HOW IS MY LAKE DOING? FROM SEDIMENT TO SATELLITES

Paul Garrison
& Eric Erdmann

Bureau of Science Services

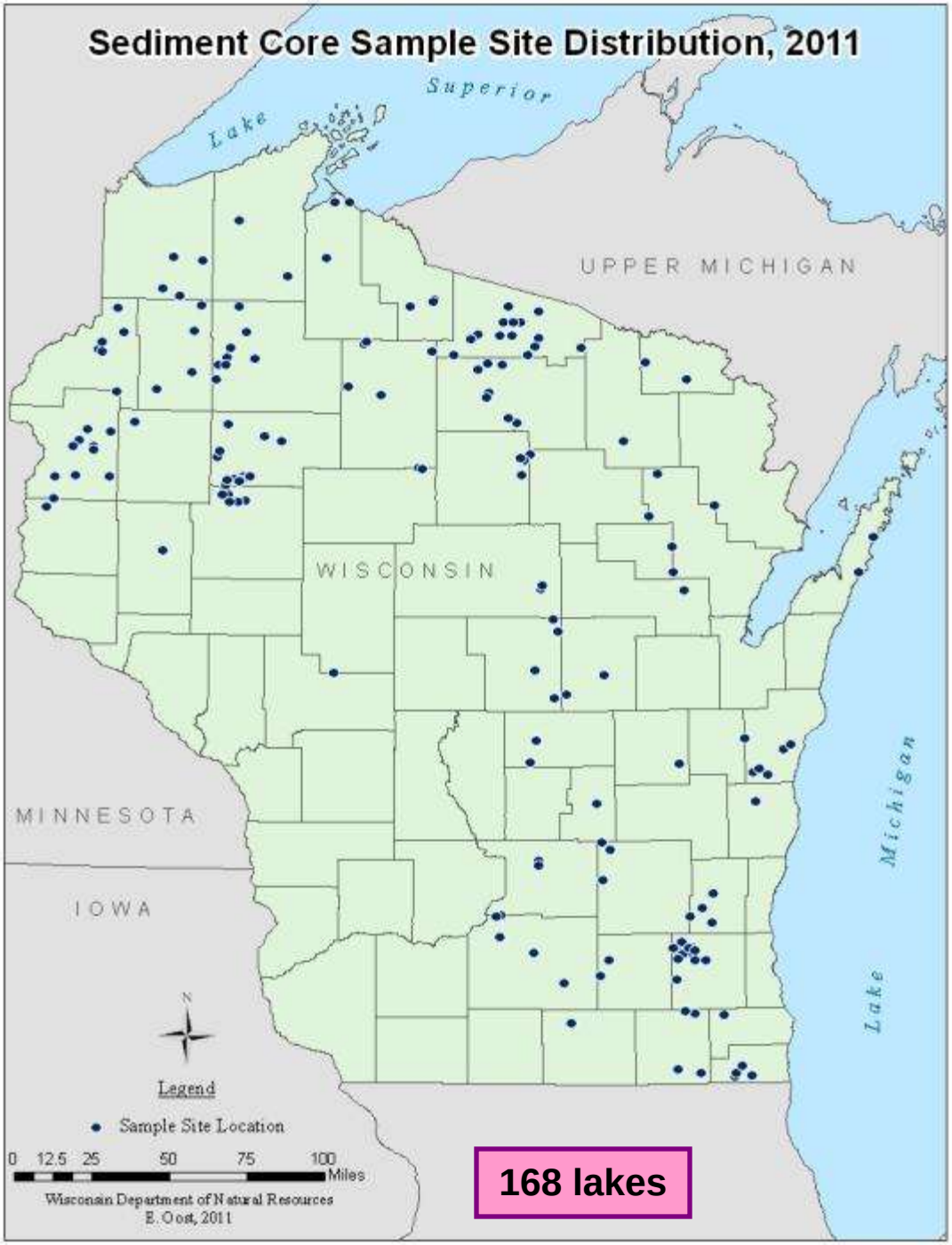
HOW WE MONITOR LAKES

- **Sediment Cores**
  - **Timeline: century**
- **Lake Sampling**
  - **Timeline: annual to decades**
  - Citizen Based Monitoring
  - Long Term Trends
  - Special Projects
- **Satellite**
  - **Timeline: decades**
  - Large spacial coverage

HOW DO YOU COLLECT SEDIMENT CORES?

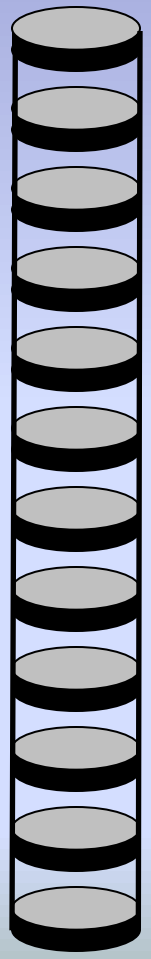
Gravity Corer

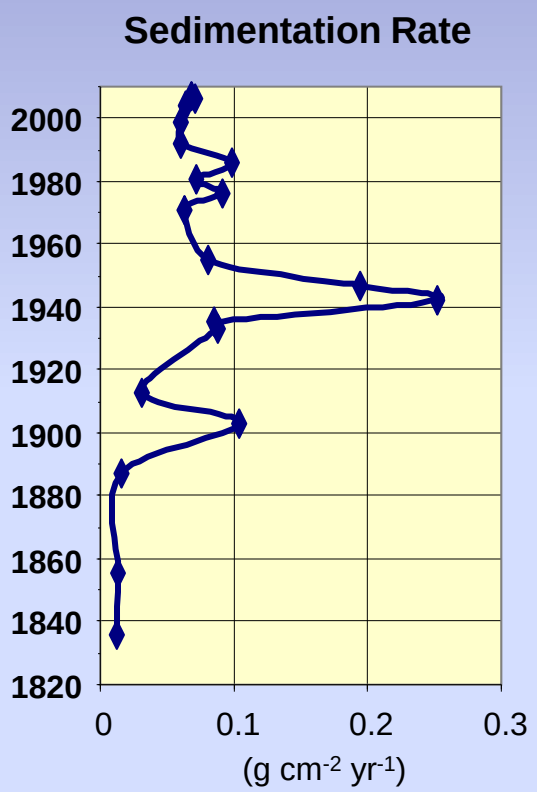
Piston Corer


Sediment Core Sample Site Distribution, 2011
Lake Superior
UPPER MICHIGAN
WISCONSIN
MINNESOTA
IOWA
Lake Michigan
N
Legend
Sample Site Location
0 12.5 25 50 75 100
Miles
Wisconsin Department of Natural Resources
E. Oost, 2011
168 lakes

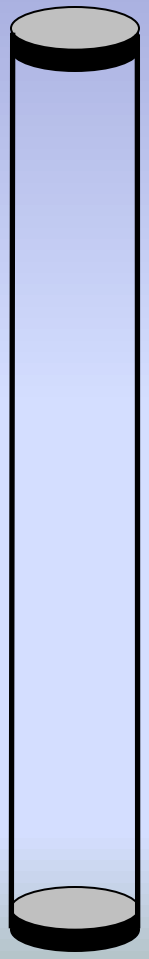
Types of Cores

Full core





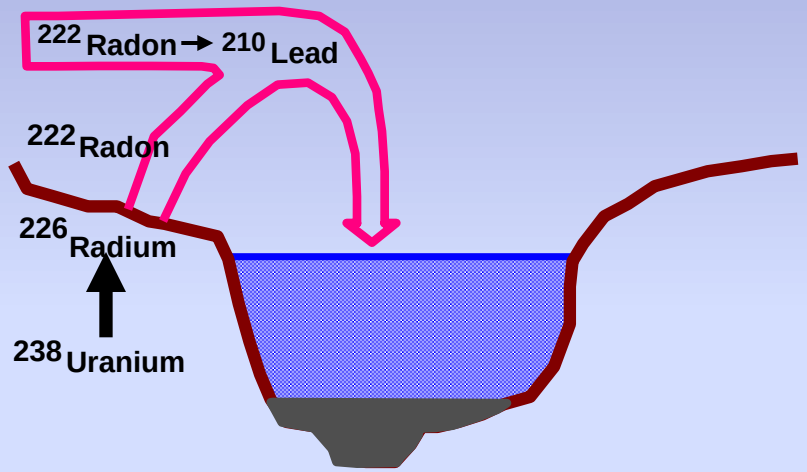
Top/Bottom



Modern

Reference

Lead-210 Dating

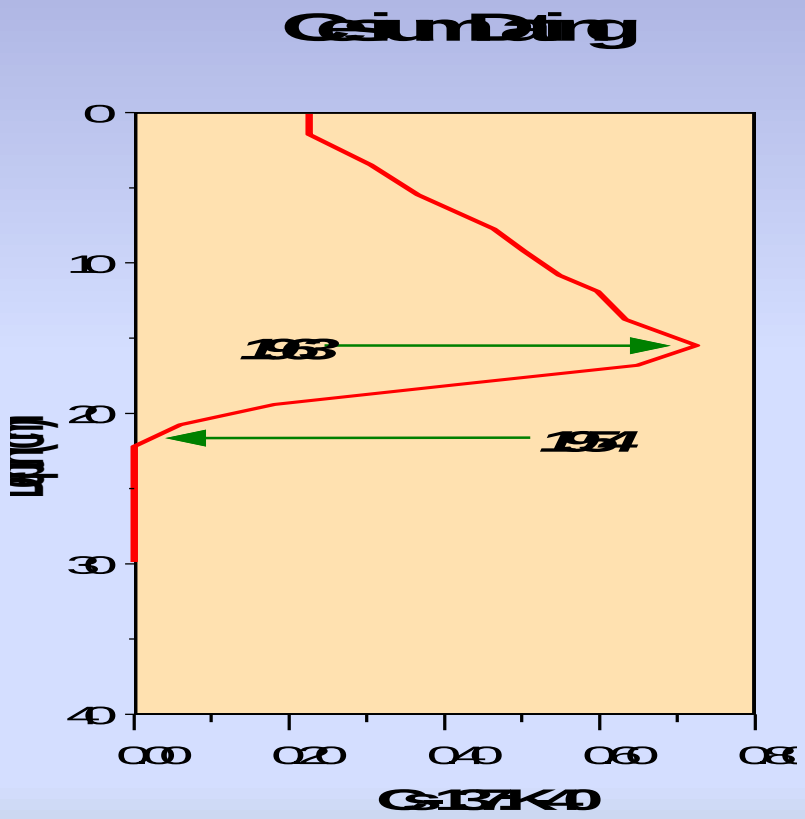


HALF LIVES

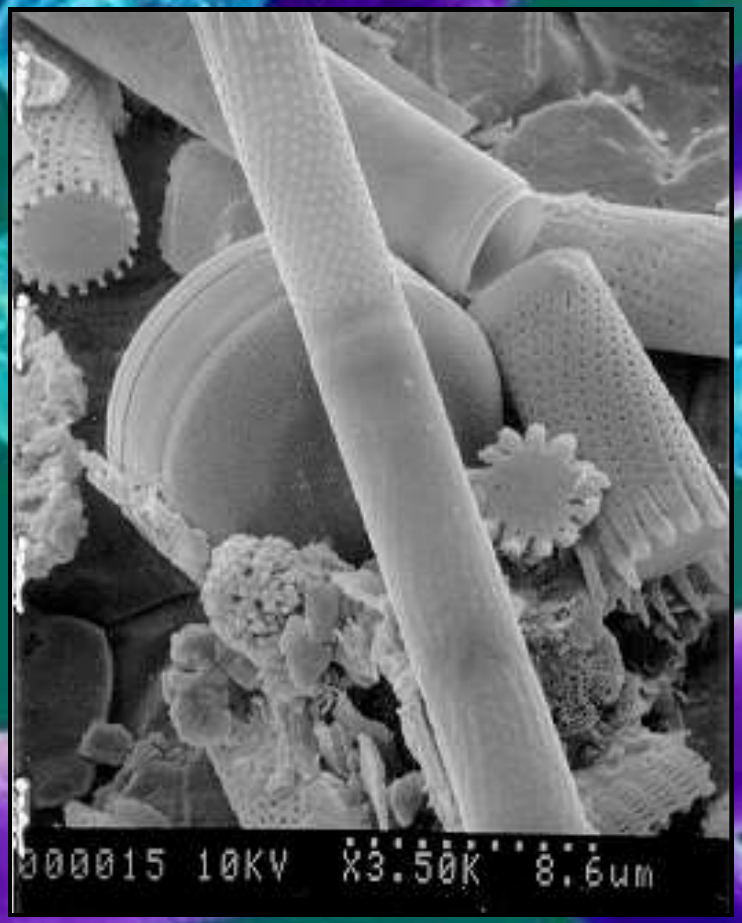
^{226}Radium	1024 yr
^{222}Radon	3.8 days
^{210}Lead	22.26 yr

FALLOUT FROM ATMOSPHERIC BOMB TESTING

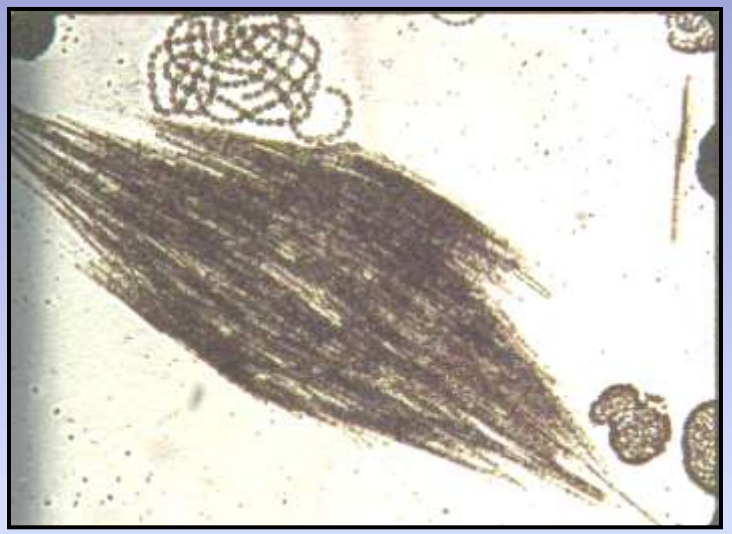
(or Chernobyl or Japan)

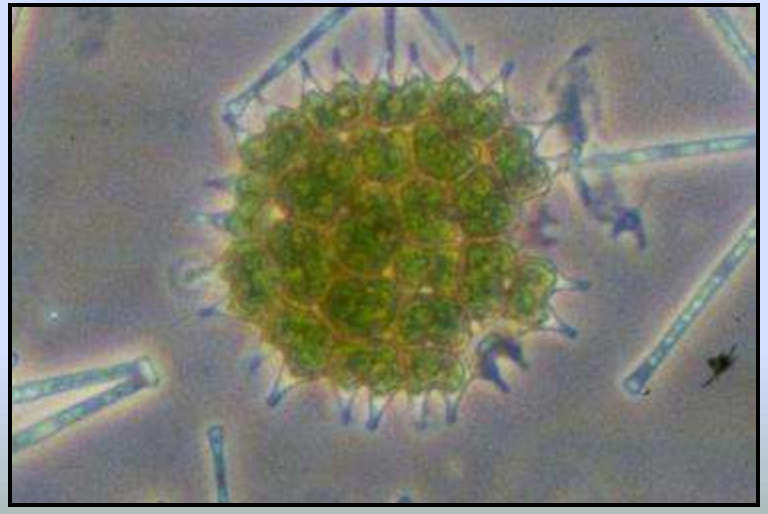


DIATOMS



BLUE-GREEN and GREEN ALGAE





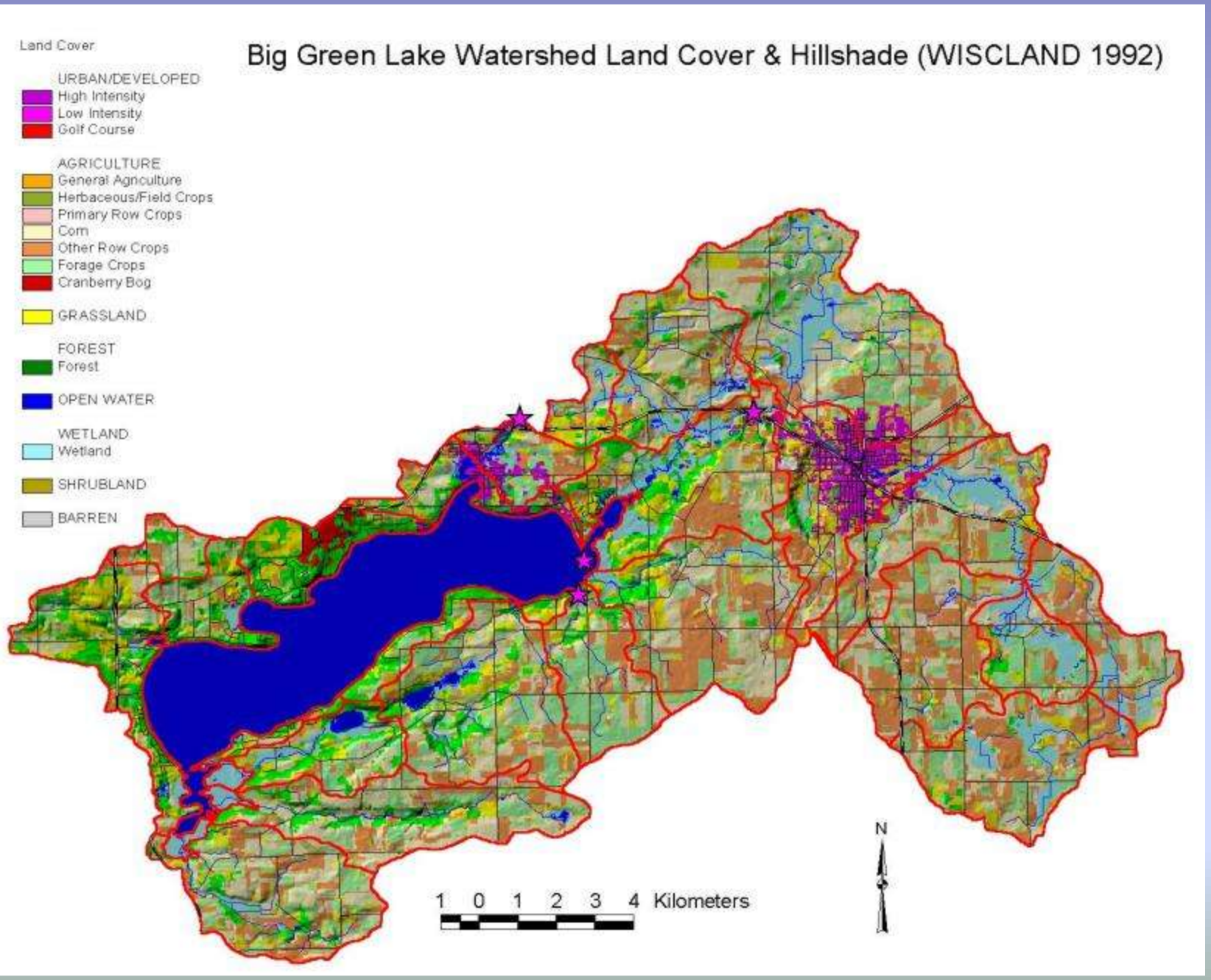
AGRICULTURE

Circa 1880

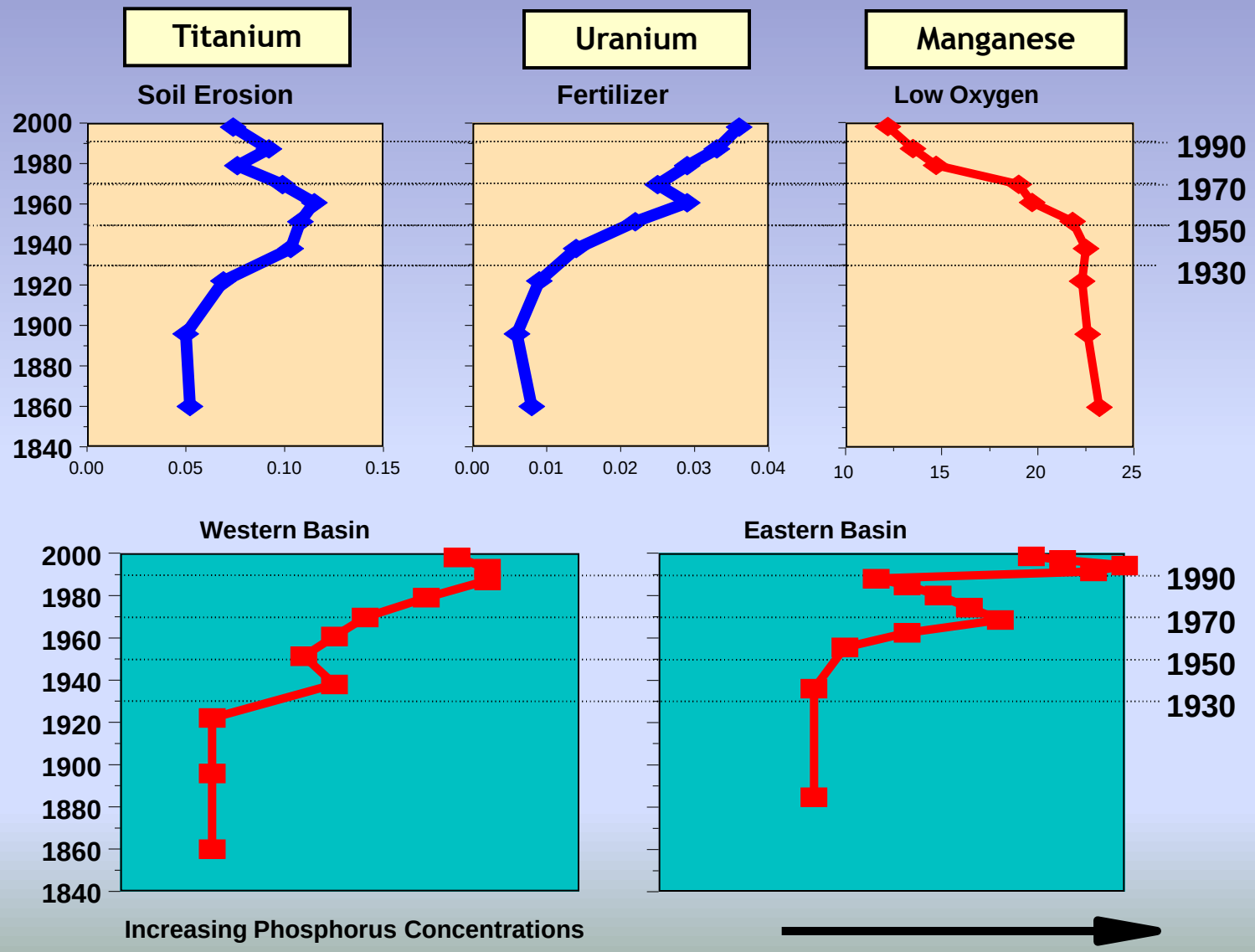
Circa 1910


Green
Lake

Big Green Lake Watershed Land Cover & Hillshade (WISCLAND 1992)



Green Lake


Titanium
Uranium
Manganese
Soil Erosion
Fertilizer
Low Oxygen
2000
1980
1960
1940
1920
1900
1880
1860
1840
0.00
0.05
0.10
0.15
0.00
0.01
0.02
0.03
0.04
10
15
20
25
1990
1970
1950
1930
Western Basin
Eastern Basin
Increasing Phosphorus Concentrations

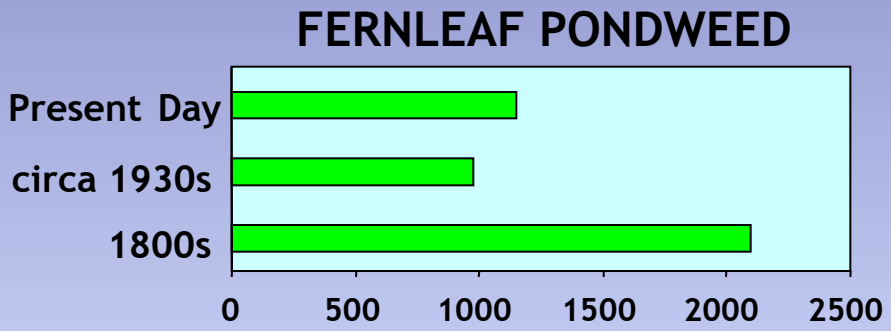
SHORELAND DEVELOPMENT

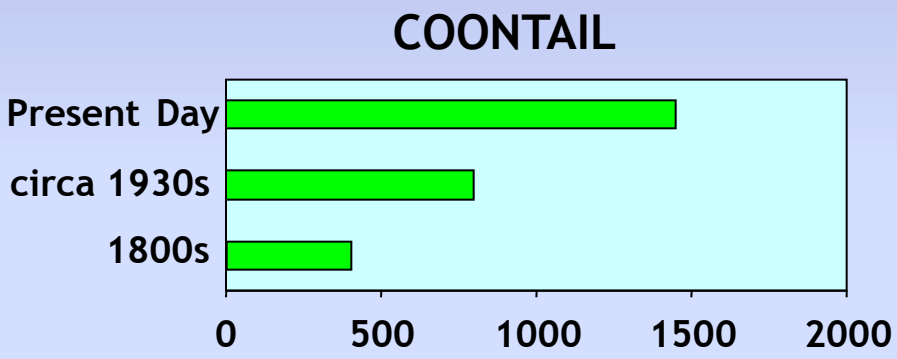
circa 1940

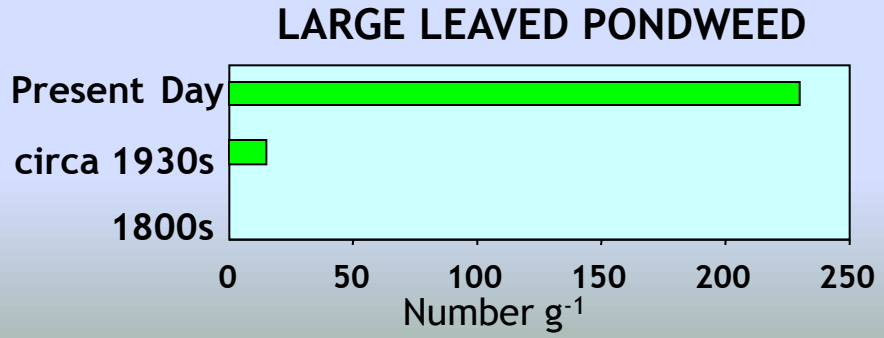
2009


Little
Bearskin
Lake

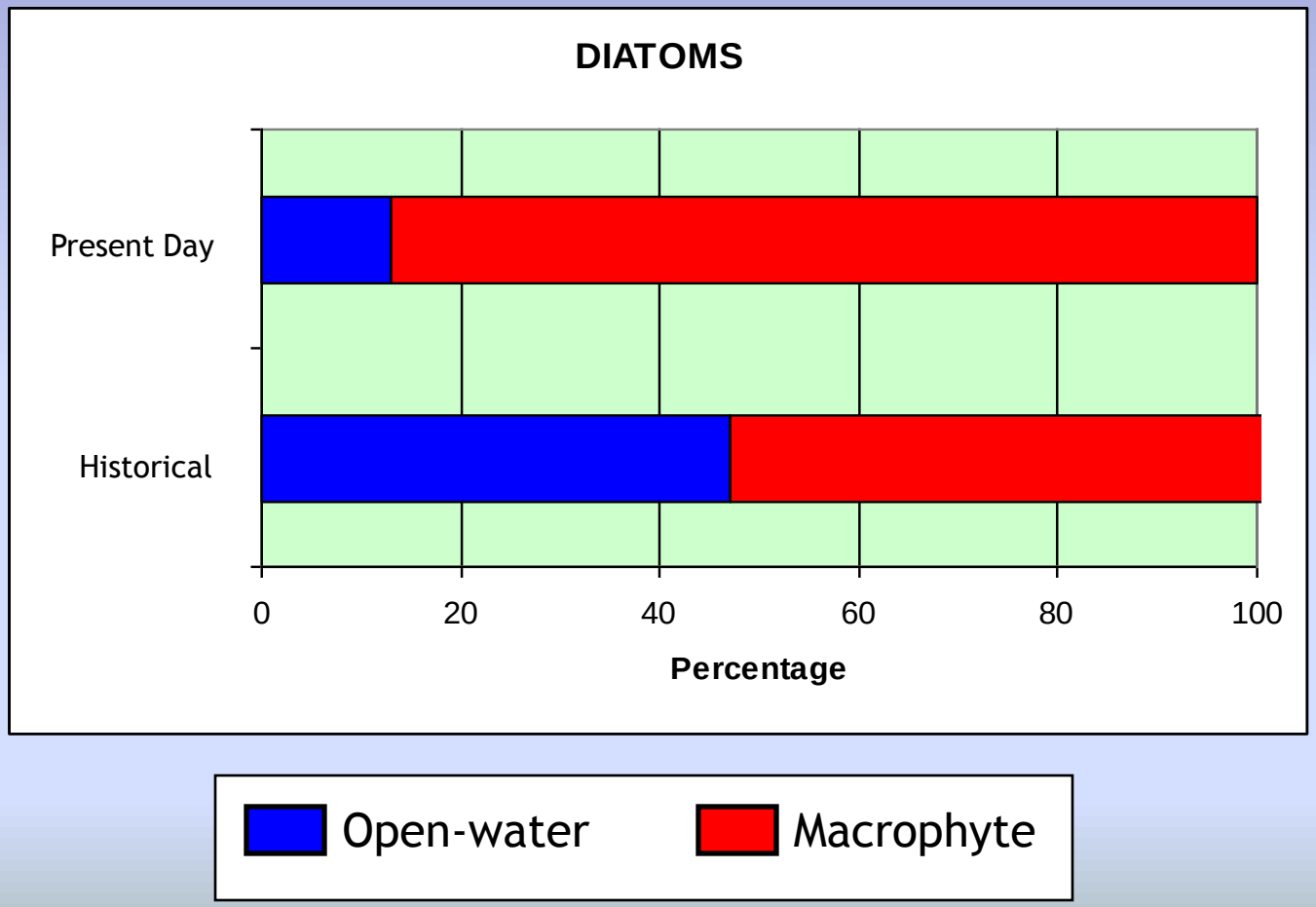
Little Bearskin Lake



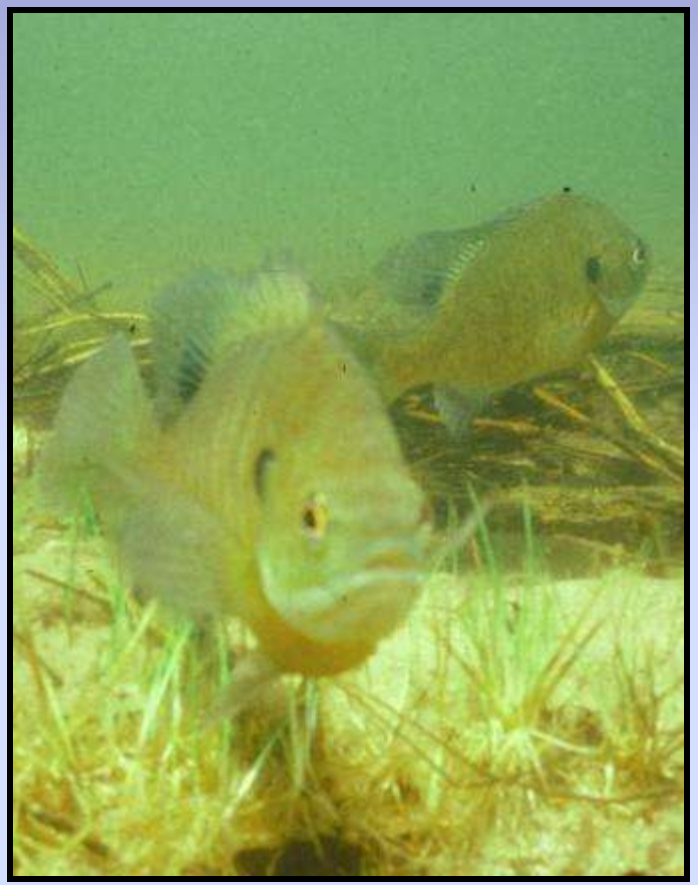




Little Bearskin Lake



Shift in the ratio of isoetids to elodeids



1930s: 50/50

2000s: 30/70

Susan Borman and Ray Newman-U. of Minnesota

CHANGING WATER LEVELS

Berry Lake, Oconto County

LAKE TYPE: Seepage

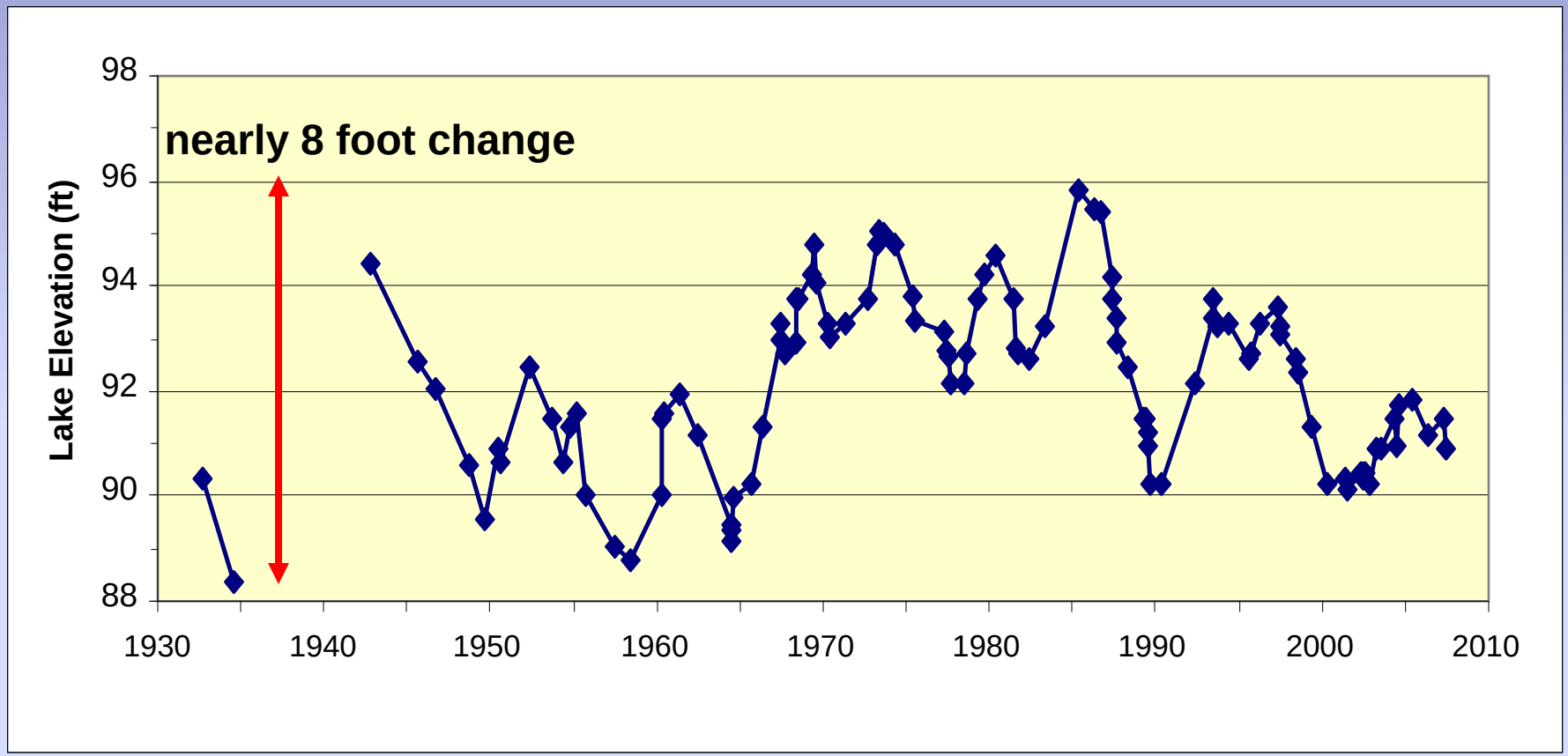
AREA: 200 ac

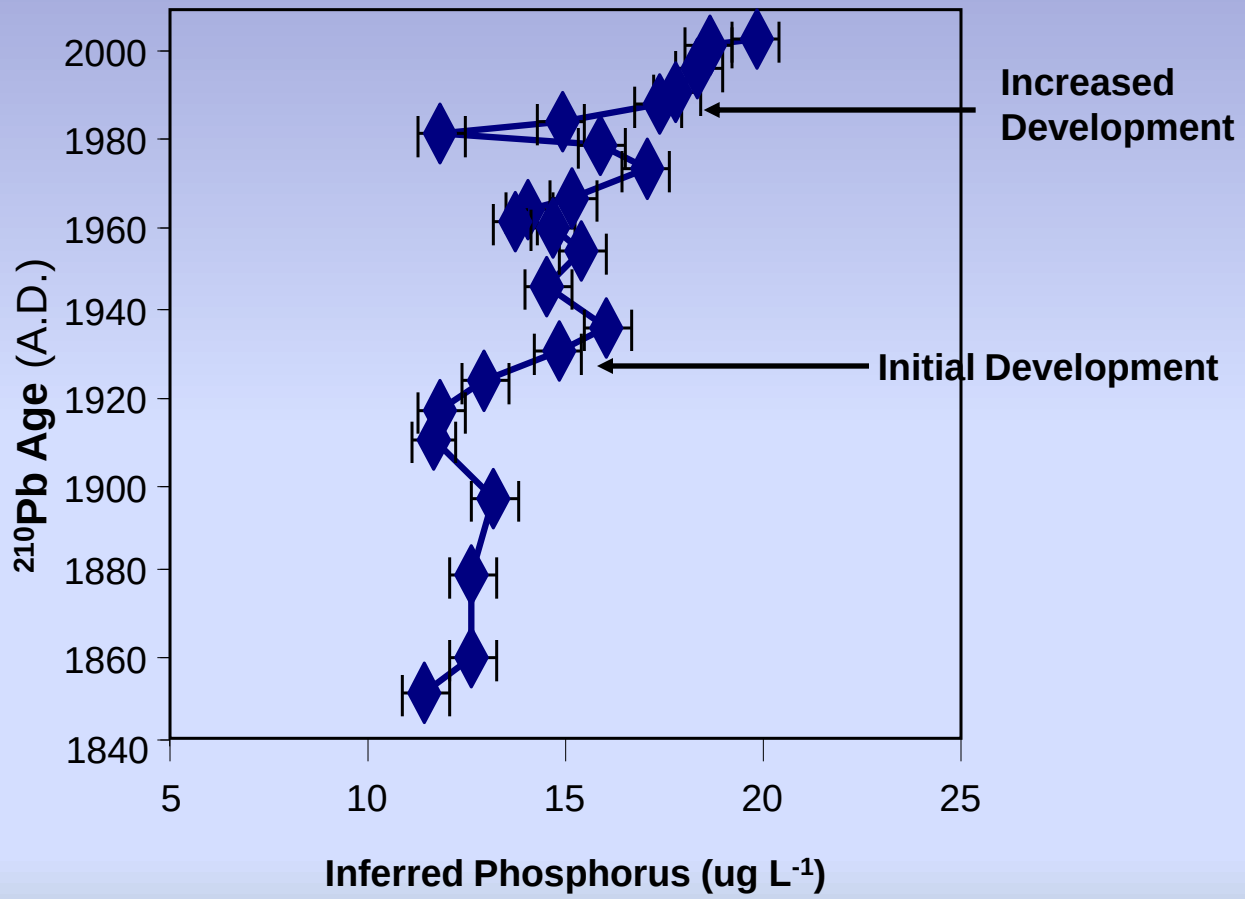
MAXIMUM DEPTH: 27 feet

MEAN DEPTH: 7 feet

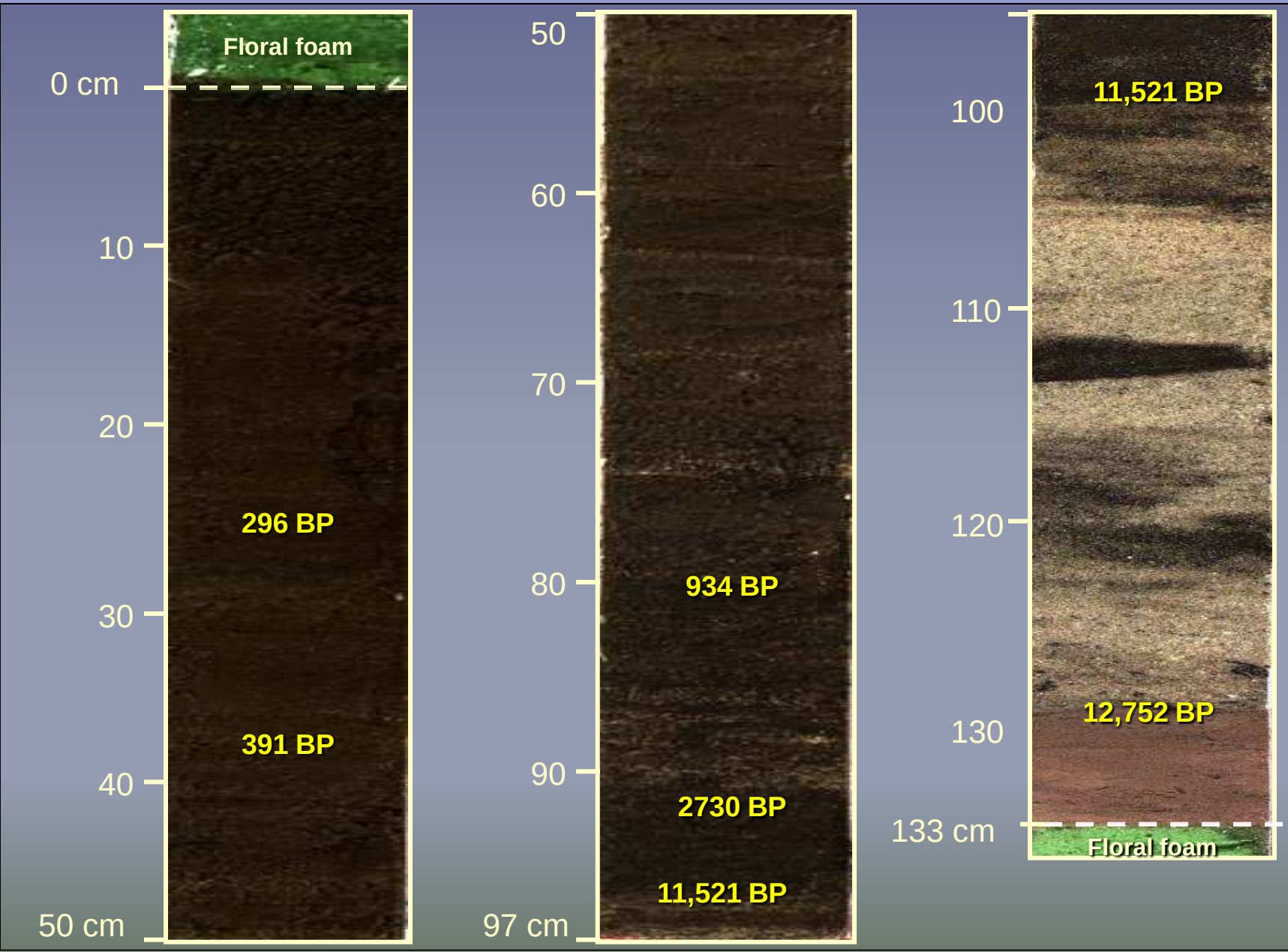
SHORELINE PROPERTIES: 113 or 34 dwellings per mile

LAKE LEVEL


nearly 8 foot change
Lake Elevation (ft)
98
96
94
92
90
88
1930
1940
1950
1960
1970
1980
1990
2000
2010


2000
1980
1960
1940
1920
1900
1880
1860
1840
^{210}Pb Age (A.D.)
5
10
15
20
25
Inferred Phosphorus (ug L^{-1})
Increased Development
Initial Development

Dr. Samatha Kaplan—
UW Stevens Point



SUMMARY

- Many lakes with significant agriculture in their watersheds have experienced a reduction in soil erosion during the last 30 years but not necessarily a reduction in nutrient input because of the use of synthetic fertilizers.

- In northern lakes that have experienced increased shoreland development during the last 2-3 decades, phosphorus levels may not have increased, but nearly all of these lakes have experienced an increase in plant growth.

- With a change in our climate - watershed landuse will have the greatest impact on nutrients.

LAKETIDES

Winter 2007

Paleolimnology
History in the Mucking

Lake folks often get into lively discussions over what the lake used to be like...more plants, fewer plants, clear water, murky water... Is there any way to really know for sure? Well, the answer is yes! In fact we can have a good idea of what lakes used to be like hundreds of years ago with a science called Paleolimnology.

Winter 2008

Paleolimnology
A Reflection of Our History

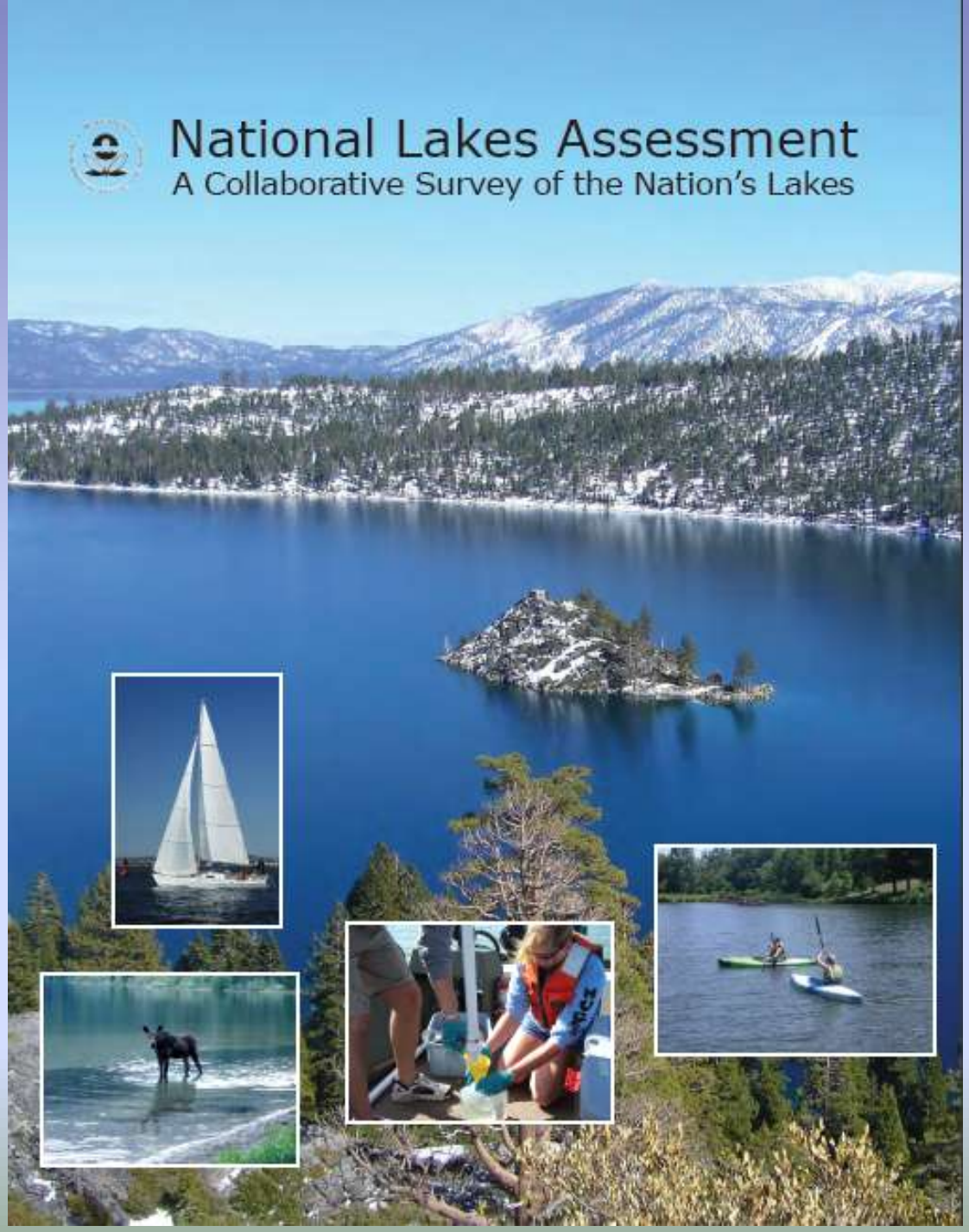
An article in Lake Tides *(vol. 32, no. 1), "Paleolimnology: History in the Mucking," discussed how sediment cores are taken and utilized to understand past changes in lakes. This article will take us on a historical journey that links changes on the landscape with environmental impacts to our lakes, which are revealed in the lake sediments.*

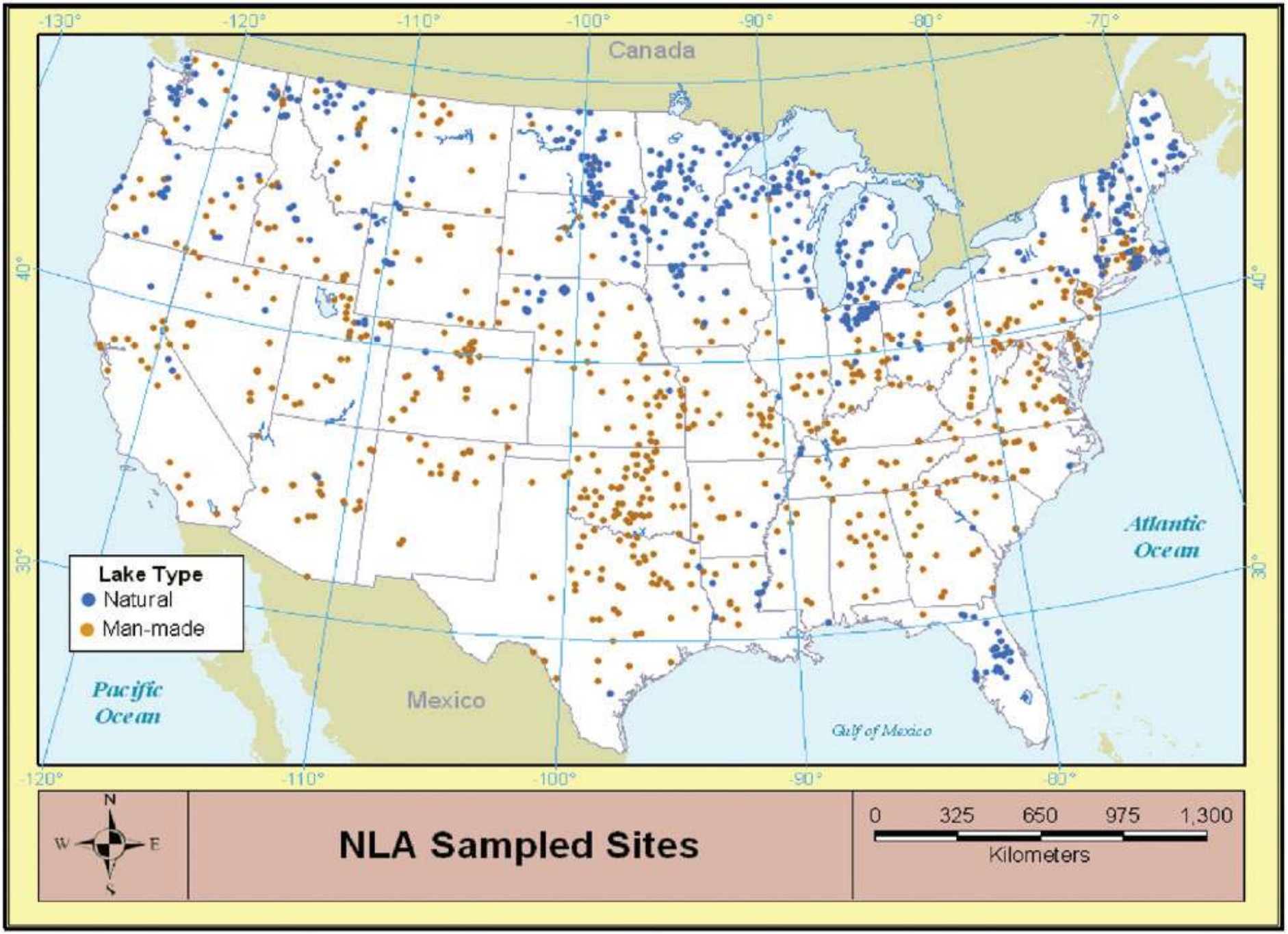
on the land. The opening of the forest allowed large amounts of sediments and nutrients to be exported from the land to the water.

Major events in the history of our country, like World War II, had definite impacts on our lakes. World War II marked another period in which agricultural practices intensified. To

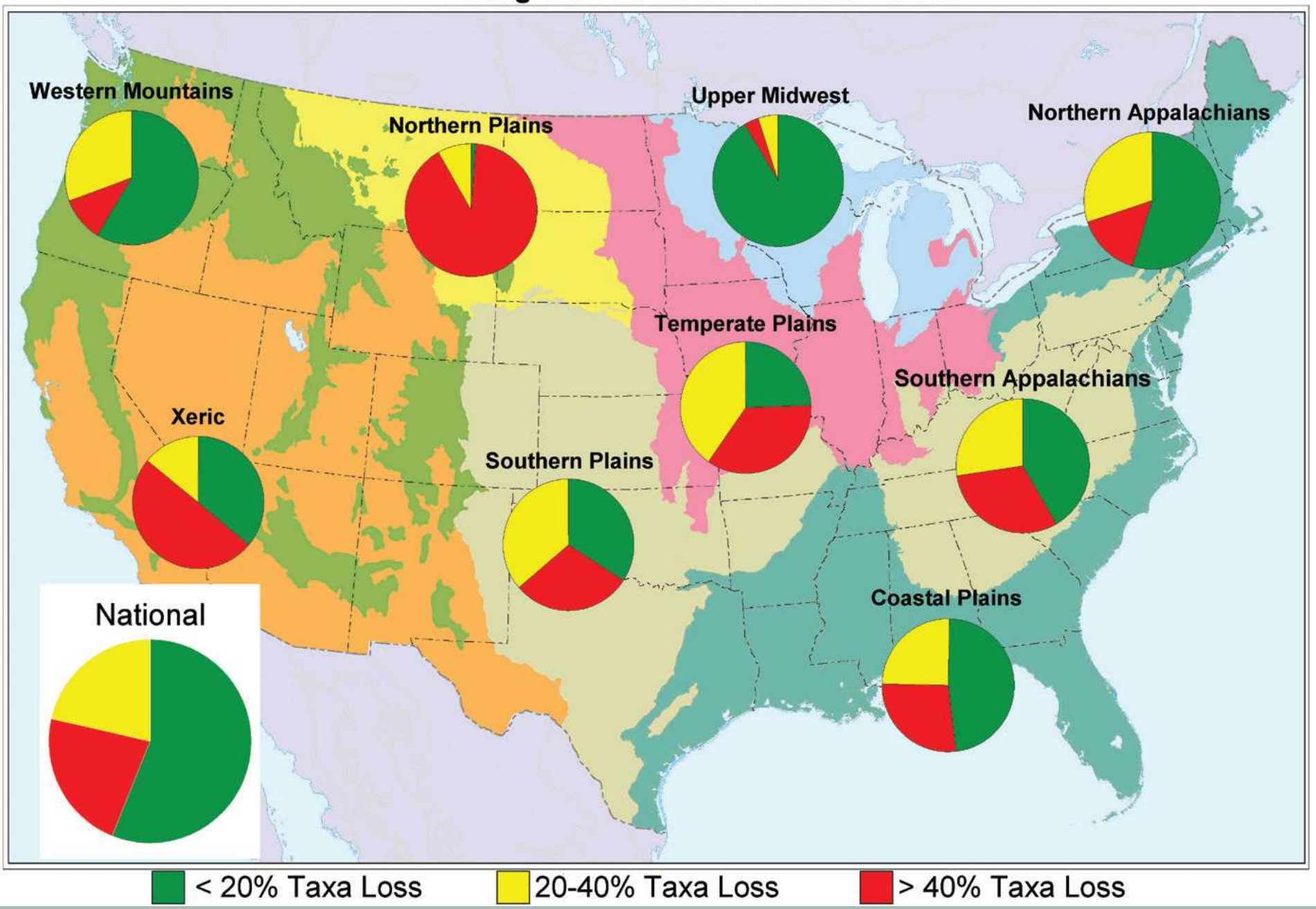
National Lakes Assessment

A Collaborative Survey of the Nation's Lakes

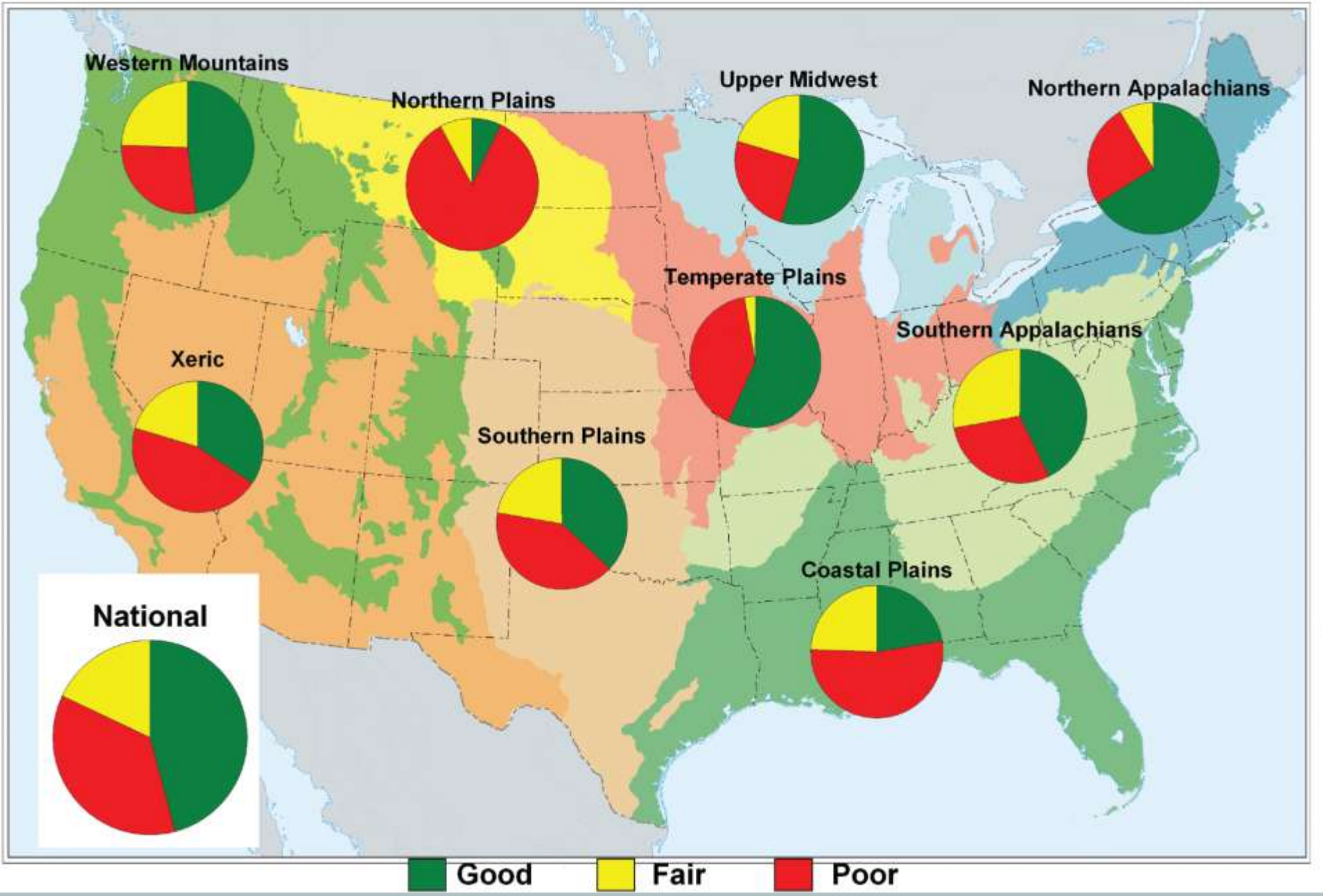



-130°
-120°
-110°
-100°
-90°
-80°
-70°
Canada
40°
30°
Lake Type
Natural
Man-made
Atlantic Ocean
Pacific Ocean
Mexico
Gulf of Mexico
N
W
E
S
NLA Sampled Sites
0
325
650
975
1,300
Kilometers

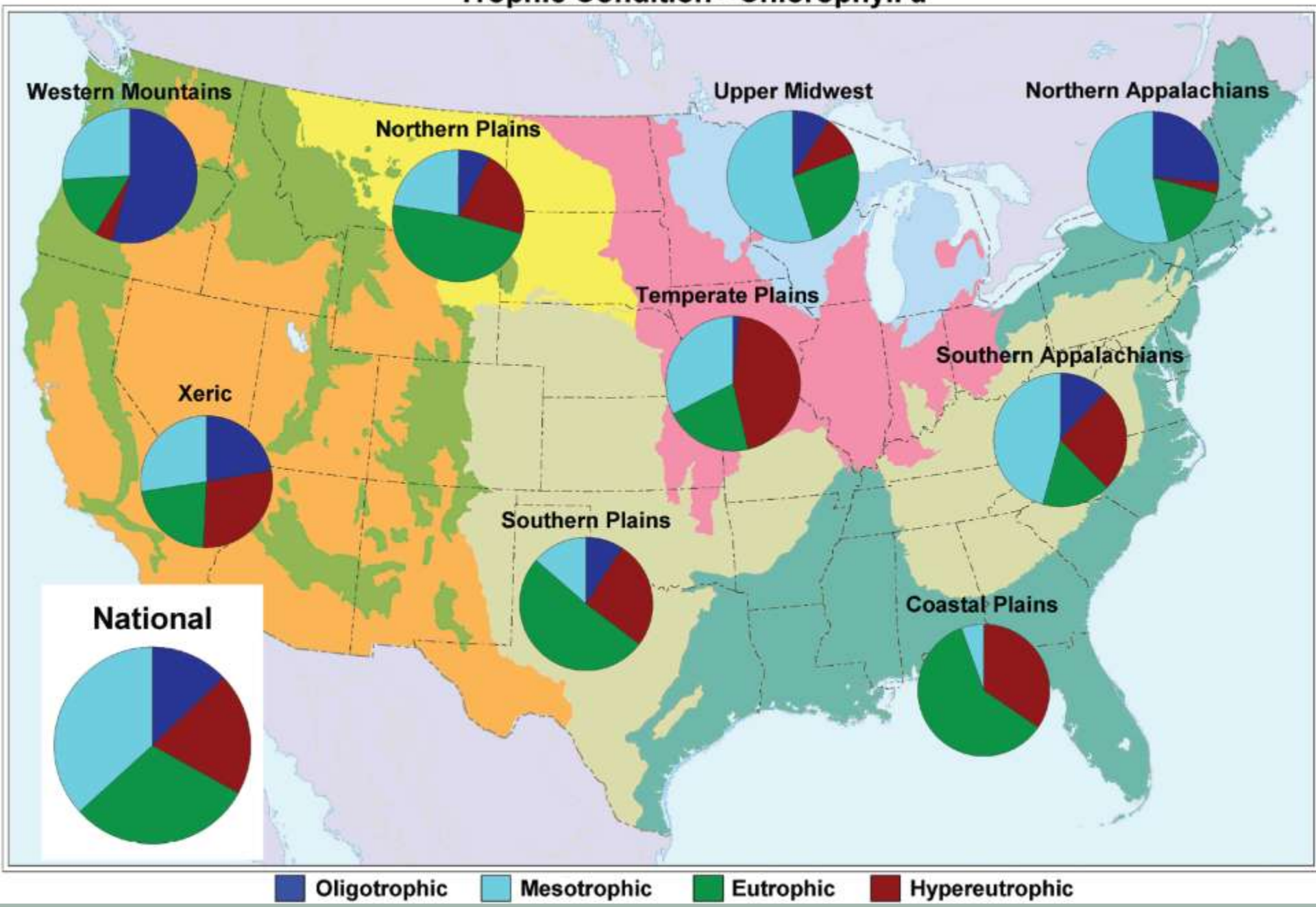
Biological Condition - Planktonic O/E



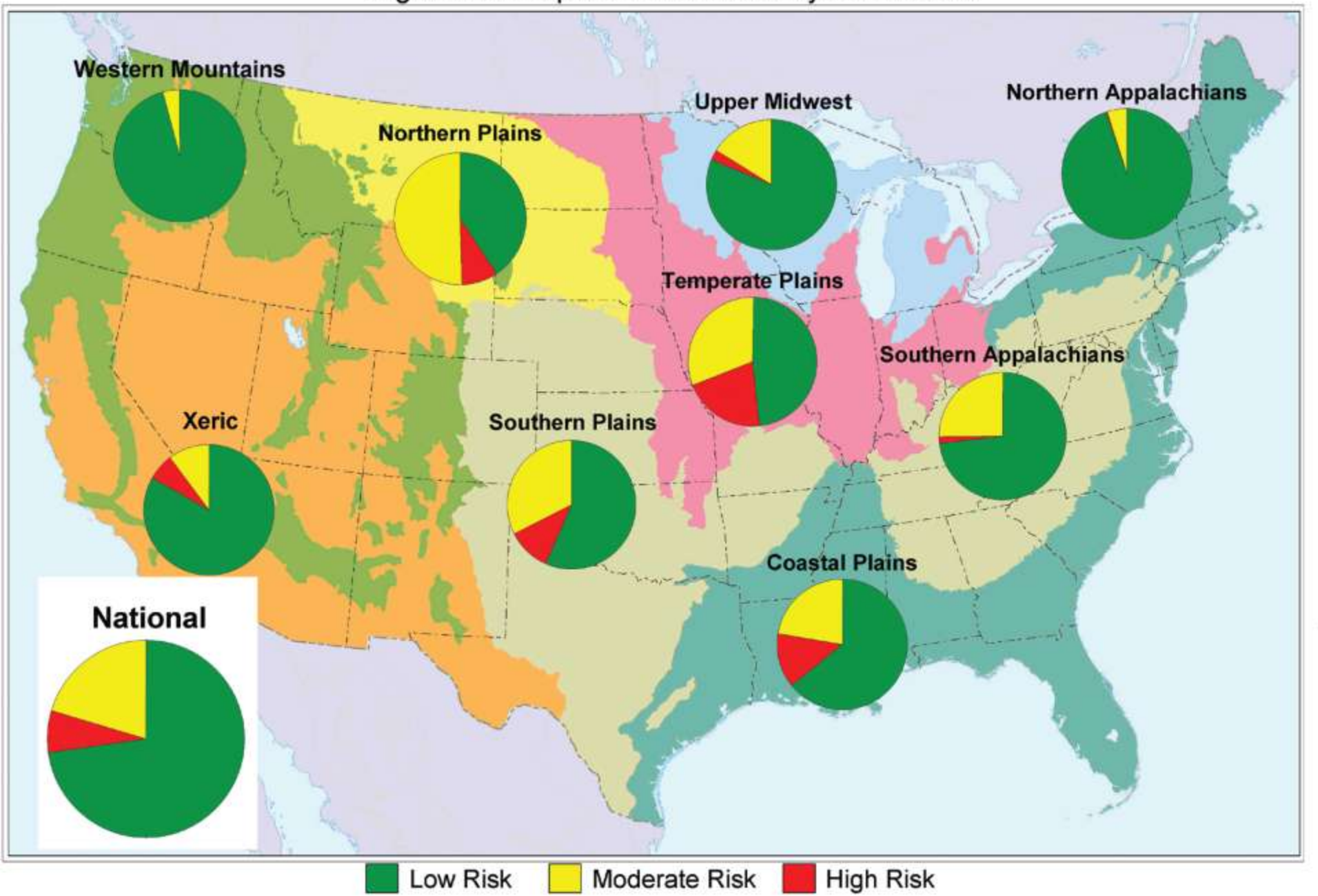
Lakeshore Habitat



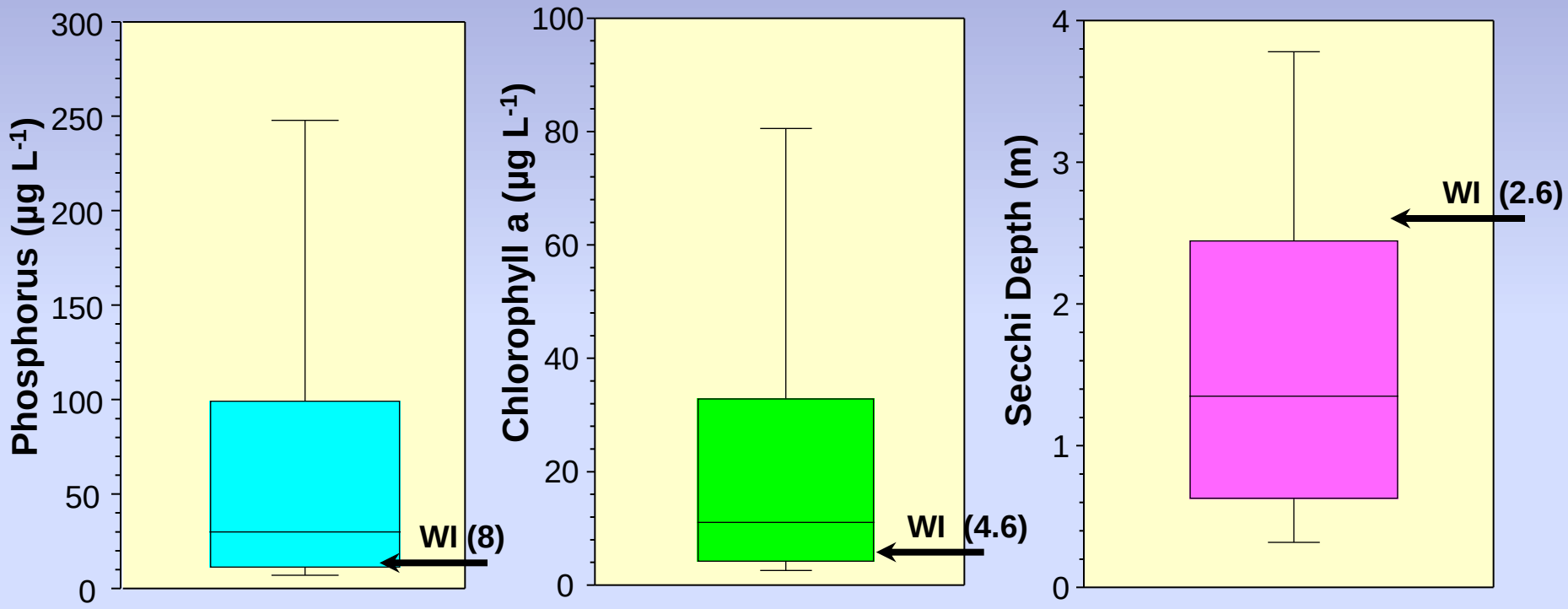
Trophic Condition - Chlorophyll *a*



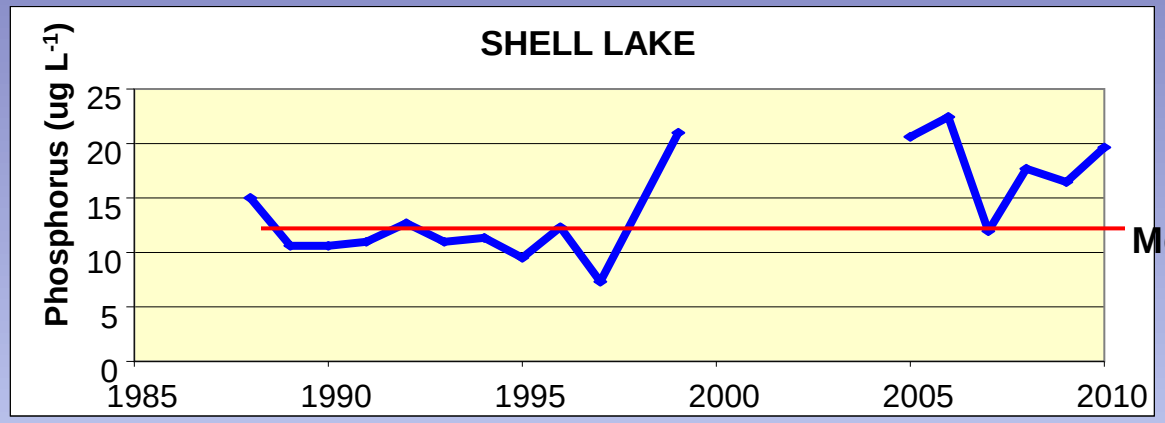
Algal Toxin Exposure Risk from Cyanobacteria

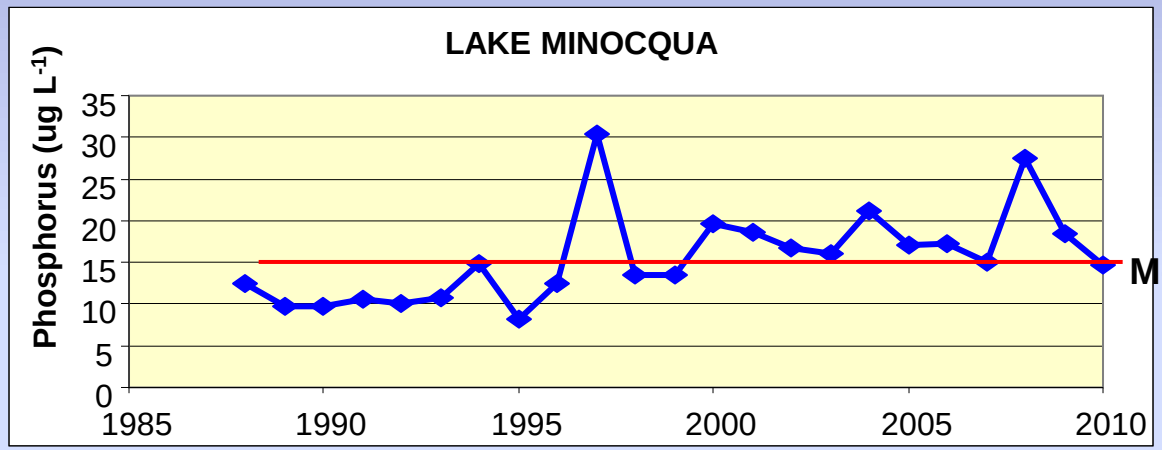


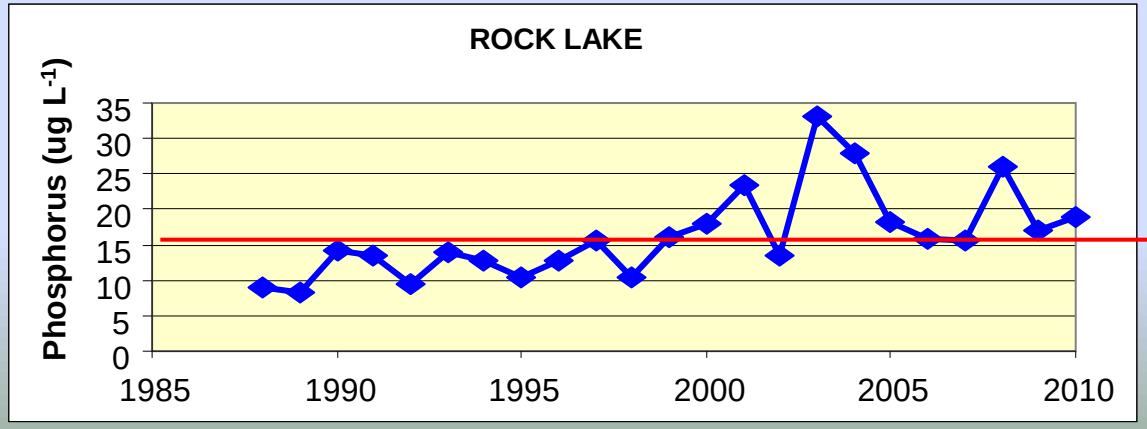
TROPHIC VARIABLES




Wisconsin Long-Term Trend (LTT) Lakes
Lake Superior
UPPER MICHIGAN
WISCONSIN
MINNESOTA
IOWA
Lake Michigan
Amnicon
Eau Claire Lakes
Mineral
Diamond
McKenzie
Shell
Lac Courte Oreilles
Silver
Cedar
Squaw
Bass
Long
Round
Axhandle
Tainter
Kentuck
Keyes
Franklin
Minocqua
Lost
Patten
Musser Flowage
Pelican
Rolling Stone
Bear Paw
Pike
Big Bass
Shawano
White Clay
Clark
Collins
School Section
Emily
Silver
Sherwood
Long
Winnebago
Green
Crystal
Long
Redstone
Mason
Fox
Cedar
Devils
Keesus
Rock
Pewaukee
Ripley
Nagawicka
School Section
Phantom
Browns
Yellowstone
Mary
Legend
Location of LTT Study Lakes
0 12.5 25 50 75 100 Miles
Wisconsin Department of Natural Resources
E. Oost, 2011
58 lakes


SHELL LAKE
Phosphorus (ug L-1)
25
20
15
10
5
0
1985
1990
1995
2000
2005
2010
Median


LAKE MINOCQUA
Phosphorus (ug L-1)
35
30
25
20
15
10
5
0
1985
1990
1995
2000
2005
2010
Median


ROCK LAKE
Phosphorus (ug L-1)
35
30
25
20
15
10
5
0
1985
1990
1995
2000
2005
2010
Median