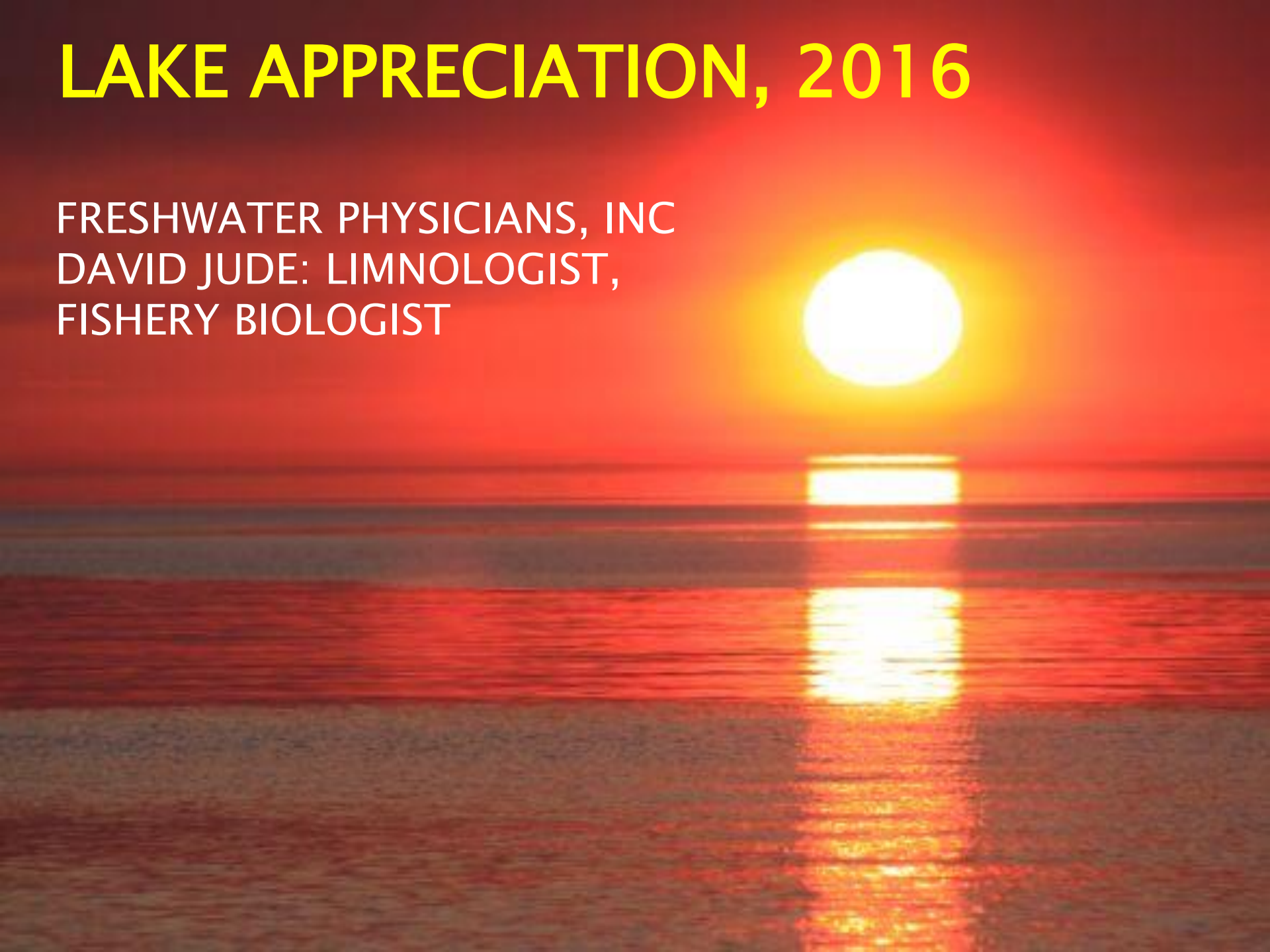
LAKE APPRECIATION, 2016



FRESHWATER PHYSICIANS, INC
DAVID JUDE: LIMNOLOGIST,
FISHERY BIOLOGIST

OUTLINE

- CREDENTIALS
- INTRODUCION
- SOME CONCEPTS
- WATER QUALITY
- ALGAE
- AQUATIC PLANTS
- FISH
- OUTCOMES/RECOMMENDATIONS

CREDENTIALS

- BS : UNIVERSITY OF MINNESOTA
- ---FISH AND WILDLIFE MANAGEMENT
- MS: IOWA STATE UNIVERSITY
- ---FISHERY BIOLOGY
- PHD: MICHIGAN STATE UNIVERSITY
- ---LIMNOLOGY
- CAREER: UNIVERSITY OF MICHIGAN
- ---40 YEARS ON THE GREAT LAKES

FRESHWATER PHYSICIANS, INC

- INCORPORATED IN 1974
- WE DO A RANGE OF STUDIES FROM POWER PLANT IMPACTS, LAKE MANAGEMENT, WETLAND EVALUATIONS, AND FISH SAMPLING/MANAGEMENT

EPIGRAPH

“One of the penalties of an ecological education is that one lives in a world of wounds. Much of the damage inflicted on land is quite invisible to laymen. An ecologist must either harden his shell and make believe that the consequences of science are none of his business or he must be the doctor who sees the marks of death in a community that believes itself well and does not want to be told otherwise." Aldo Leopold

INTRODUCTION

1,000 WAYS TO DIE

- ASSAULT:
- -FROM THE AIR
- -FROM THE LAND
- -FROM THE SEA

TWO MAJOR DECISIONS FOR LAKES

- 1. TREAT SYMPTOMS: ALGAL BLOOMS, AQUATIC PLANTS, ANOXIA
- -REDUCE FERTILIZATION, SWITCH FROM SPETIC TANKS TO SEWERS, REDUCE RUNOFF
- 2. TREAT PROBLEM (EXPENSIVE!!!)
- -DREDGING
- -DRAWDOWN
- -ALUM TREATMENT

SOME CONCEPTS

- CARRYING CAPACITY: ALGAE OR MACROPHYTES
- LIMITING FACTORS – P USUALLY LIMITING
- LAKE STRATIFICATION PATTERNS
- LAKE NUTRIENT BUDGETS

CARRYING CAPACITY

- INHERENT CAPACITY TO PRODUCE BIOMASS
- BUSHELS OF CORN PER ACRE
- LIMITED OR ENHANCED BY NUTRIENTS

LIMITING FACTORS

- AQUATIC PLANTS AND ALGAE ARE COMPOSED OF : 1 PHOSPHORUS 7 NITROGEN AND 40 CARBONS
- IF YOU USED THREE TYPES OF TINKER TOYS AND HAD A BOX OF EACH ELEMENT, AT SOME POINT YOU WOULD STOP MAKING THEM SINCE ONE WOULD BECOME LIMITING
- MOST LAKES RUN OUT OF P DURING SUMMER

COMPOSITION OF PLANTS

- PHOSPHORUS CAN GENERATE 500 TIMES ITS WEIGHT IN A LAKE IN PLANT MATERIAL
- 1 POUND OF P = 500 POUNDS OF PLANTS
- AVERAGE AMOUNT OF P DISCHARGED BY ONE HOUSEHOLD SEPTIC TANK/YR = 2.2 POUNDS

SOME EXAMPLES OF LAWN RUNOFF

- -RESOLUTE, AK
- -HOWELL, MI GOLF COURSE
- -LAKE RESIDENT WATERING LAWN

Eutrophication in the Canadian Arctic (Aug. 1970). Upper — unpolluted stream flowing into Meretta Lake, Cornwallis Is. located at 75° N lat. Lower — algal scums in a polluted stream entering the same lake. Pollution is caused by sewage from the community of Resolute (mean annual population about 100). Photographs by Dr D. W. Schindler.

GOLF COURSE RUNOFF

WATER QUALITY

NITRATES – 1.15 MG/L

SRP – 0.08 MG/L

STRATIFICATION

- IMPORTANT TO UNDERSTAND:
- -INTERNAL LOADING OF NUTRIENTS
- -IF BOTTOM WATERS ARE ANOXIC (DEVOID OF OXYGEN) THEN MORE P IS RELEASED FROM THE SEDIMENT DECOMPOSITION PROCESSES
- -FISH ARE PREVENTED FROM OCCUPYING DEEPER, COOLER WATER

LAKE STRATIFICATION PATTERNS

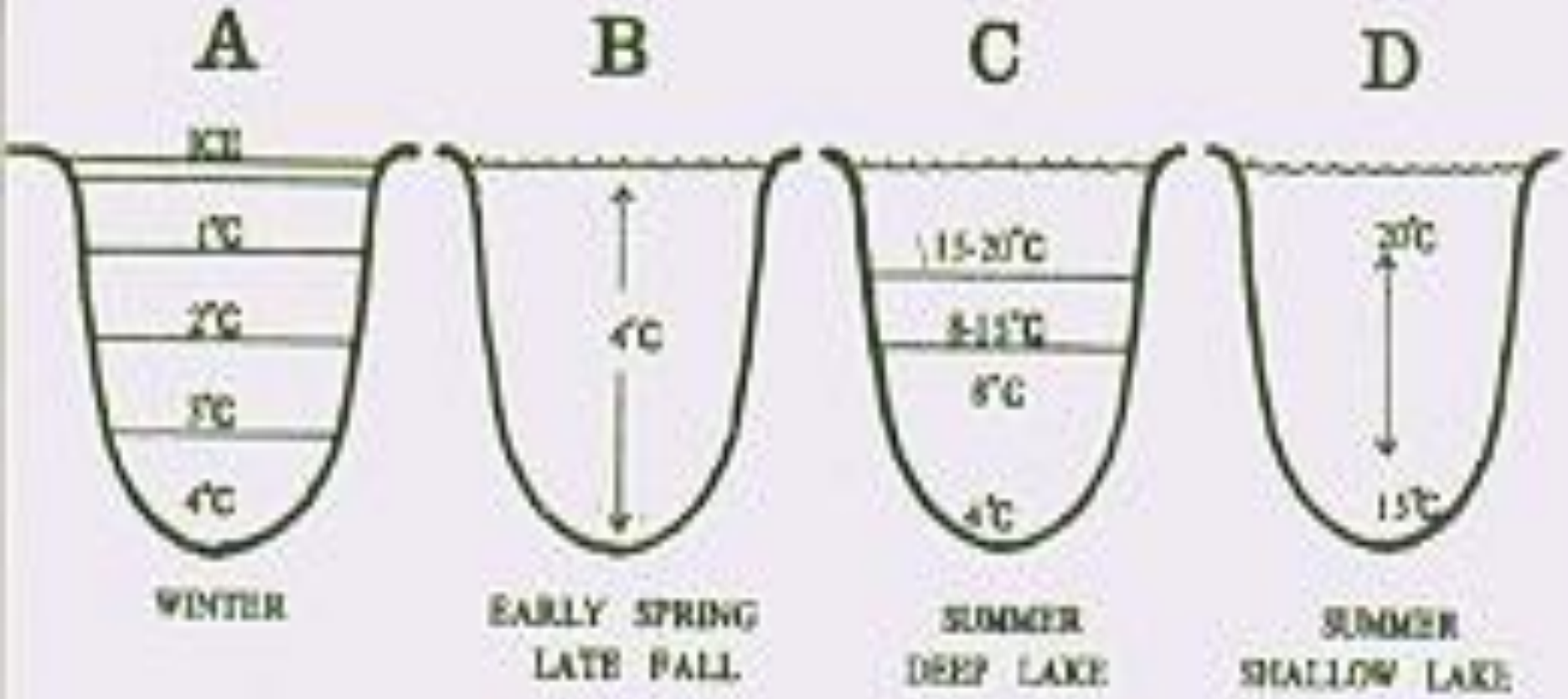
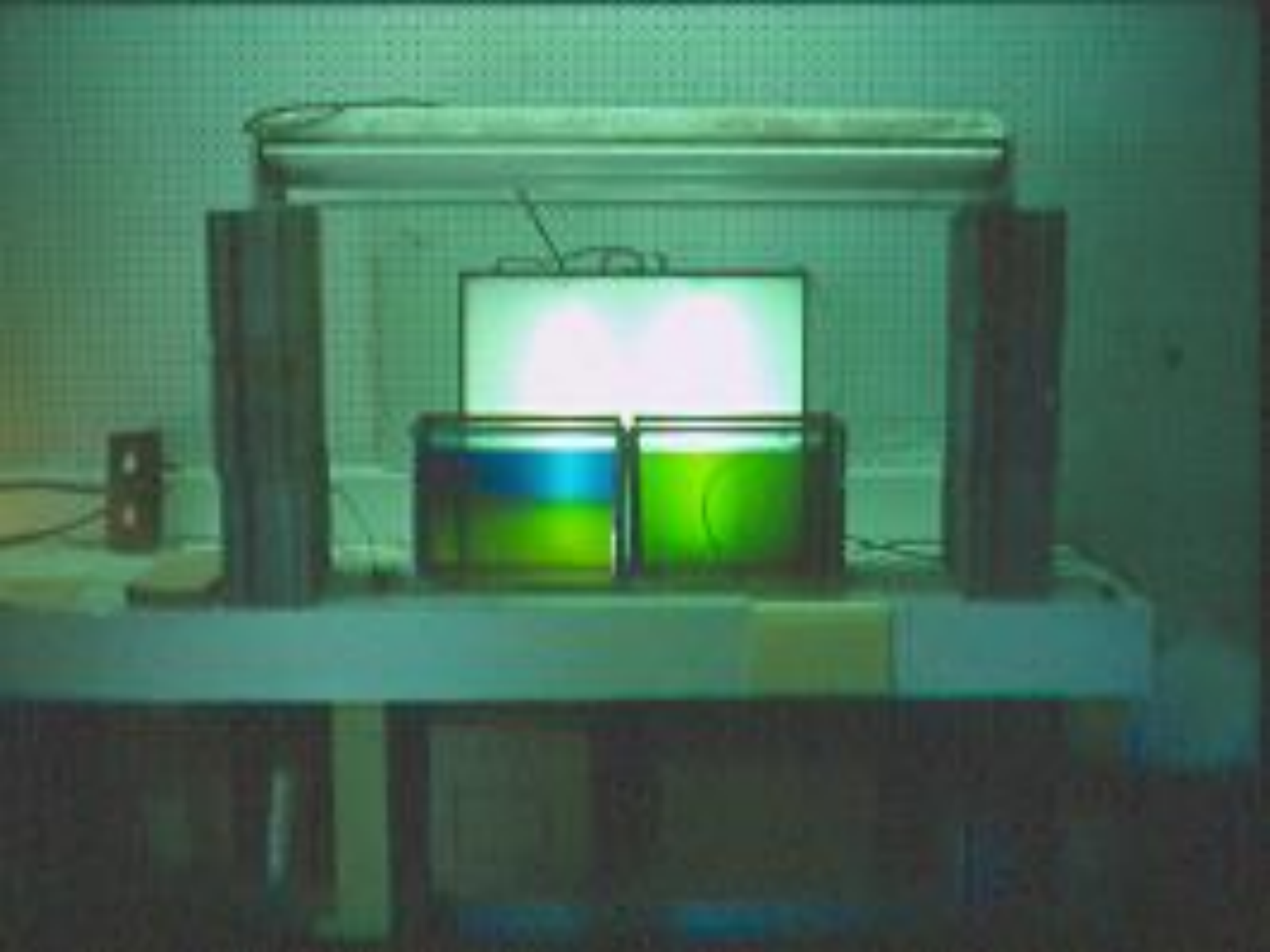
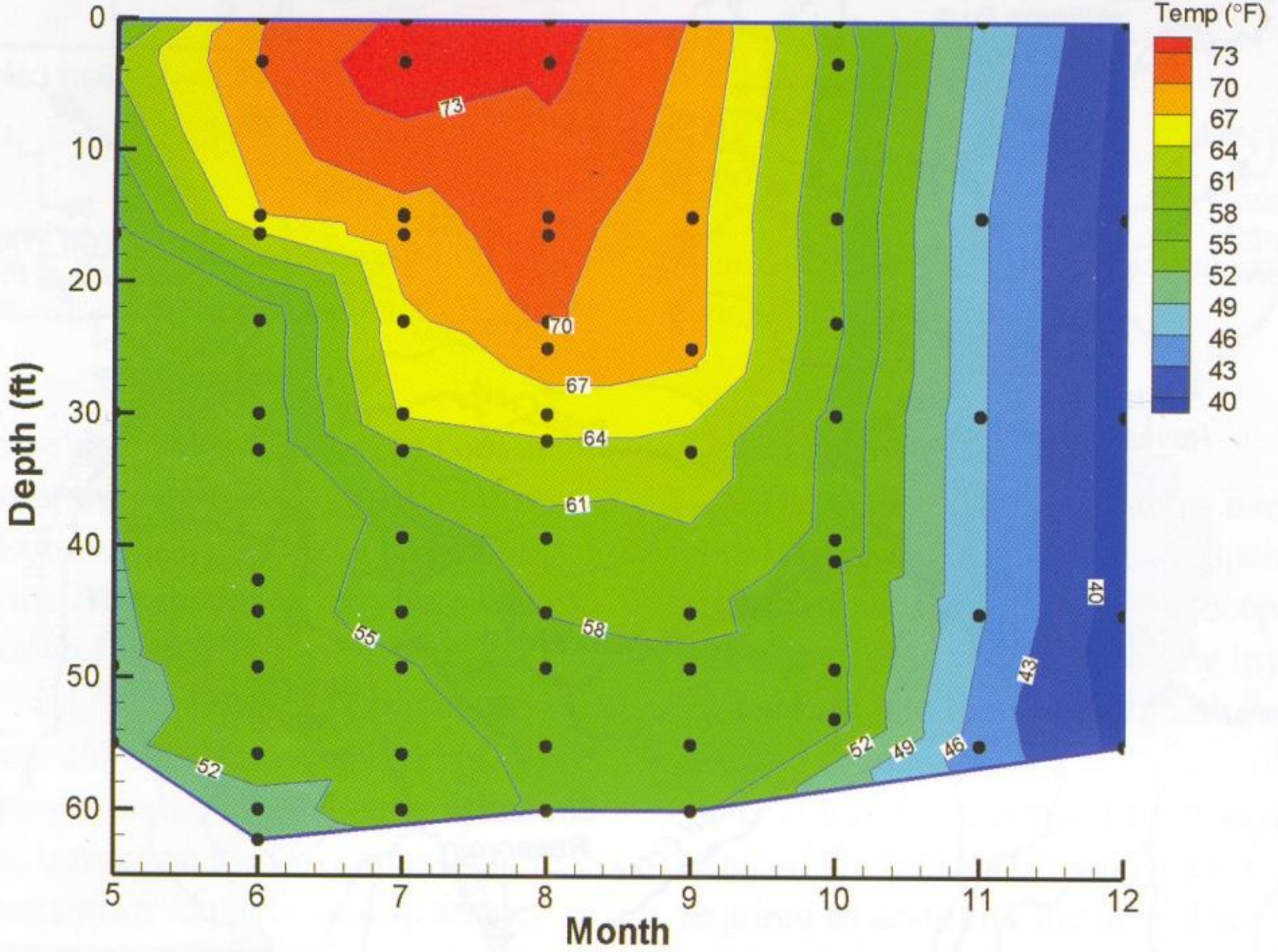
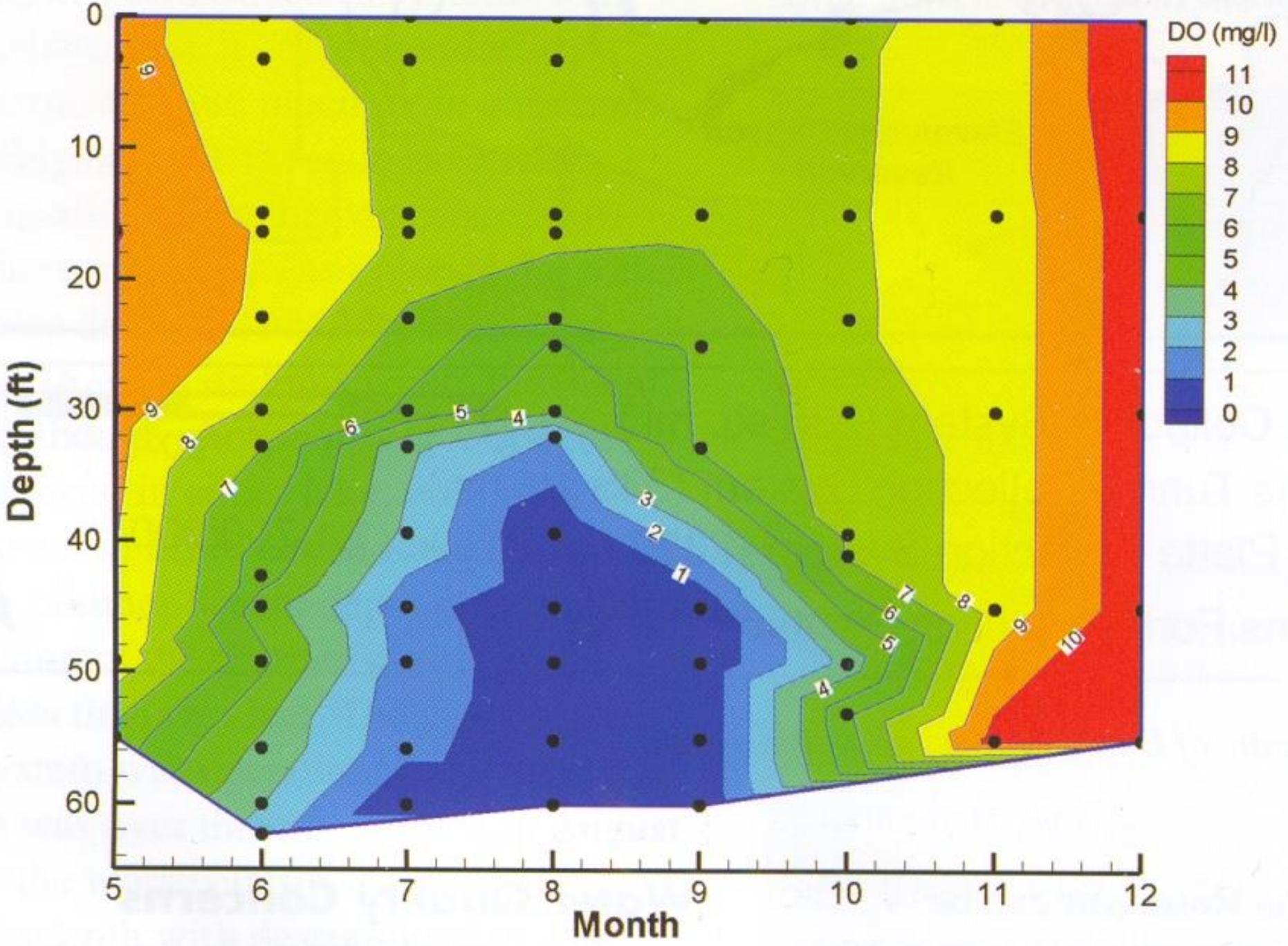


FIGURE 3: Seasonal Temperature Profiles




Temp (°F)
73
70
67
64
61
58
55
52
49
46
43
40
Depth (ft)
0
10
20
30
40
50
60
Month
5
6
7
8
9
10
11
12


DO (mg/l)
11
10
9
8
7
6
5
4
3
2
1
0
Depth (ft)
0
10
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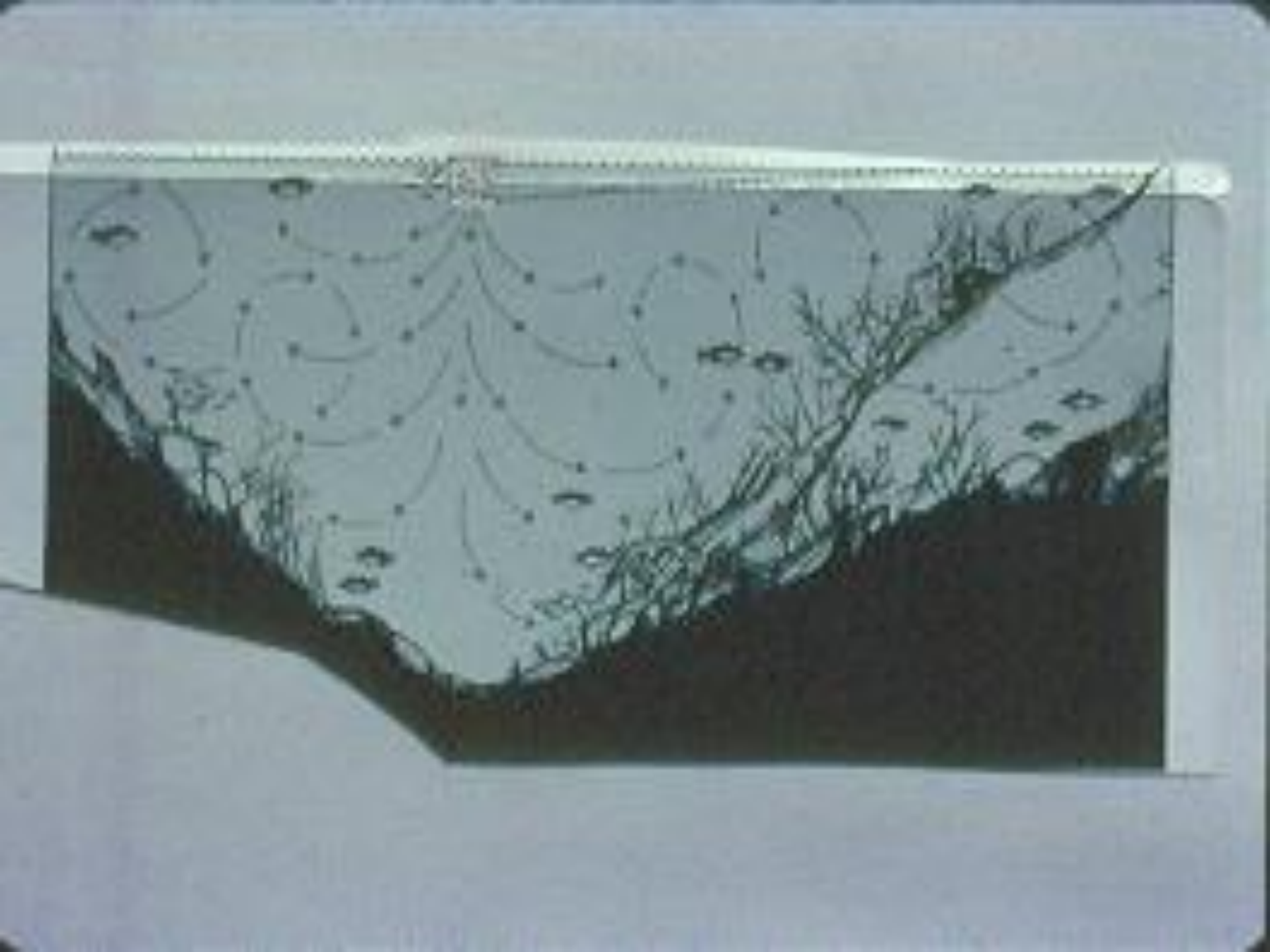
40
50
60
Month
5
6
7
8
9
10
11
12

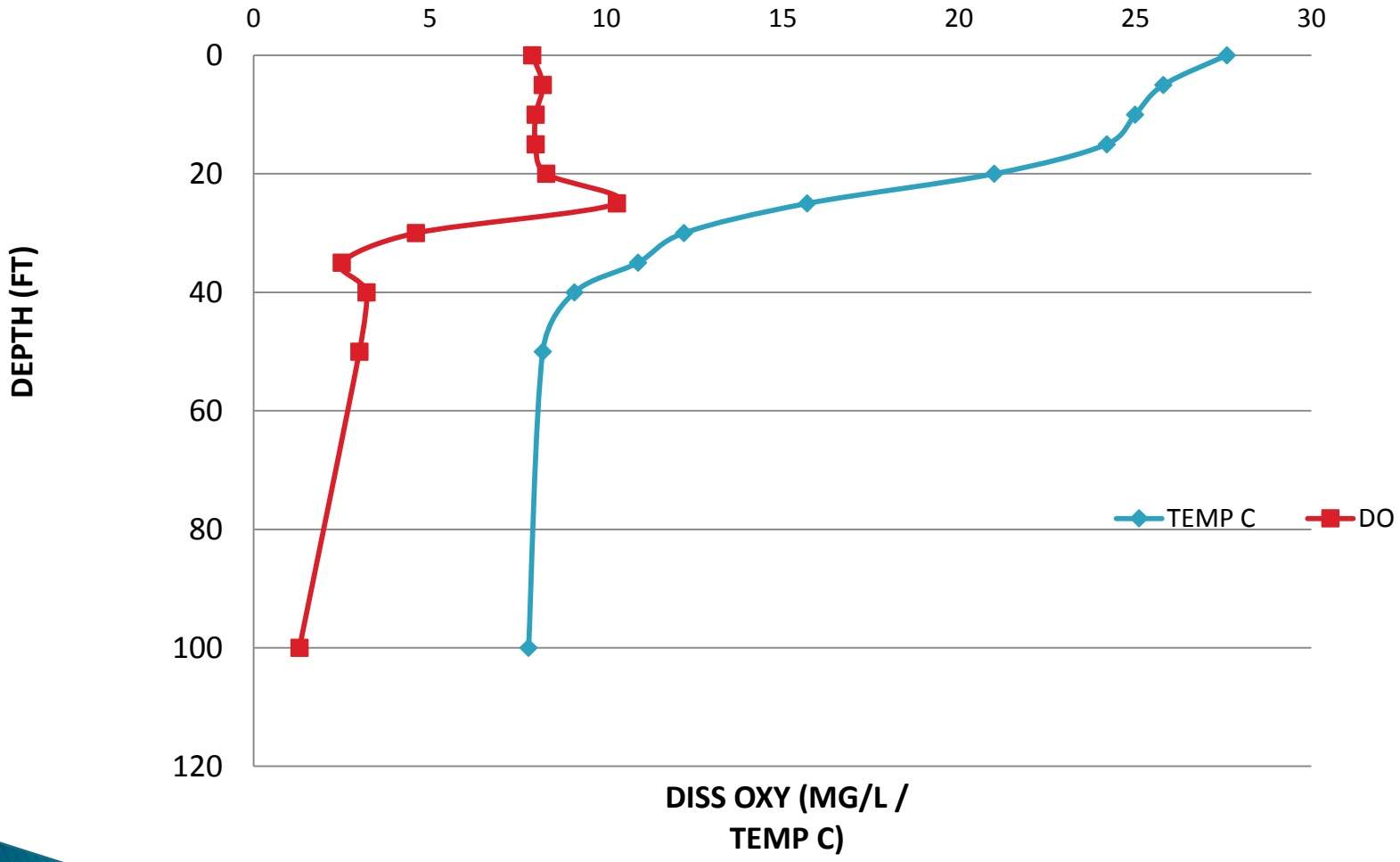


PUTTING THE SQUEEZE ON FISH

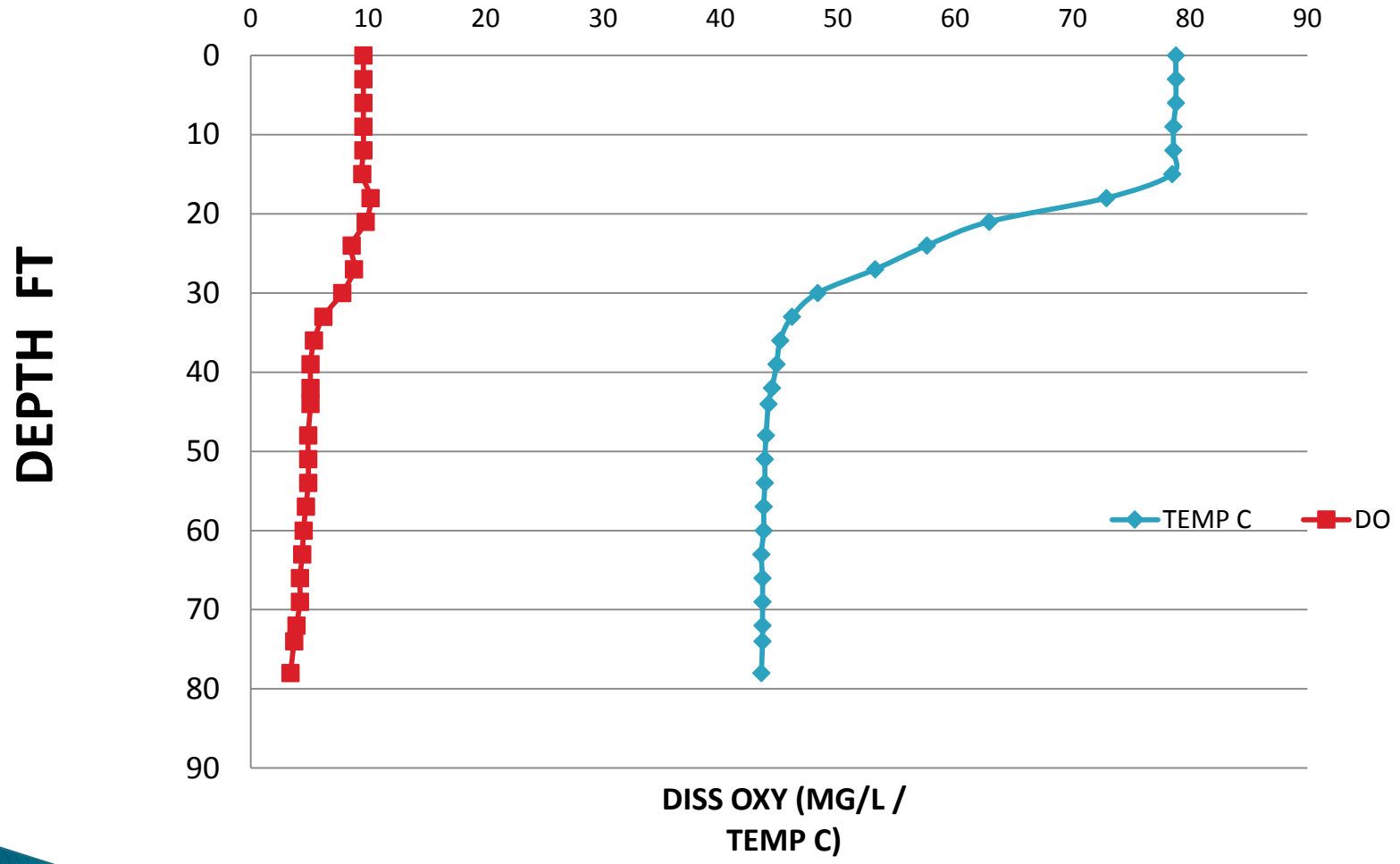
TOO HOT

NO DISSOLVED OXYGEN

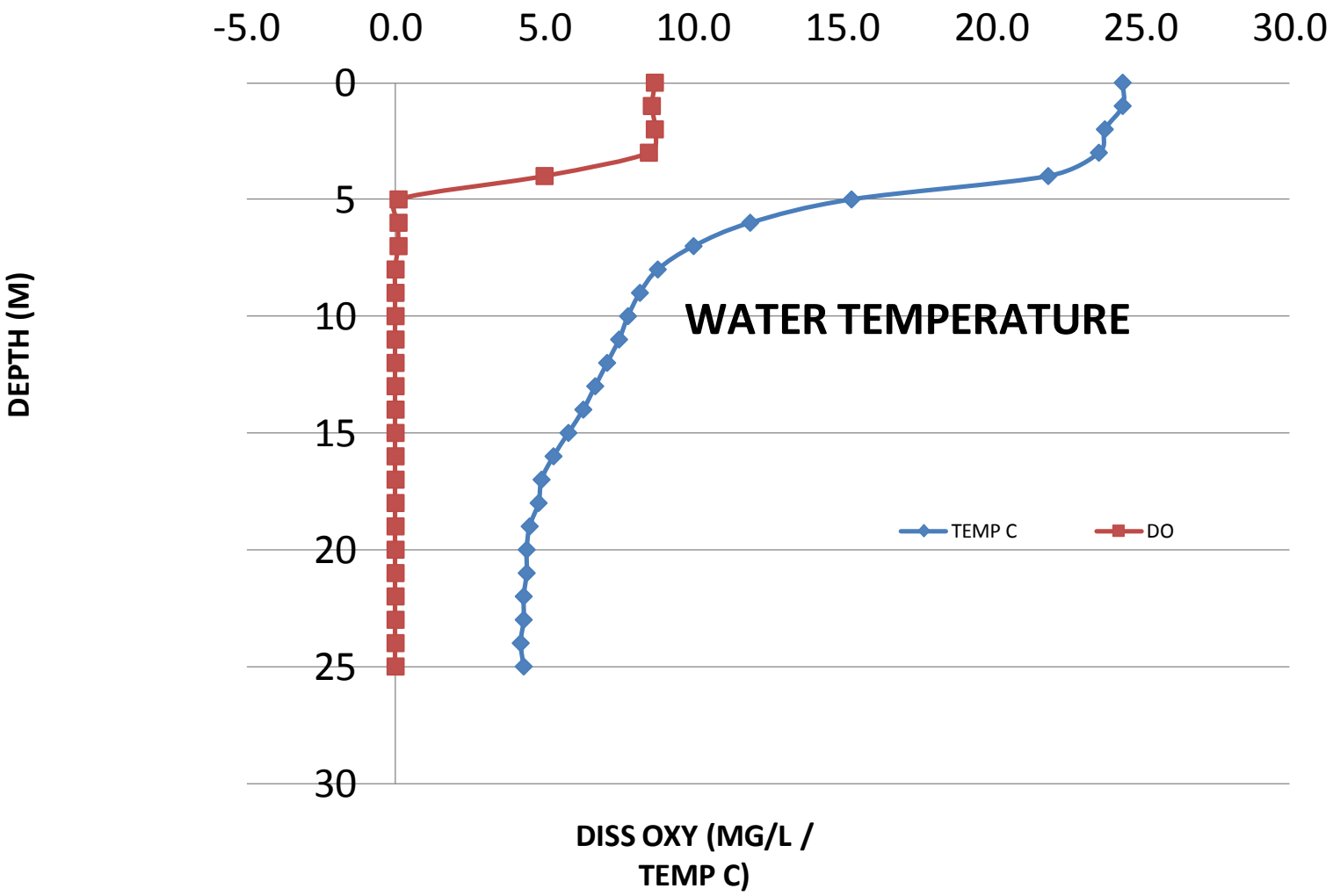
DISSOLVED OXYGEN/TEMP RELATIONSHIPS



DISSOLVED OXYGEN/TEMP RELATIONSHIPS



DISSOLVED OXYGEN/TEMP RELATIONSHIPS FOR RYERSON LAKE, 24 JULY 2014



INTERNAL LOADING

- THE NUTRIENTS (PHOSPHORUS AND NITRATES) THAT ARE RELEASED FROM A LAKE FROM DECOMPOSITION OF SEDIMENTS ON THE BOTTOM
- NUTRIENTS ARE RELEASED DURING SPRING AND FALL OVERTURN
- THESE NUTRIENTS FUEL AQUATIC PLANT AND AGAL BLOOMS IN THE SUMMER ALONG WITH OTHER INPUTS

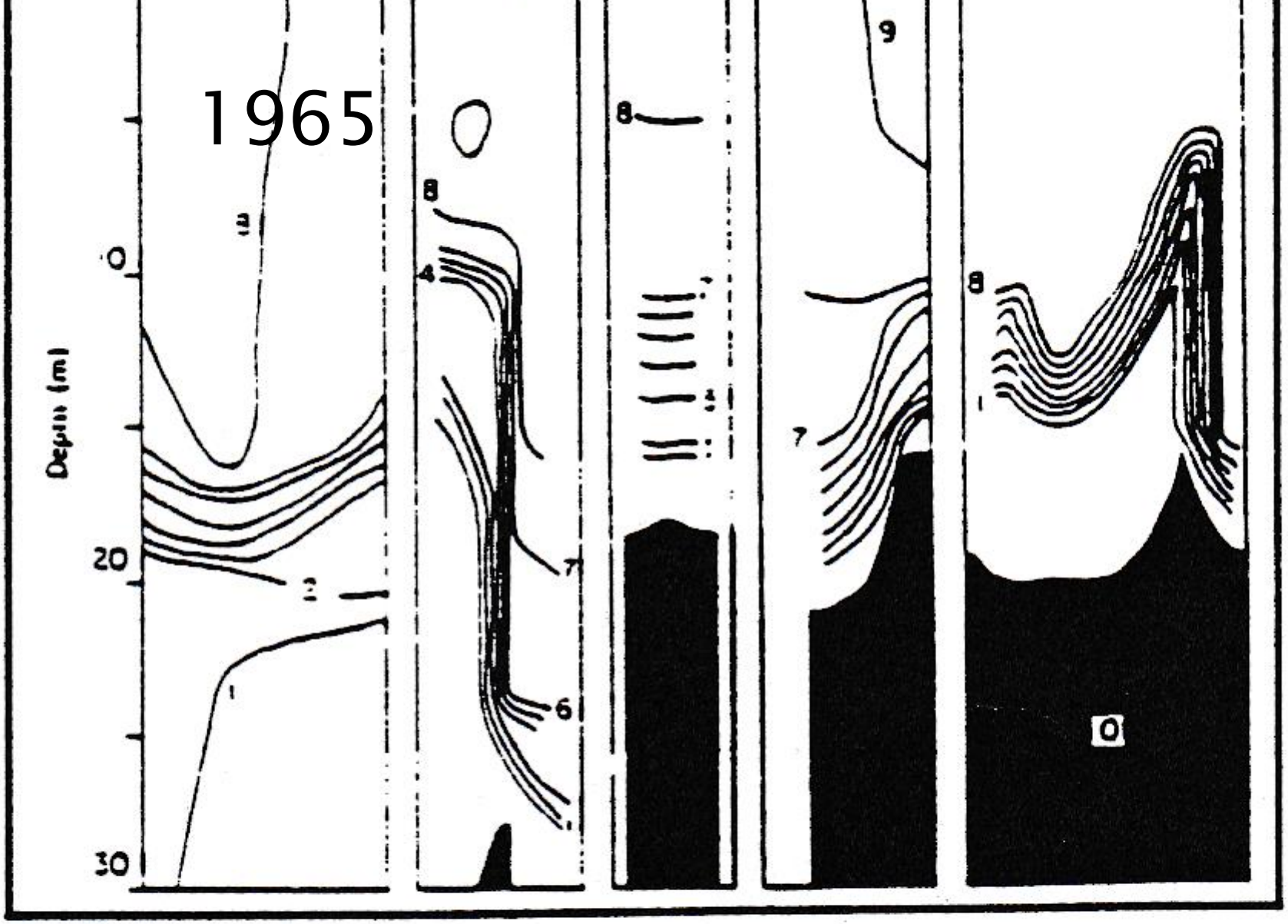
NUTRIENT BUDGET EXAMPLES

- GULL LAKE LARGE OLIGOTROPHIC LAKE
- ANOTHER LAKE WITH SEWERS
- A EUTROPHIC LAKE WITH DENSE HOUSING

GULL LAKE CASE

- HAD LAKE HERRING BUT LOST THEM
- PEOPLE ON SEPTIC TANKS
- LARGE INCREASE IN ALGAE FROM 1965-75
- DISSOLVED OXYGEN DEPLETED (SEE FIG BELOW) - DEAD ZONE
- BUDGET: 67% OF P FROM SEPTIC TANKS; 8% FROM LAWNS
- REMEDY: PUT IN SEWERS AND RESTORED THE LAKE (From: Lauff, Michigan Riparian 1992)

LL
KE

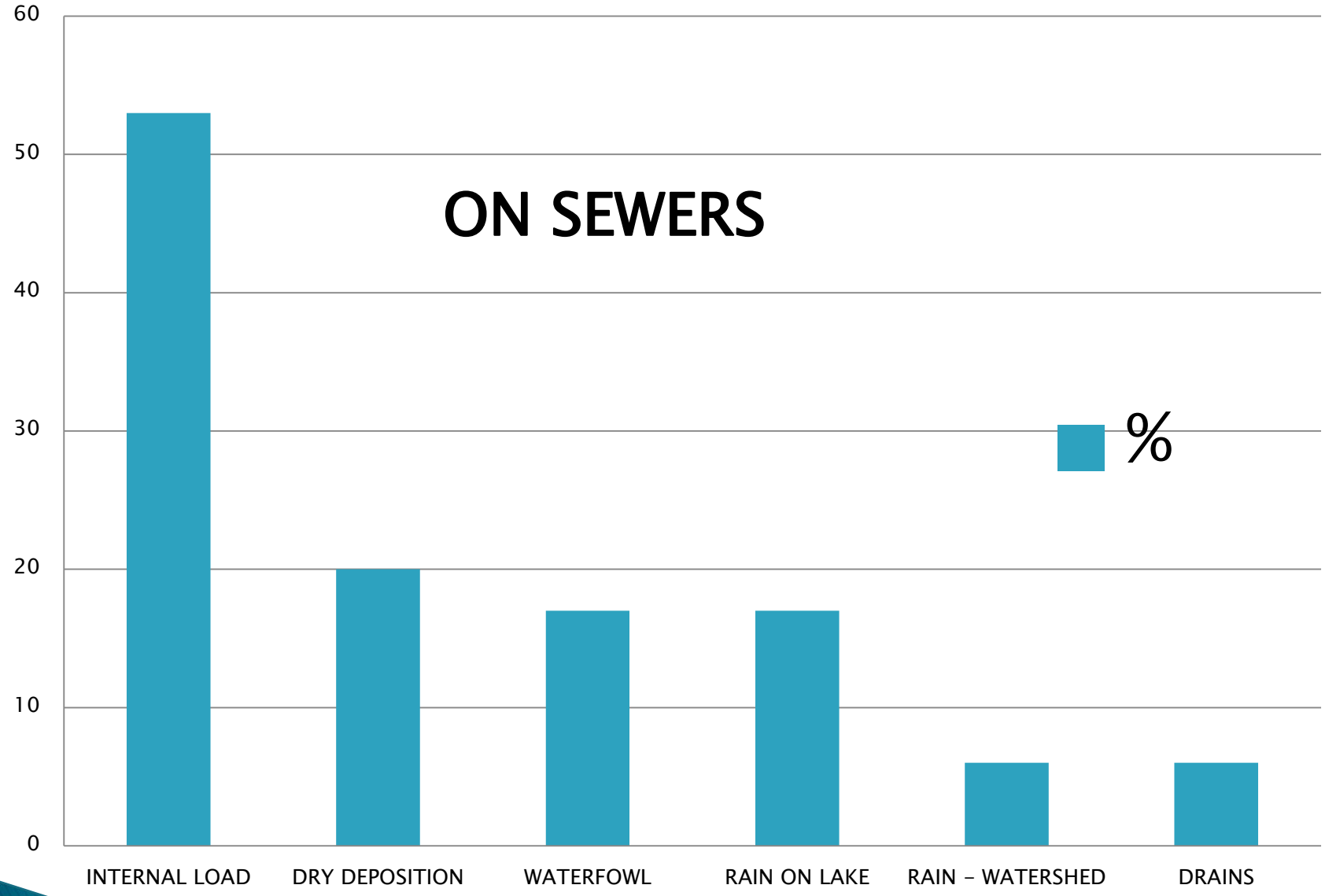


re 2. Concentration of oxygen expressed in milligrams per lit
rent depths in Gull Lake for 5 years during the month of Octo
line indicates a level of equal oxygen concentration. The dark

MAPLE LAKE: MI LARGE LAKE

- ON SEWERS
- HAVE DEEP HOLE – 90 FT
- 390 ACRES AND GREAT WATER CLARITY
- ZEBRA MUSSELS
- 168 RESIDENCES
- P BUDGET:
- –INTERNAL LOADING 54%
- –DRY DEPOSITION 20%
- –WATERFOWL 17%
- STILL SUFFERS FROM DO DEPLETION/MILFOIL

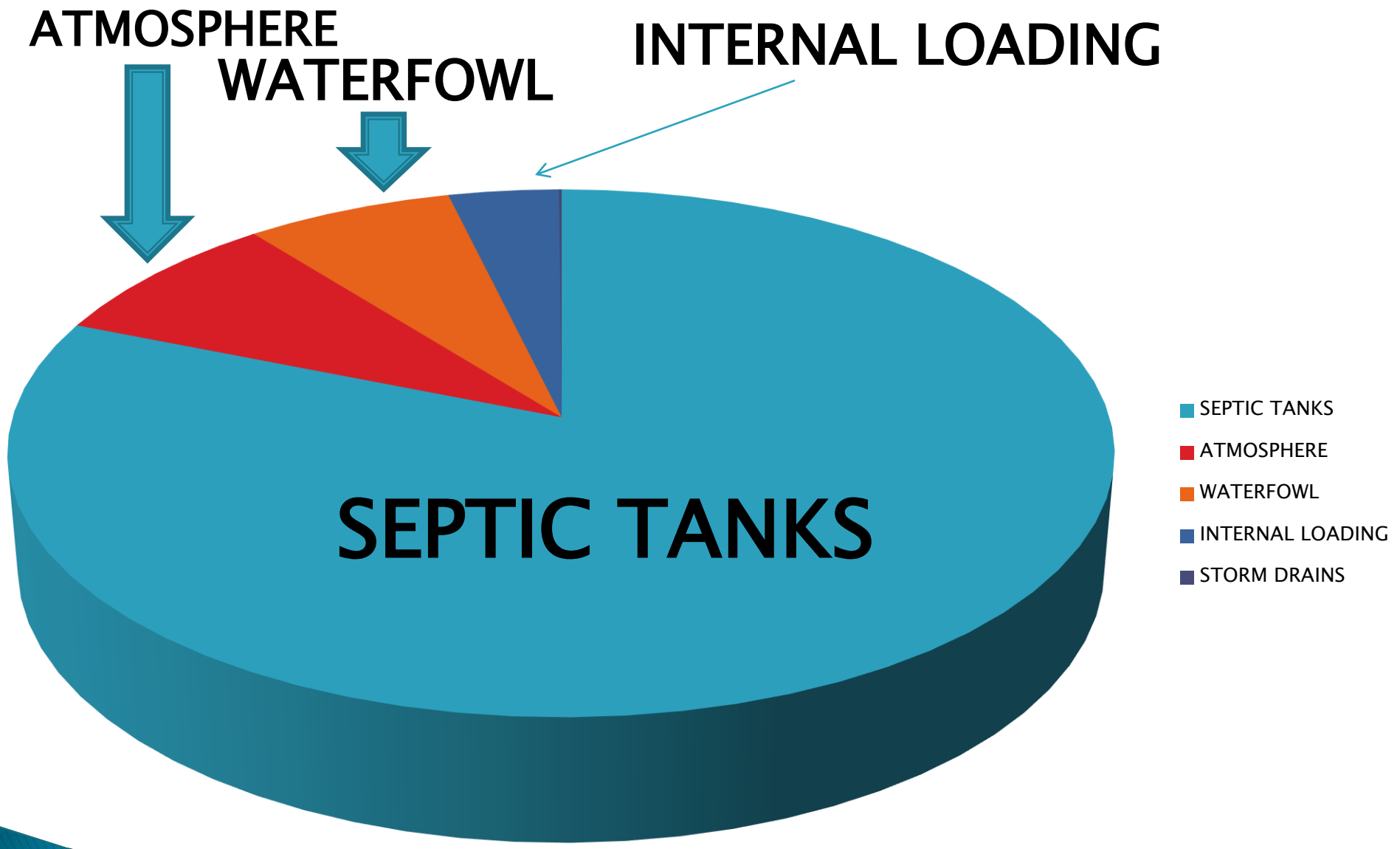
PHOSPHORUS LOADING TO LAKE (% OF TOTAL)



NUTRIENT BUDGET: EUTROPHIC LAKE

- -SHALLOW – 30 FT MAX DEPTH
- -192 RESIDENCES
- -SMALL 30 ACRES
- -DISSOLVED OXYGEN TO ZERO DURING SUMMER
- P BUDGET:
- -81% SEPTIC TANKS
- -8% ATMOSPHERIC INPUTS
- -7% WATERFOWL
- -4% INTERNAL LOADING

PHOSPHORUS BUDGET FOR LAKE: % CONTRIBUTION OF SOURCES




YOUR LAKE

WHAT CAN WE DO?

- -LAKES WITH HIGH INTERNAL LOADING: DIFFICULT, MAJOR EFFORT REQUIRED TO REMOVED SEDIMENTS THROUGH DREDGING, PRECIPITATE P THROUGH ALUM TREATMENT, DIVERT/TREAT SEWAGE INPUTS OR AG INPUTS FROM INCOMING STREAMS/RIVERS

- LAKES WITH SEPTIC TANKS: OBVIOUSLY PUT IN SEWERS OR AT LEAST PUMP SEPTIC TANKS OFTEN

HYPOTHETICAL LAKE SEPTIC TANK CONTRIBUTIONS

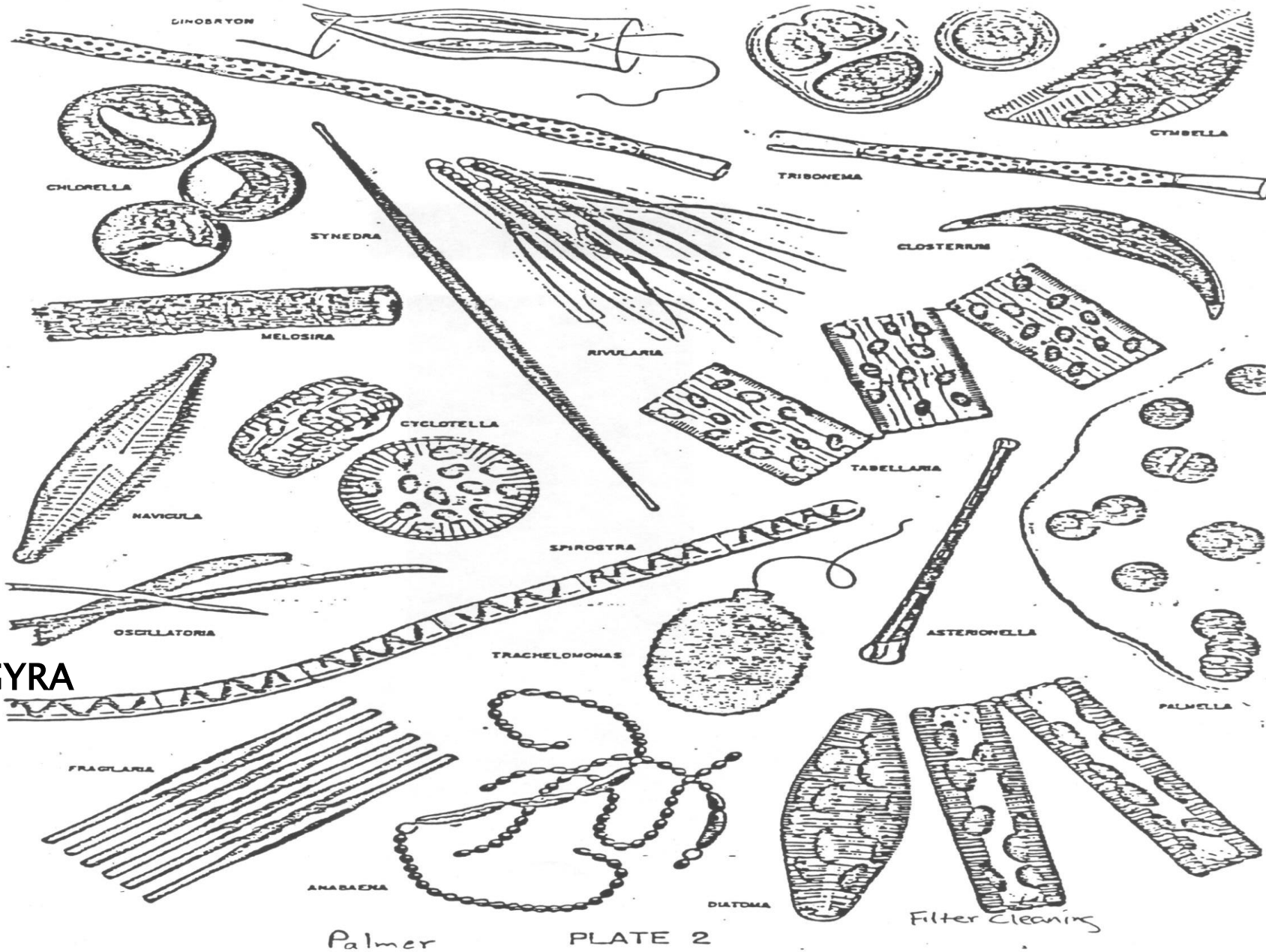
- CALCULATED P CONTRIBUTIONS OF 150 RESIDENTS BY MAKING SOME ASSUMPTIONS
- LAKE IS 417 ACRES
- -ASSUMED 80% SEASONAL; 20% PERMANENT
- -ASSUMED 4 PEOPLE/HOUSEHOLD FOR WEEKENDERS; 3 FOR PERMANENT
- -USED 1.4 G/PERSON/DAY OF P PRODUCED
- 233 POUNDS/YR OF P GENERATED BY RESIDENTS
- THEY COULD PRODUCE 60 TONS OF PLANTS

ALGAE: TYPES AND DISTRIBUTION

- TYPES OF ALGAE
- -PHYTOPLANKTON: FLOATS IN THE WATER COLUMN; GIVES IT A BROWN OR GREEN COLOR; MICROSCOPIC
- -BENTHIC ALGAE: GROWS ON THE BOTTOM, CAN FLOAT TO SURFACE DUE TO GASES PRODUCED IN SEDIMENT AND BY THE ALGAE; EXAMPLES ARE: *CLADOPHORA, SPIROGYRA*, AND *ZYGNEMA*

SEASONAL DISTRIBUTION OF ALGAE

- SEASONAL PROGRESSION OF ALGAE
- – DIATOMS
- – GREEN ALGAE
- – BLUE-GREEN ALGAE



SPIROGYRA

Palmer PLATE 2

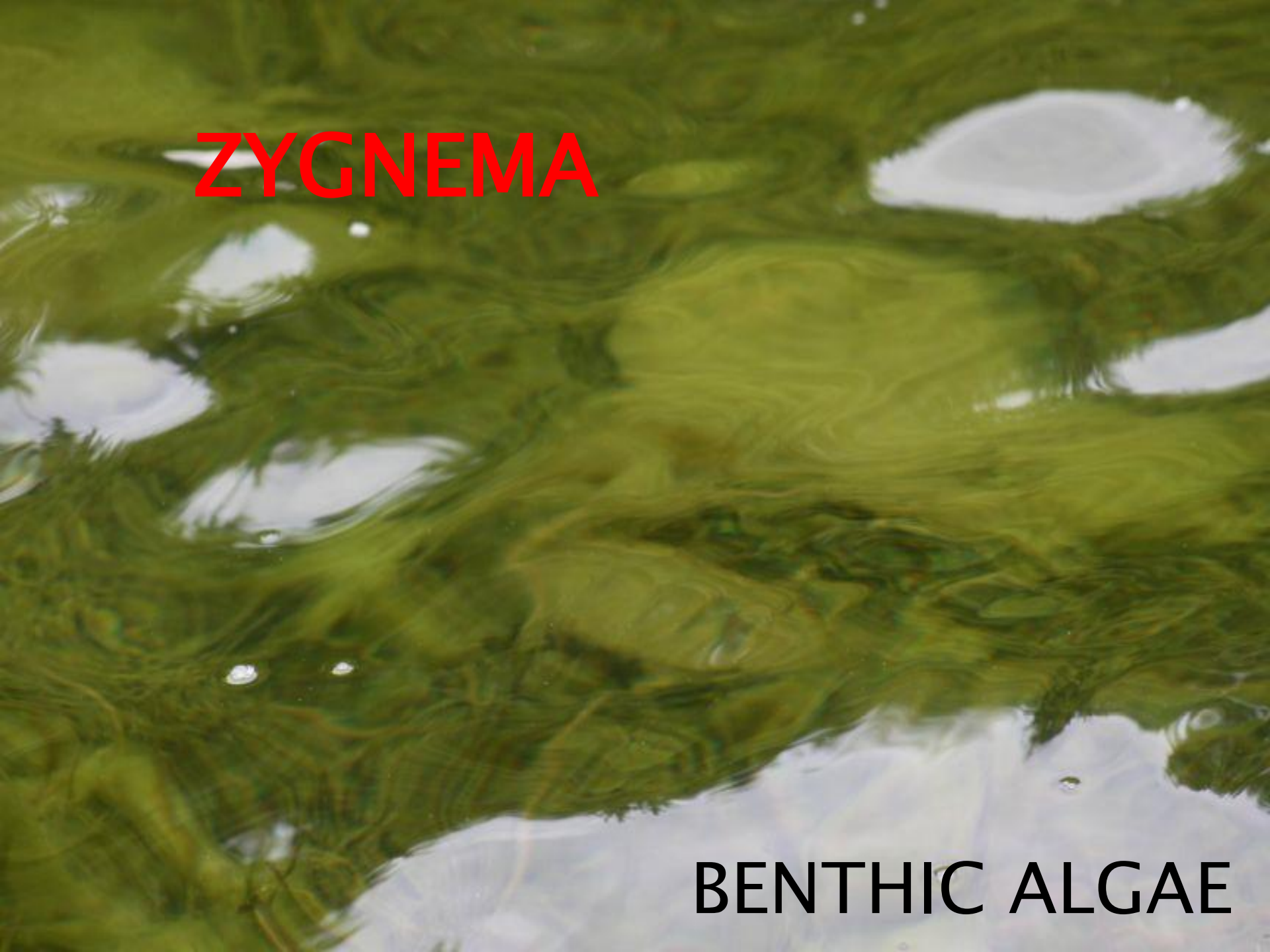
Filter Cleaning

ALGAE


ALGAE: MICROCYSTIS
circle of blue

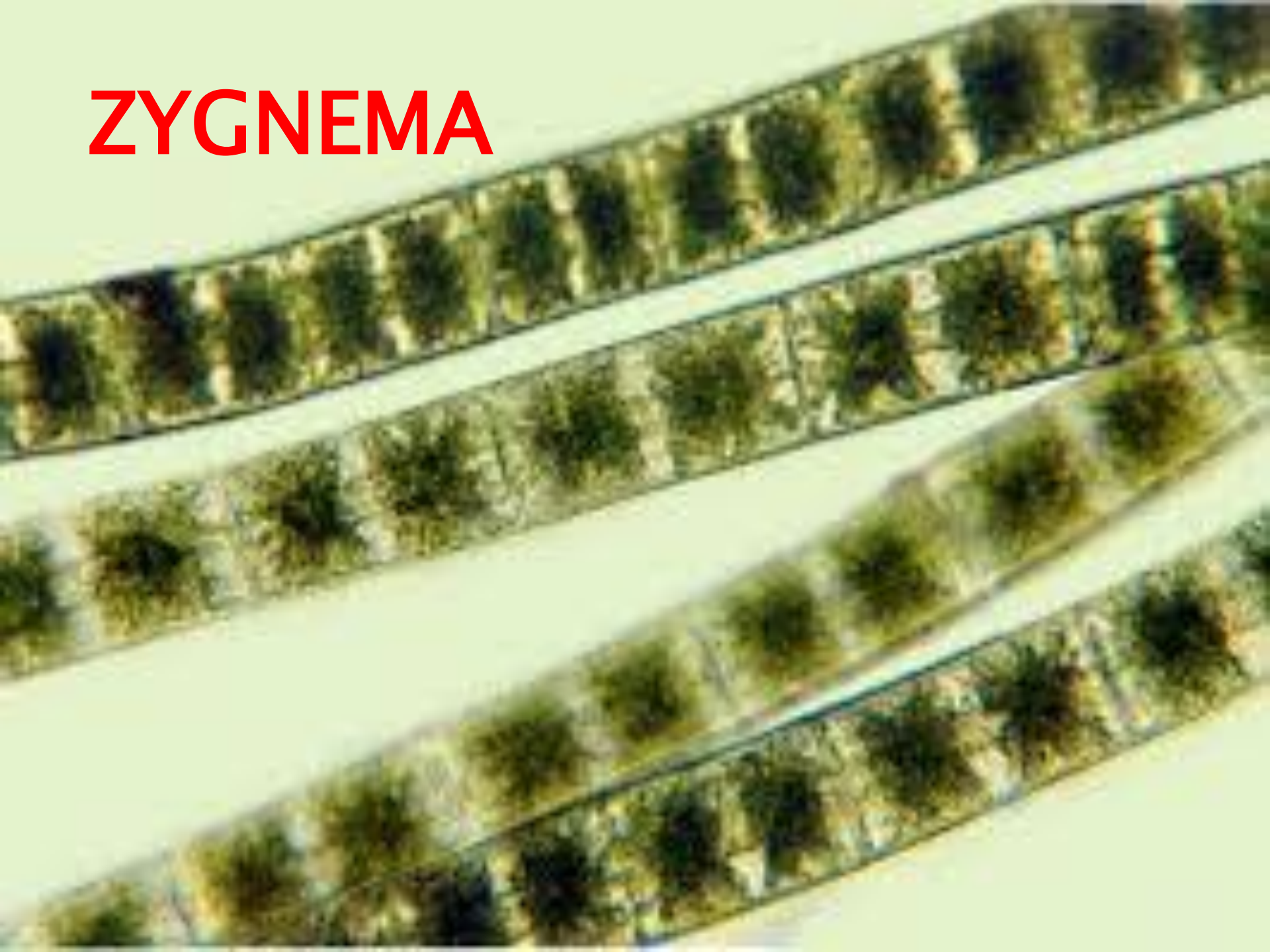

ALGAE PHYTOPLANKTON: *MICROCYSTIS*


MILFOIL COVERED WITH ALGA ZGYNEMA


ZYGNEMA
BENTHIC ALGAE


FLOATING ZYGNEMA

ZYGNEMA



BENTHIC ALGAE ELSEWHERE

- –WHEN LAKE ERIE WAS DEAD: CLADOPHORA
- –SAGINAW BAY WHEN ZEBRA MUSSELS FIRST ENTERED: SPIROGYRA
- –LAKE MICHIGAN : ZEBRA AND QUAGGA MUSSELS INDUCED GROWTH OF CLADOPHORA
- LED TO THE BOTULISM KILLING OF WATERFOWL AND ICONIC FISHES

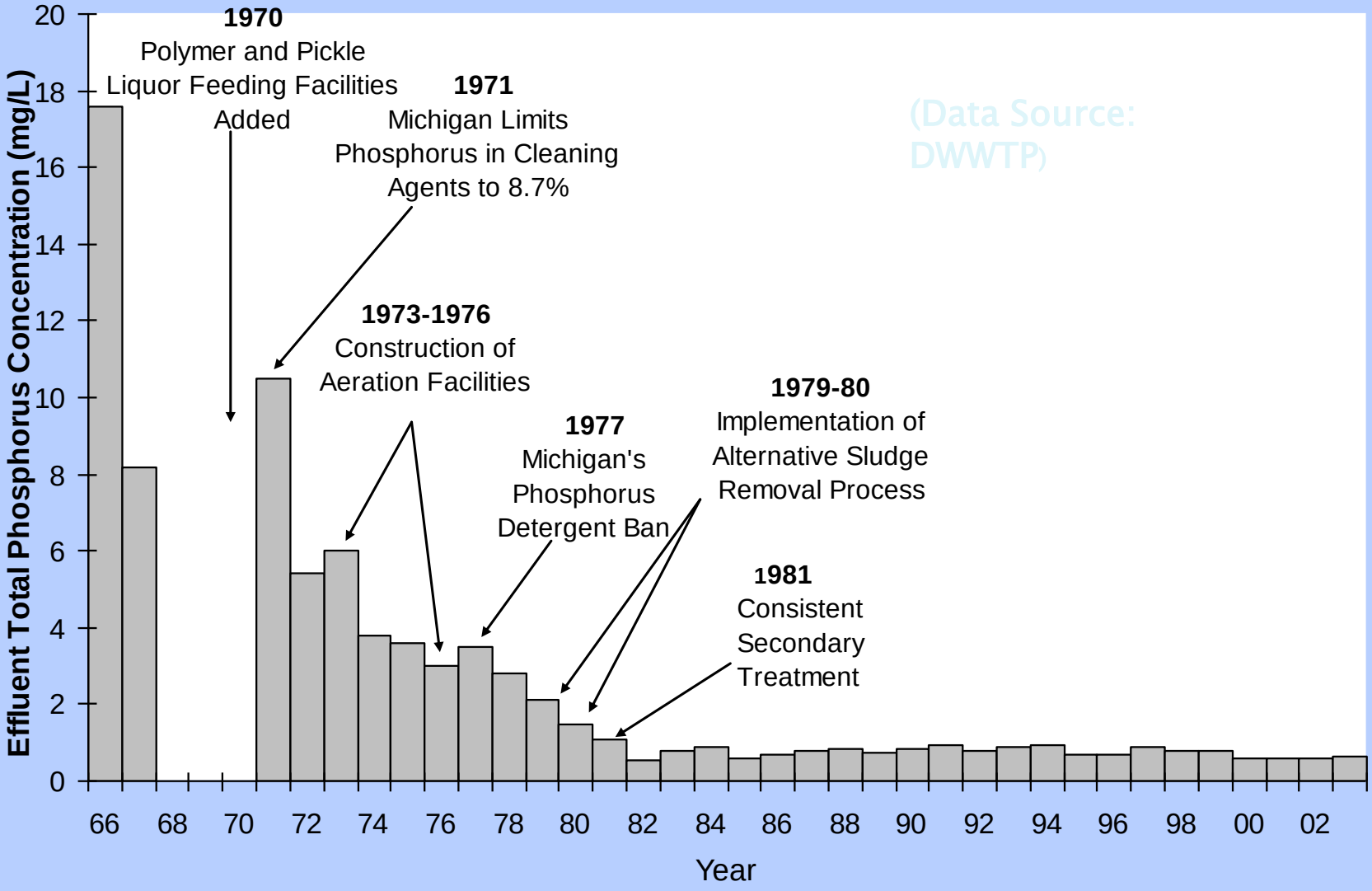
LAKE ERIE IS DEAD!

TIME

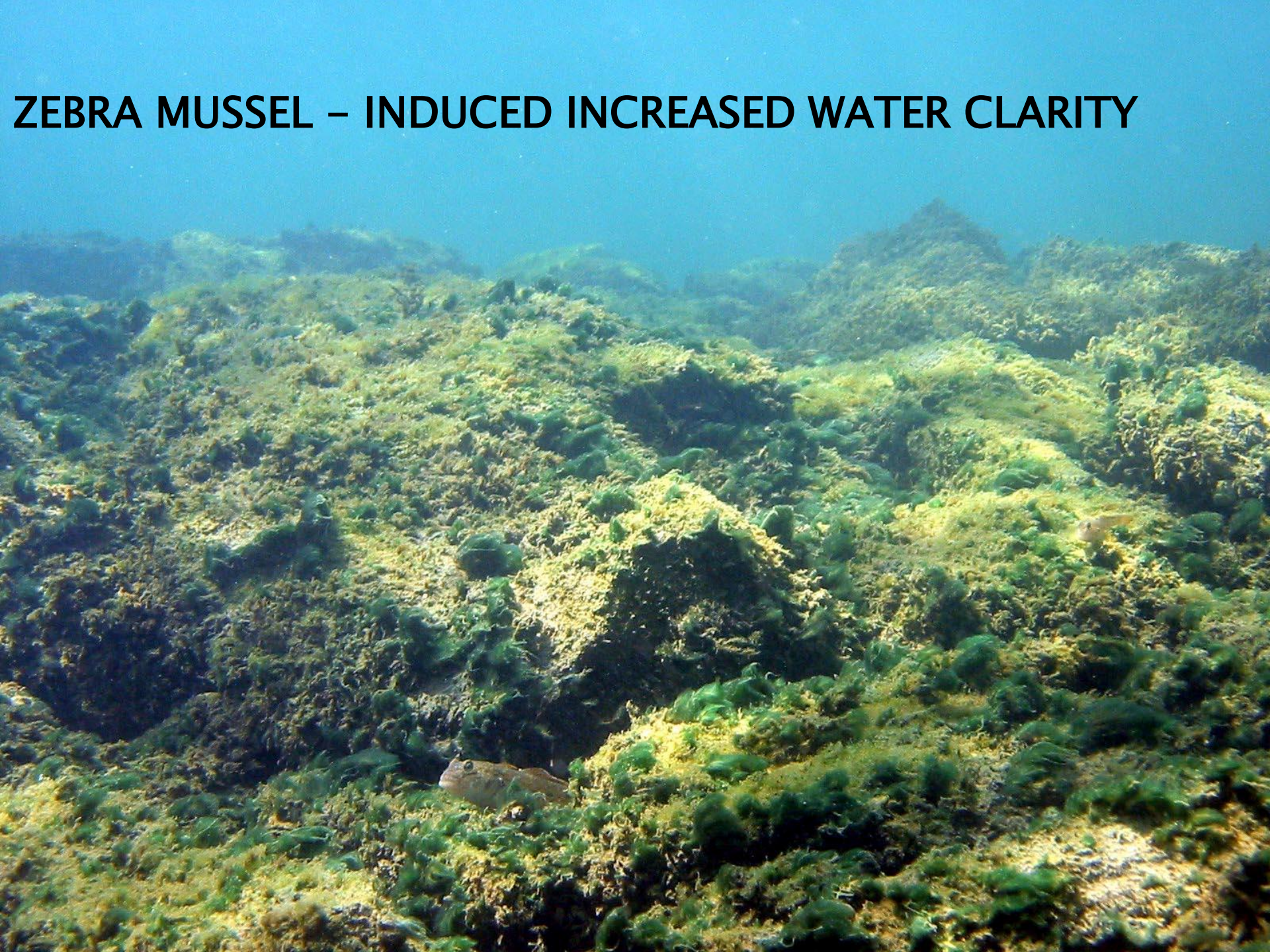
August 20, 1965

Detroit Wastewater Treatment Plant

Total phosphorus concentration: 1966–2003



ZEBRA MUSSEL – INDUCED INCREASED WATER CLARITY




SAGINAW BAY
SPIROGYRA – GREEN ALGA
ZEBRA MUSSEL INDUCED


LAKE MICHIGAN
CLADOPHORA

AQUATIC MACROPHYTES

- THE WAR ON AQUATIC PLANTS:

- –IMPORTANT FISH HABITAT
- –IMPORTANT FISH–FOOD PRODUCERS
- –IMPORTANT SPAWNING SUBSTRATE
- –INTERACT WITH ALGAE (MANAGE FOR MACROPHYTES NOT ALGAE)

LAKE HERRING

LAKE HERRING OR CISCO

- ONLY 153 LAKES IN MICHIGAN HAVE LAKE HERRING PRESENT – COLDWATER FISH THAT NEEDS >5 MG/L DISSOLVED OXYGEN IN THE HYPOLIMNION/THERMOCLINE AREA
- I WORKED ON TWO LAKES WITH LAKE HERRING
- –POPULATIONS ARE NOW BOTH EXTINCT
- –INDICATOR OF PRISTINE CONDITIONS AND OLIGOTROPHIC CONDITIONS
- –SPECULATE THAT STOCKING OF WALLEYES/LOW DO DOOMED THE LAKE HERRING

WHAT DOES IT ALL MEAN?

- –WHAT CAN YOU DO?

POGO


MANURE
ONLY
NO TRASH


there
is NO
poop
fairy.


YOUR LAKE

A Day in the Life of a Polluter

1. Test your soil to determine the correct amount of fertilizers and keep fertilizer off paved areas so that it doesn't wash nutrients into streets and storm drains. Landscape with native plants that require less water and fewer pesticides.

2. Select porous materials like gravel for walkways and driveways to increase infiltration and decrease surface runoff.

3. Never pour toxic household chemicals down the drain or on the ground. Take them to hazardous-waste collection centers.

4. Clean up after pets to avoid runoff of nutrients and pathogens into surface waters.

5. Recycle used oil and antifreeze at service stations and other centers. Schedule regular tuneups for your car to reduce deposits of toxic pollutants.

RECOMMENDATIONS – PART 1

- PUMP SEPTIC TANKS YEARLY OR AT LEAST ONCE EVERY TWO YEARS; EMBRACE SEWERS
- CUT NO TREES, PLANT GREENBELTS IF NECESSARY
- NO LAWNS, BUT IF NECESSARY, NO FERTILIZATION
- ESCHEW IMPERVIOUS SURFACES:COBBLESTONE NOT PAVED ROADS/TENNIS COURTS/DRIVEWAYS
- OTHER POLLUTING ACTIVITIES: NO LEAF BURNING AT LAKE, NO HIGH P DETERGENTS FOR HOUSE OR CAR WASHING, CLEAN UP PET WASTE, DISCOURAGE WATERFOWL

RECOMMENDATIONS – PART 2

- BE CAUTIOUS IN THE USE OF STRONG CLEANERS, HERBICIDES, PESTICIDES IN THE WATERSHED
- DISCOURAGE LARGE FLOCKS OF WATERFOWL, ESPECIALLY GEESE AND SWANS FROM RESIDING ON THE LAKE
- EXCESSIVE BOAT TRAFFIC STIRS UP AND RE SUSPENDS SEDIMENTS; STAY IN DEEP WATER

AQUATIC PLANT AND ALGAE MANAGEMENT

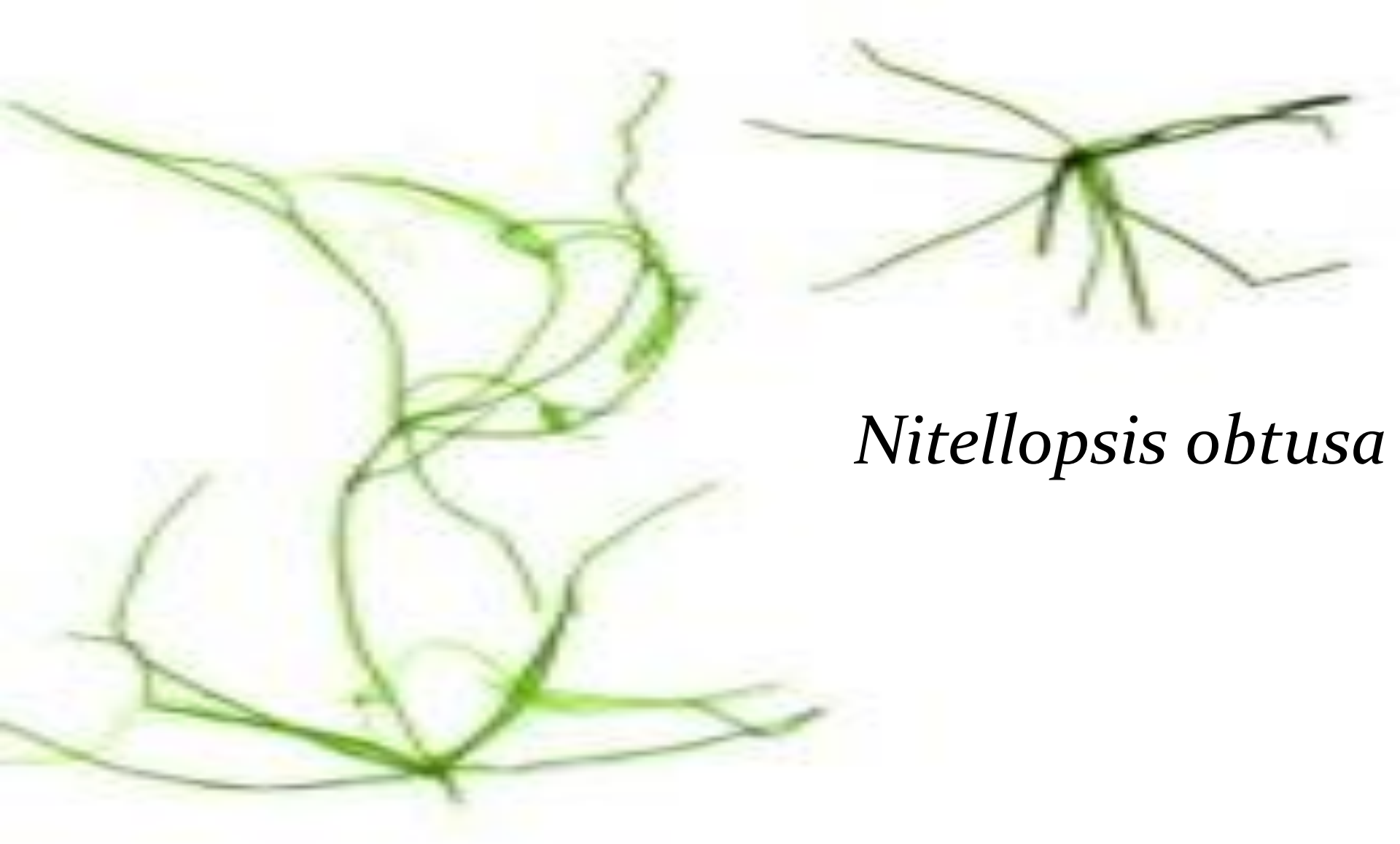
- REDUCE TREATMENTS OF AQUATIC PLANTS TO STRATEGIC AREAS
- TRY TO MAINTAIN PLANT BIOMASS AS MACROPHYTES NOT ALGAE (EXCEPTION: CHARA A GREEN ALGA IS EXCELLENT)
- DO NOT KILL ALGAE WITH COPPER; USE MECHANICAL MEANS (IF YOU LIVE ON A LAKE, GET A RAKE!!!!)

PREVENT INVASIVE SPECIES

- -RESIDENTS MUST BE CAREFUL BRINGING IN CONTAMINATED WATER FROM OTHER SOURCES: CHECK FOR PLANTS, NO BAIT FROM OUTSIDE, DRY OR BLEACH BOATS/GEAR FROM OUTSIDE THE LAKE
- -PREVENT QUAGGA MUSSELS/VHS FROM ENTRY
- -PREVENT EURASIAN MILFOIL AND STARRY STONEWORT FROM ENTRY
- -BEWARE OF ROCK SNOT DIDYMO (ALGA)


EURASIAN
MILFOIL


STARRY STONEWORT



Nitellopsis obtusa

VIRAL HEMORRHAGIC SEPTICEMIA

USA TODAY

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Ebola-like virus killing fish in Great Lakes

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Enlarge By Lars Hagberg, CP via AP

Two men enjoy the early morning sunrise as they fish along the shore of Lake Ontario in Kingston, Ontario, on April 20. An Ebola-like virus has been killing fish in several Great Lakes, including Lake Ontario.

By Dennis Cauchon, USA TODAY

Mixx it

Other ways to share:

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What's this?

A deadly Ebola-like virus is killing fish of all types in the Great Lakes, a development some scientists fear could trigger disaster for the USA's freshwater fish.

Because of a lack of genetic resistance to viral hemorrhagic septicemia, fish populations could be damaged in the same way the smallpox virus struck Native Americans and Dutch elm disease decimated elm trees, says Jim Winton, chief of fish health at the U.S. Geological Survey in Seattle.

The disease has been found in Lake Erie, Lake Ontario, Lake Huron, the St. Lawrence Seaway, the Niagara River and an inland lake in New York. The aggressive virus, which causes fish to hemorrhage, was unexpectedly found in the Great Lakes in 2005. Last year, it resulted in large fish kills that struck at least 20 species. Scientists are watching to see whether the disease returns in mid-May when water in the lakes warms to temperatures at which the virus attacks.

"VHS is the most important and dangerous fish virus known worldwide," Winton says. "Its discovery in our fresh water is disturbing and potentially catastrophic."

The United States and Canada try to contain the virus by restricting the transporting of fish and live bait and telling boaters to wash their boats when moving them between lakes. Michigan's Department of Natural Resources has taken the most dramatic action: closing hatcheries that produce three important sport fish — walleye, northern pike and muskellunge.

29 April 2007

Mohammed Faisal, USGS (2007)

Lorain, OH: Dave Kelch, Ohio Sea Grant Extension (2006)

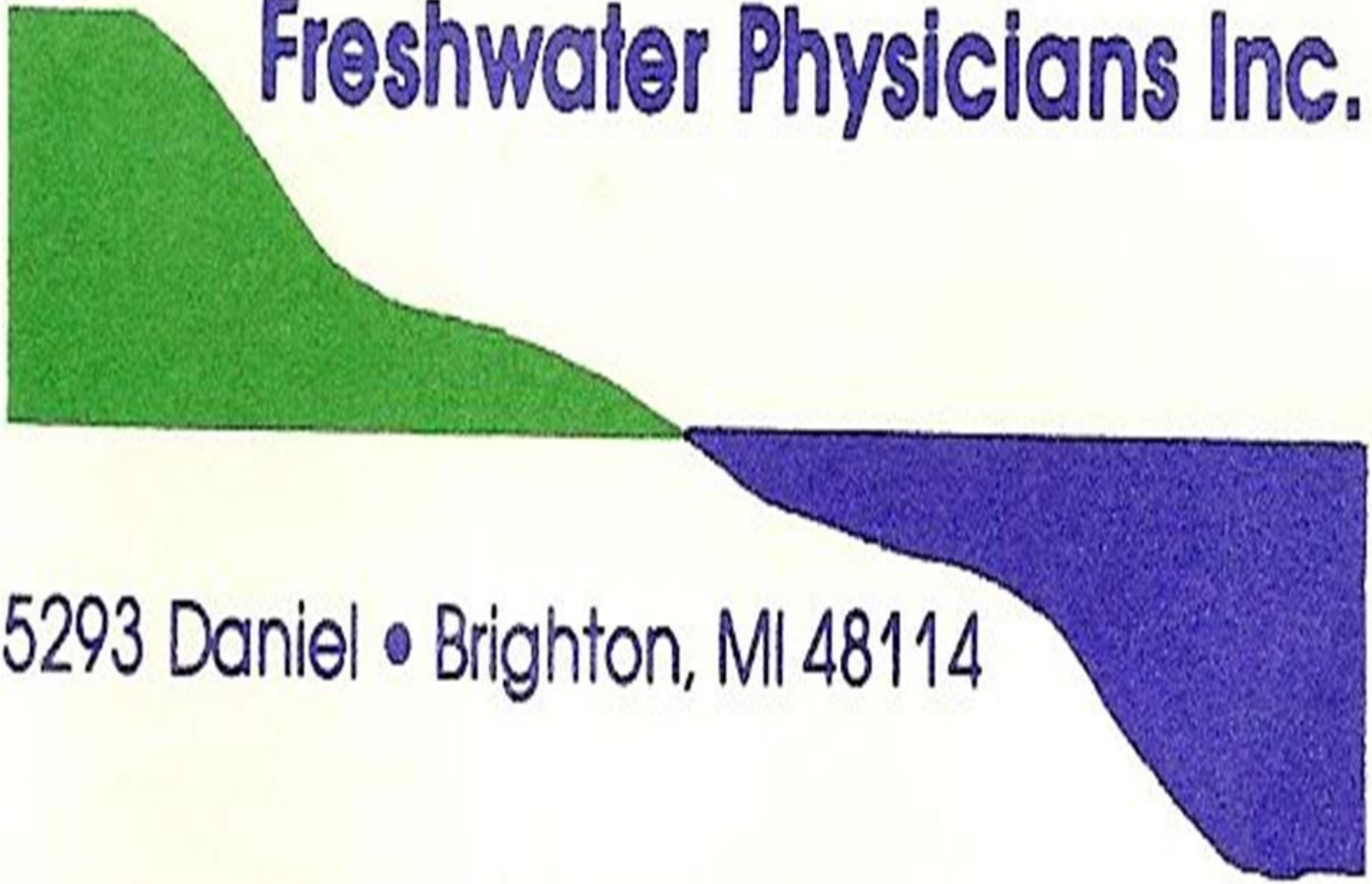

ALGEBRA

What can you do?

- Do **not** release unused live bait or transport live game fish from one water body to another; consider banning live bait
- Clean and dry trailers, boats (especially live wells and bilges), and bait buckets after use or before use in a different body of water; treat with bleach if necessary
- Report unusual numbers of dead or dying fish, especially multi-species kills

QUESTIONS?

Freshwater Physicians Inc.



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