

# Wisconsin Lakes



Wisconsin has the 3rd largest concentration of fresh water glacial lakes on the planet.

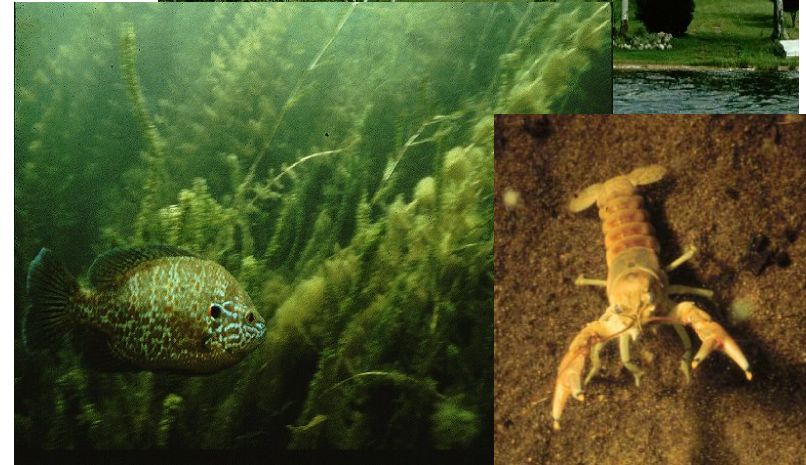


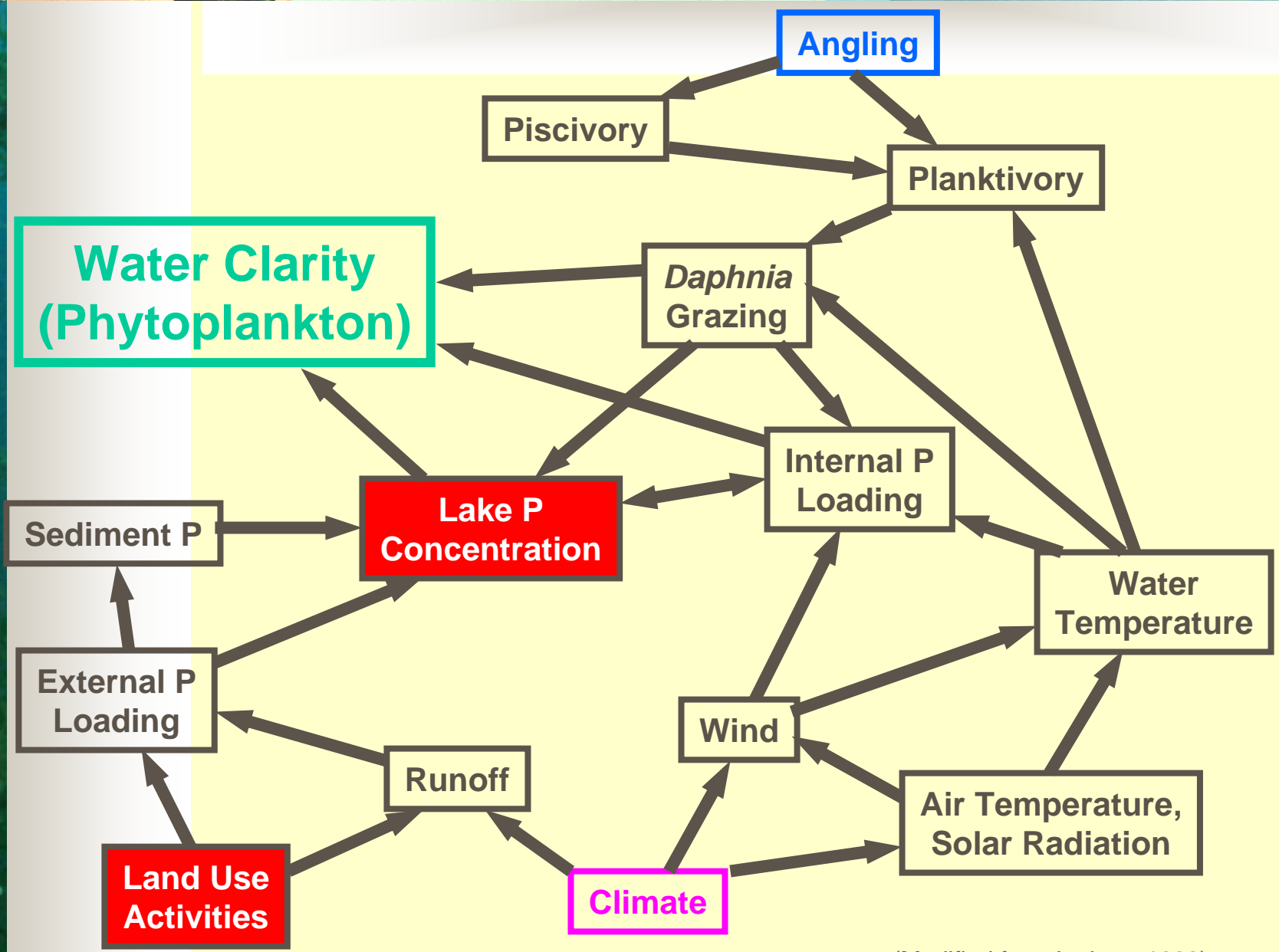
# Wisconsin's Lakes are Changing Faster than Ever:

Algae blooms  
(phosphorus pollution)

Destruction of  
shoreline habitat

Invading plants and  
animals





(Modified from Lathrop 1998)



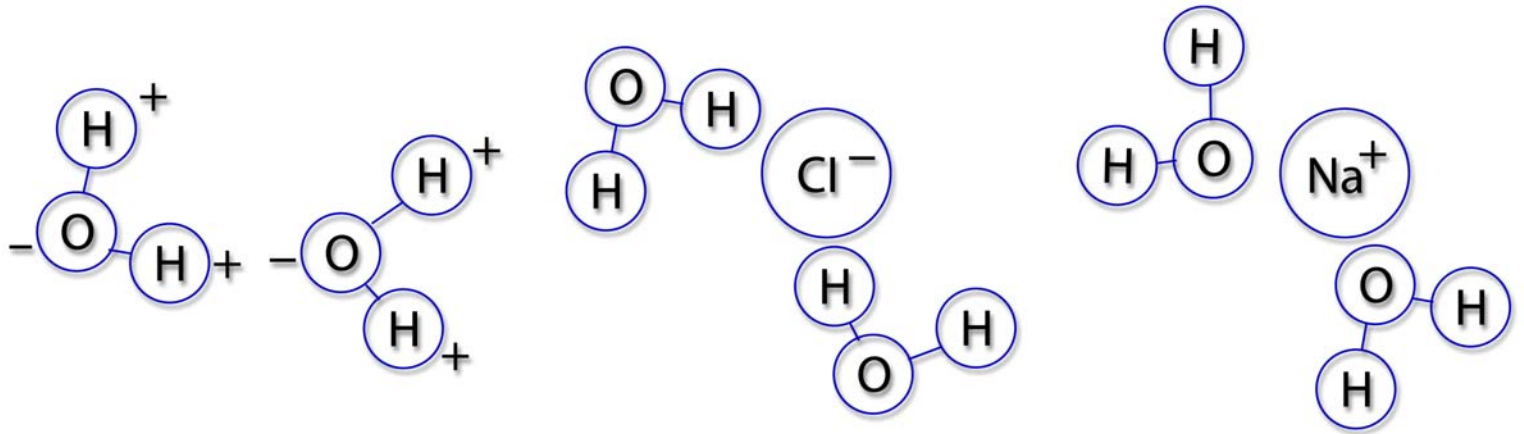
# OVERVIEW

- **Unique Properties of Water**
- Lake Types
- Physical, Chemical, Biological and Habitat Characteristics
- Technical Aspects



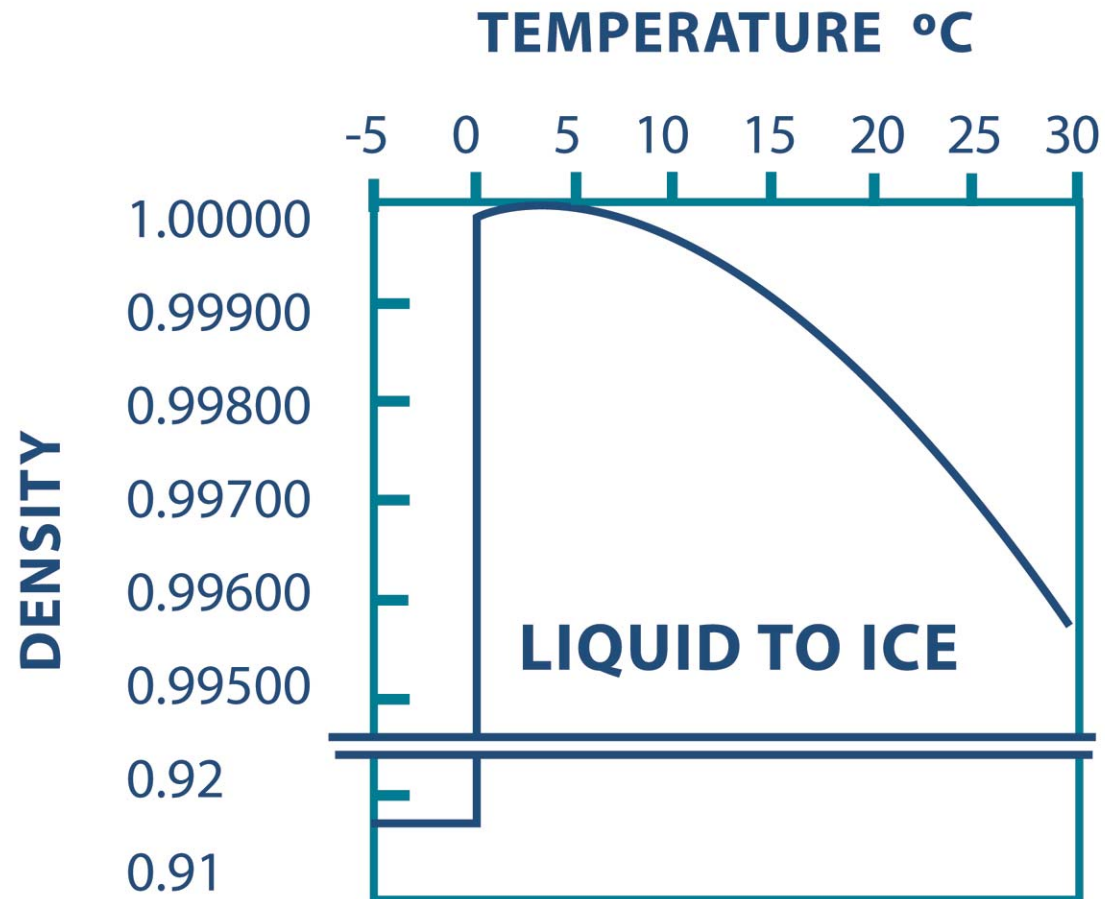
# UNIQUE PROPERTIES OF WATER

- Universal Solvent
- Chemical Molecular Structure  $H_2O$
- Greatest Density at  $4^{\circ} C$  or  $39^{\circ} F$

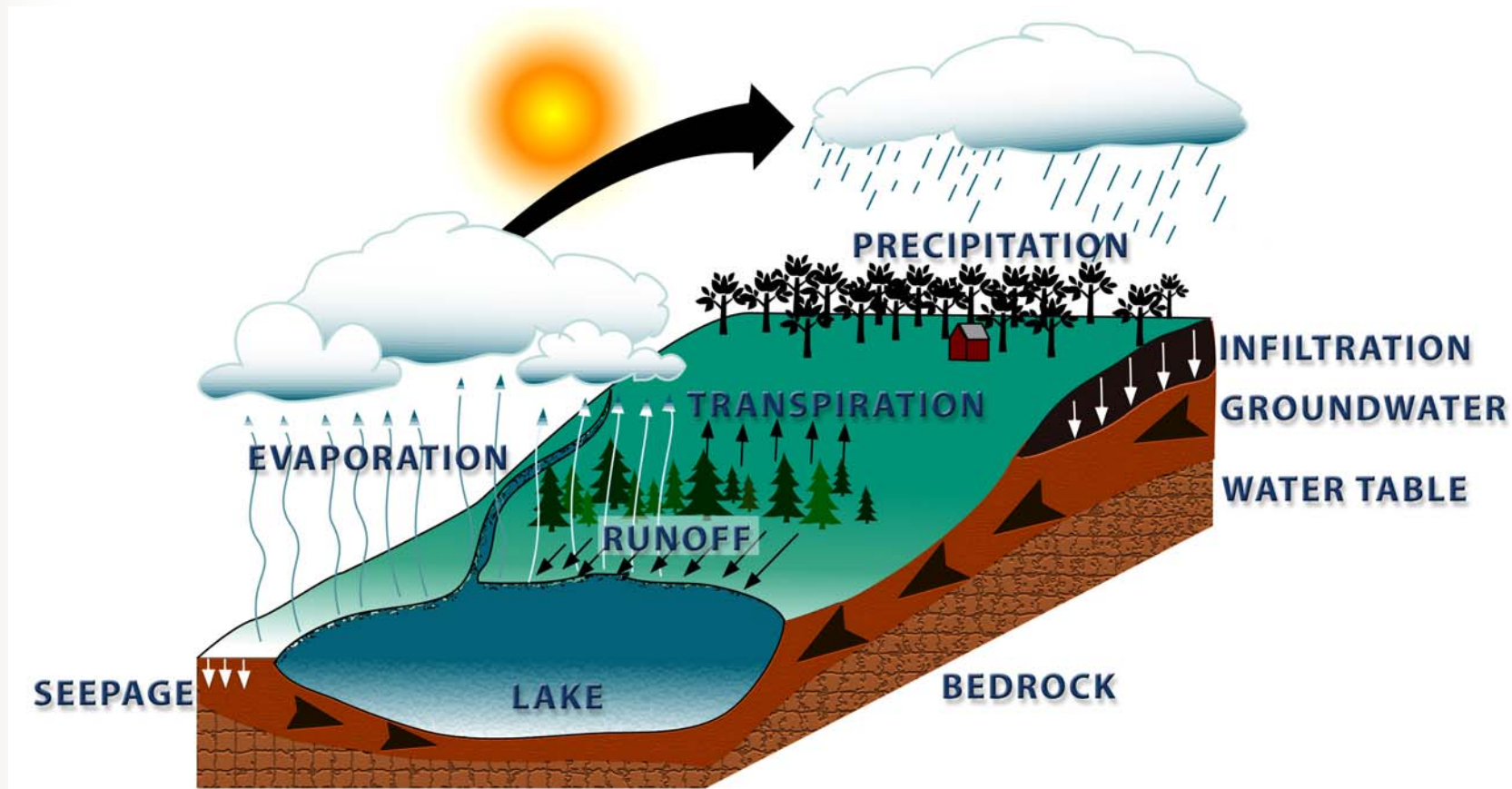


# UNIQUE PROPERTIES OF WATER

- Physical Properties
- 71% Earth's Surface Covered by Water
- <1% Water on Earth is Freshwater
- .009% water on Earth is Freshwater Lakes



# HYDROLOGIC CYCLE





# OVERVIEW

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- **Lake Types**
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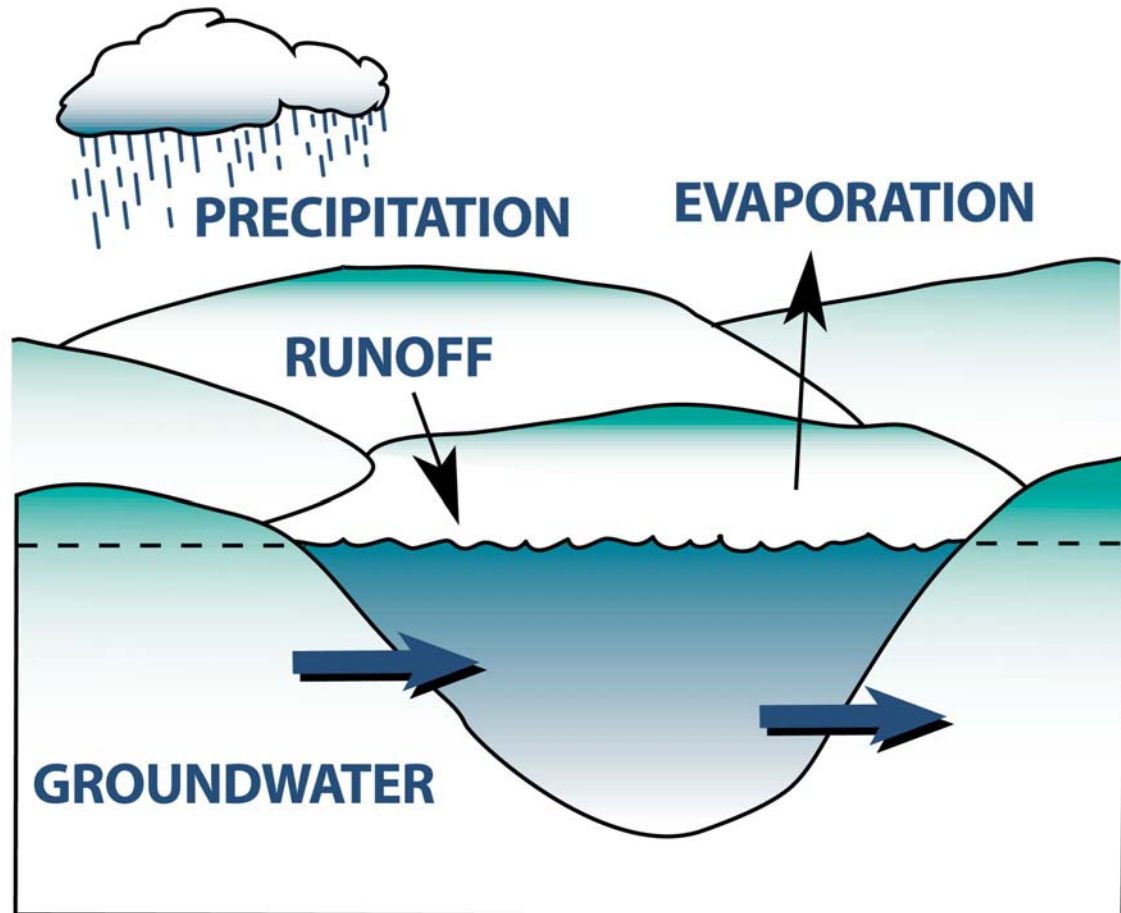
# LAKE TYPES

- Seepage
- Groundwater Drainage
- Drainage
- Impoundments
- Oxbow



# SEEPAGE LAKE

- Natural Lake
- Water Source
  - Groundwater
  - Precipitation
- No Stream Outlet/ Inlet



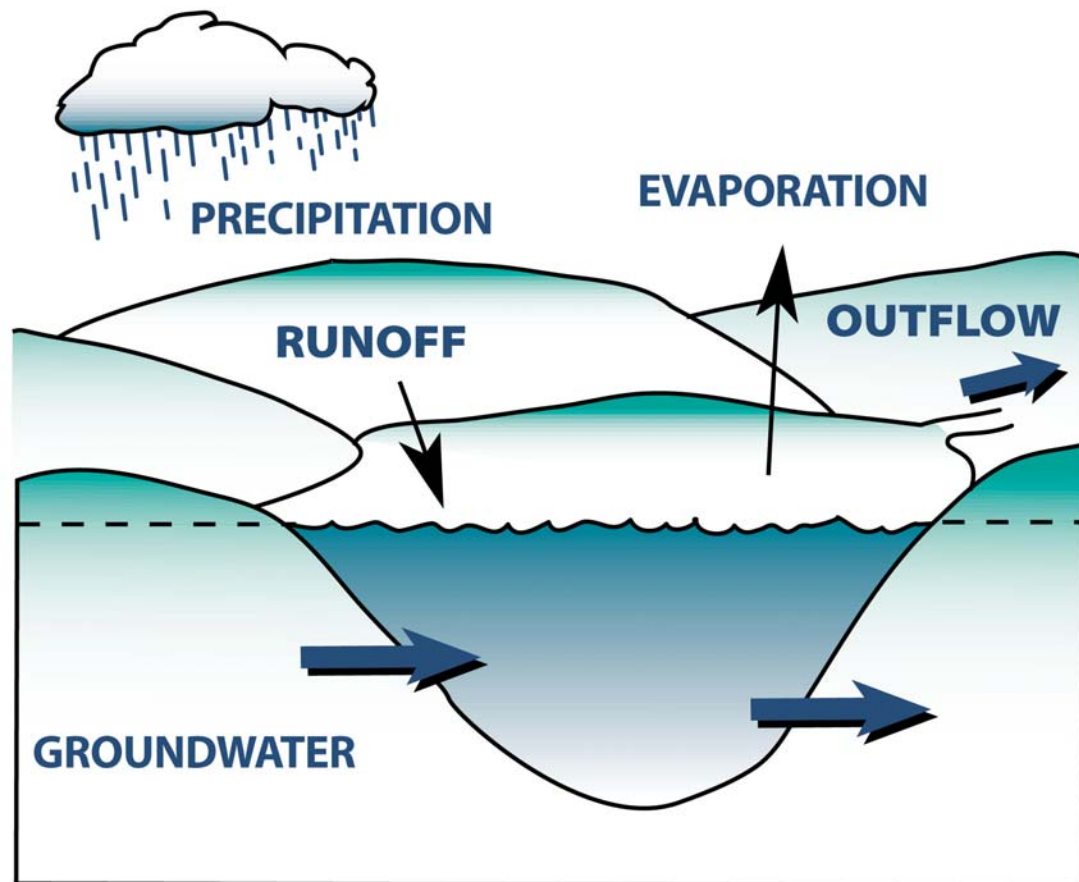
# SEEPAGE LAKE

An aerial photograph showing a vast, flat landscape covered in dense green vegetation. The terrain is characterized by a complex network of interconnected water bodies, including large lakes and numerous smaller ponds, creating a mosaic of blue and green. The water bodies vary in size and shape, some appearing as long, narrow channels while others are more circular or irregular. The overall scene depicts a rich, natural wetland environment.

■ Round Lake, Chippewa County

# GROUNDWATER DRAINAGE

- Natural Lake
- Water Source
  - Groundwater
  - Precipitation
  - Limited Runoff
- Has Stream Outlet



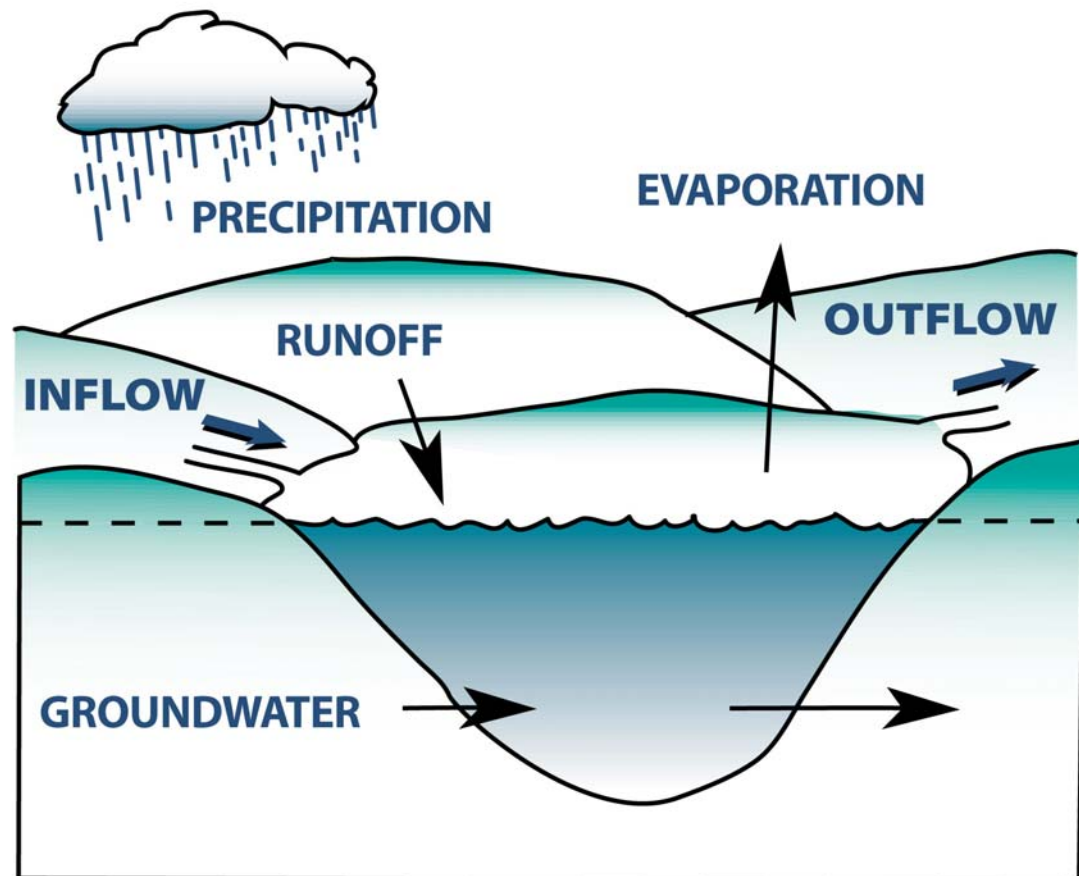
# GROUNDWATER DRAINAGE LAKE



■ Sand Lake, Chippewa County

# DRAINAGE LAKE

- Water Source
  - Streams
  - Groundwater
  - Precipitation
  - Runoff
- Stream Drained



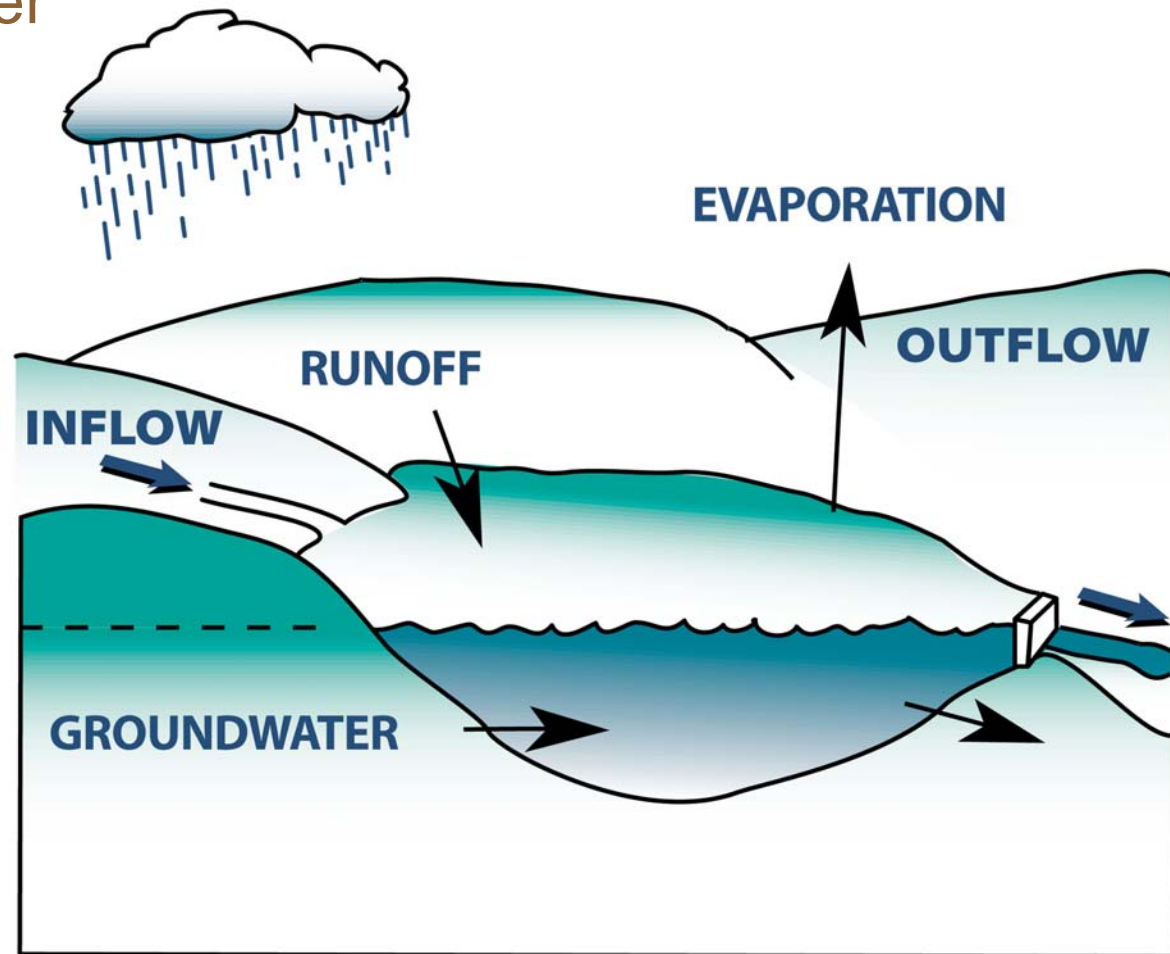
# DRAINAGE LAKE



■ Long Lake, Chippewa County

# IMPOUNDMENT

- A manmade lake
- Dammed River or Stream





# IMPOUNDMENT



- Lake Altoona, Eau Claire County

# OXBOW

An aerial photograph showing a large, dark, crescent-shaped oxbow lake. The lake is surrounded by dense green trees and a grassy area. A road or path runs along the right side of the lake. In the background, there are residential areas with houses and a large body of water, likely a reservoir or another lake. The overall scene is a mix of natural and developed land.

■ Lake Hallie, Chippewa County



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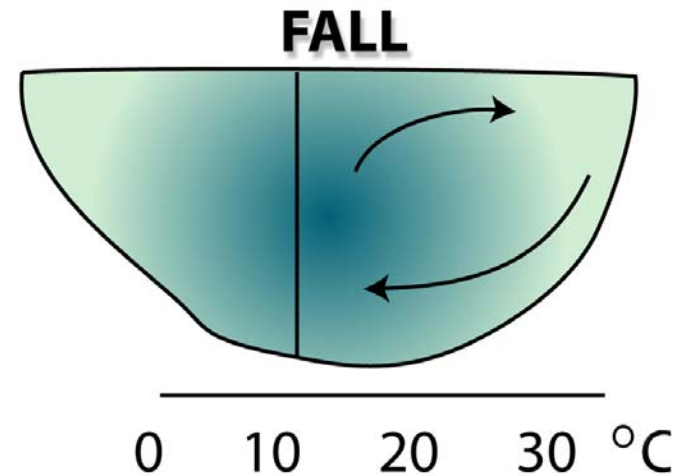
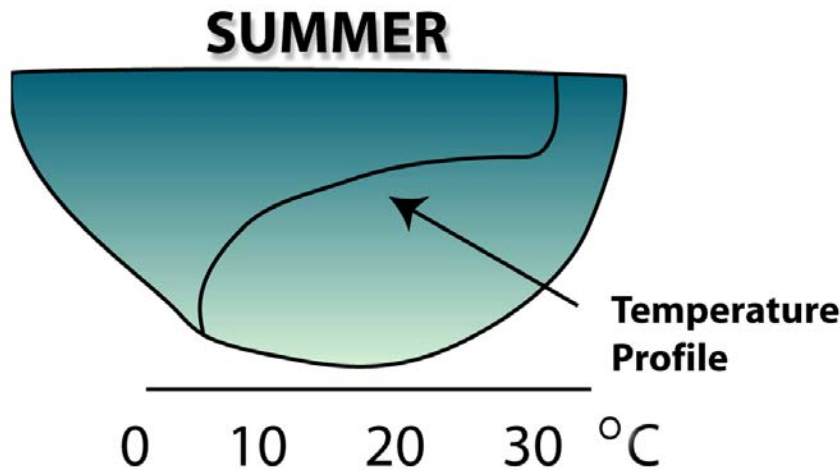
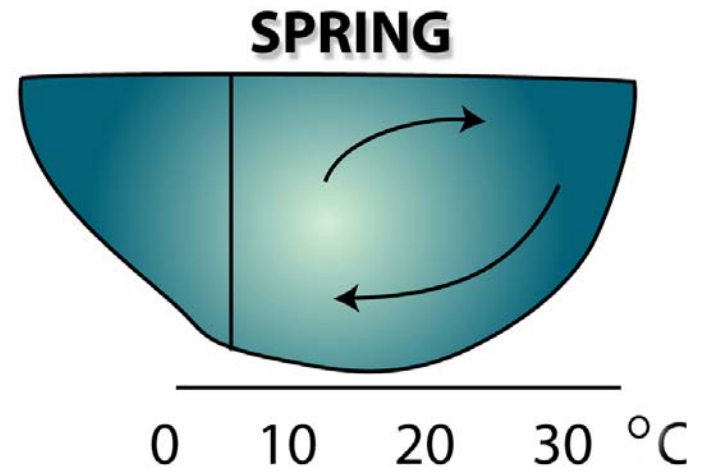
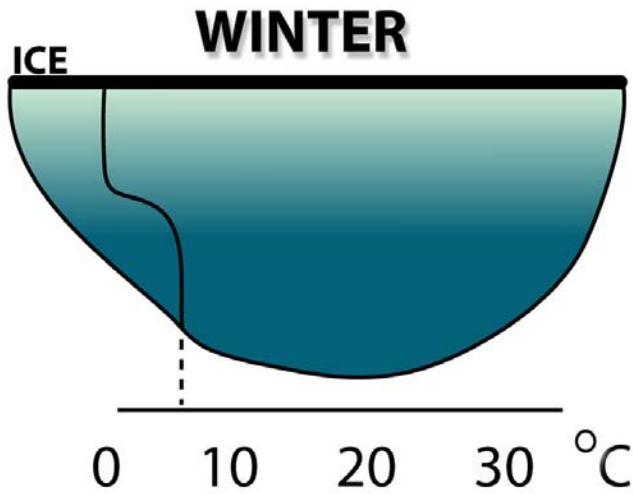


# PHYSICAL CHARACTERISTICS

- Mixing / Stratification
- Lake Depth
- Retention Time / Flushing Rate
- Drainage Basin/ Lake Area Ratio
- Influence of Watershed Runoff

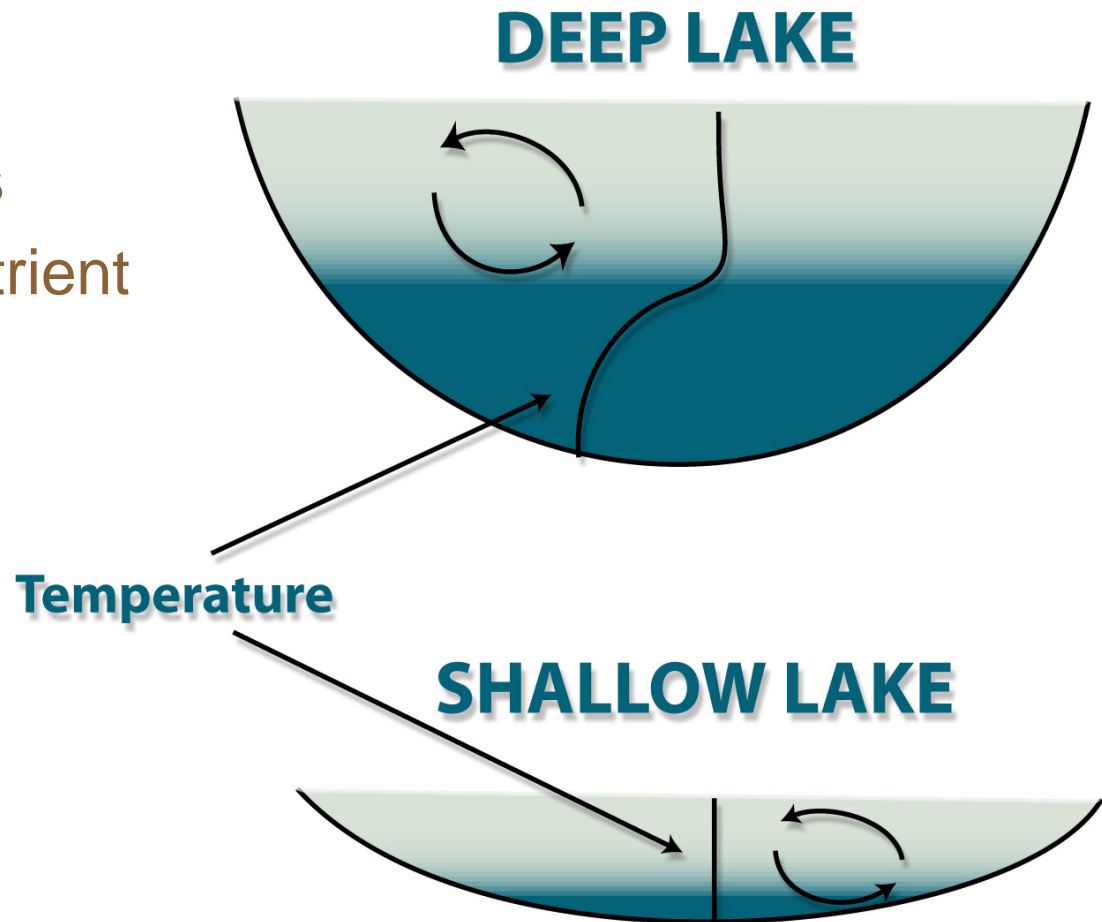


# MIXING/ STRATIFICATION



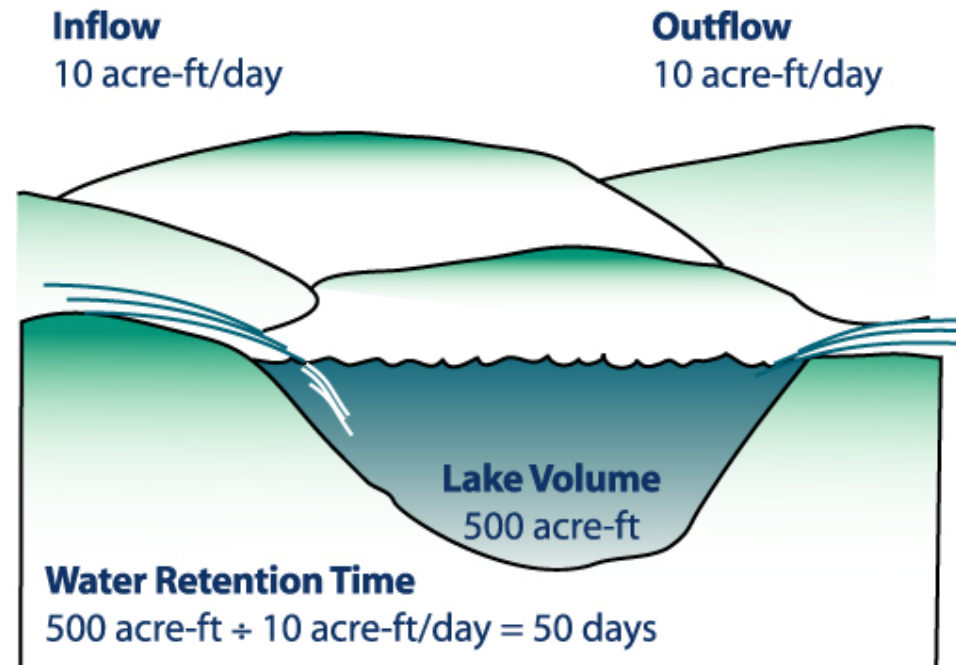
# LAKE DEPTH MATTERS

- **Deep Lakes**  
Stratify
- **Shallow Lakes**  
Continuous Nutrient Recycling



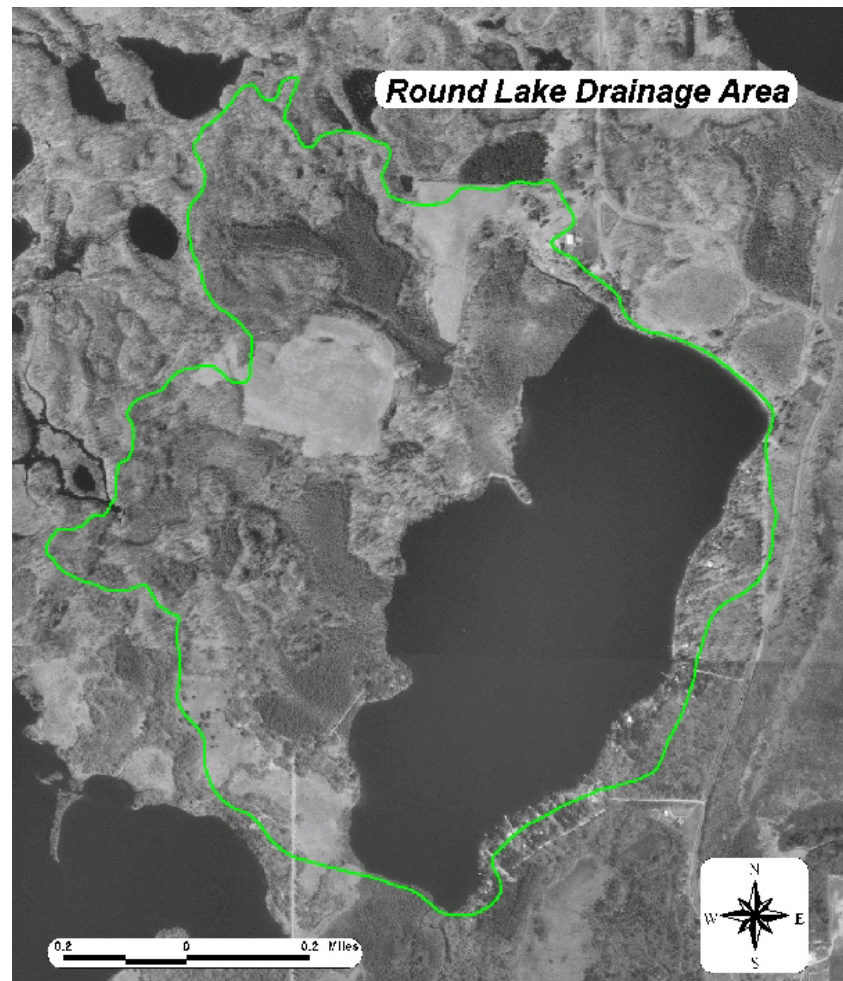
# RETENTION TIME/ FLUSHING RATE

- How long would it take to fill a drained lake?
- Retention Time Matters
- Long Lake & Altoona
  - Long Lake, 7years
  - Lake Altoona, 22days



# DRAINAGE BASIN/ LAKE AREA RATIO

- Seepage Lake- small
- Drainage Lake- large watershed
  - Seepage Lake w/  
drainage area mapped  
Round Lake







# CHEMICAL CHARACTERISTICS

- Chemical Characteristics
- Limiting Nutrient Concept P vs N
- Lake 227





# CHEMICAL CHARACTERISTICS

- Nutrients
  - P
  - N
- pH
- Hardness/ Alkalinity
- Dissolved Oxygen (optimum 5 ppm)

## NUTRIENT FUNCTIONS

ELEMENT	AVAILABILITY	DEMAND	AVAILABILITY DEMAND	FUNCTION
Na	32	0.5	64	Cell membrane
Mg	22	1.4	16	Chlorophyll, energy transfer
Si	268	0.7	383	Cell wall (diatoms)
P	1	1	1	DNA, RNA, ATP, enzymes
K	20	6	3	Enzyme activator
Ca	40	8	5	Cell membrane
Mn	0.9	0.3	3	Photosynthesis, enzymes
Fe	54	0.06	900	Enzymes
Co	0.02	0.0002	100	Vitamin B12
Cu	0.05	0.006	8	Enzymes
Zn	0.07	0.04	2	Enzyme activator
Mo	0.001	0.0004	3	Enzymes



# LIMITING NUTRIENT PRINCIPLE

...That Nutrient in Least Supply  
Relative to Plant Needs

N:P Ratio in plant Tissue 10:1 - 15:1

If the Ratio of N:P in Water is

<10:1 Nitrogen Limited

>15:1 Phosphorus Limited



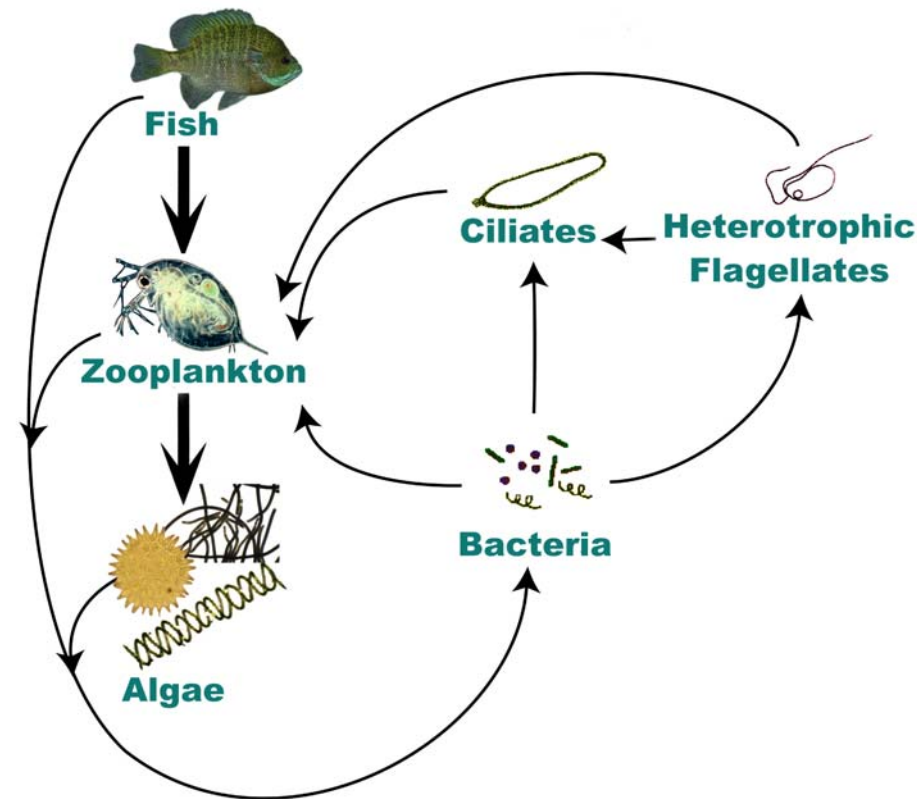


# PHOSPHORUS LIMITATION LAKE 227



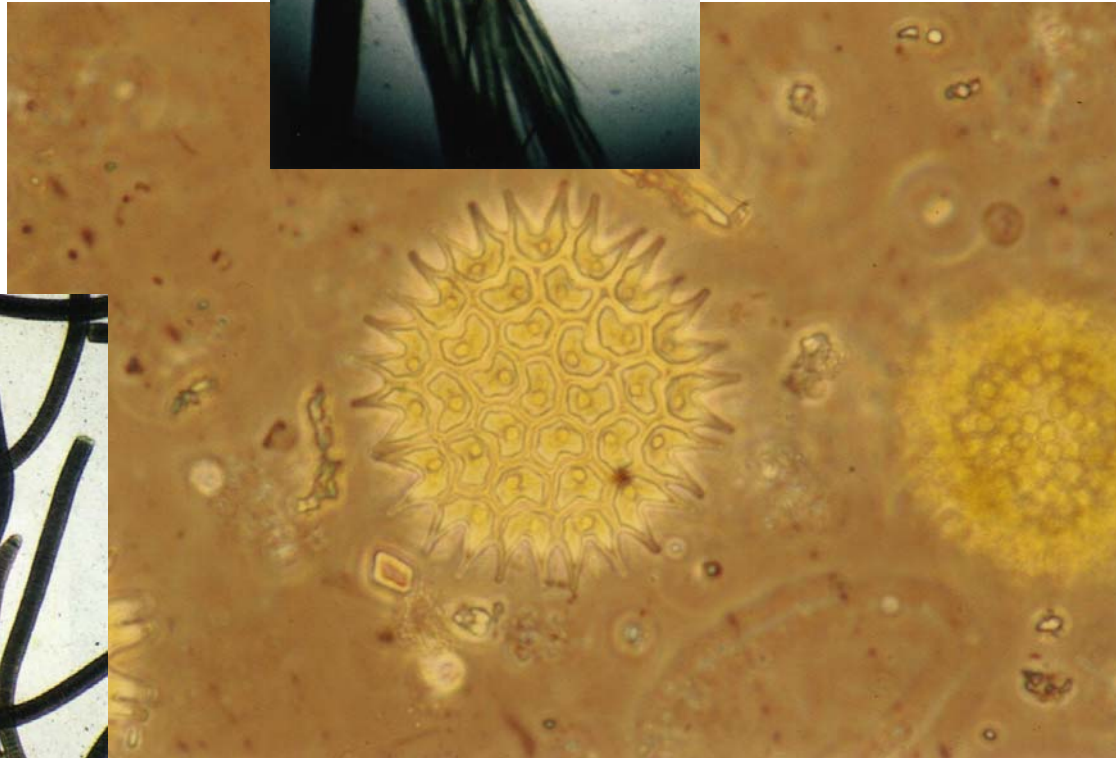
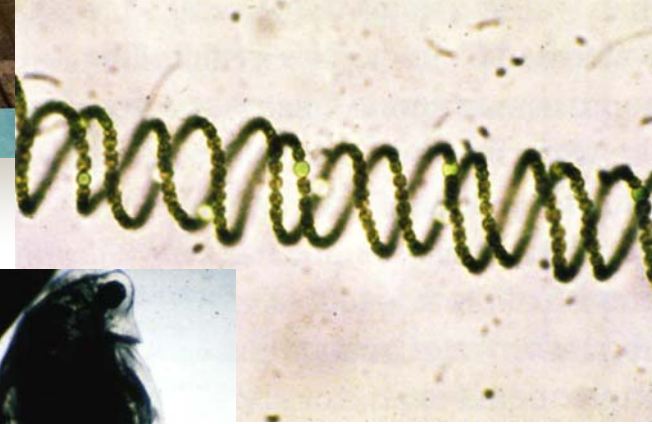
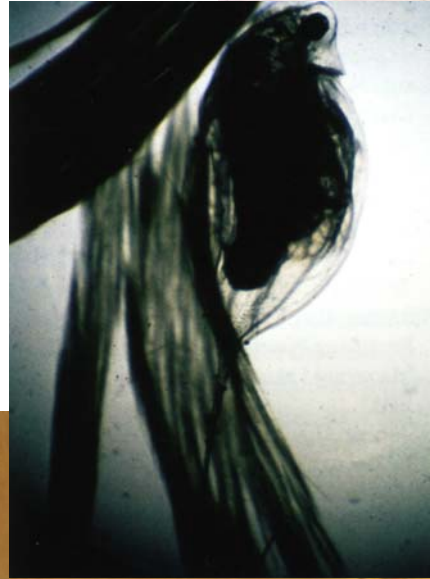
# BIOLOGICAL CHARACTERISTICS

- Viruses/ Bacteria/ Fungi
- Primary - Producers  
Algae/ Macrophyte
- Zooplankton/ Inverts
- Fish



# ALGAE

- Primary Energy Source for Invertebrates
- Can be Nuisance
- Produce O<sub>2</sub>





# AQUATIC PLANTS

- Habitat
- Energy Dissipation
- O<sub>2</sub> Producers





# ZOOPLANKTON & AQUATIC INVERTEBRATES

Zooplankton

Dragonfly





# FISH

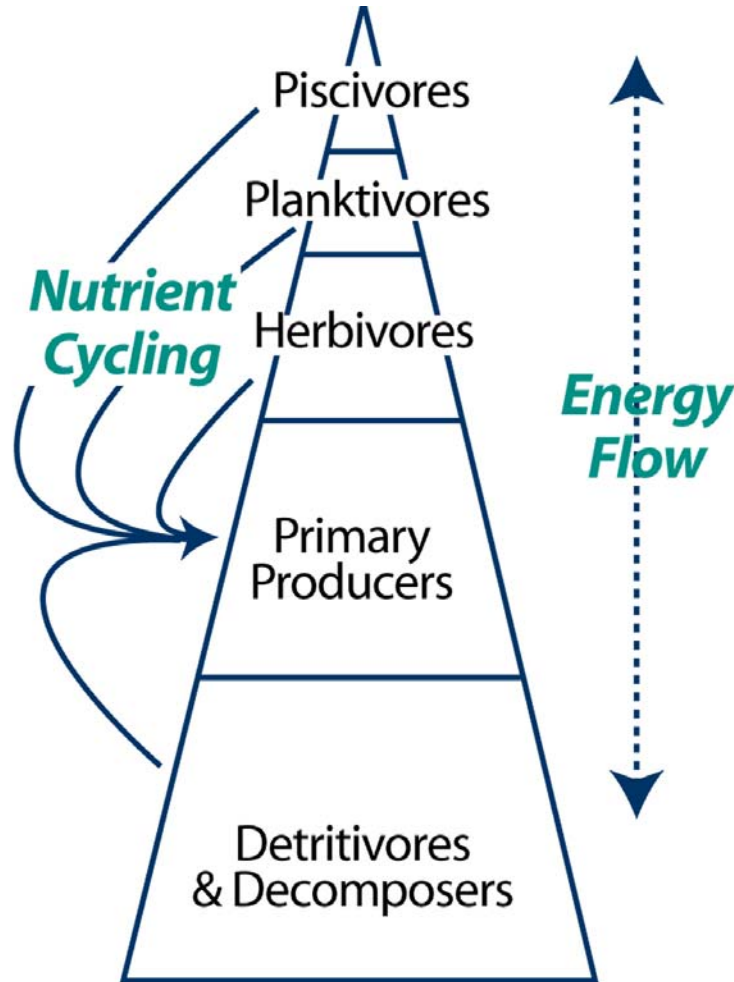
Planktivore

Piscivore

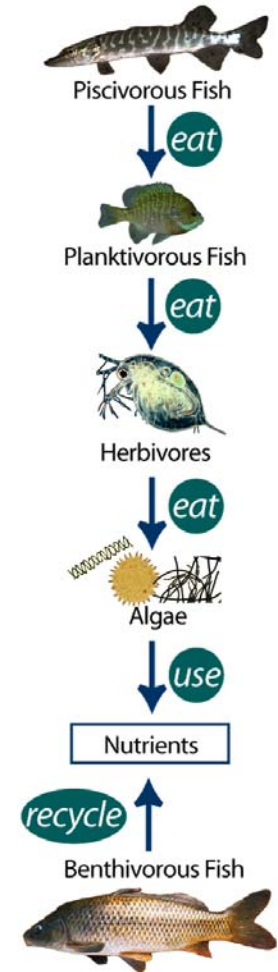
Benthivore



# TROPHIC PYRIMID



**ENERGY PYRIMID**



**AQUATIC FOOD CHAIN**



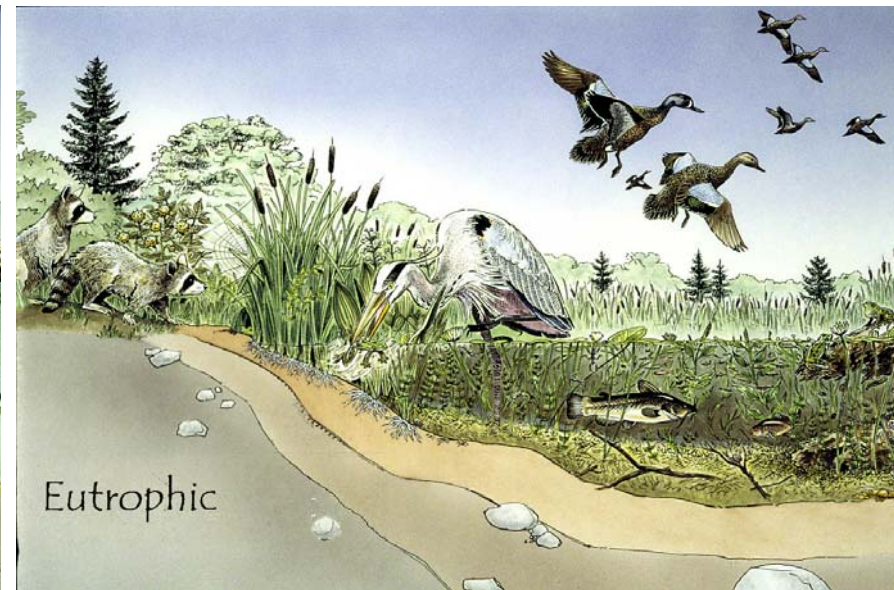
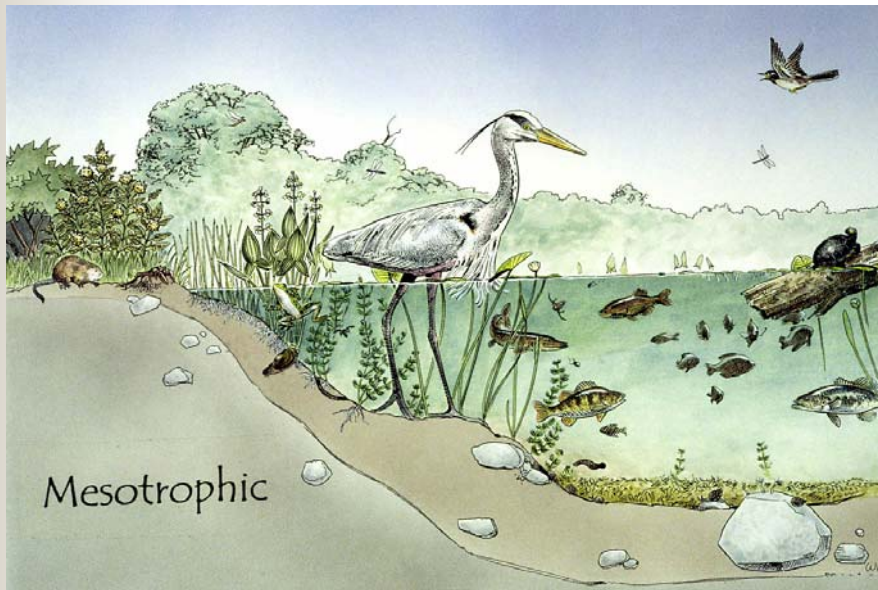
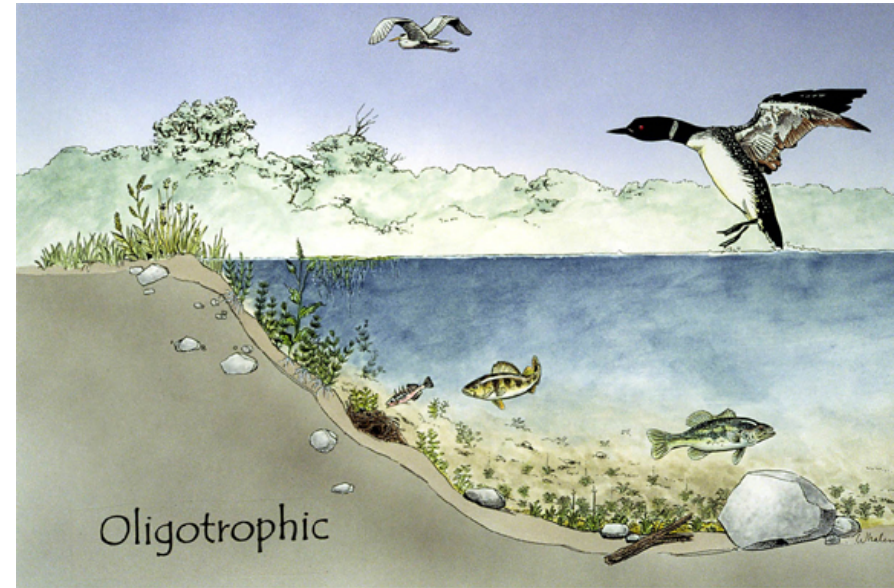
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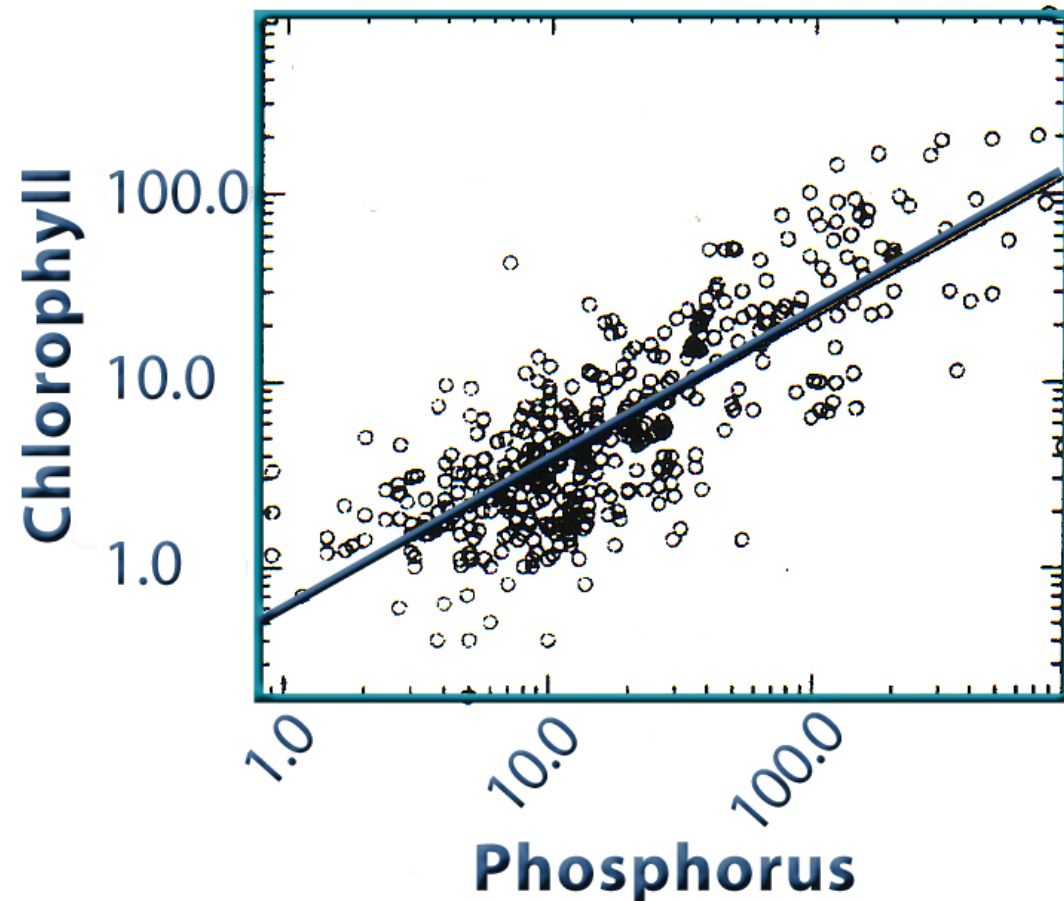
# TROPHIC STATE

- Nutrients & Productivity
- Sediment & Accumulation
- Species Shifts
- Species Richness

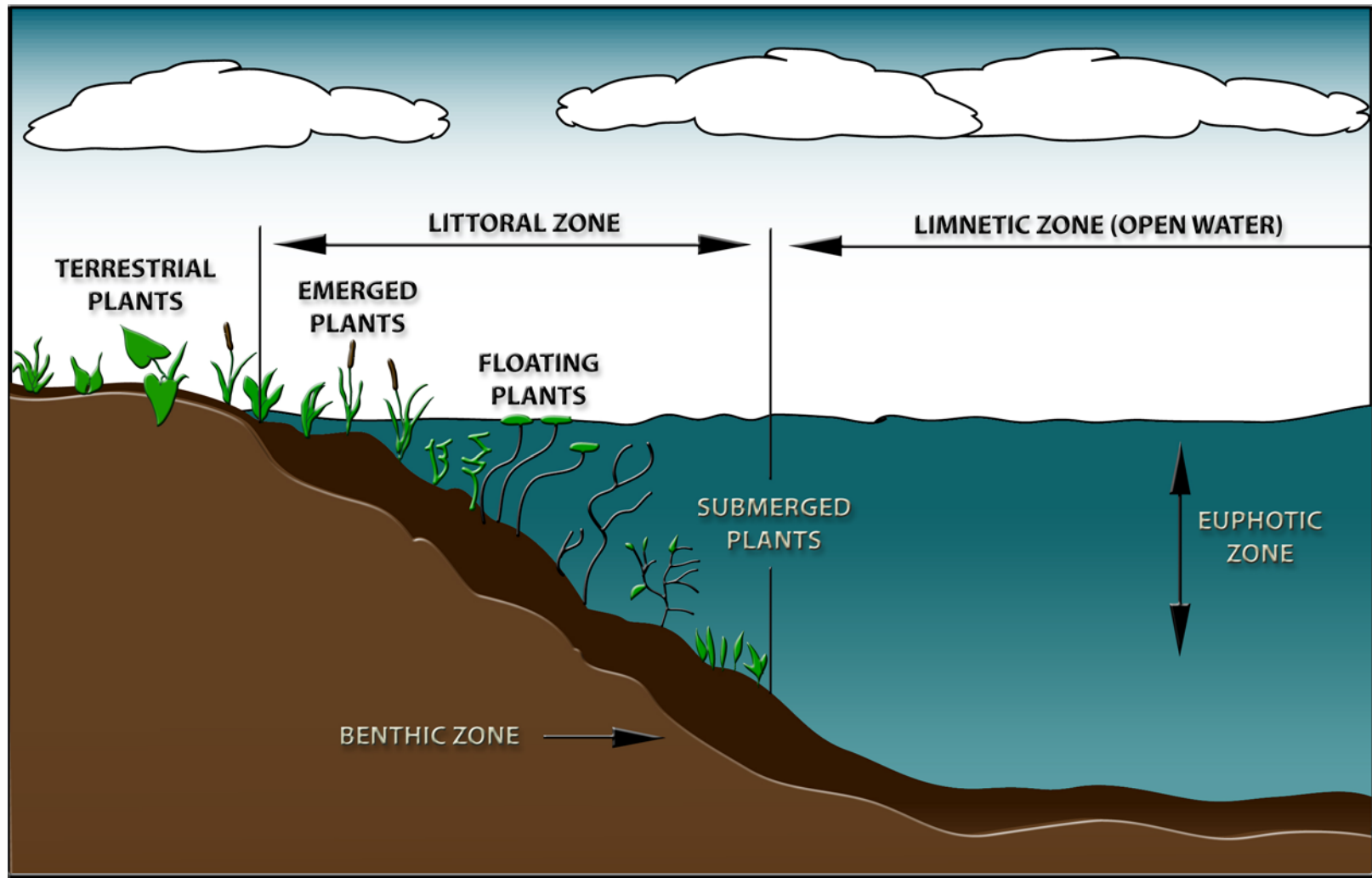


# TOTAL PHOSPHORUS/ CHLOROPHYLL a RELATIONSHIP

- Phosphorus causes algae to grow



# LAKE HABITAT ZONES

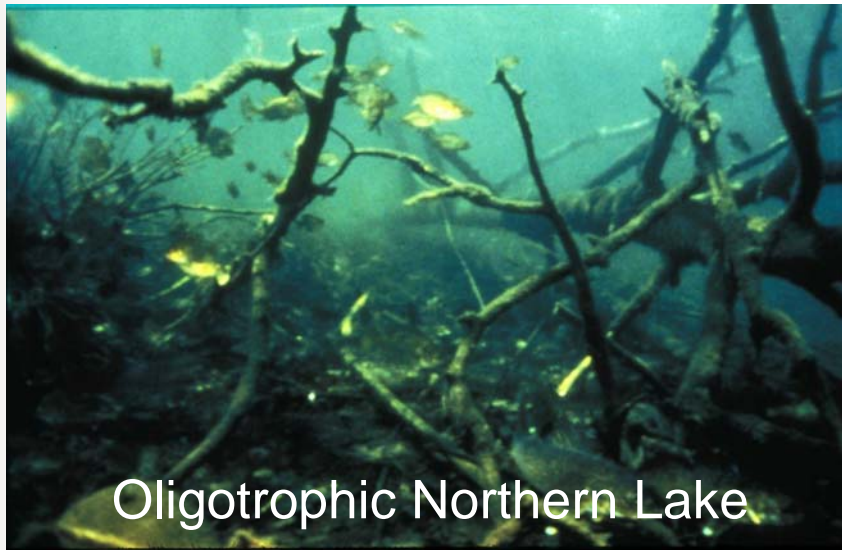
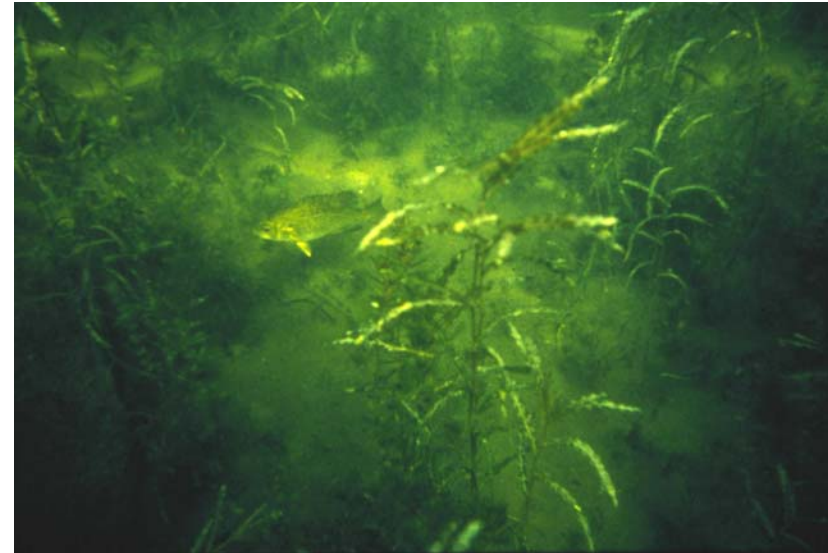




# LAKE LITTORAL ZONE

## ■ Functions

- Intercepts Nutrients
- Refuge from Predators
- Nursery for Fish



Oligotrophic Northern Lake



Eutrophic Southern Lake

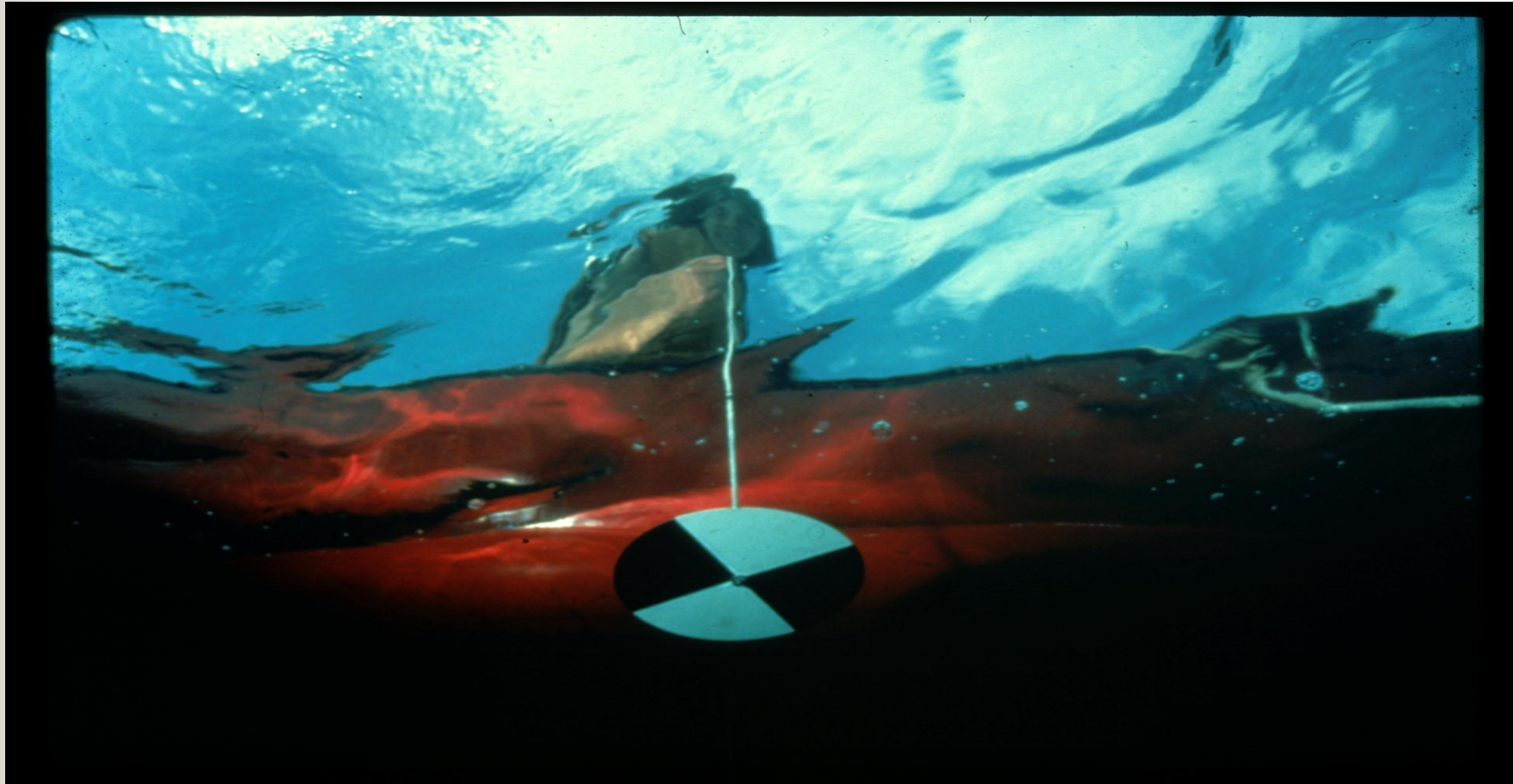


# ENVIRONMENTAL SIGNS OF DEGRADATION

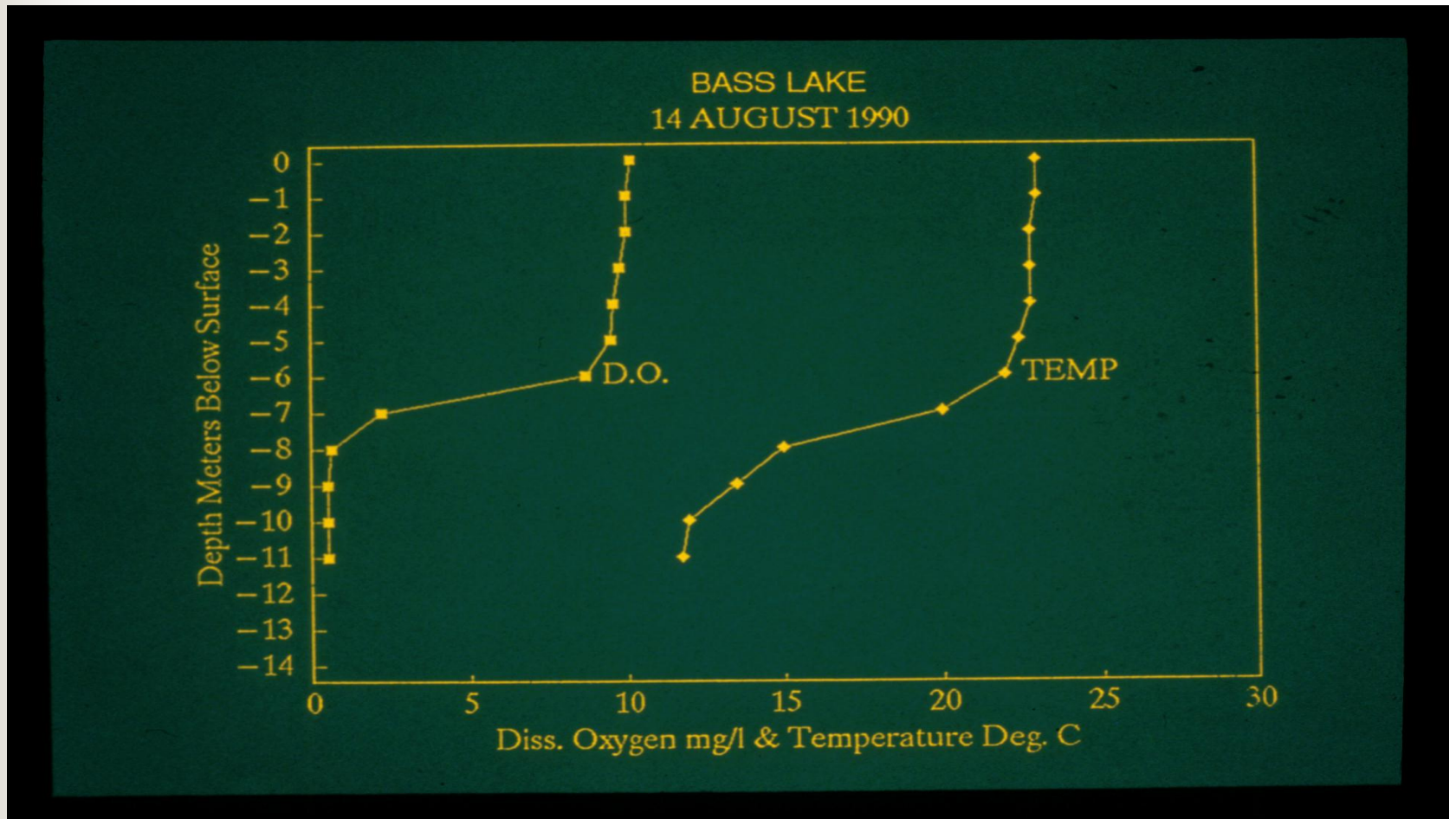


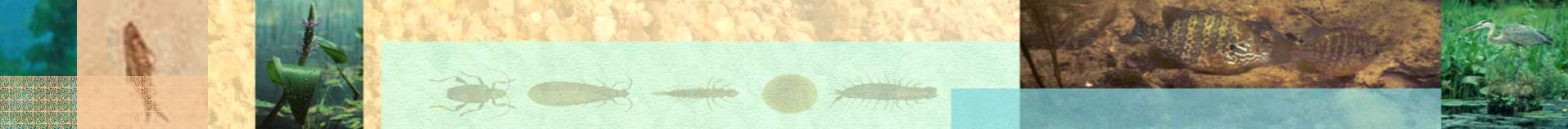


# LOSS OF WATER CLARITY

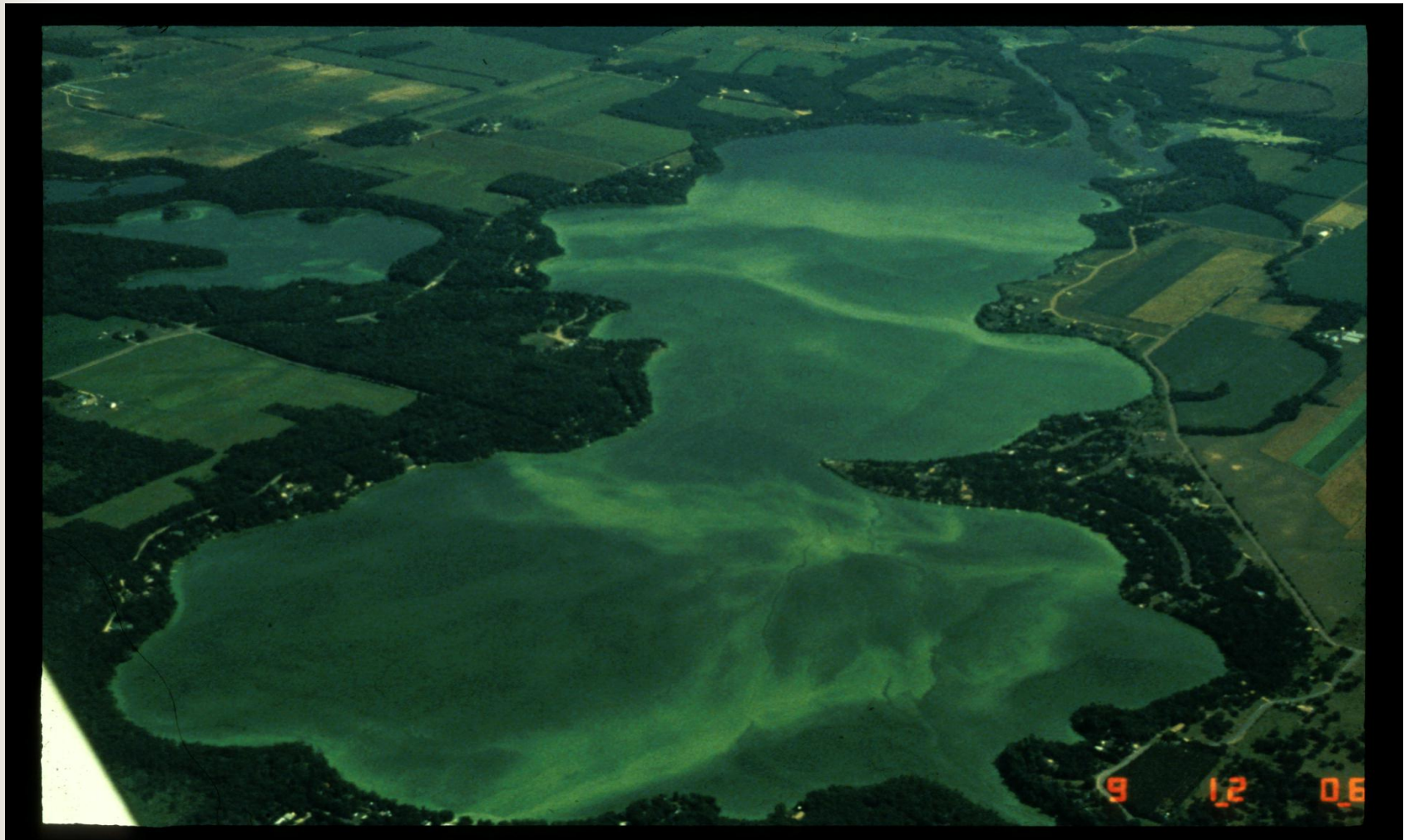


# HYPOLIMNETIC DO DEPLETION





# NUISANCE ALGAE BLOOMS

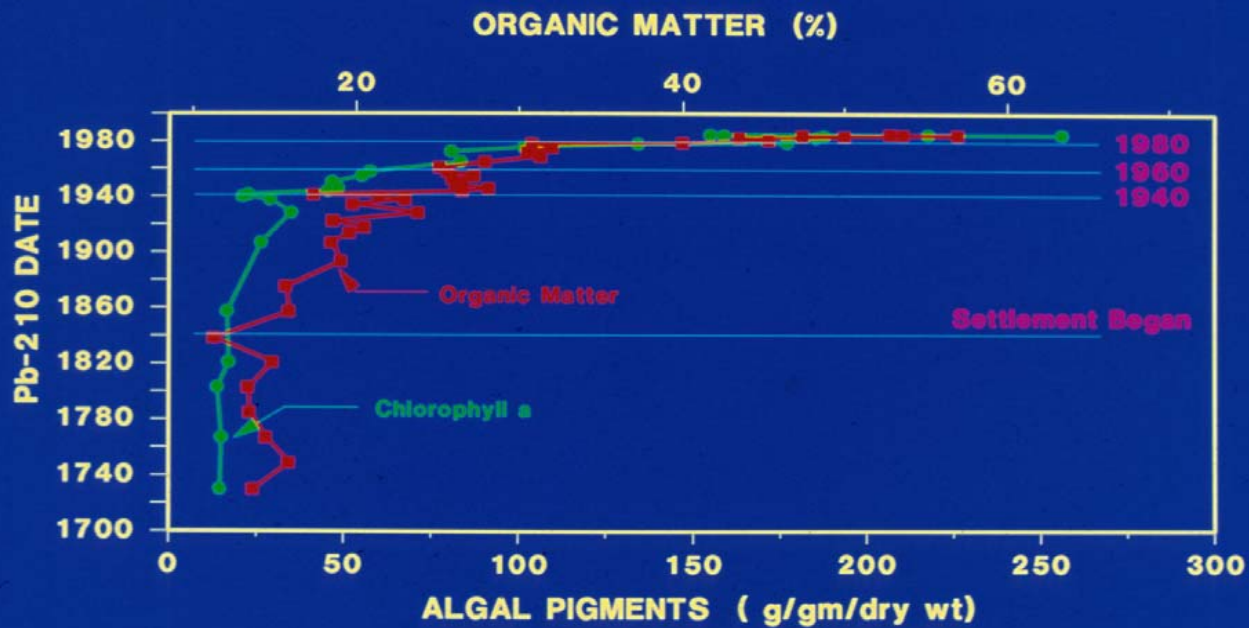


# FISHERIES DEGRADATION



# PALEOLIMNOLGY

## SQUAW LAKE St. Croix County





# LEAVING A LEGACY



*Help Protect Wisconsin's...*

**WATER RESOURCES.**

