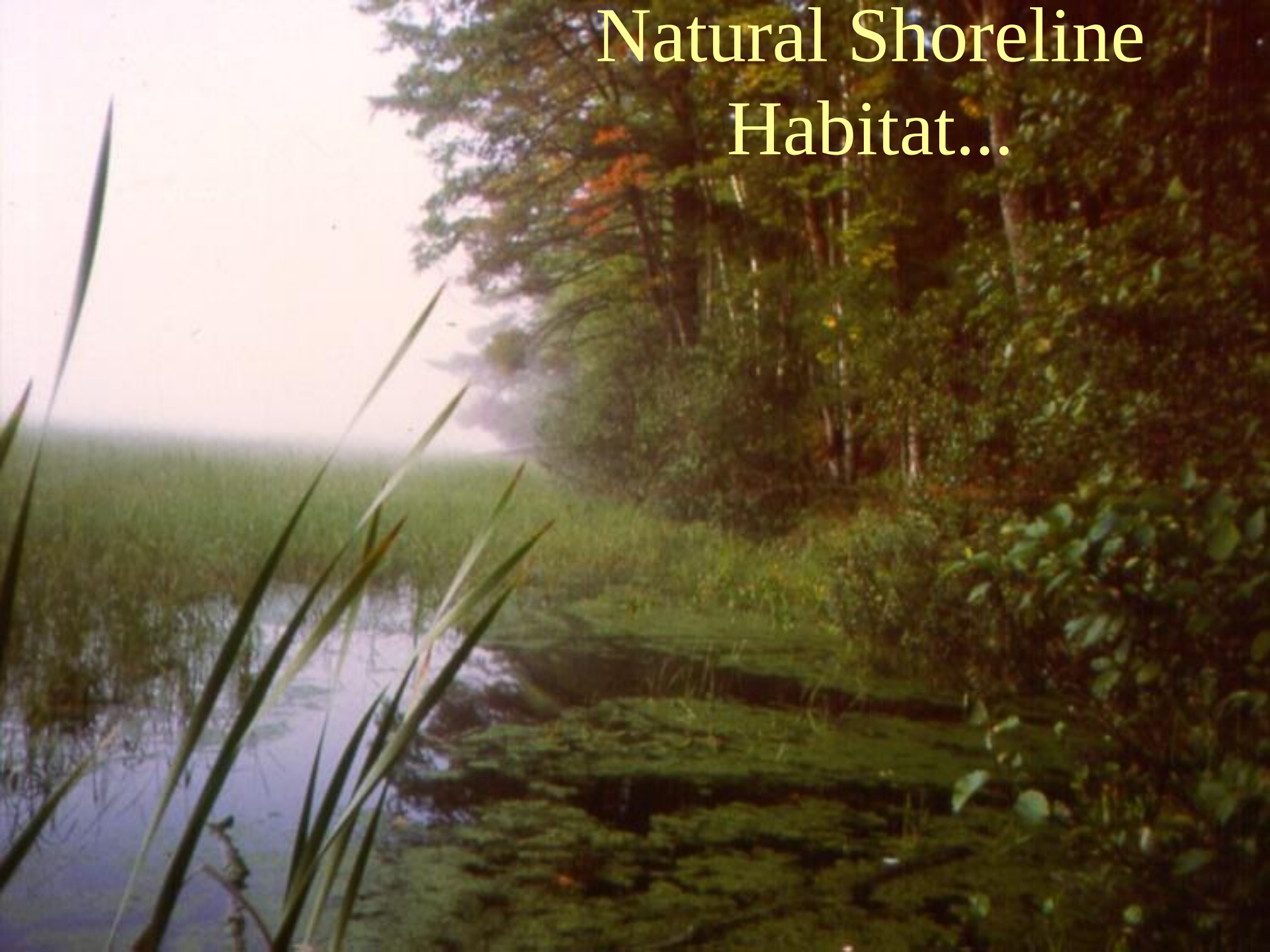


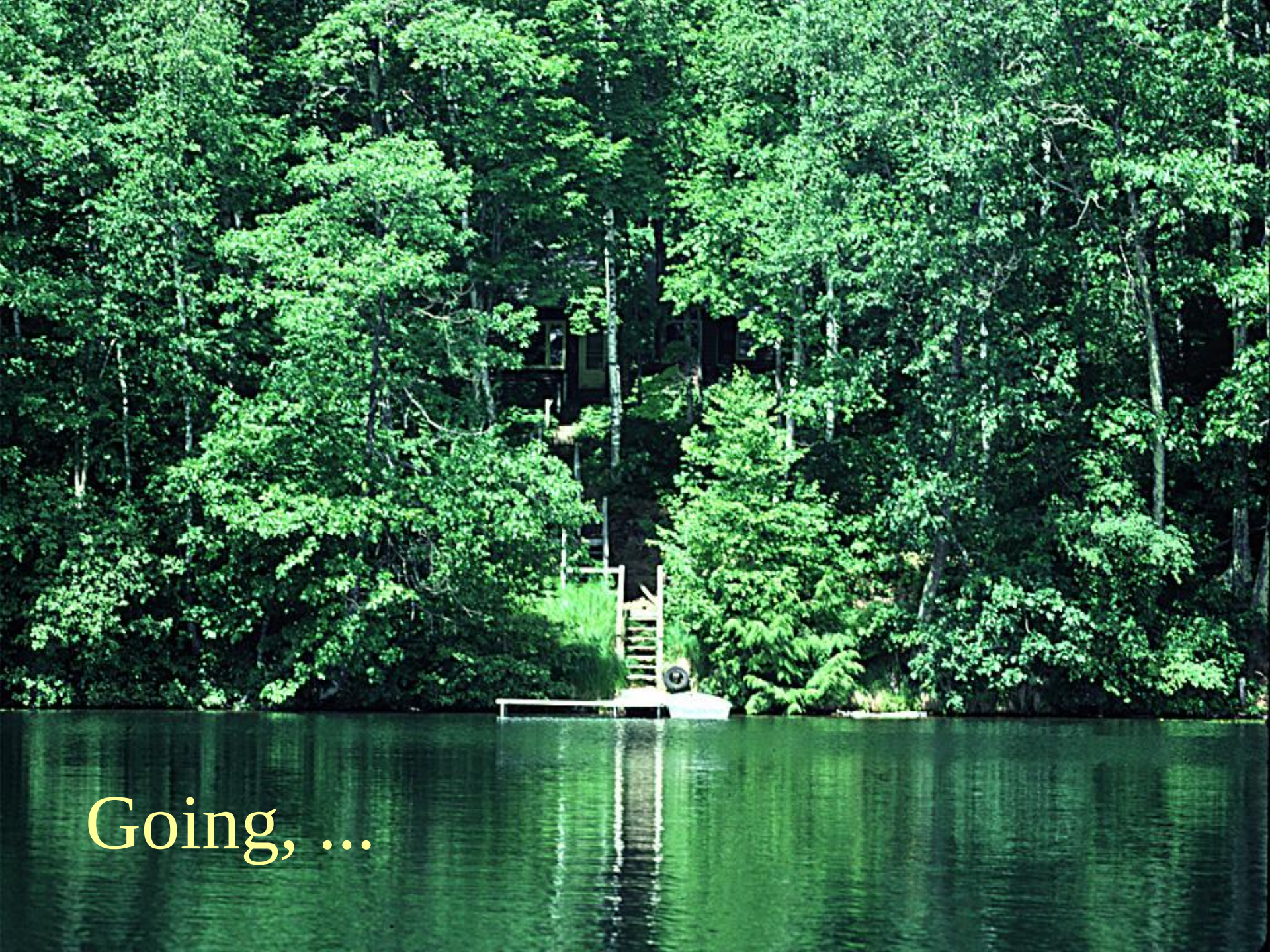
Ecological Effects of Piers on Fish



Habitat Changes With Lakeshore Development




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

Lake Tomahawk, Oneida County