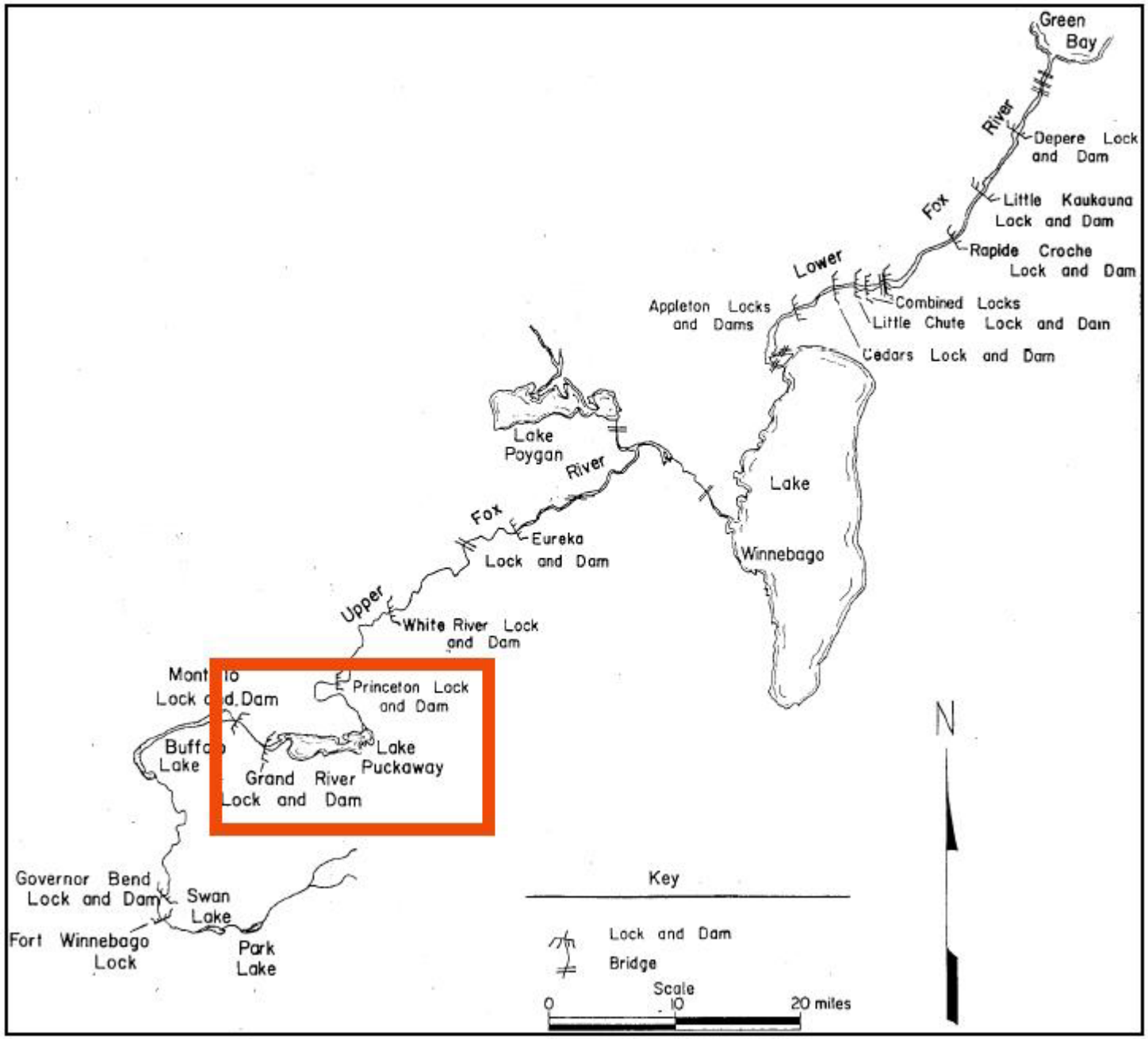
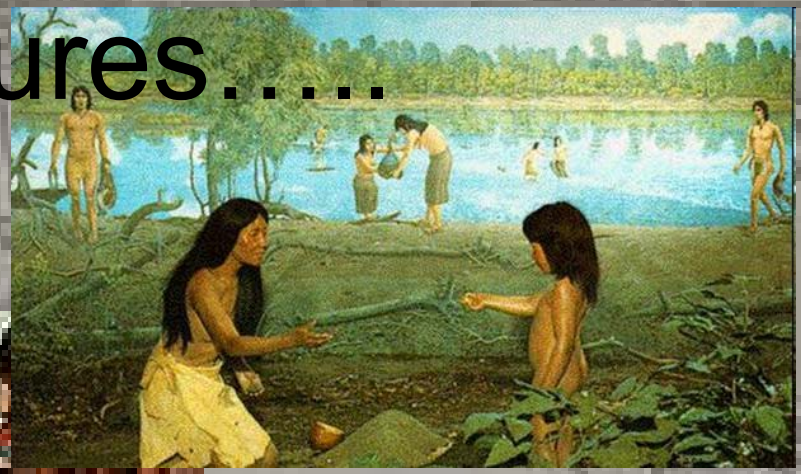
Lake Puckaway's

Vanishing Act.....


Green Bay
River
Depere Lock and Dam
Fox
Little Kaukauna Lock and Dam
Rapide Croche Lock and Dam
Lower
Appleton Locks and Dams
Combined Locks
Little Chute Lock and Dam
Cedars Lock and Dam
Lake Poygan
River
Lake Winnebago
Fox
Eureka Lock and Dam
Upper
White River Lock and Dam
Princeton Lock and Dam
Lake Puckaway
Grand River Lock and Dam
Buffalo Lake
Governor Bend Lock and Dam
Swan Lake
Fort Winnebago Lock
Park Lake
N
Key
Lock and Dam
Bridge
Scale
0
10
20 miles

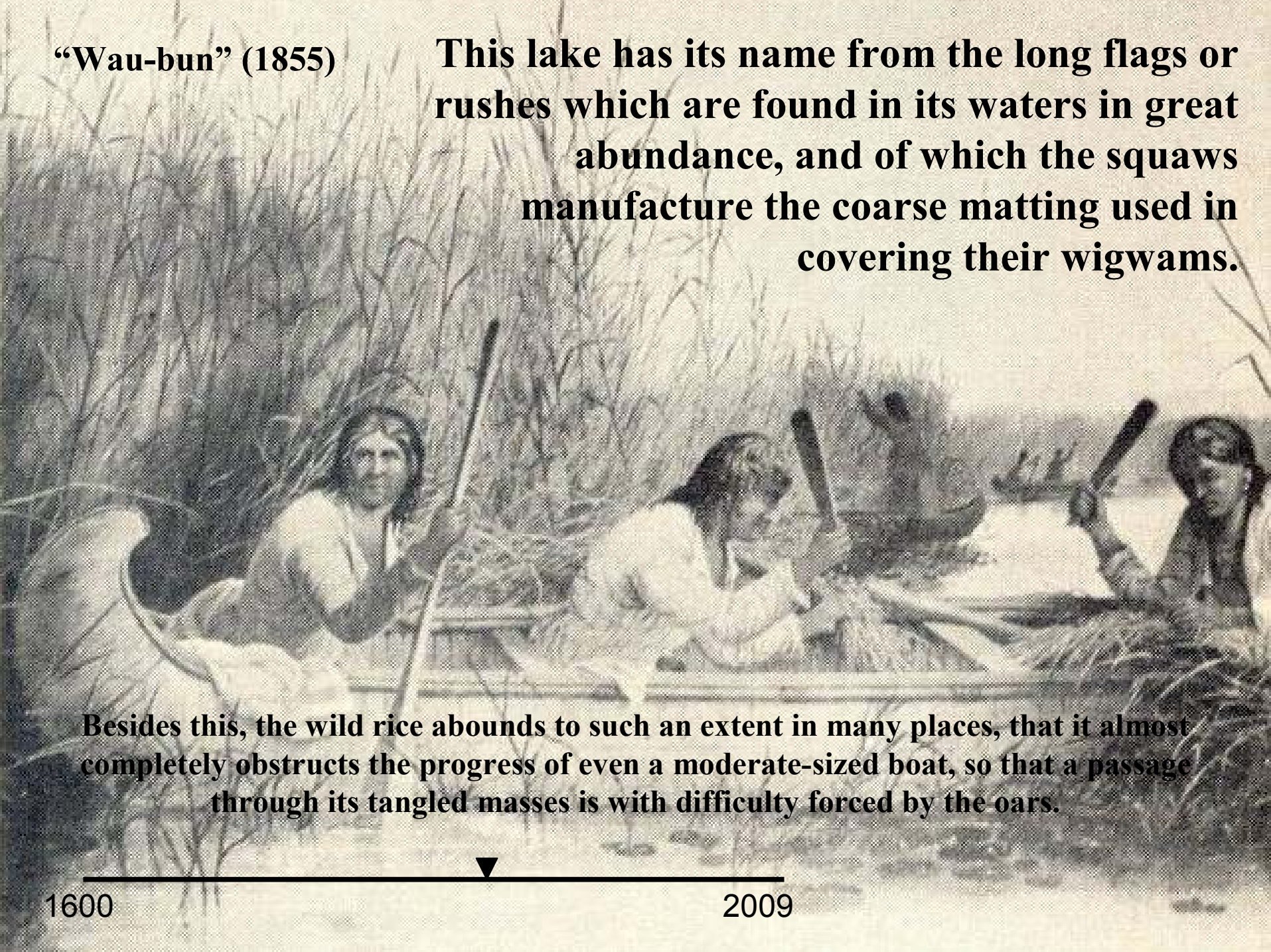
A lake of many cultures…..



Supporting Families for Thousands of Years


“It is easy to lose one's way, especially as the River leading thither is so full of wild rice that it is difficult to find the Channel” Father Marquette (1673)
1600
2009

The Expeditions of Zebulon Montgomery Pike (1805-1807) – "The lake is three leagues long (9 miles), this is full of wild rice, and has a a great many fowl in their season."


“Wau-bun” (1855)
This lake has its name from the long flags or rushes which are found in its waters in great abundance, and of which the squaws manufacture the coarse matting used in covering their wigwams.
Besides this, the wild rice abounds to such an extent in many places, that it almost completely obstructs the progress of even a moderate-sized boat, so that a passage through its tangled masses is with difficulty forced by the oars.
1600
2009

Nee Pee Nauk Duck Hunting Club, whose diary tells of members around 1885:
“Shooting lousy. We killed only 30 canvasback, 50 bluebill, 21 pintail, and 18 redhead.”
“Fishing only fair. We caught 63 smallmouth and 66 pike.”

1600 2009

Not far north of Horicon…lies Lake Puckaway, like Koshkonong, this was a famous “wild celery” lake.

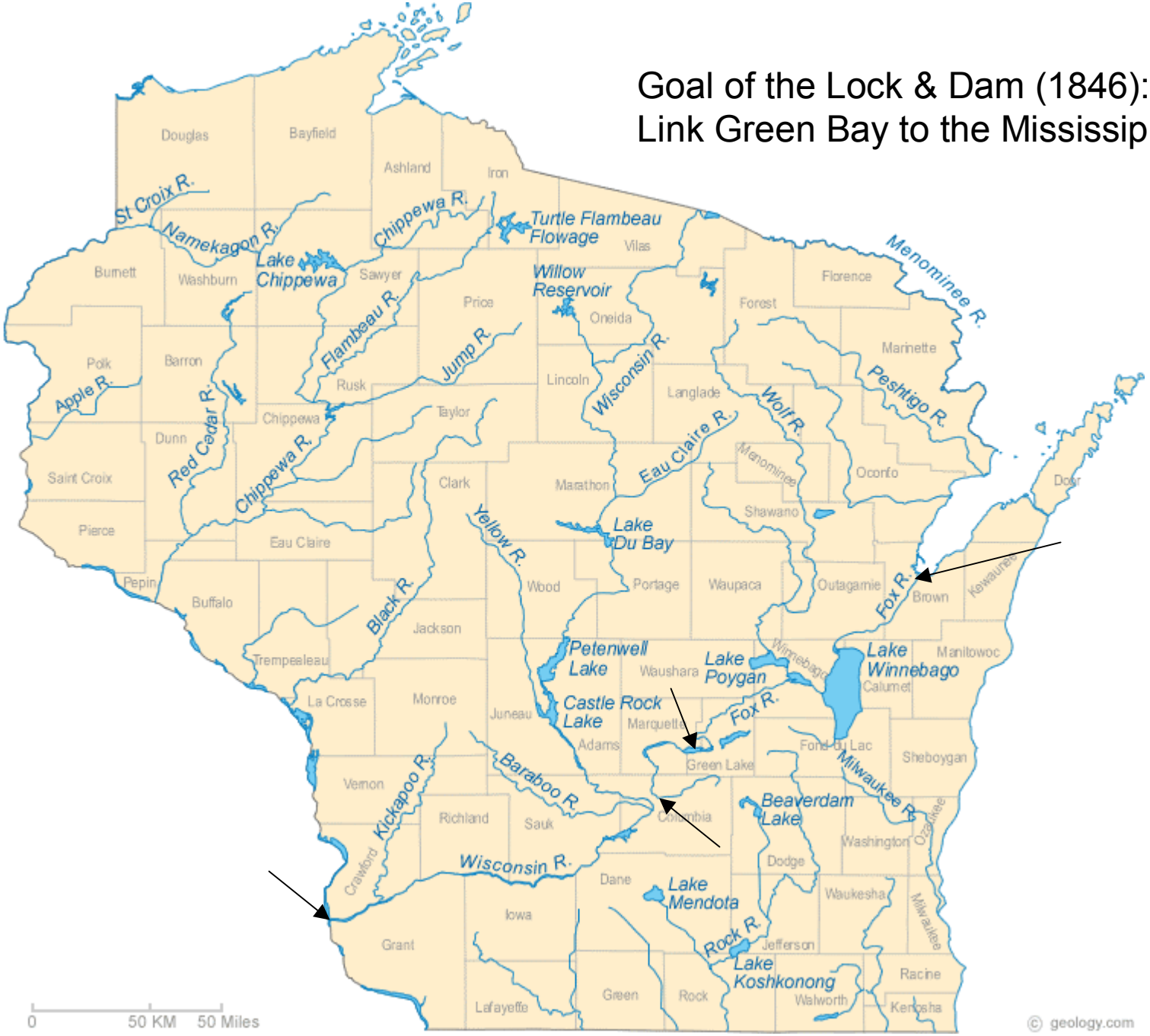
1869

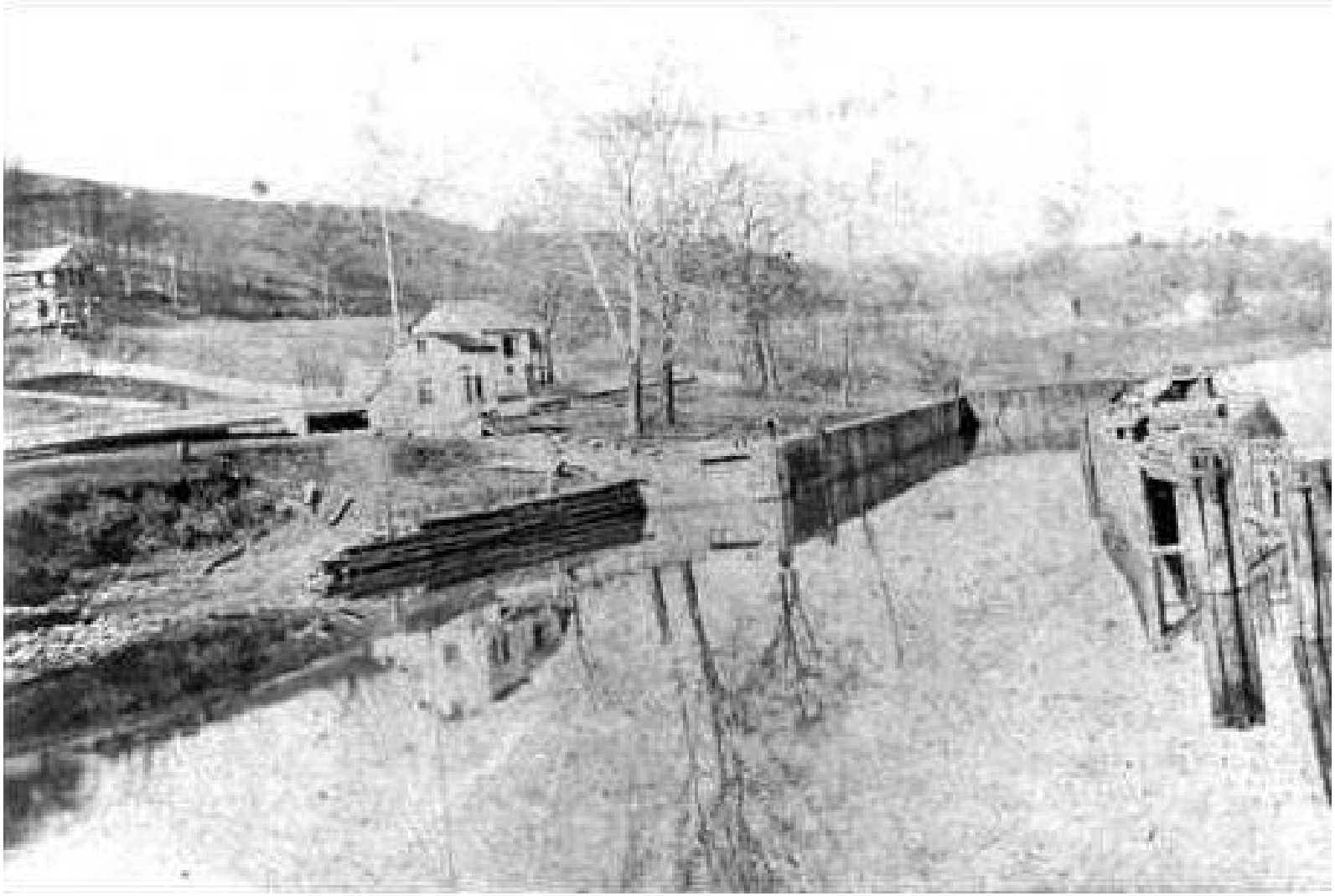
“The boys were fed up with puddle ducks, and wanted to get into the diving game.” For these reasons the Caw-Caw Club moved to Lake Puckaway, which was found more suitable than Poygan, and most of its history was made on that famous celery lake.

“…fantastic bags of game were secured, and sadly it must be confessed that occasionally excess birds, impossible to keep in those pre-refrigeration days were buried under the hillside brush.”

1600 2009

In 1837 and 1839, the Corps examined the waterway's feasibility and recommended a “slack-water” (lock and dam) system. After numerous memorials from the territorial legislature, Congress authorized a land grant for the waterway project in 1846.

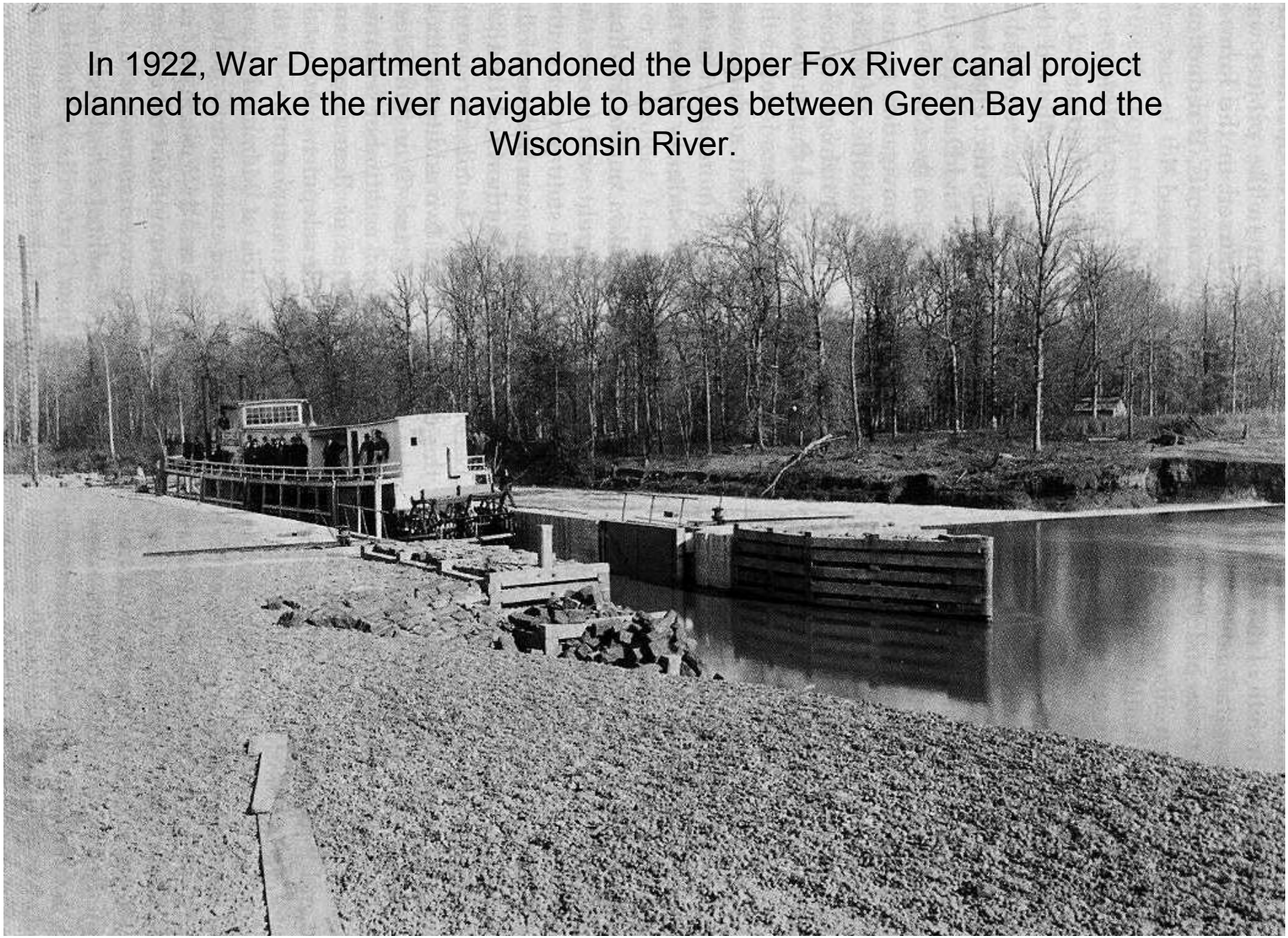

Goal of the Lock & Dam (1846):
Link Green Bay to the Mississippi
Douglas
Bayfield
Ashland
Iron
St Croix R.
Namekagon R.
Chippewa R.
Turtle Flambeau Flowage
Vilas
Florence
Menominee R.
Lake Chippewa
Sawyer
Willow Reservoir
Burnett
Washburn
Price
Oneida
Forest
Marinette
Flambeau R.
Jump R.
Wisconsin R.
Polk
Barron
Apple R.
Rusk
Lincoln
Langlade
Wolf R.
Peshtigo R.
Red Cedar R.
Chippewa
Taylor
Dunn
Chippewa R.
Eau Claire R.
Menominee
Oconto
Door
Saint Croix
Clark
Marathon
Shawano
Pierce
Eau Claire
Yellow R.
Lake Du Bay
Pepin
Buffalo
Black R.
Wood
Portage
Waupaca
Outagamie
Fox R.
Brown
Kewaunee
Jackson
Petenwell Lake
Lake Poygan
Lake Winnebago
Manitowoc
Trempealeau
Waushara
Winnebago
Calumet
La Crosse
Monroe
Juneau
Castle Rock Lake
Marquette
Fox R.
Adams
Fond Du Lac
Sheboygan
Green Lake
Milwaukee R.
Vernon
Kickapoo R.
Baraboo R.
Beaverdam Lake
Richland
Sauk
Columbia
Washington
Ozaukee
Crawford
Wisconsin R.
Dodge
Dane
Lake Mendota
Waukesha
Milwaukee
Iowa
Rock R.
Grant
Jefferson
Lake Koshkonong
Racine
Green
Rock
Walworth
Kenosha
Lafayette
0
50 KM
50 Miles
© geology.com



Original Lock and Dam built around 1860 soon feel into disrepair

The Princeton Dam was built by the Army Corps of Engineers in 1897 in an effort to provide water deep enough for commercial freight steamers.

In 1922, War Department abandoned the Upper Fox River canal project planned to make the river navigable to barges between Green Bay and the Wisconsin River.



1941

Wild rice emerged along the entire shoreline. It formed an almost impenetrable bed throughout the eastern basin, with only the navigation channel remaining open.

1600

2009

By 1946, local residents noticed a significant decline in aquatic plants, and water quality was reduced

Historical Management

- 1946 – Puckaway Restoration League attempts to improve declining emergent plants by planting hundreds of lbs of wild rice.
- 1949 – Large expanses of open water start to develop.

Historical Management

- 1951: “Only 2550 Acres” of Emergent Plants Remain, Nearly Half of previous decades

- 1950-1951: Water levels are drawn down for 2 consecutive springs to improve plant growth.

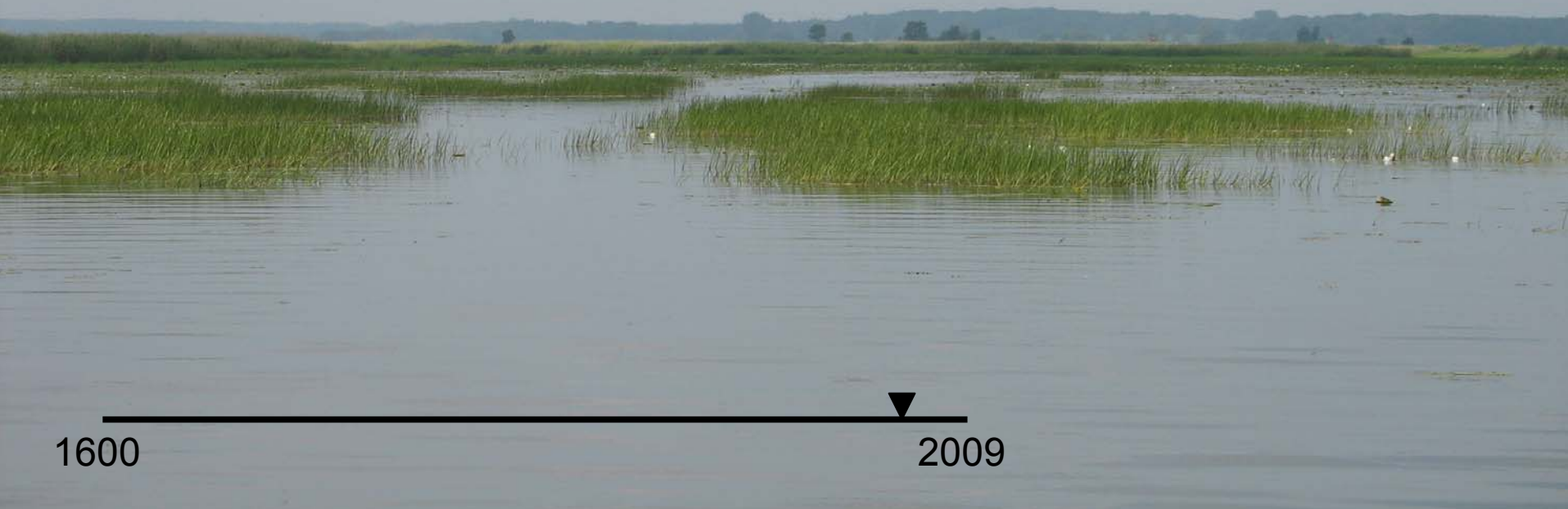
“Should the openings continue to expand, the breakup of this marsh (Lake Puckaway) can be expected with conditions similar to Beaver Dam Lake and Lake Koshkonong appearing. Intensive prosecution of the carp and careful regulation of water levels is necessary to avoid such a development…Largely because of high water the carp are able to invade the shallows which had the best stands of wild rice and arrowhead. Both are now scarce in former areas of abundance. To maintain the marsh ecology of Lake Puckaway a decrease in the water level of 6 inches to 1 foot from what it was on August 11, 1952 is justified.” (Thompson 1959)

Historical Accounts

- “Wild rice has “precipitously declined” since 1880, whereas is is no longer a dominant species.” - 1959
- “Once famous fish and waterfowl haven into a dead mud puddle” - 1959

1977

- Almost no submergent plants were present in the muddy waters.
- Carp comprised of 76% of the fishery.
- Secchi disc measurements in August were 6 inches.
- Lake Puckaway Protection & Rehabilitation District (LPPRD) forms



1600 2009

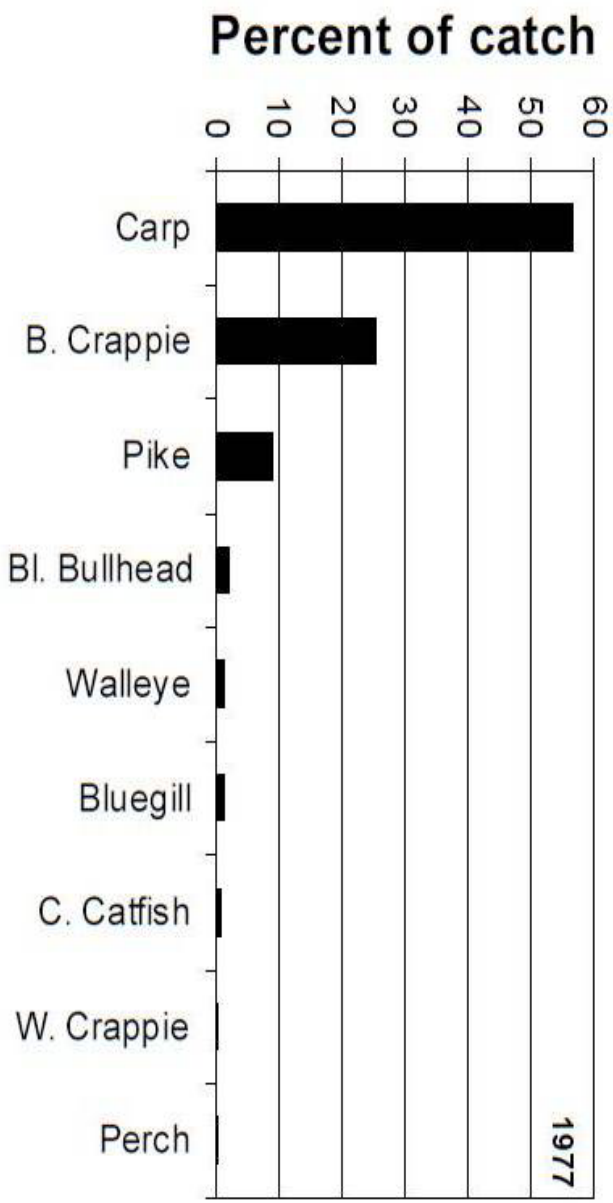
WI DNR worked with LPPRD and LPIA to develop a management plan.

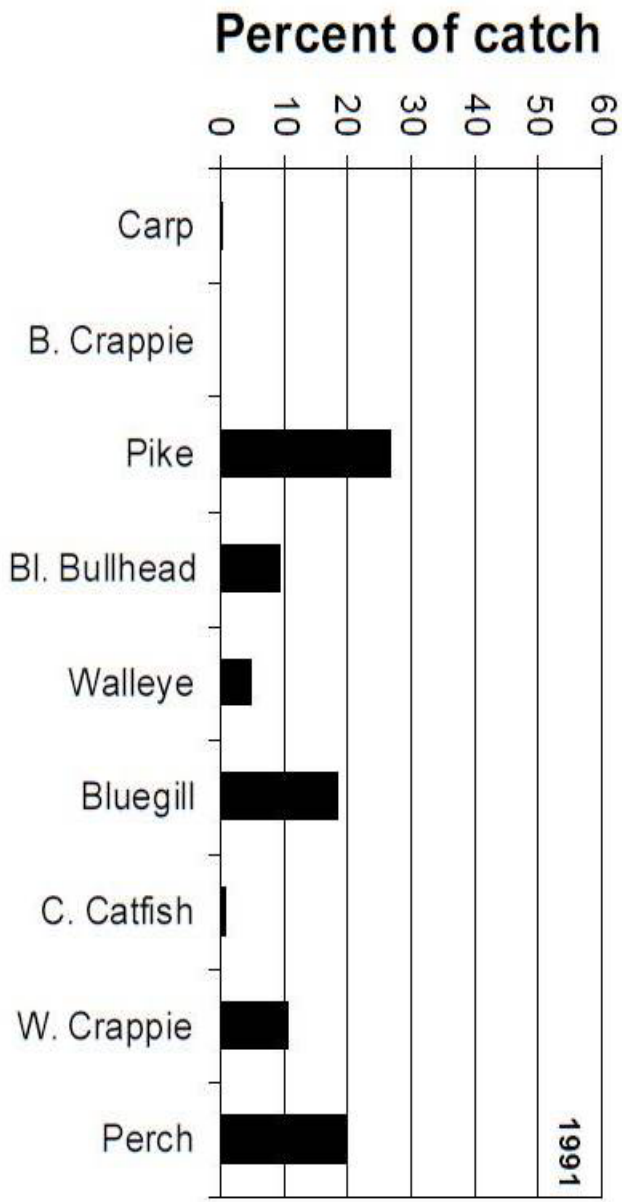
The 1978 Three-phase plan:

- Partial drawdown of the lake
- Mechanical removal of carp
- Restocking of game fish species.

Historical Management

- 1983-1984: Plant restoration project planted wild rice, wild celery, sago pondweed.
- 1991 Fishery Study Shows change in fisheries.



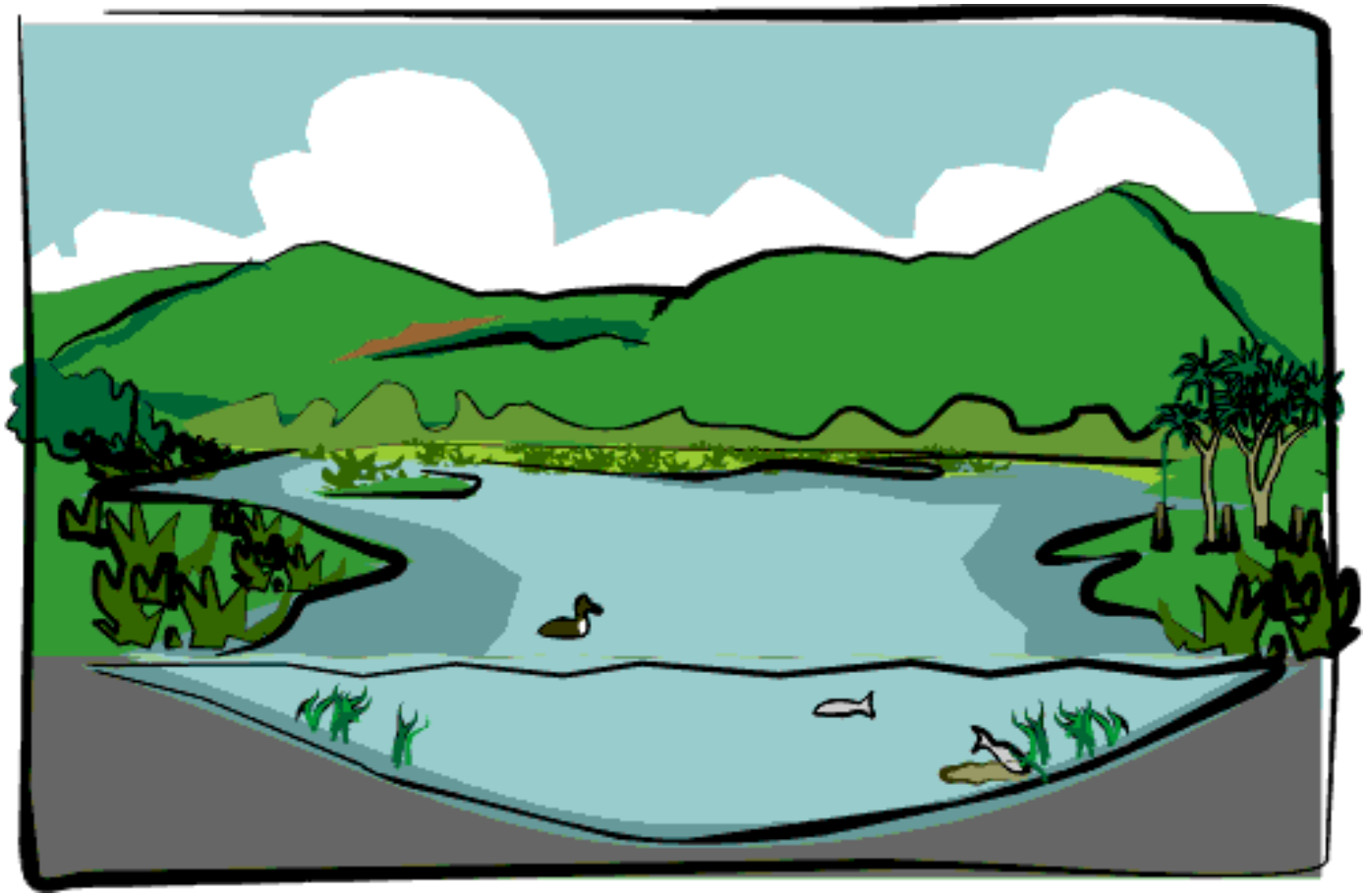


Prior to 1977 Lake Plan Implementation

1991

GOAL:

Maintain and Improve Water Quality, Sport Fishing, and a Natural and Serene Environment that is enjoyed by many Families of Lake Residents and Visitors for years into the future.



1. Why do we care about reduction in emergent beds?
2. How do we measure it?
3. What is causing the reduction?
4. How do we manage it?

1. Why do we care about reduction in emergent beds?

A diverse emergent plant community is important to lakes –

Especially in shallow, littoral dominated system, such as Puckaway

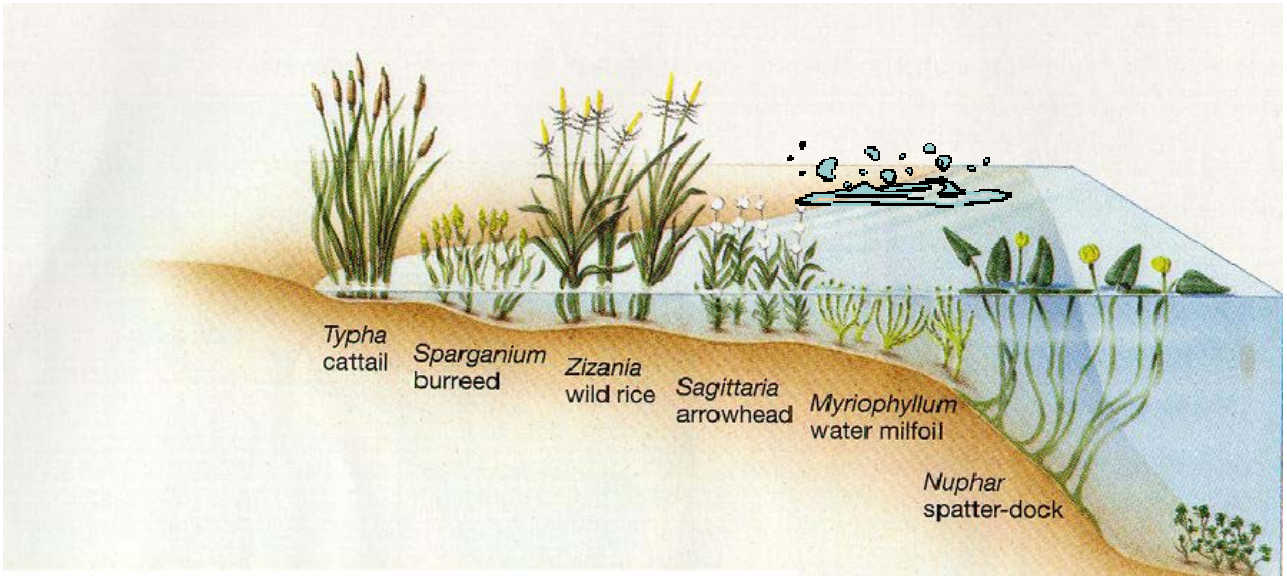


Figure 51–15 The littoral zone of a lake (or a large pond or a riverbank). Note the changes in vegetation with water depth. (*Chara* is an alga; all other vegetation are flowering plants.)

Maintenance of clear water

Refuge for small invertebrates (especially Cladocera) against fish predation

Absorb wind and wave energy, minimising turbidity caused by sediment resuspension

Maintenance of clear water

'Services' to people through bank edge protection against erosion, products, (reed, sedge, biomass, fish and fowl), amenity and conservation

Habitat, food cover and nesting materials for birds

Provide habitat for attached algae

Food for invertebrates

Food for adult fish

Spawning habitat for fish

Cover and habitat for piscivorous fish

Refuges for small fish against predators

High production creates sediment conditions favouring nitrogen loss by denitrification and phosphate availability through release

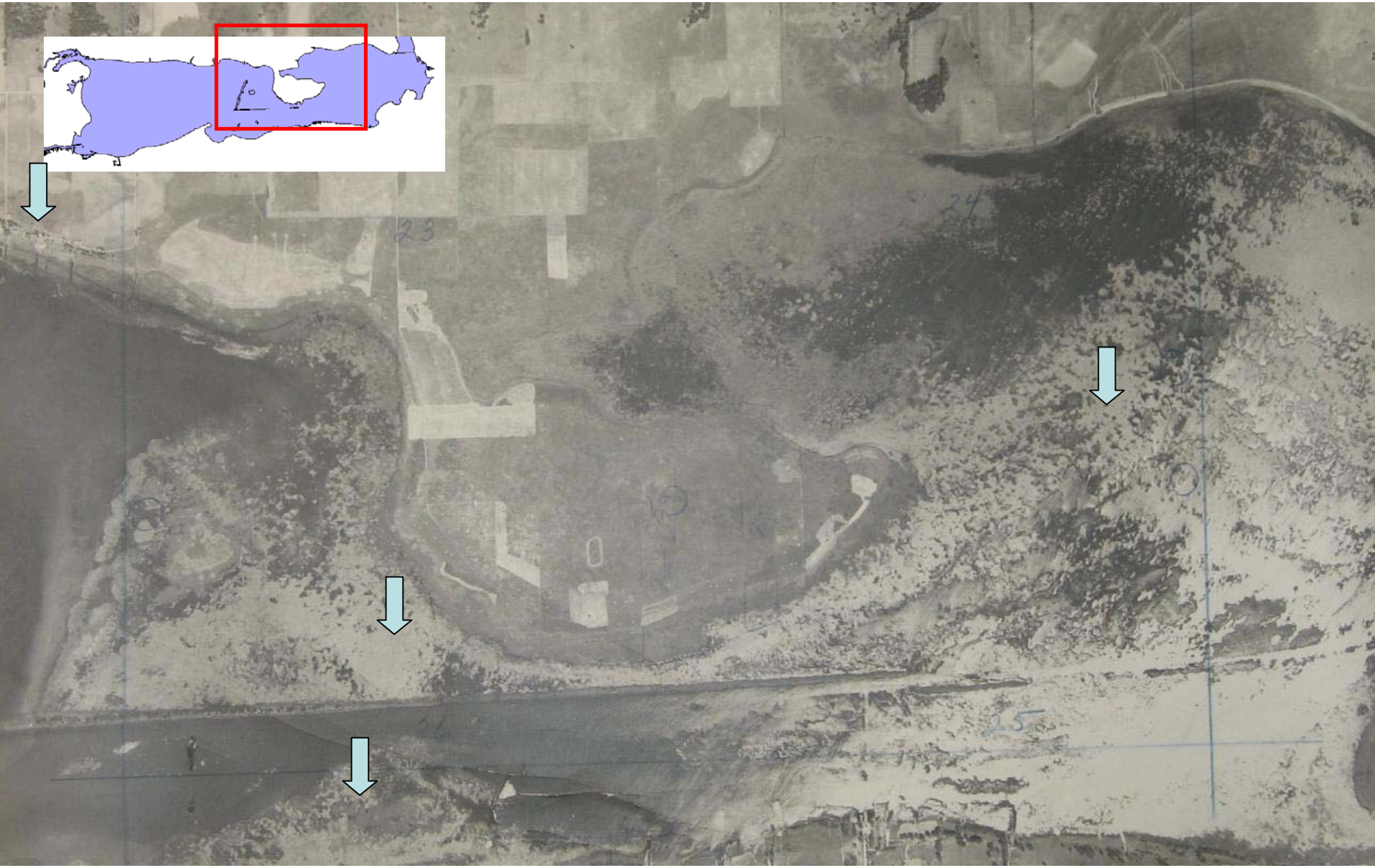
A lake without plants is like a forest without trees…..

Endangered Species, such as the Foster's Tern, is found on Lake Puckaway, and uses dead emergent vegetation to nest on.

2. How do we measure it?

Lakes and Vegetation vary year to year depending on weather patterns…..But….What is the TREND over time?

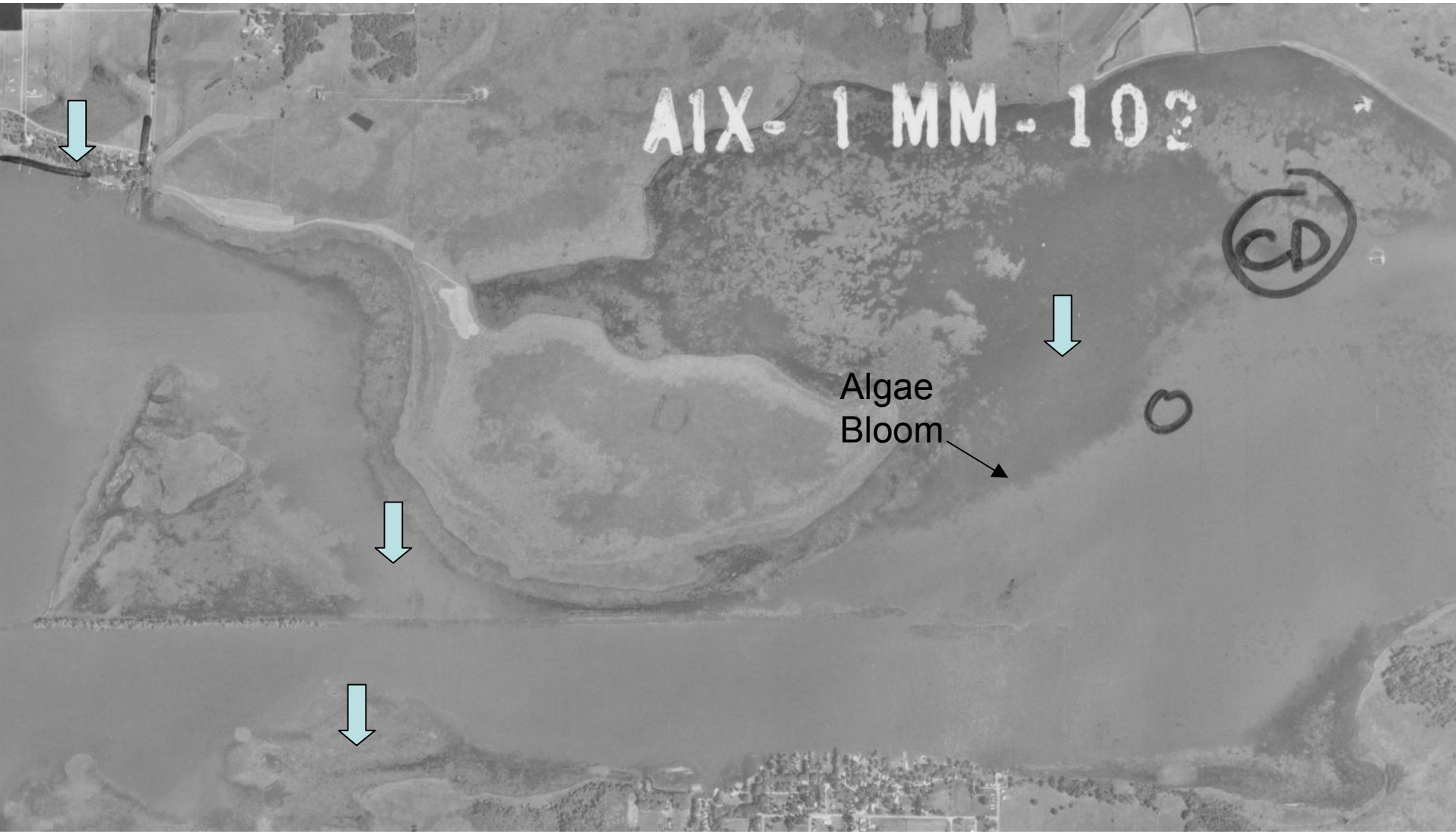
1946



August 23rd 1941

September 23rd 1950

June 25th 1964



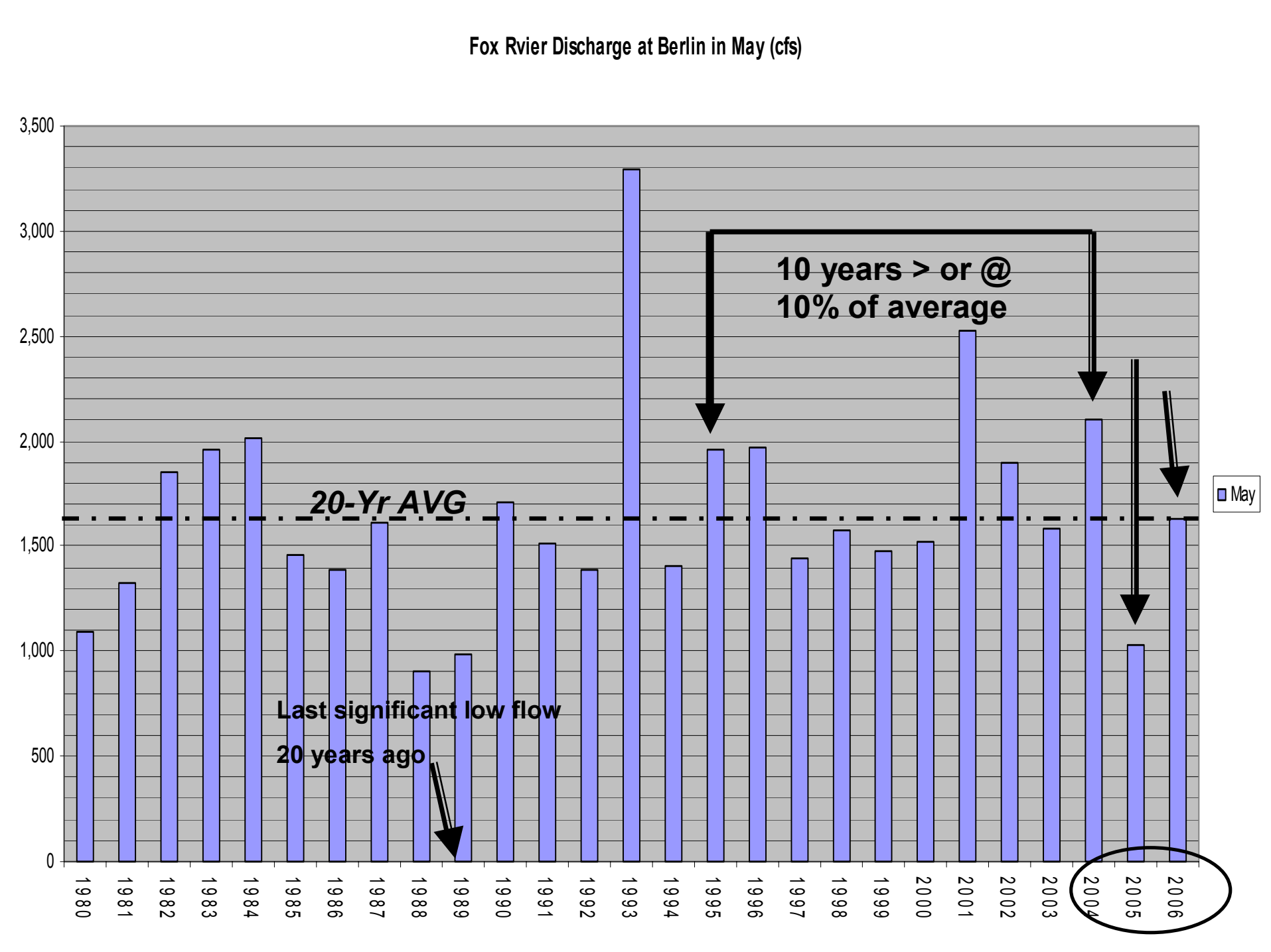
September 7th 1971

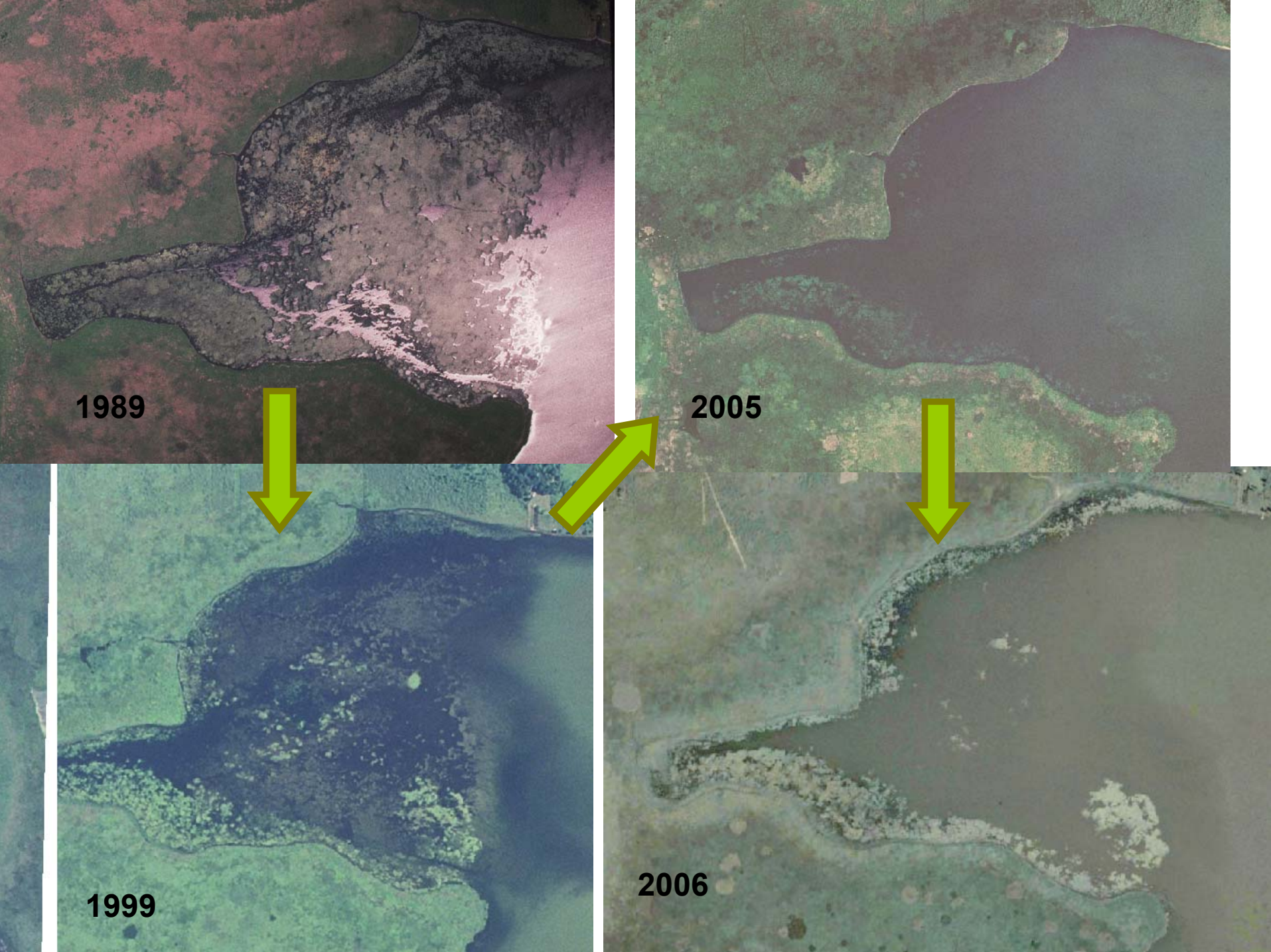

23
24
35

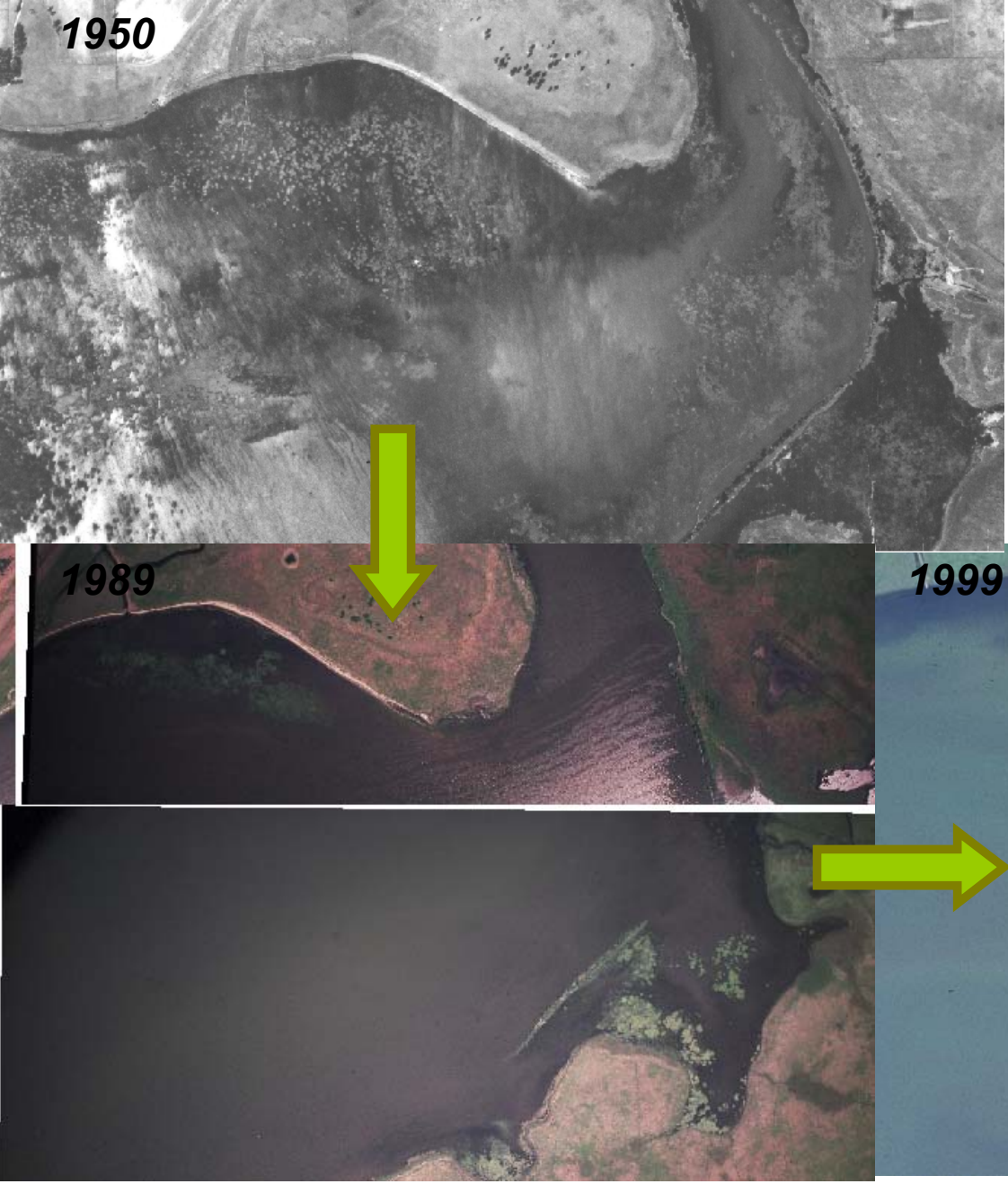

2005

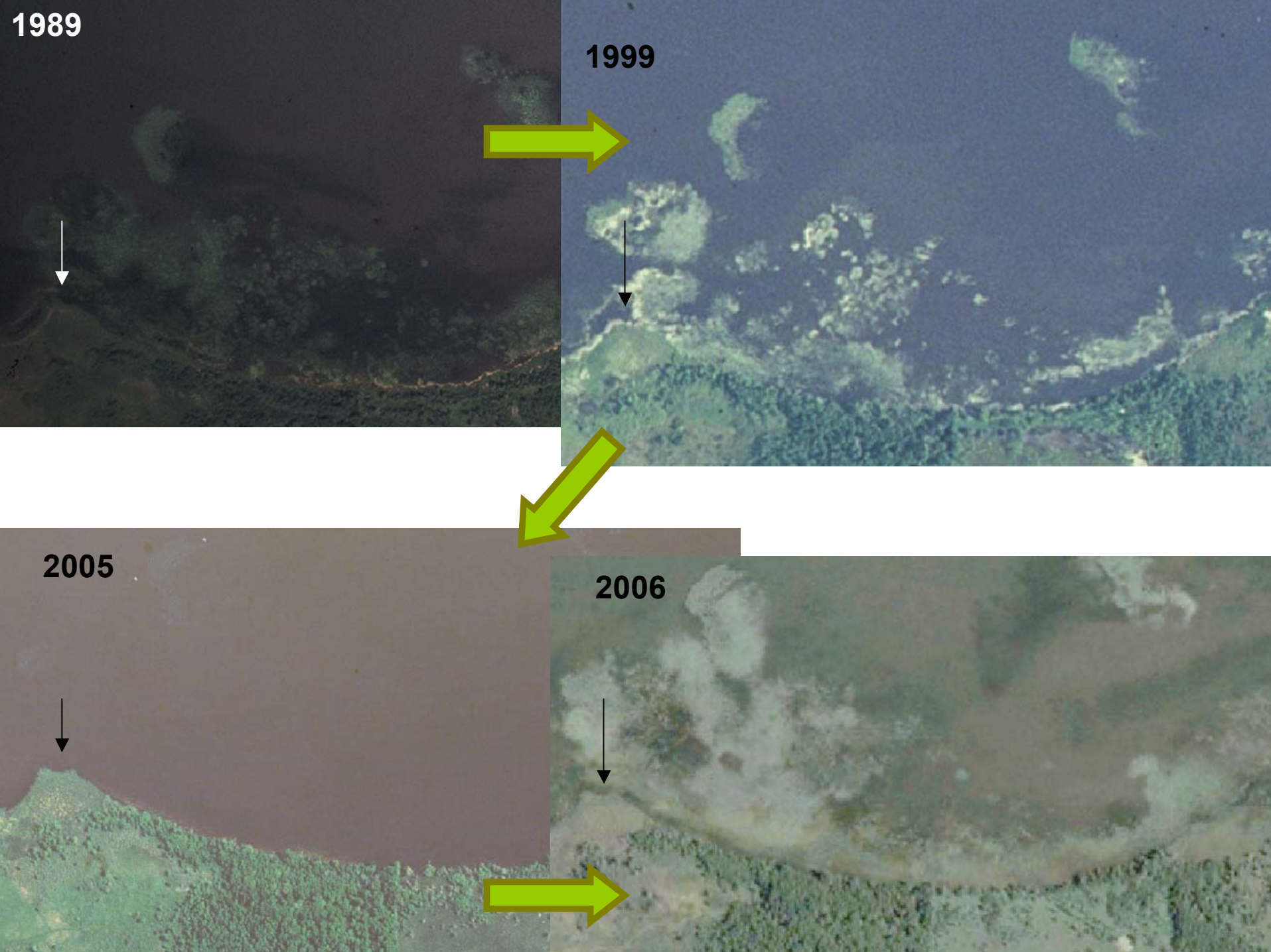

2006


Increased Vegetation Growth Noticed
throughout the Lake
2006

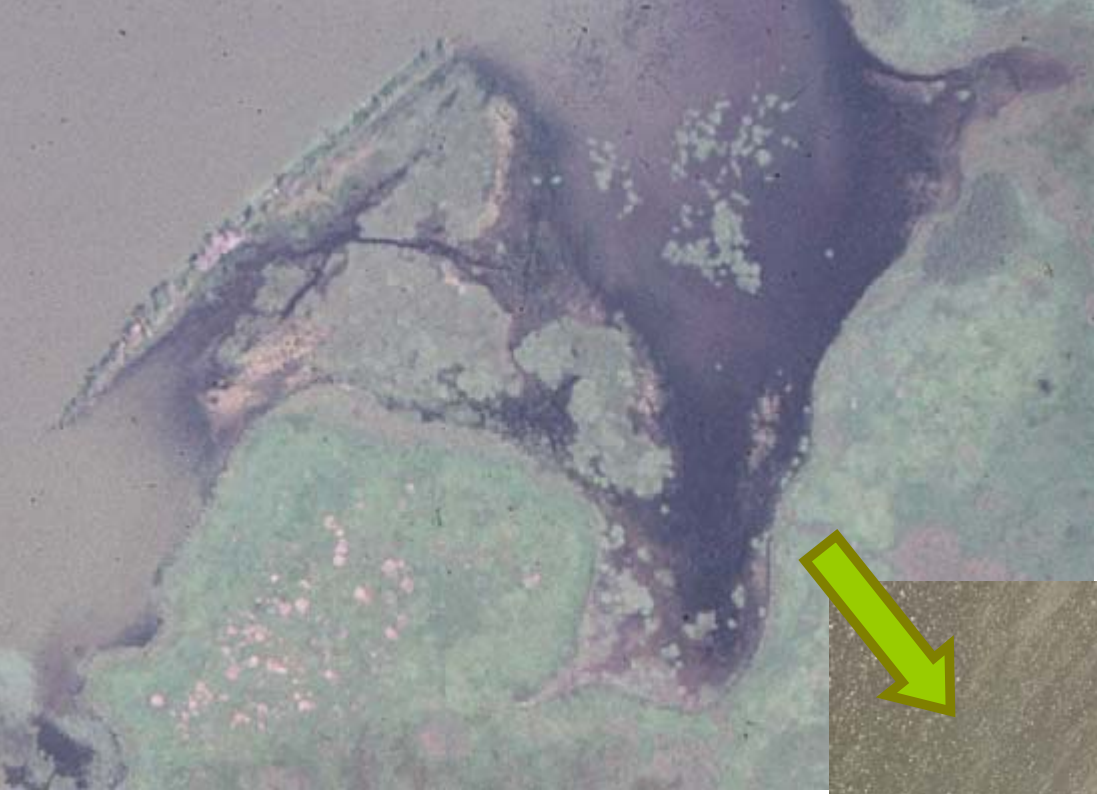

Fox Rvier Discharge at Berlin in May (cfs)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
10 years > or @
10% of average
20-Yr AVG
Last significant low flow
20 years ago
May
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006

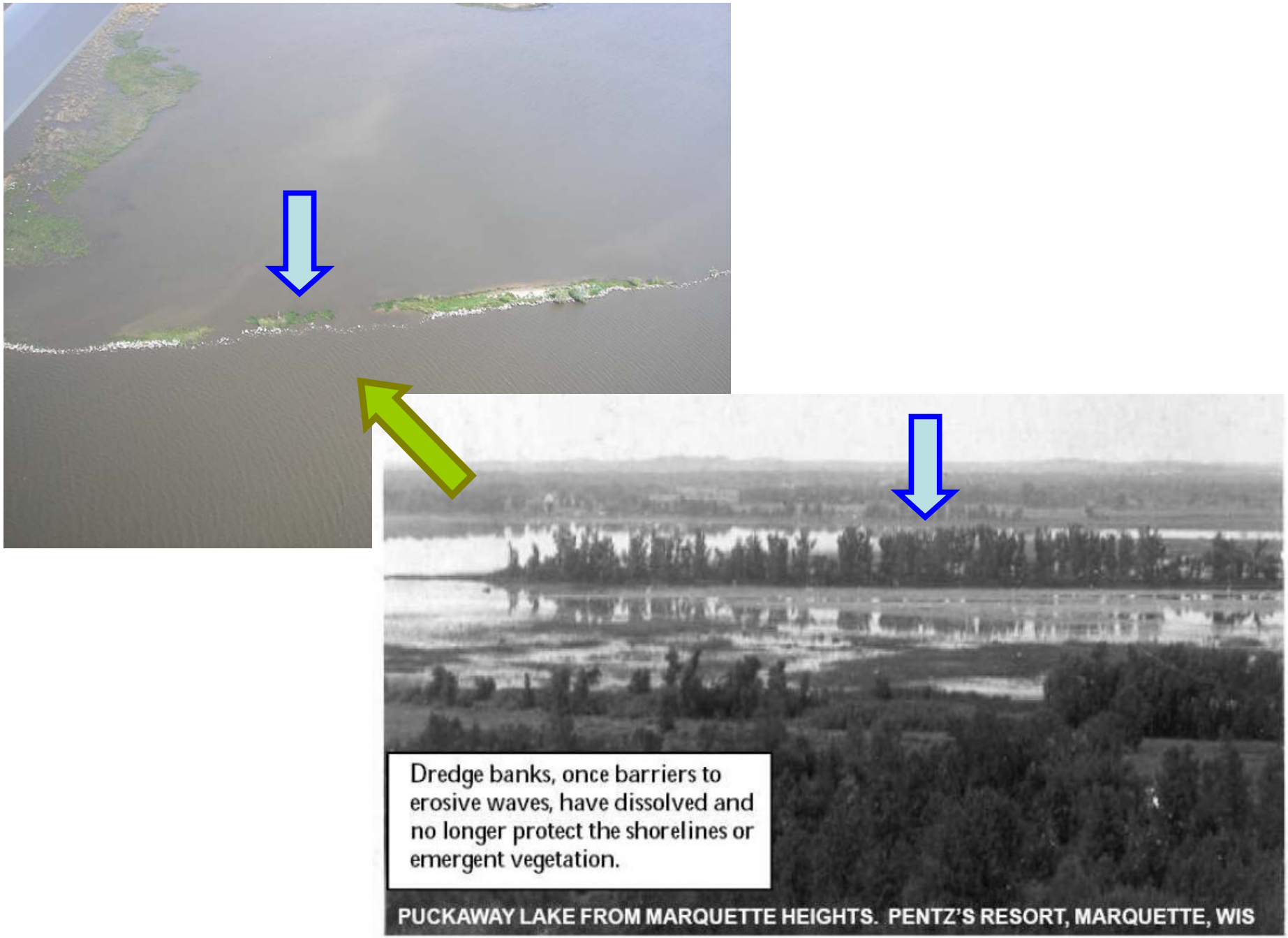

1989
2005
1999
2006


1950
1989
1999

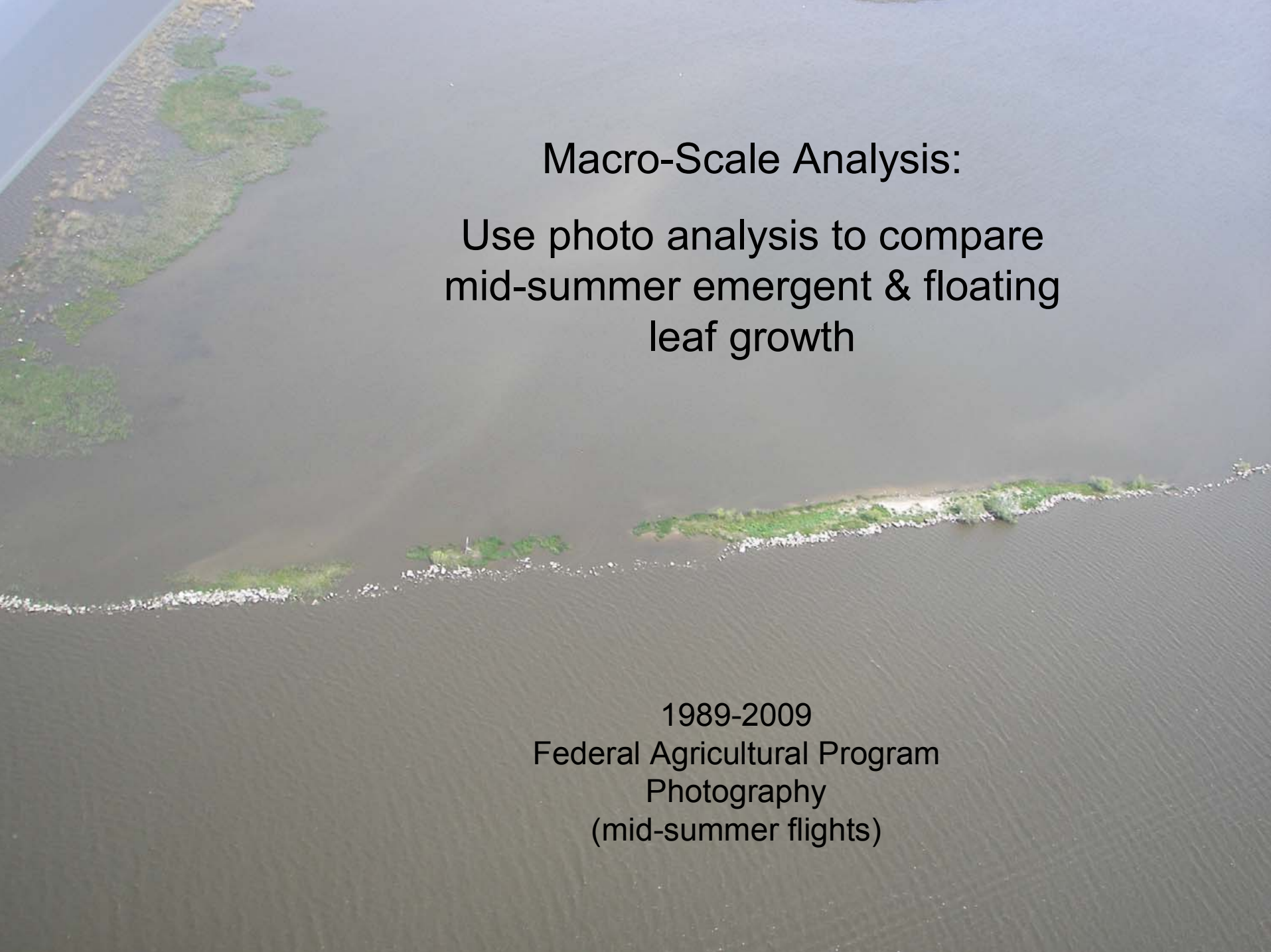

1989
1999
2005
2006


1986
2005

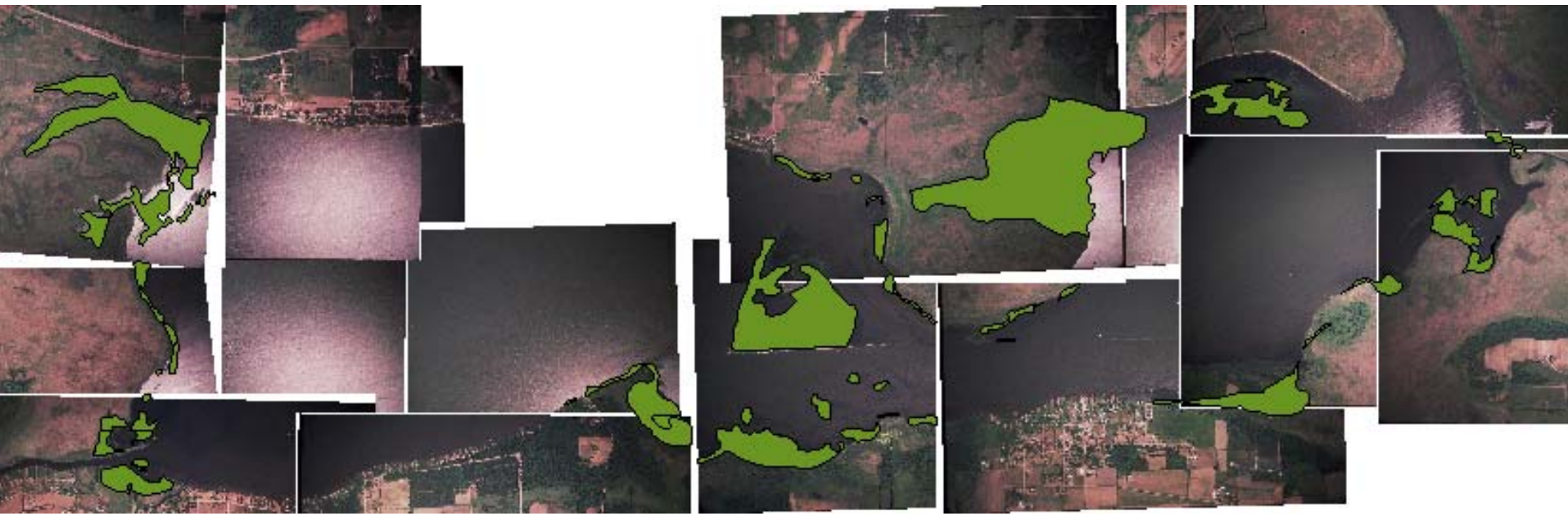



Dredge banks, once barriers to erosive waves, have dissolved and no longer protect the shorelines or emergent vegetation.
PUCKAWAY LAKE FROM MARQUETTE HEIGHTS. PENTZ'S RESORT, MARQUETTE, WIS

How do we Quantify the rate and amount of loss?

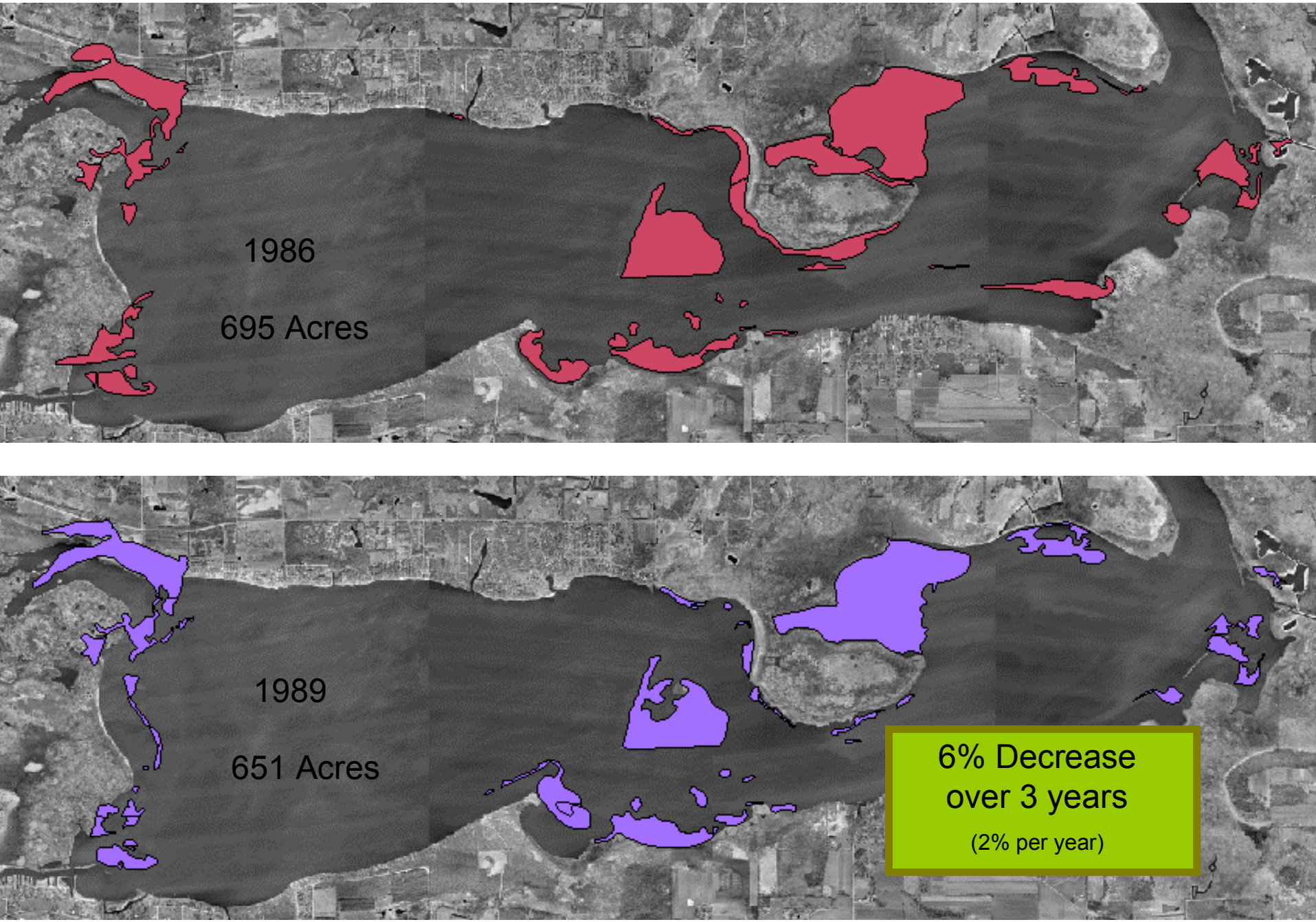

Macro-Scale Analysis:
Use photo analysis to compare mid-summer emergent & floating leaf growth
1989-2009
Federal Agricultural Program Photography
(mid-summer flights)

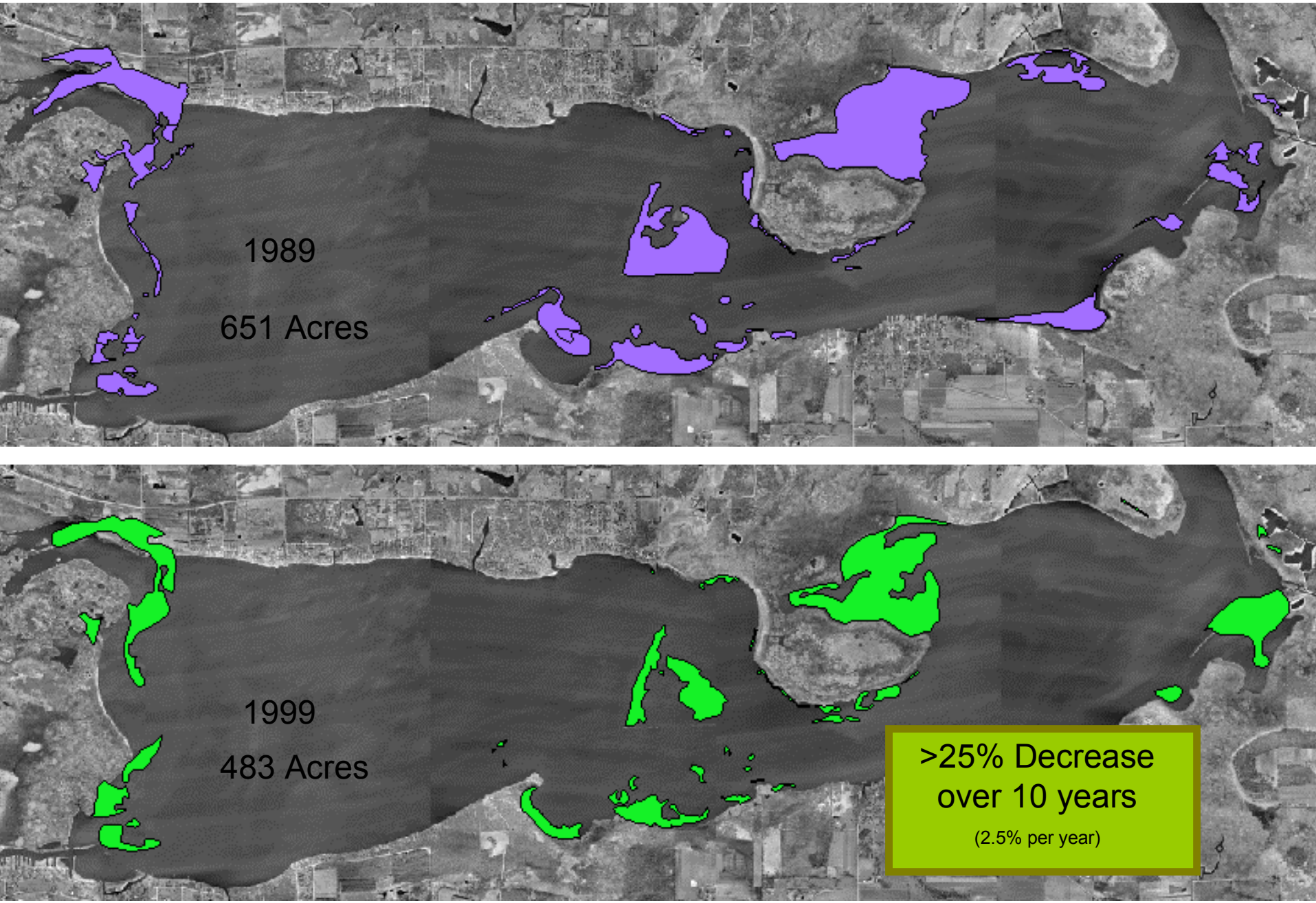
- Scanned and GeoReferenced 7000 Aerial Images
- Created a Composite Image for Each Year
- Used Mapping Software to define each visible plant bed
- Software measures exact acreage of the plant beds



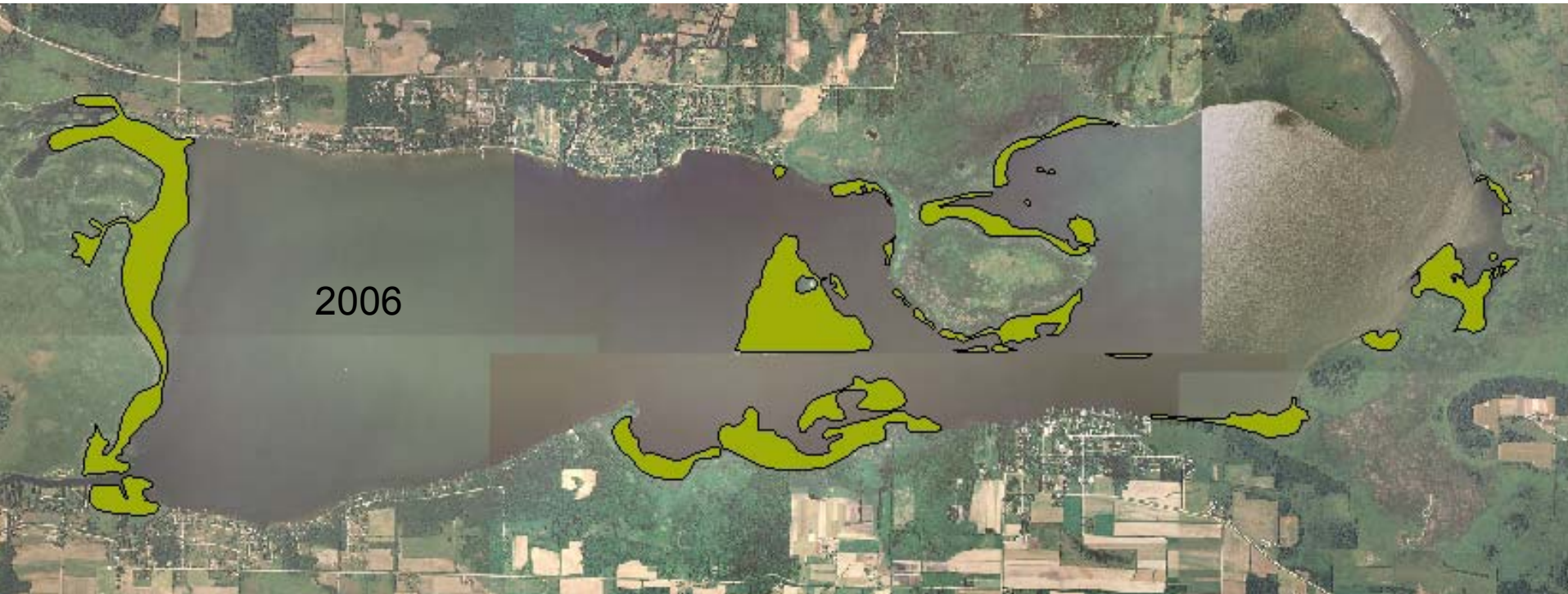
Approx. 651 acres

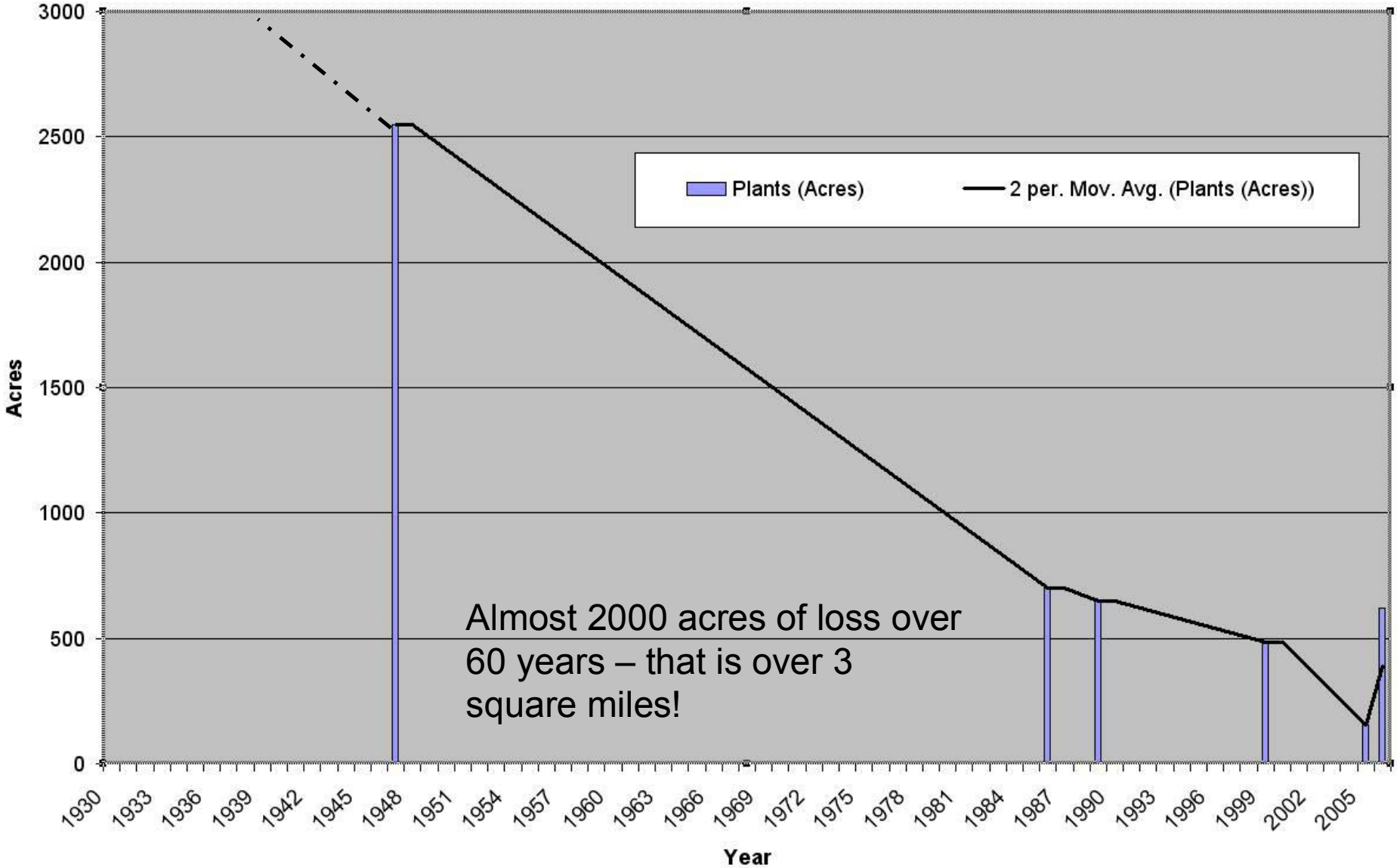
1989 Photographic Analysis of visible emergent and/or floating leaf aquatic plant beds


1986
695 Acres
1989
651 Acres
6% Decrease
over 3 years
(2% per year)


1989
651 Acres
1999
483 Acres
>25% Decrease
over 10 years
(2.5% per year)


2005


2006

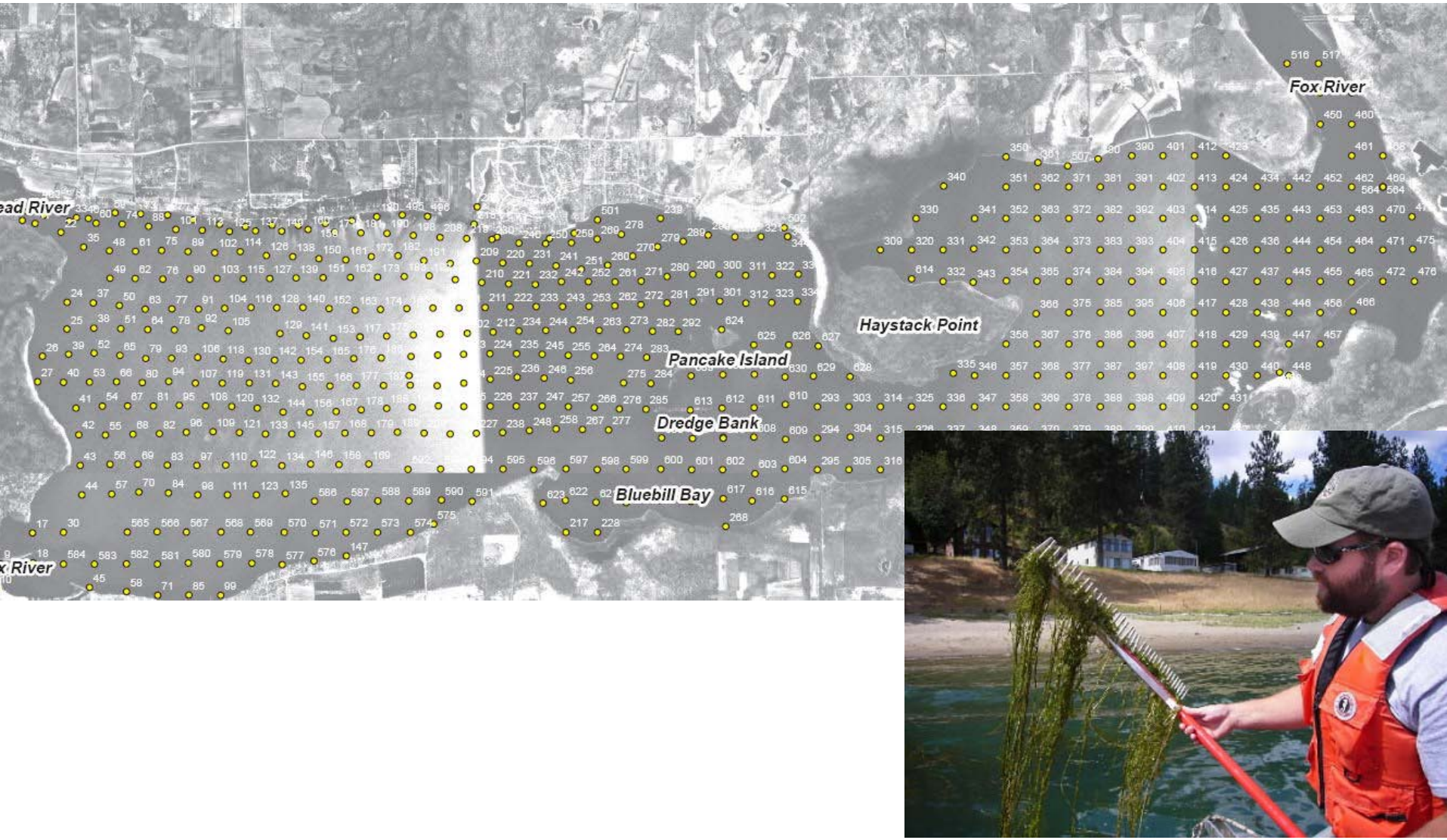

3000
2500
2000
1500
1000
500
0
Acres
Plants (Acres)
2 per. Mov. Avg. (Plants (Acres))
Almost 2000 acres of loss over 60 years – that is over 3 square miles!
1930
1933
1936
1939
1942
1945
1948
1951
1954
1957
1960
1963
1966
1969
1972
1975
1978
1981
1984
1987
1990
1993
1996
1999
2002
2005
Year

Micro-Scale Analysis:

Establish set sample points throughout the lake and conduct a plant survey annually at the same location.

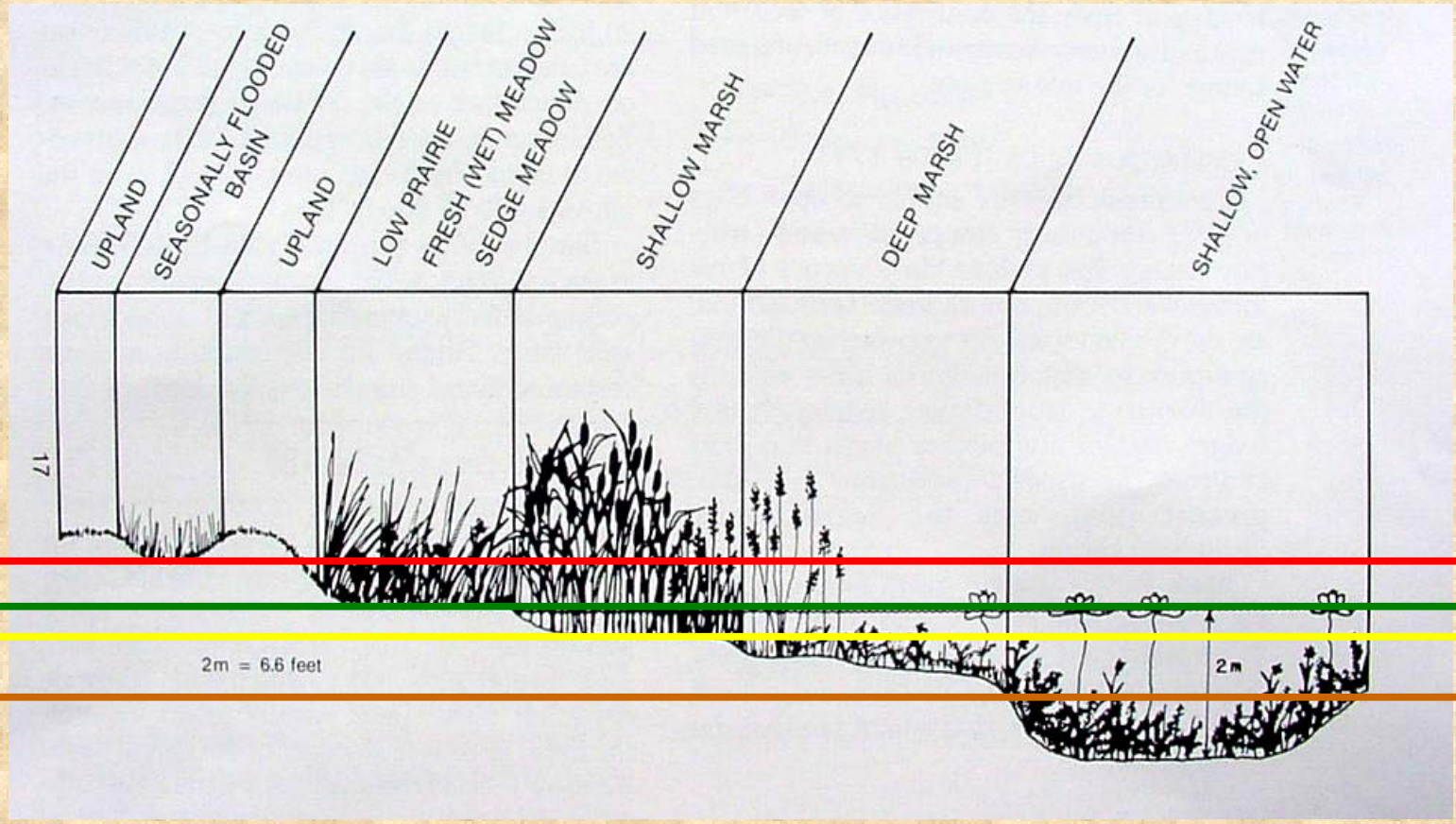
Use GPS to delineate edge of emergent plant beds for comparison over time.

Begin monitoring in 2010.


Fox River
Haystack Point
Pancake Island
Dredge Bank
Bluebill Bay

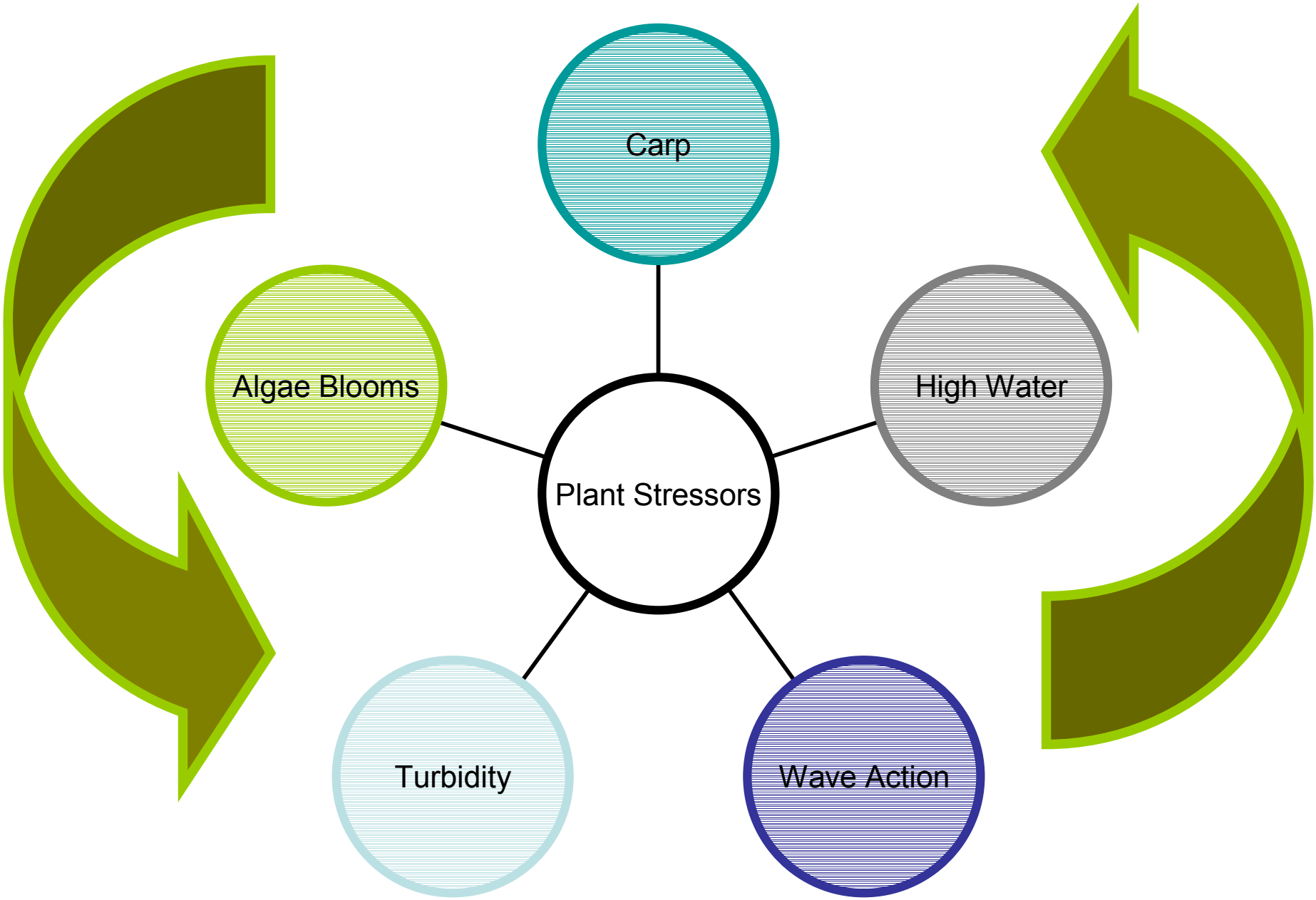
3. What causing the reduction?

Sensitive to Water levels



Green = Normal Red = Flooding Yellow = Drought Brown = Extended Drought

(WI DNR Upper Fox Basin)

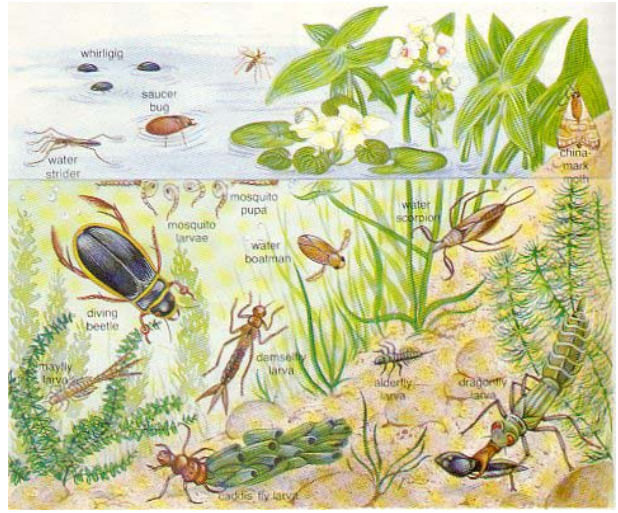

Carp
Algae Blooms
High Water
Plant Stressors
Turbidity
Wave Action

High Water Effects on Plants

- Decreased Light Penetration
- Increased Turbidity from Wave Action
- Increased Algae Blooms
- Higher Energy Needs to Reach Surface
- Increased Wave Force
- Prop Damage from More Boat Access

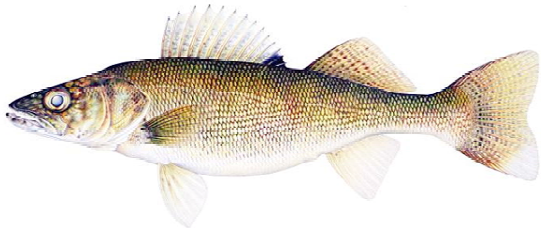
Shift in Fish Population???

Minnow/Aquatic Insect Eating Fish

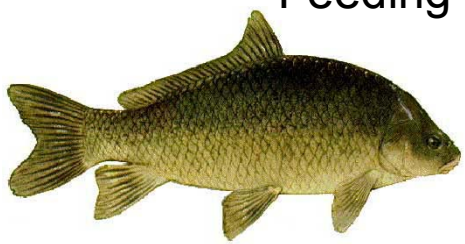


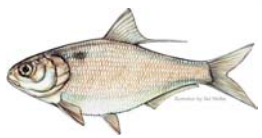
Prey – Aquatic Insects, Littoral

Sight Feeding Predator Fish

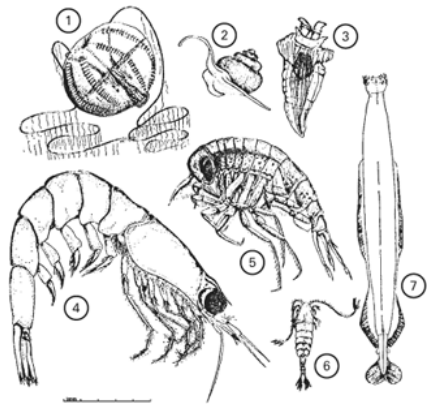


Filter/Benthic Feeding Fish

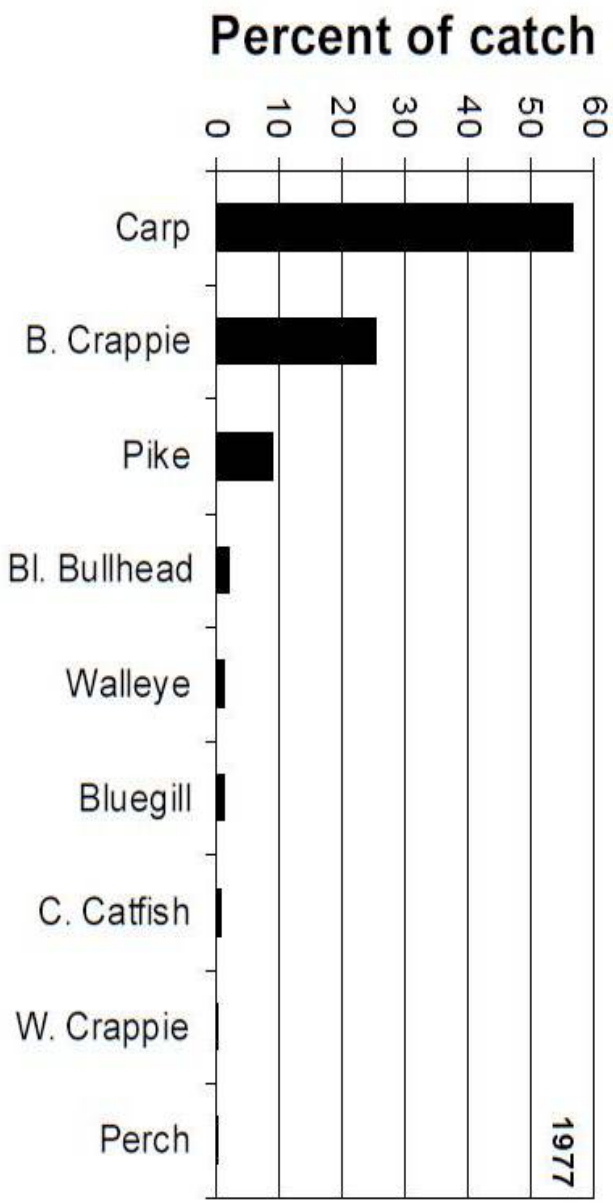


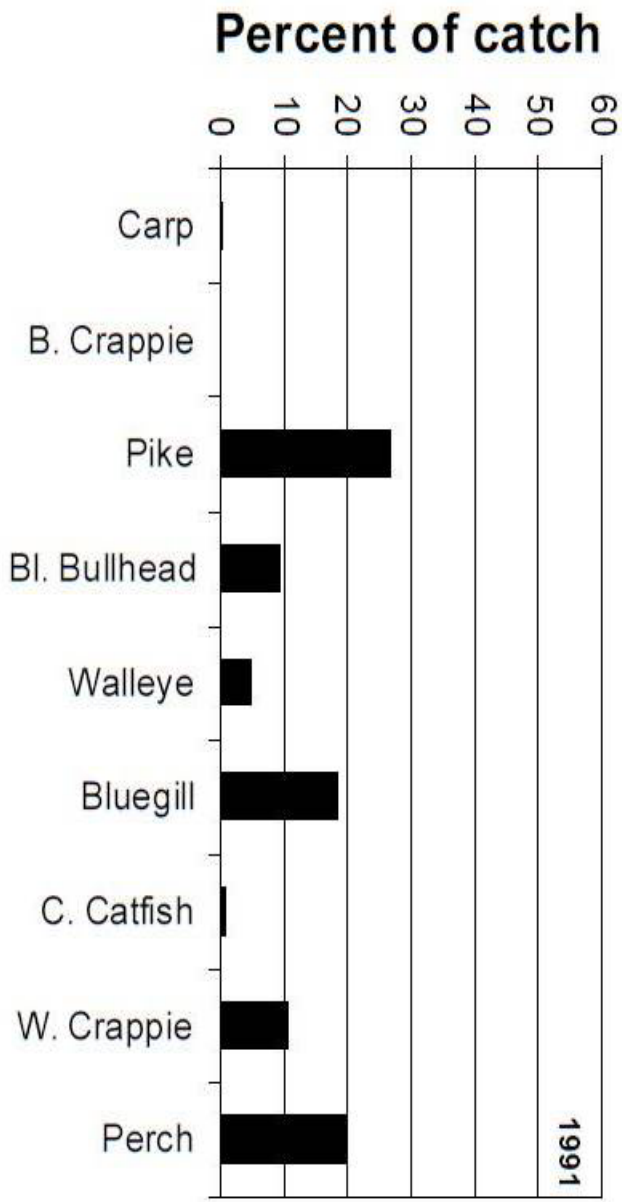


Cause or Symptom???



Prey – Zooplankton, Free Floating/Benthic





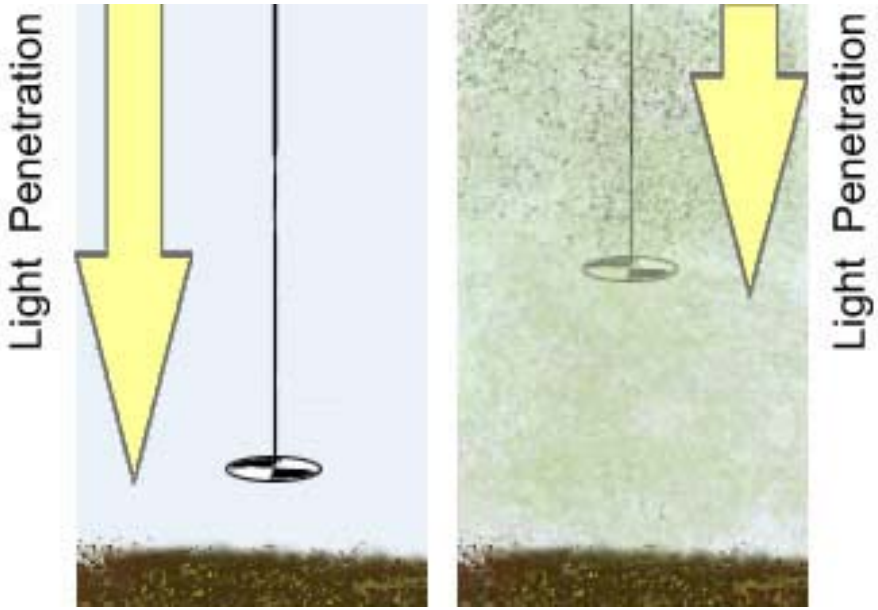
Prior to 1977 Lake Plan Implementation

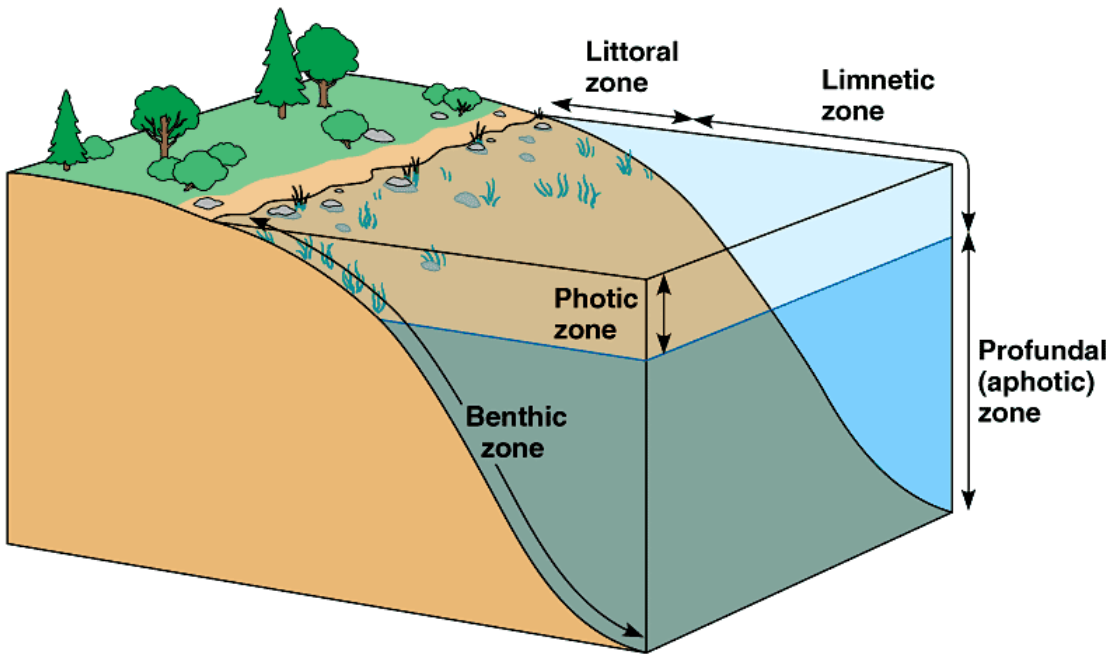
1991

•Algae prevents light front reaching bottom.

•Decreasing water depth allows sunlight to reach bottom

•Rooted plants become established





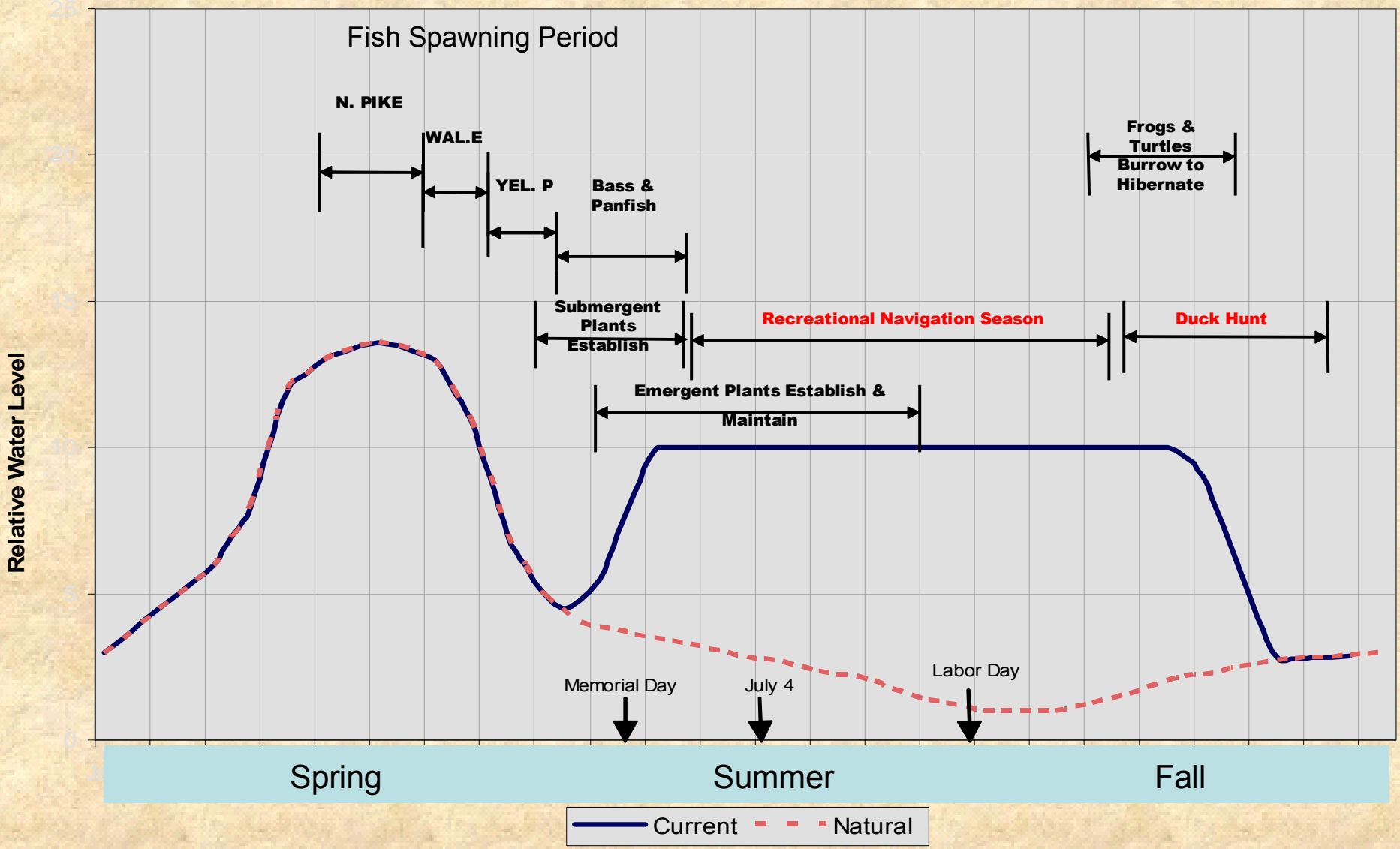
•Rooted plants utilize phosphorus

•Reduced phosphorus results in less algal blooms

•Reduced algal blooms results in clearer water

•Clearer water allows more sunlight to reach the bottom for rooted plants

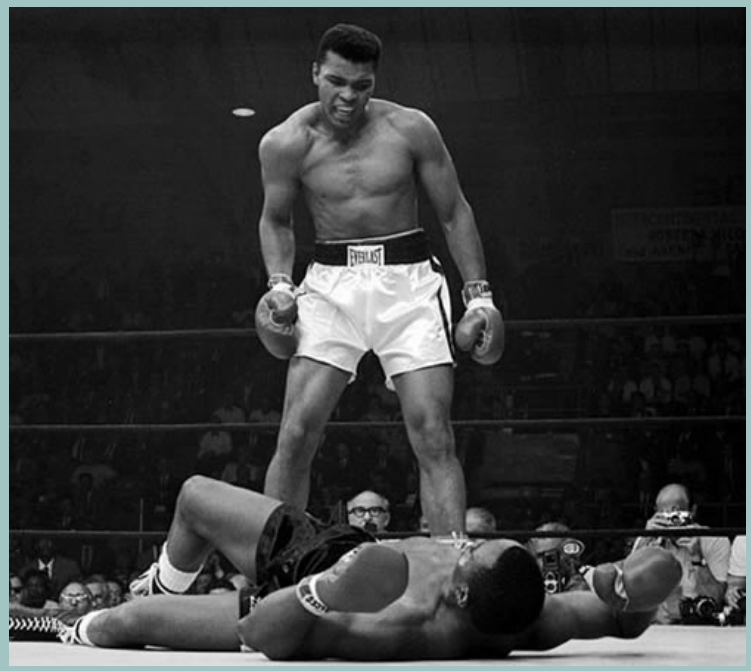
Water Level Changes
Fish, Habitat, & Recreation



(WI DNR/UWEX Upper Fox Basin)

Resiliency:

a : capable of withstanding shock without permanent deformation or rupture
b : tending to recover from or adjust easily to misfortune or change



Not to be confused with:

Resistant:

a : impervious to being affected
b : resistant to change


Unstable Lake Conditions?

Established Plant Bed

Established Lawn

“Resilience” allows them to “bounce-back”
from flooding/drought/abuse

Established Plant Bed

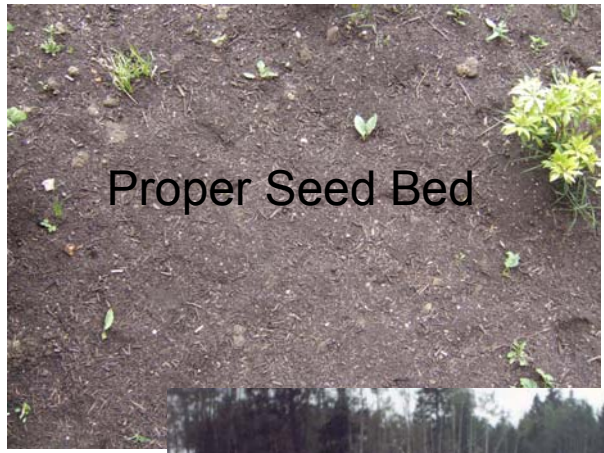
Established Lawn

Continual Abuse/Neglect will eliminate desired plants.

Establishing new plant beds require special conditions/care, not unlike establishing a new lawn……

Newly Established Plant Bed

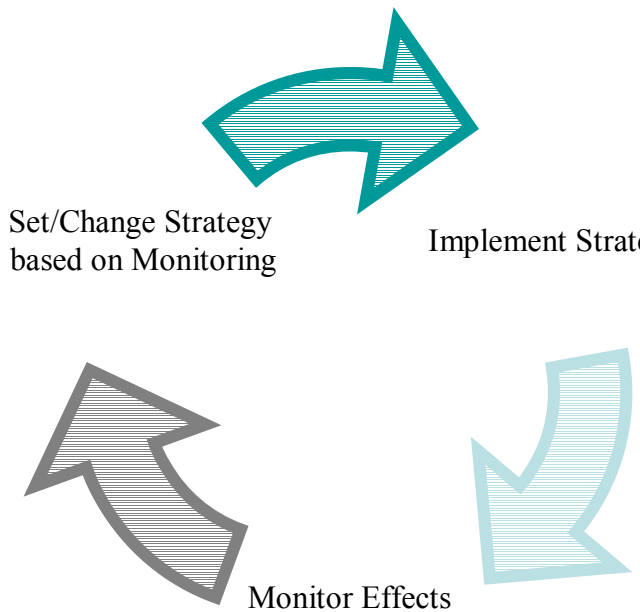
Newly Established Lawn



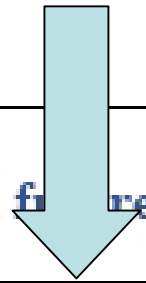
Conducted at Proper Time of Year

Moving Forward by Looking Back…

- Establish a Baseline Trend with Historical Data
- Set Objectives
- Establish Strategy to achieve Objectives
- Continuously Monitor and Adjust Strategy



Adaptive Management
approach that incorporates the results of a new monitoring program into management action in order to adapt and learn over time.



A desired future for Lake Puckaway and its human uses

Not Considered	**Desired Future**	Current Condition	Undesired Future	Not possible
Remove the dam and restore a free-flowing river-marsh system	A healthy clear lake - infrequent algal blooms - excellent habitat for plants and animals - fishery dominated by walleye, northern pike, bass, and panfish	The lake is currently in a precarious state between the Desired Future and Undesired Future	An unhealthy turbid lake - frequent algal blooms - degraded habitat for many plants and animals - fishery dominated by carp and bullheads	Construct a deep, clear-water lake

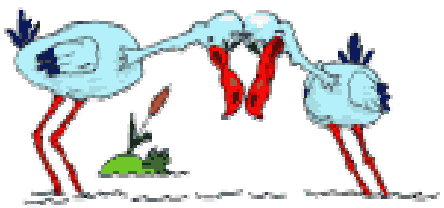
4 Variables of Water Level Fluctuations

Timing (Season)

Magnitude (How Much?)

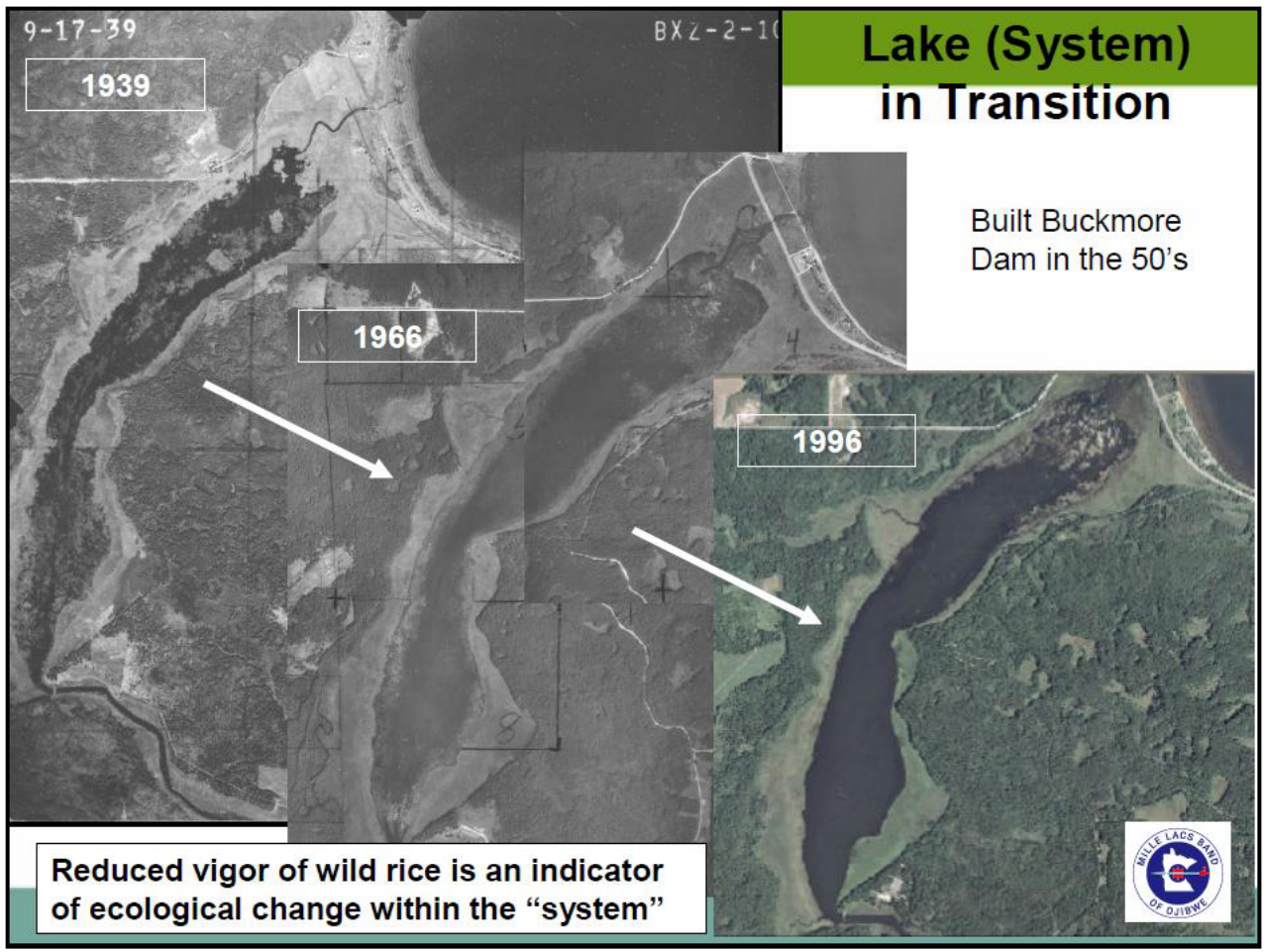
Duration (How Long?)

Frequency



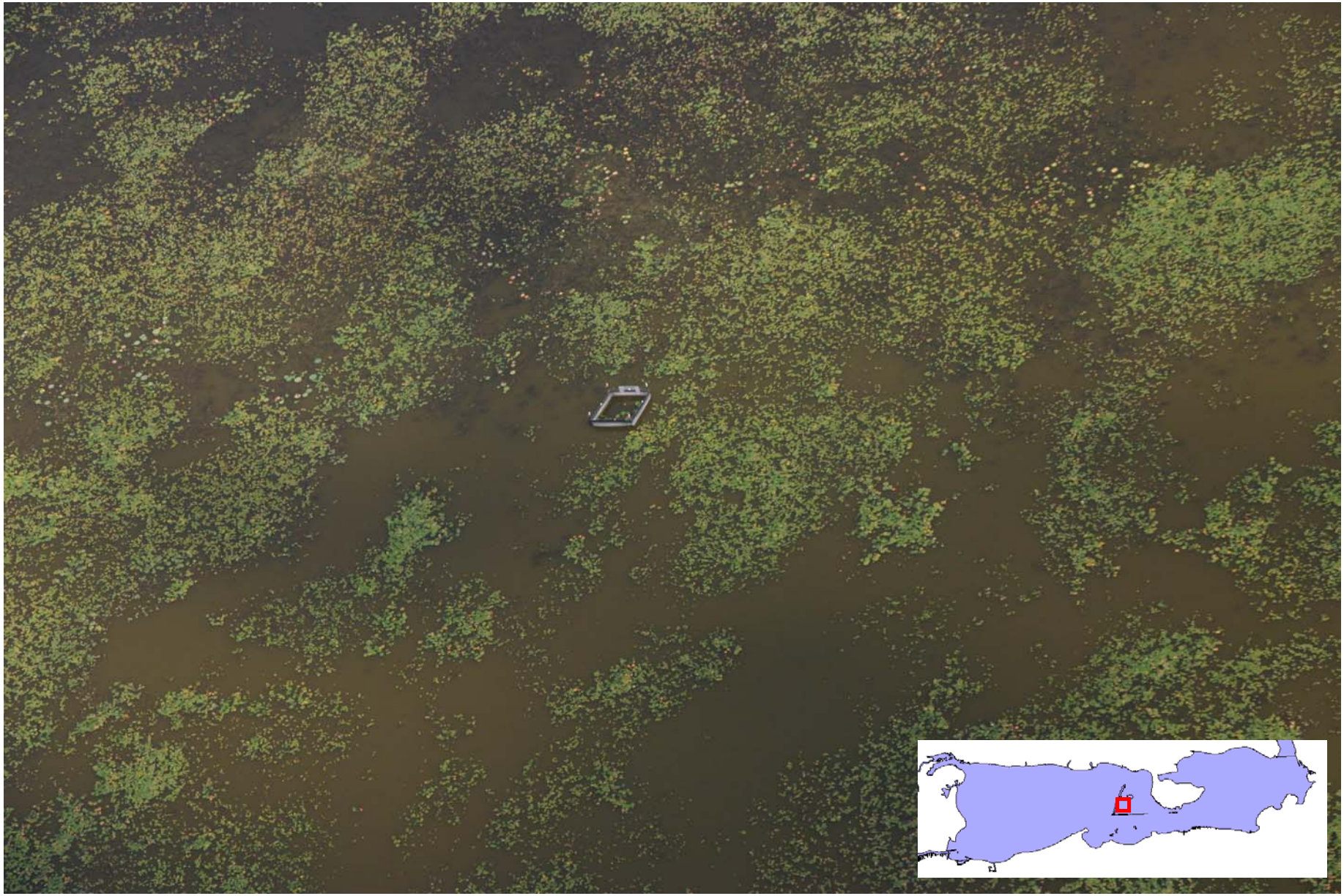
Stabilized Water Levels effect plant establishment

Water level management has become a very effective and widely recommended practice over the past decade to reestablish aquatic plant beds which have been diminished by continue stress and abuse.



Management Activities

- Historical Photo Analysis
- Increase carp removal
- Dredgebank Enhancement
- Carp Exclosures monitoring plots
- Aquatic Plant Monitoring
- AIS Monitoring
- Water Level Monitoring
- Shoreland Restoration
- Boater Education (maps, kiosk, etc)
- Cormorant Control
- Water Level Manipulation
- Fisheries Study
- Watershed Management (Runoff Control Projects, NMP, etc)
- Historical Data Collection



Take Home Message….

Modified water levels are a lake stressor that needs to be managed.

(i.e. Lakes with artificially manipulated water levels need to be properly managed to meet the needs of the lake to prevent degradation over time.)


Adventures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Questions?