

A Primer in Lake Ecology

Based on Chapter One of
Diet for a Small Lake



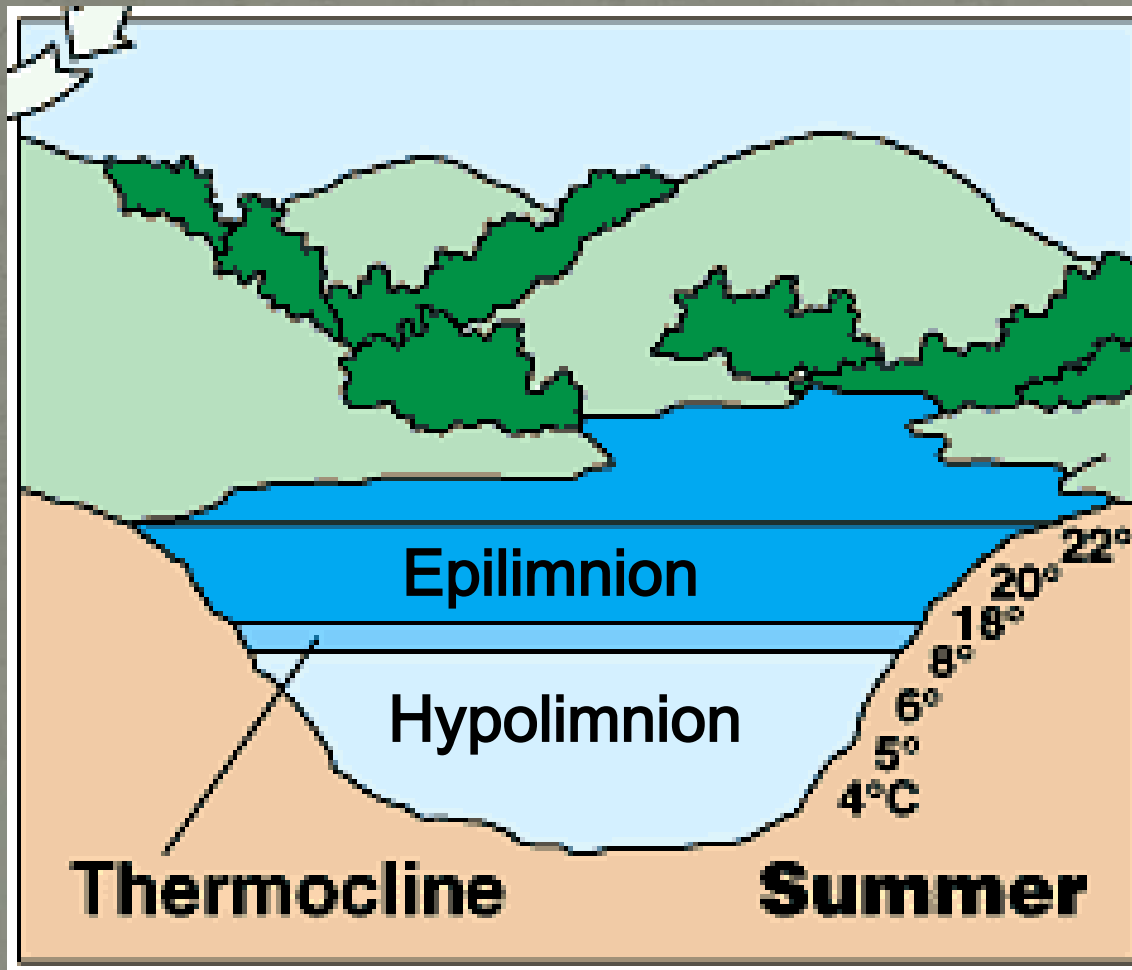
Biological Field Station

SUNY College at Oneonta

Cooperstown, NY

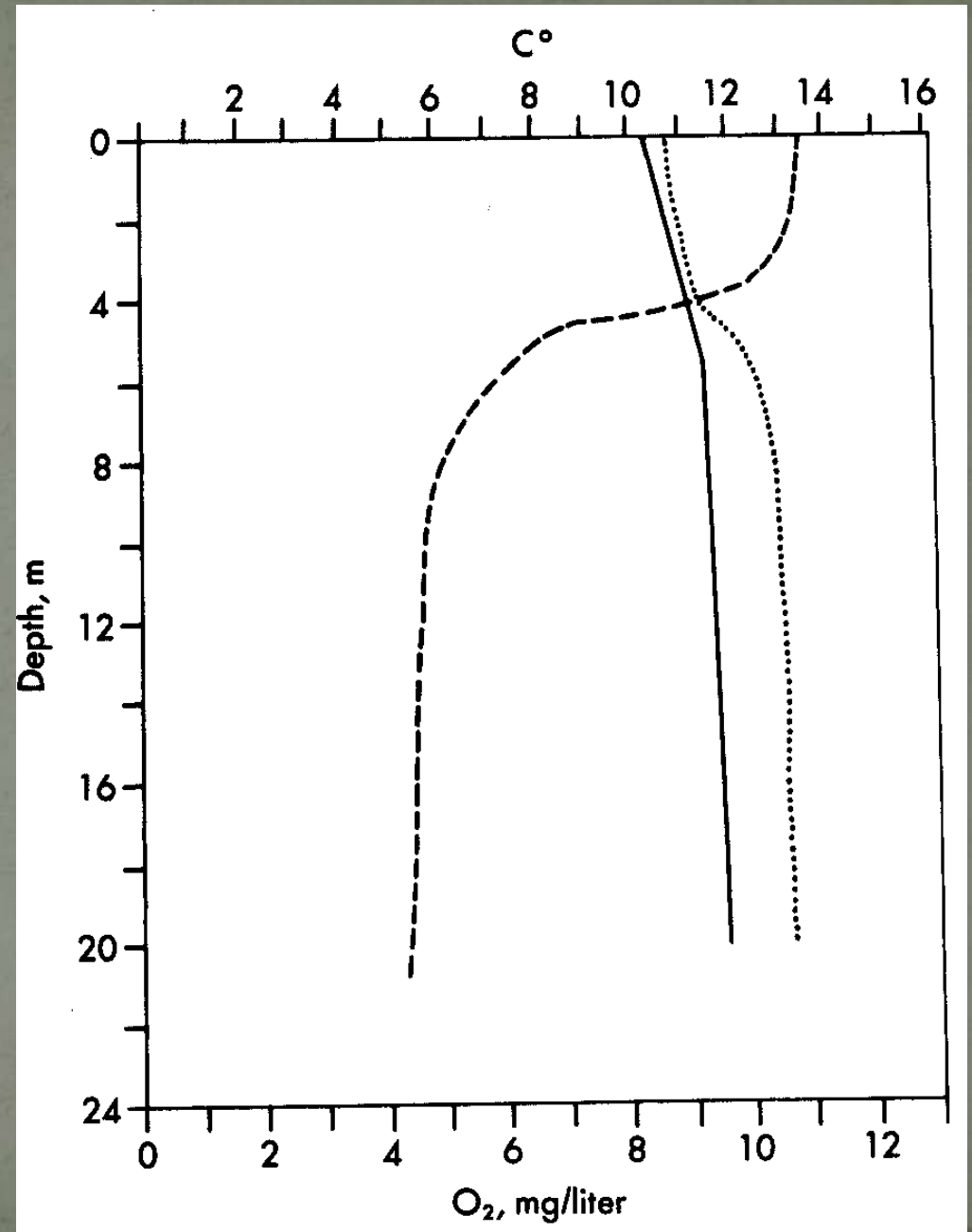


Lake Strata



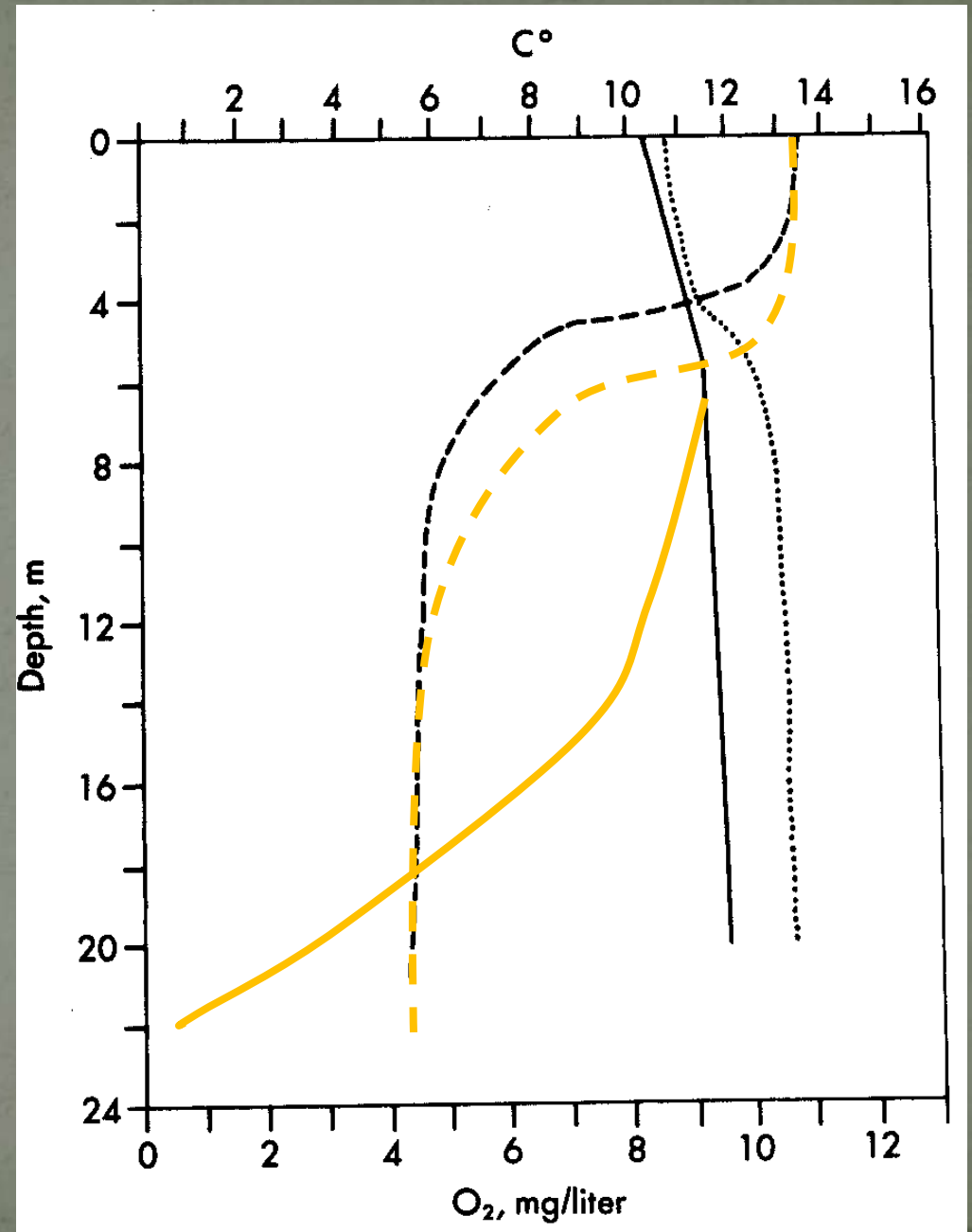
Summer Stratification

Dashed line: Temp
Solid line: Oxygen
Dotted line: 100% sat.

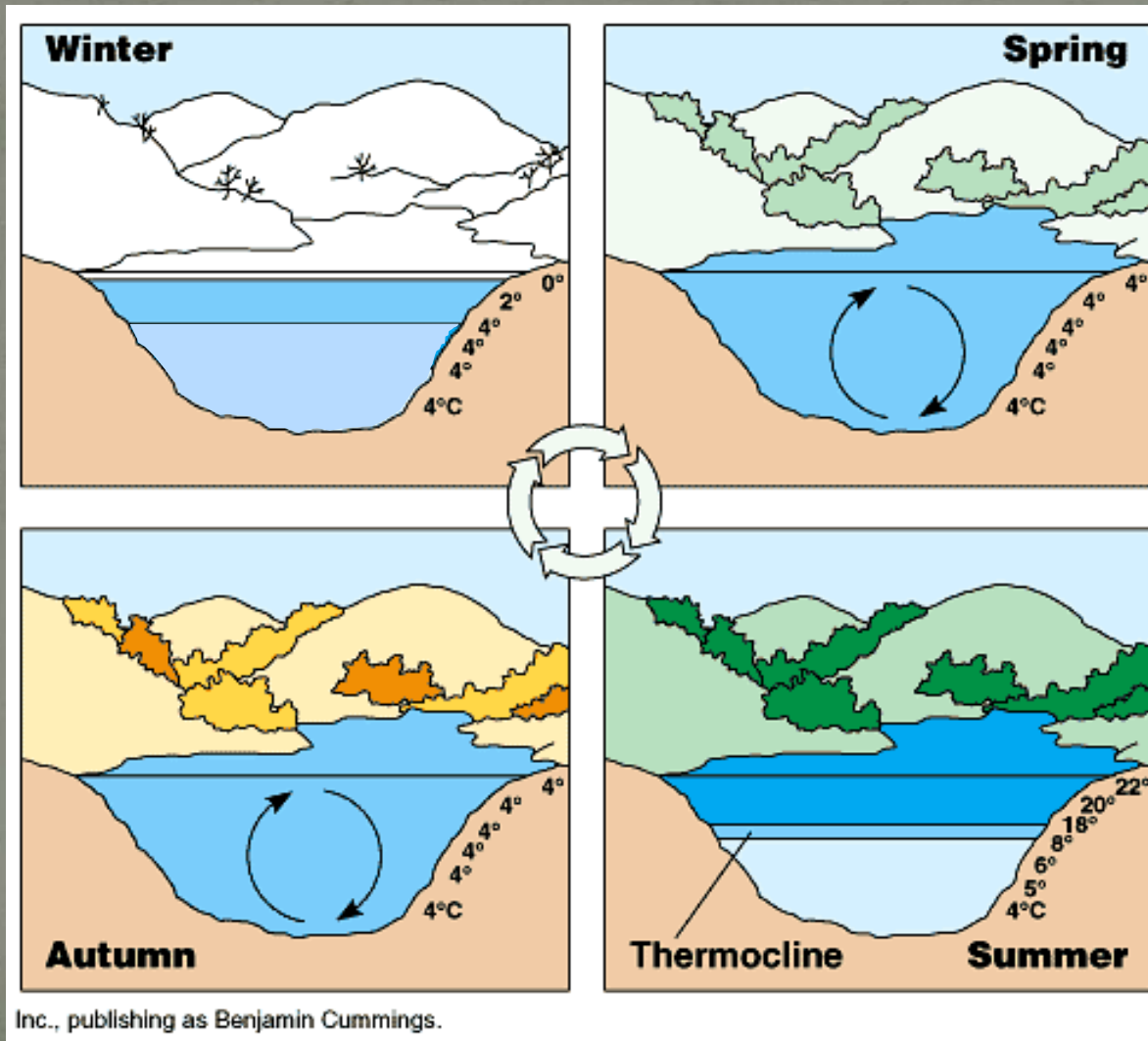


Summer Stratification

Dashed line: Temp
Solid line: Oxygen
Dotted line: 100% sat.



Thermal Stratification

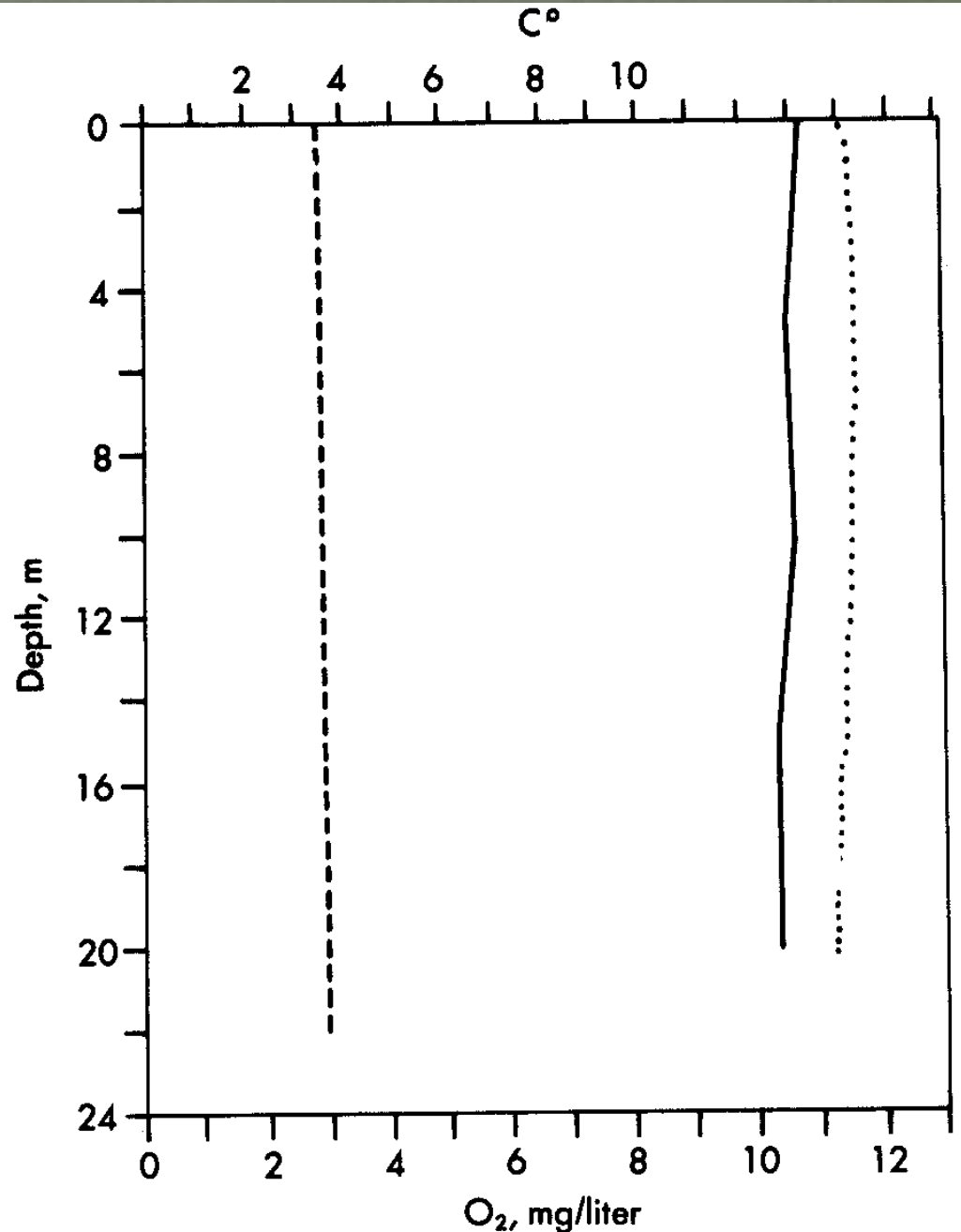


Spring Overturn

Dashed line: Temp

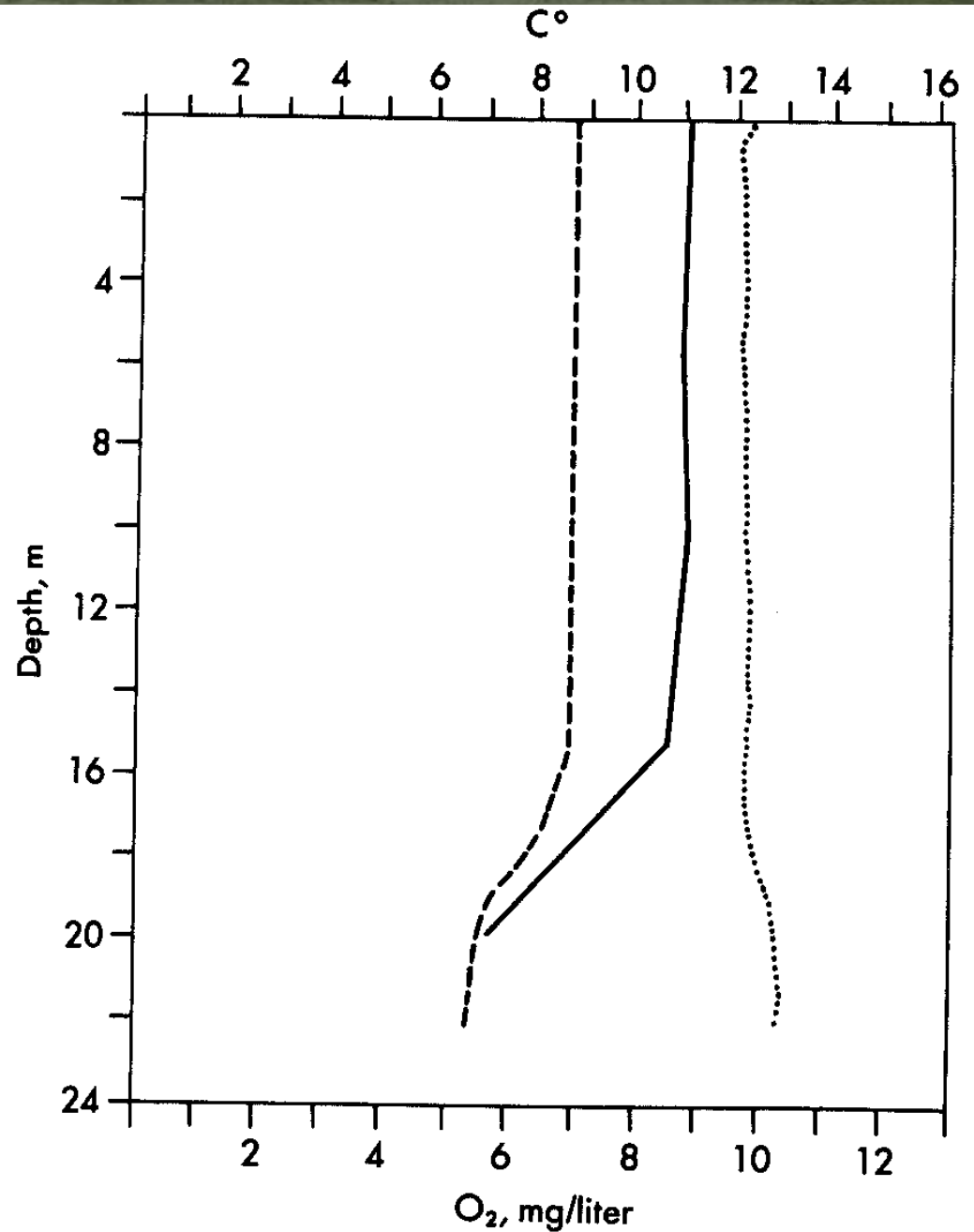
Solid line: Oxygen

Dotted line: 100% sat.



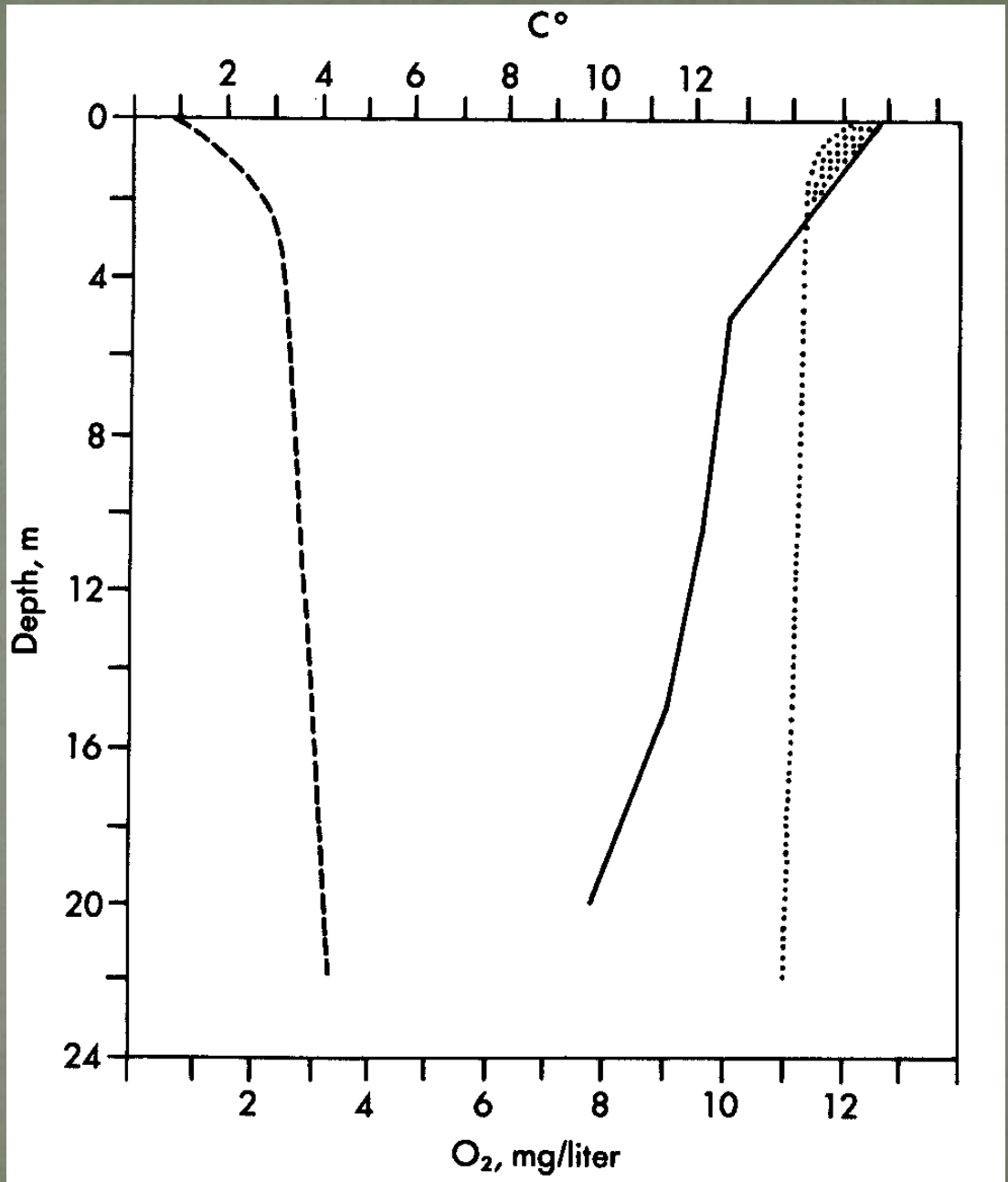
Fall Overturn

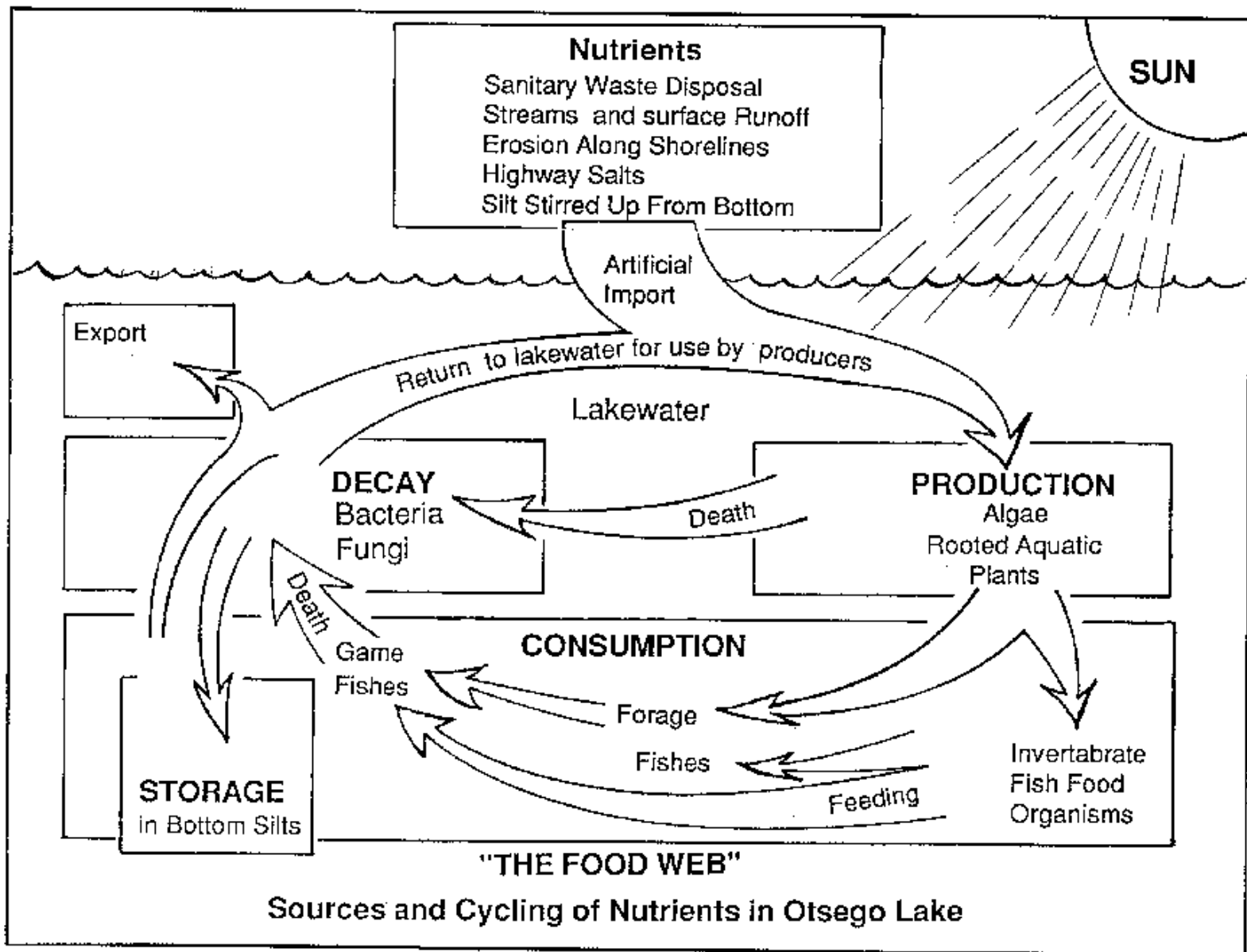
Dashed line: Temp
Solid line: Oxygen
Dotted line: 100% sat.



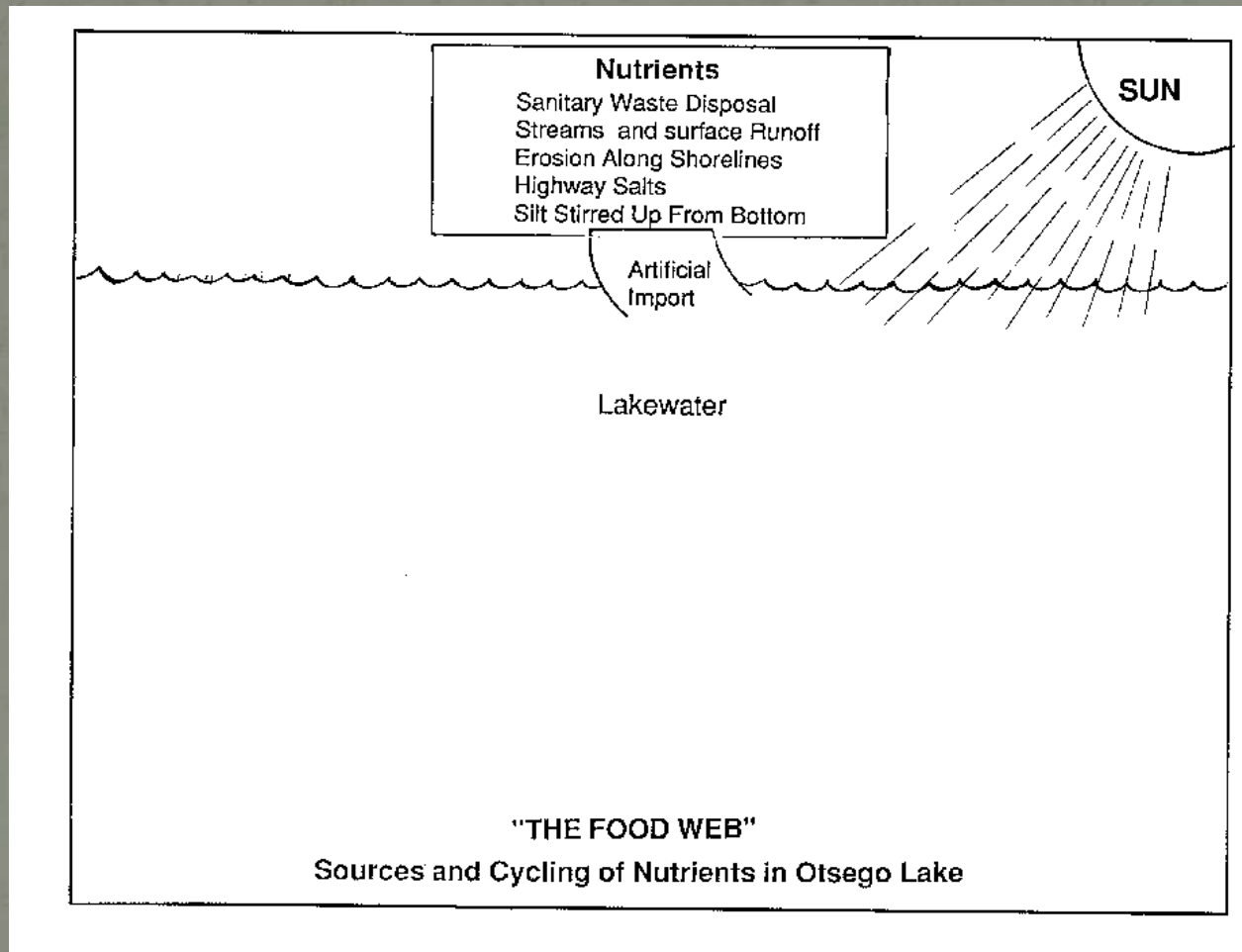
Winter Stratification

Dashed line: Temp
Solid line: Oxygen
Dotted line: 100% sat.

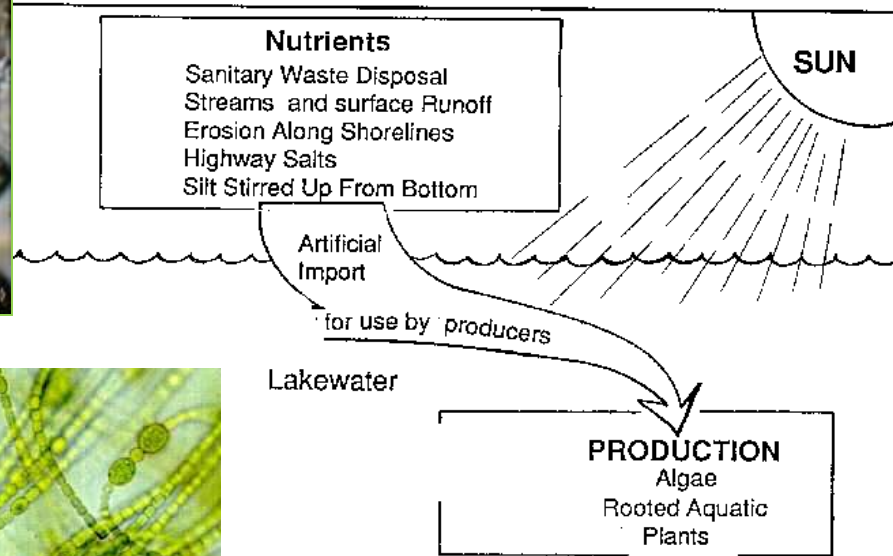




Abiotic Components



Producers

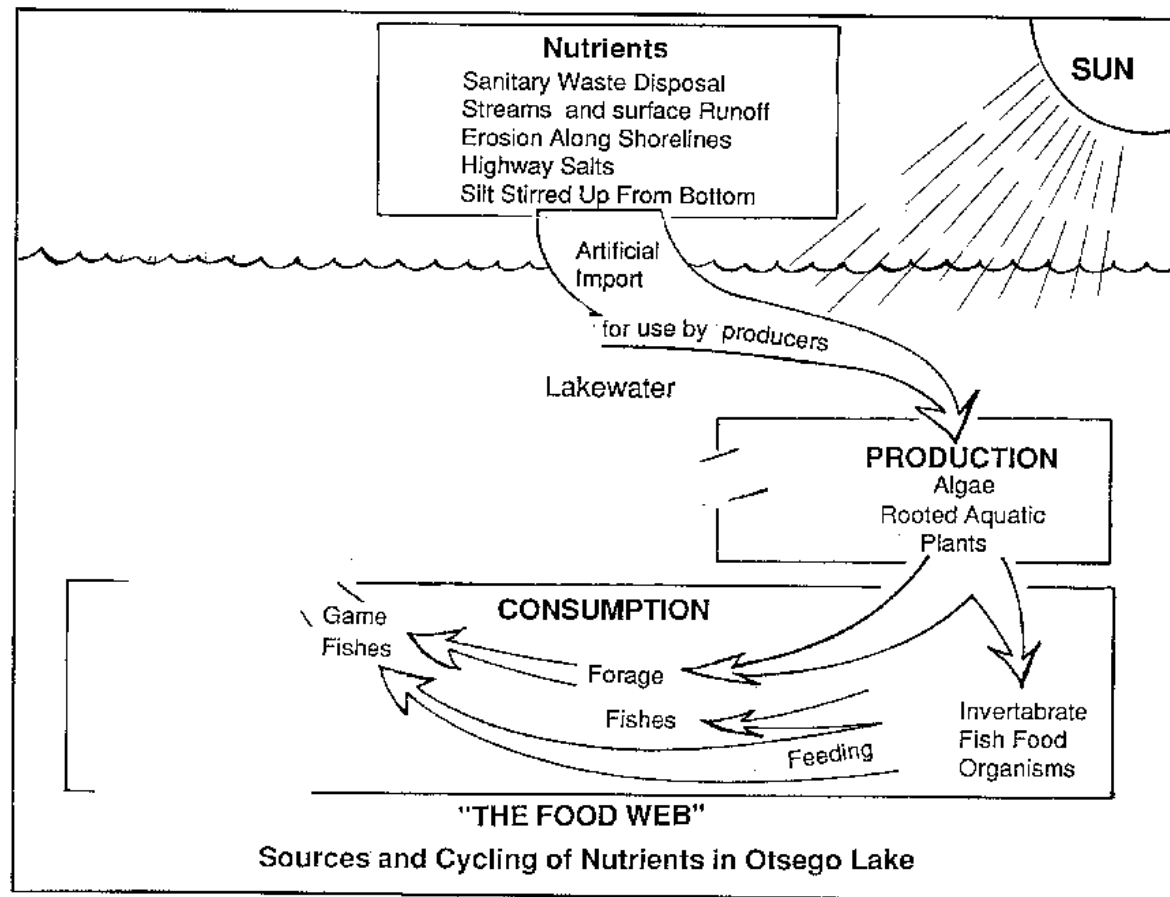


"THE FOOD WEB"

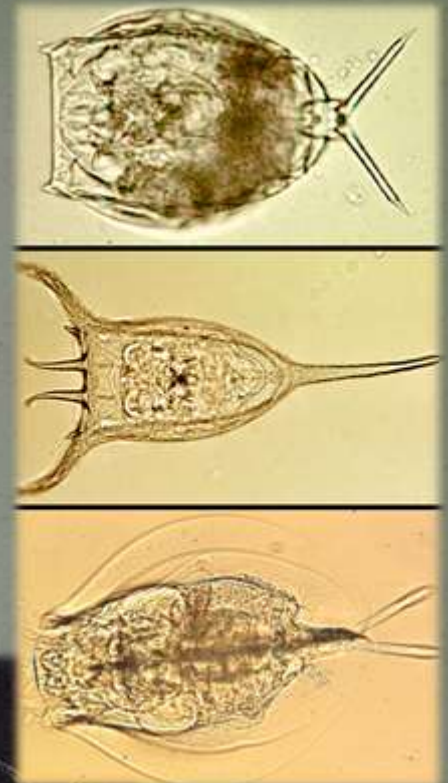
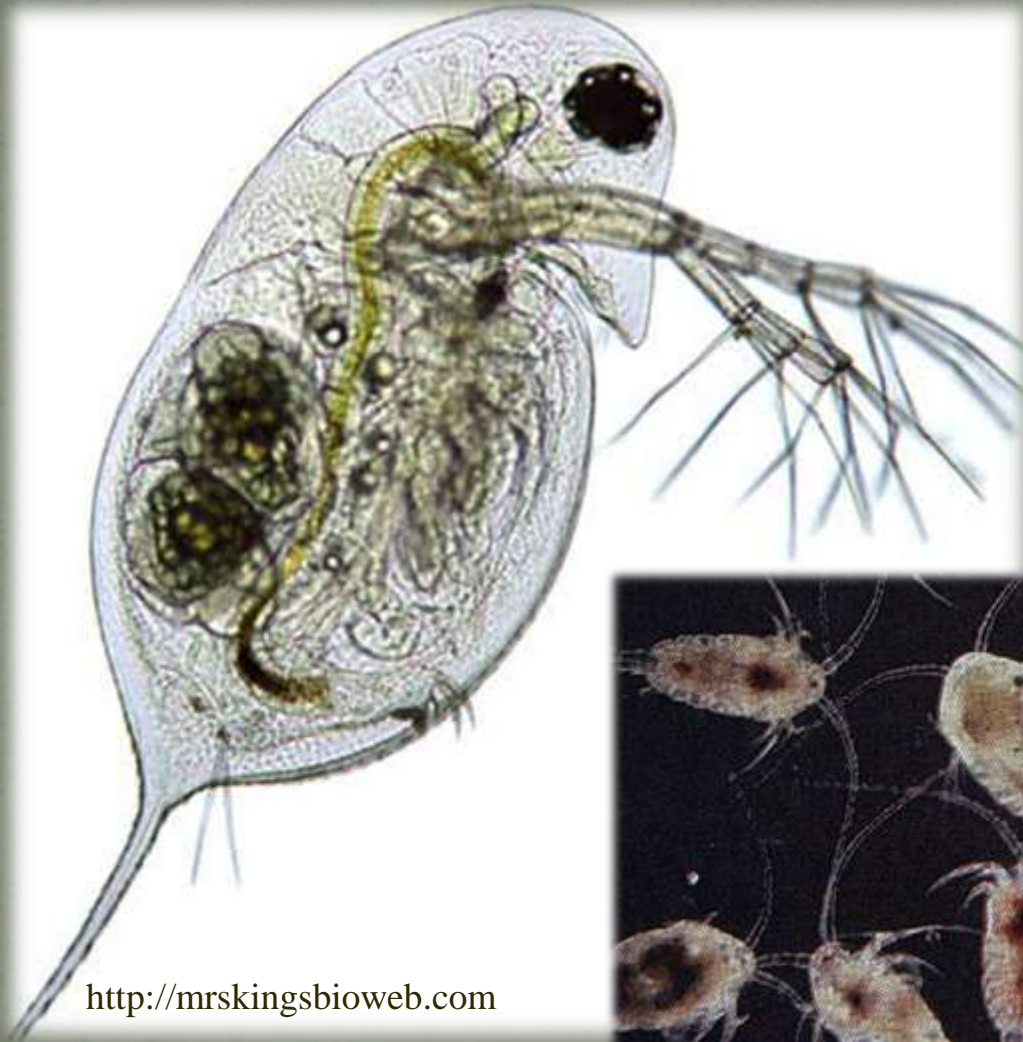
Sources and Cycling of Nutrients in Otsego Lake



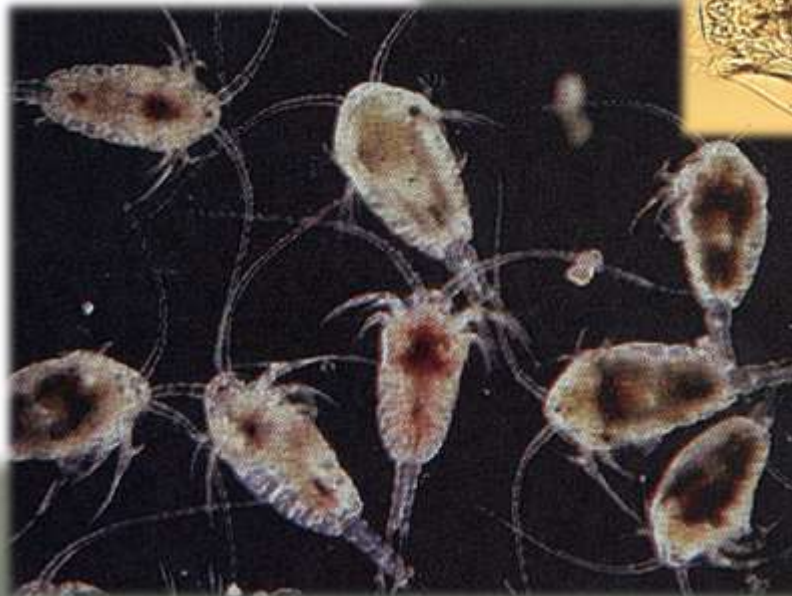
Consumers



Primary Consumers...



<http://cfb.unh.edu/CFBkey/>



<http://kingfish.coastal.edu/biology/sgilman>



Secondary Consumers...



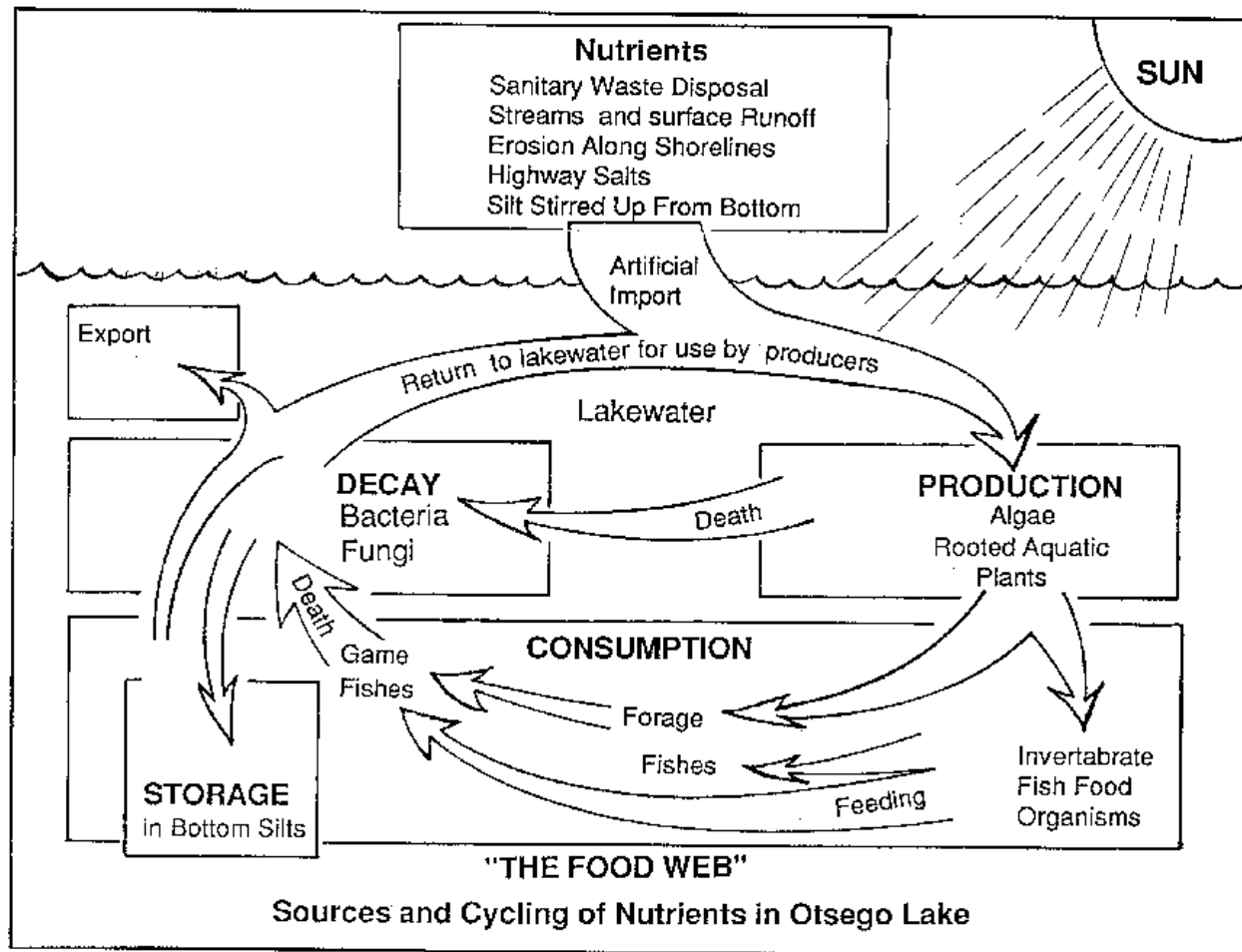


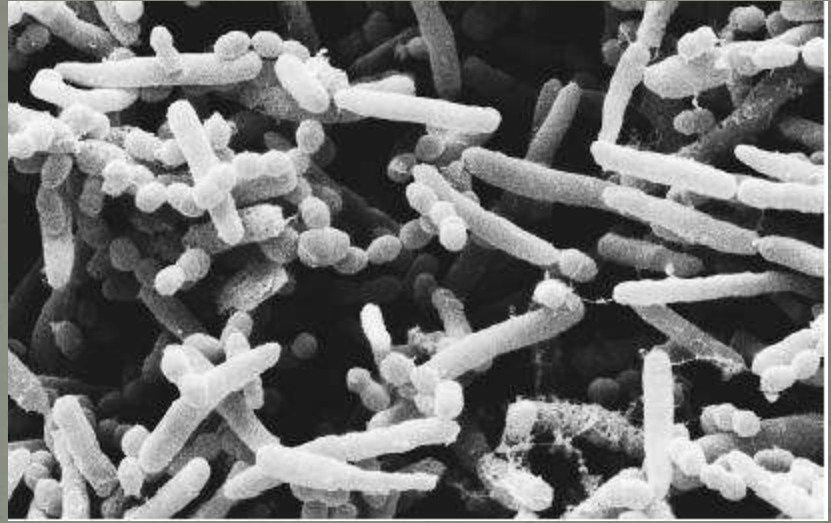
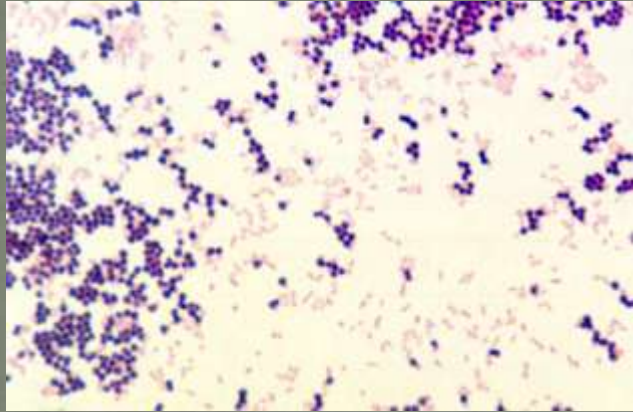
Tertiary Consumer



Quaternary Consumer

Decomposers



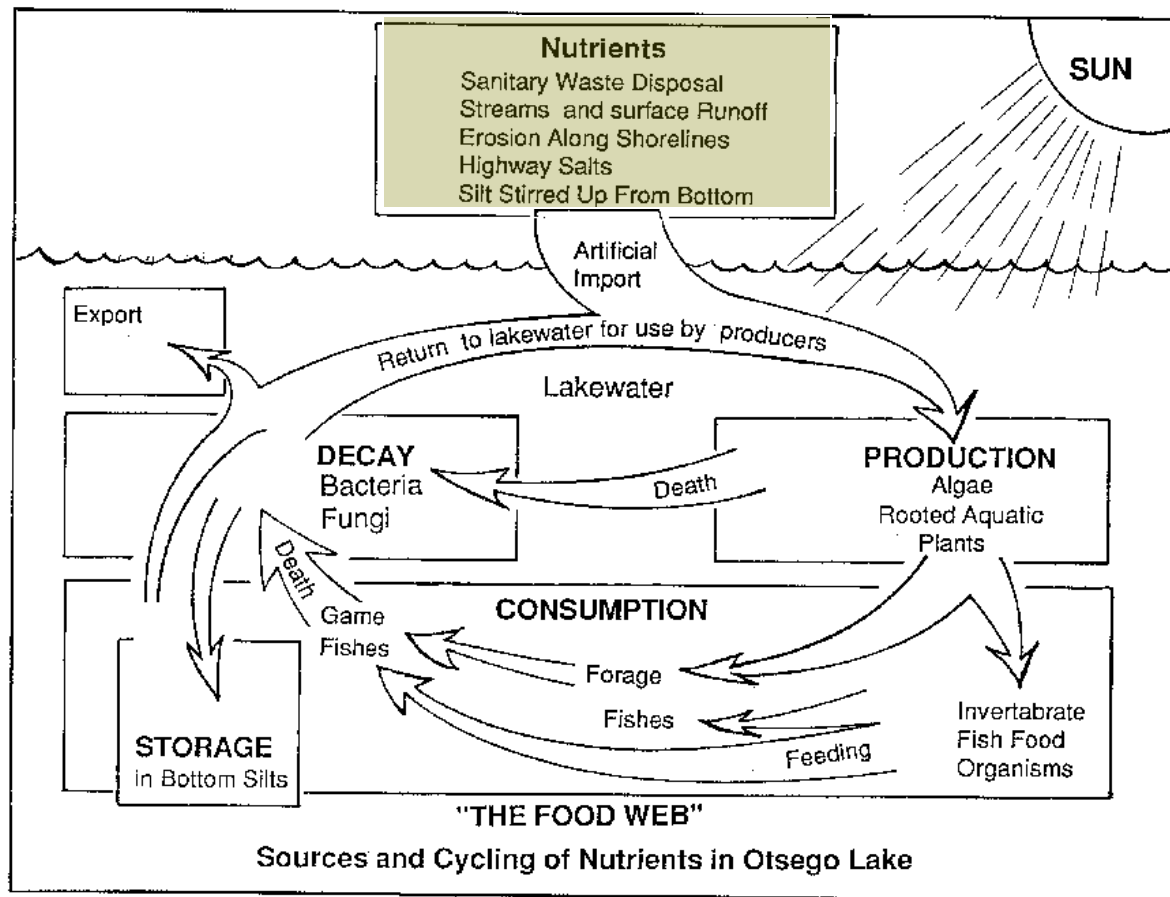


Cultural Eutrophication

- Increased inputs to the Abiotic nutrient sources
 - Agricultural Runoff
 - Urban Runoff
 - Wastewater Treatment
 - Erosion
 - Atmospheric Deposition



Cultural Pollution Abiotic Sources



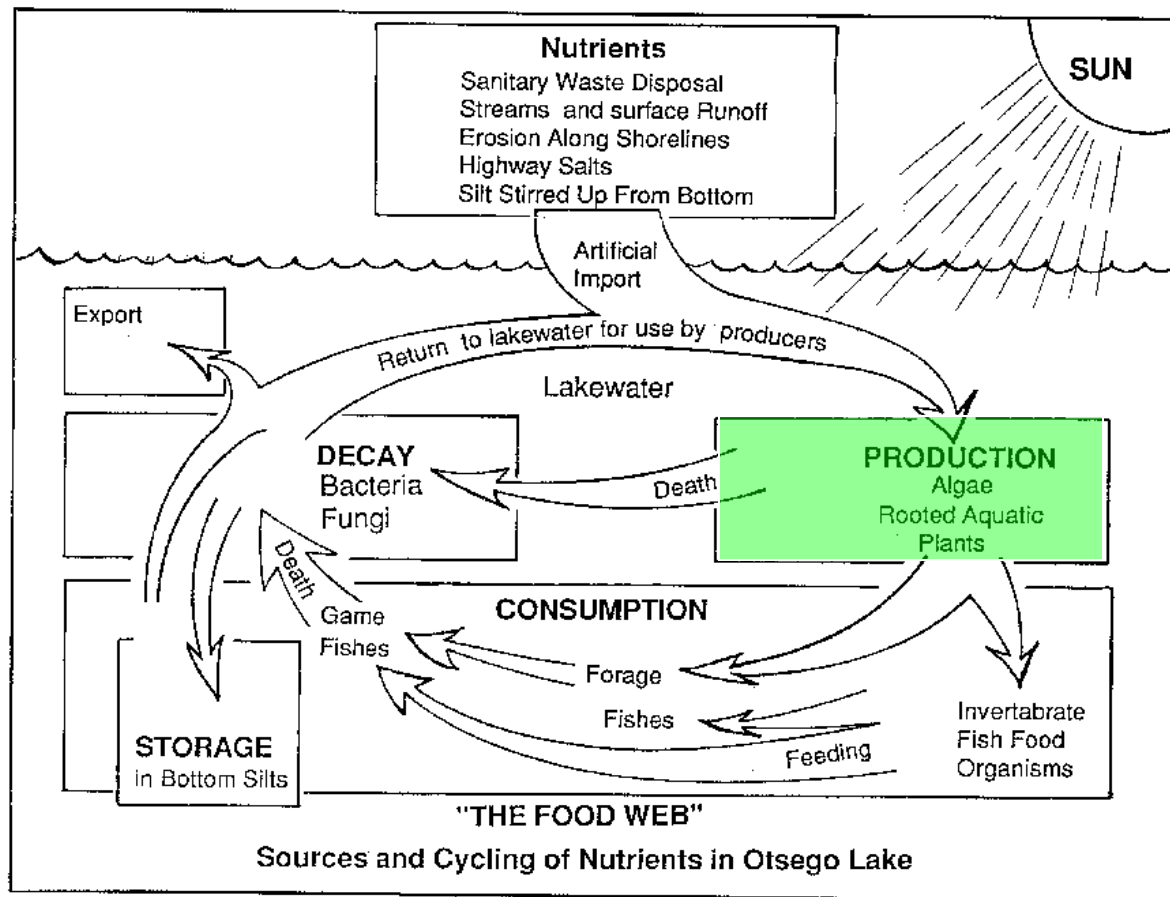








Producer's Response To Pollution

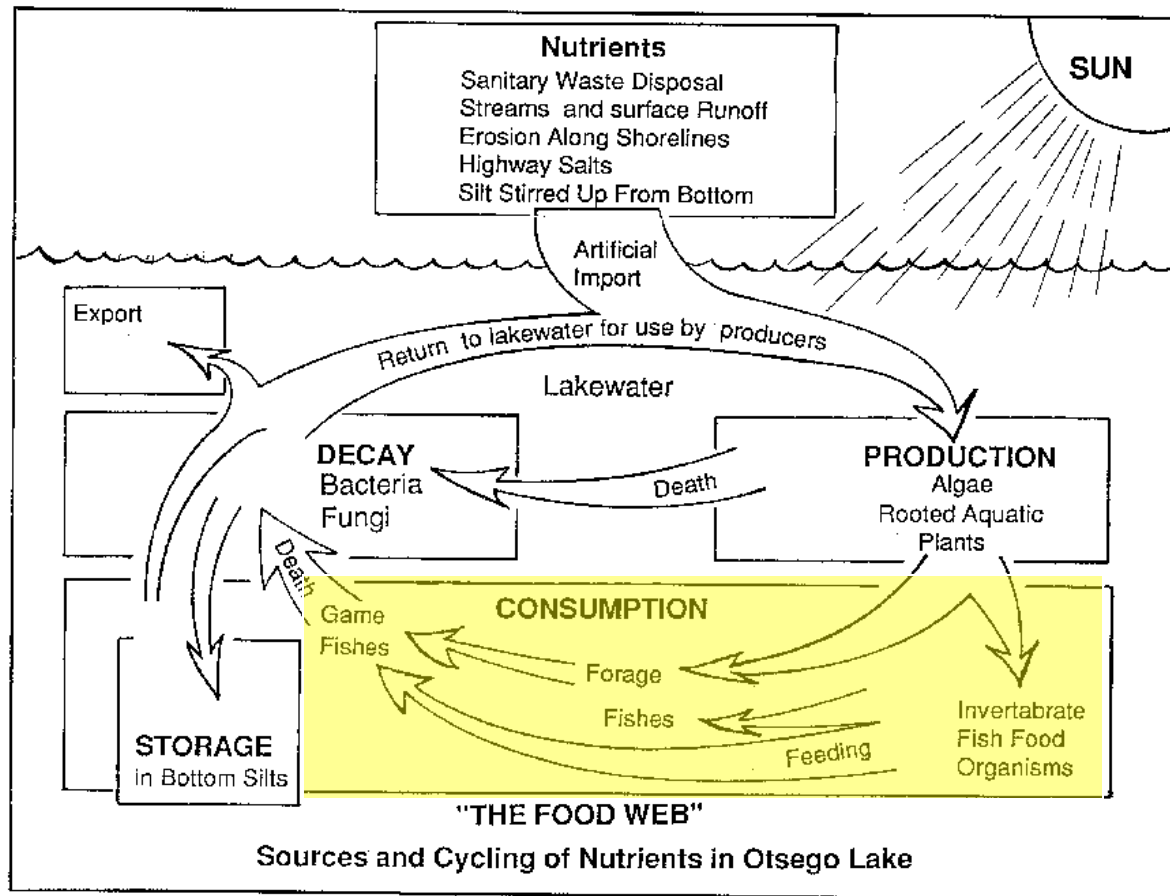






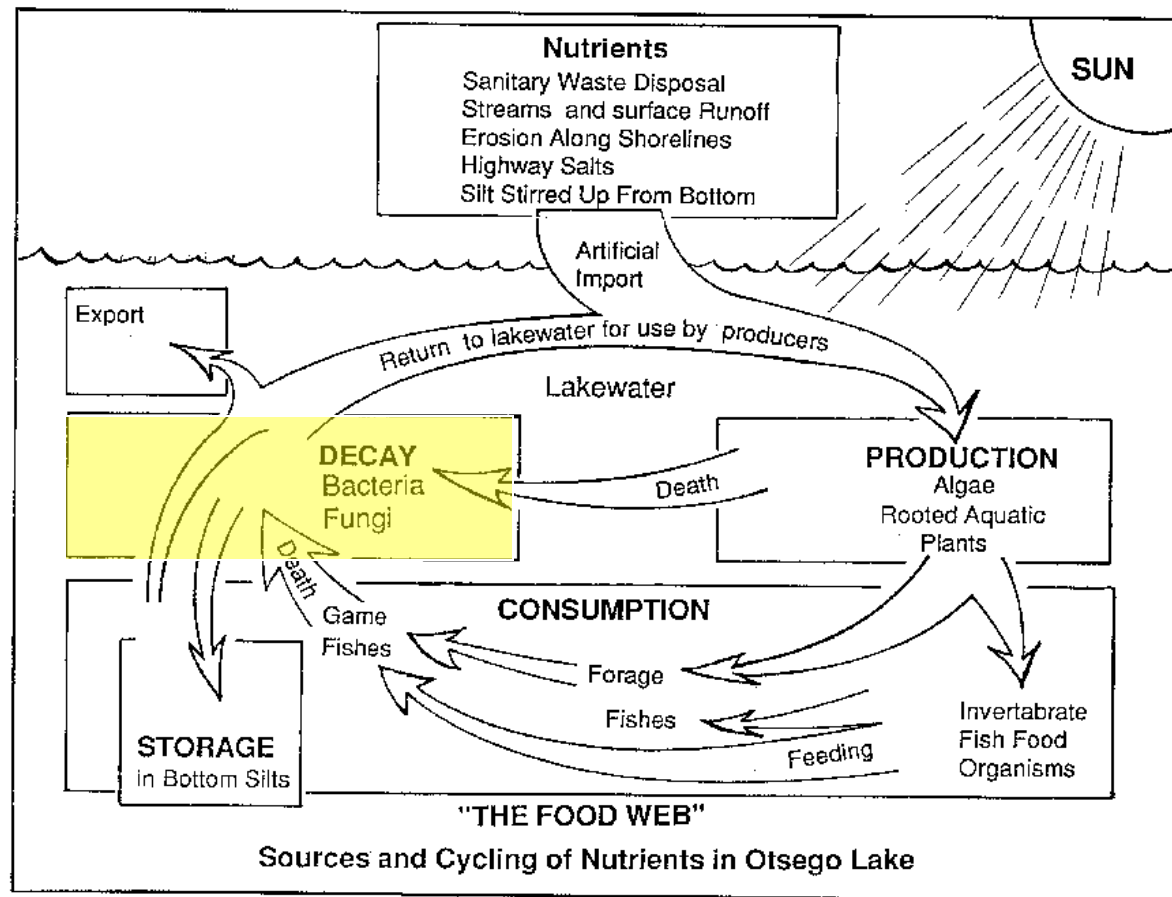


Consumer's Response to Pollution





Decomposer's Response To Pollution



Limiting factors can change

From Food (nutrients)...



Limiting factors can change

To Oxygen...

Mona Lake, Michigan



Impacts of Introduced Exotics

- PRODUCERS: Submerged Macrophytes (i.e., Rooted Aquatic Plants)
- PRIMARY CONSUMERS: Macrobenthic Invertebrates (e.g., Zebra Mussels)
- SECONDARY CONSUMERS: Forage Fish (e.g., Alewives)
- TERTIARY CONSUMERS: Predators (e.g., Walleye)
 - Often a management tool

Producers



Producers



Primary Consumers



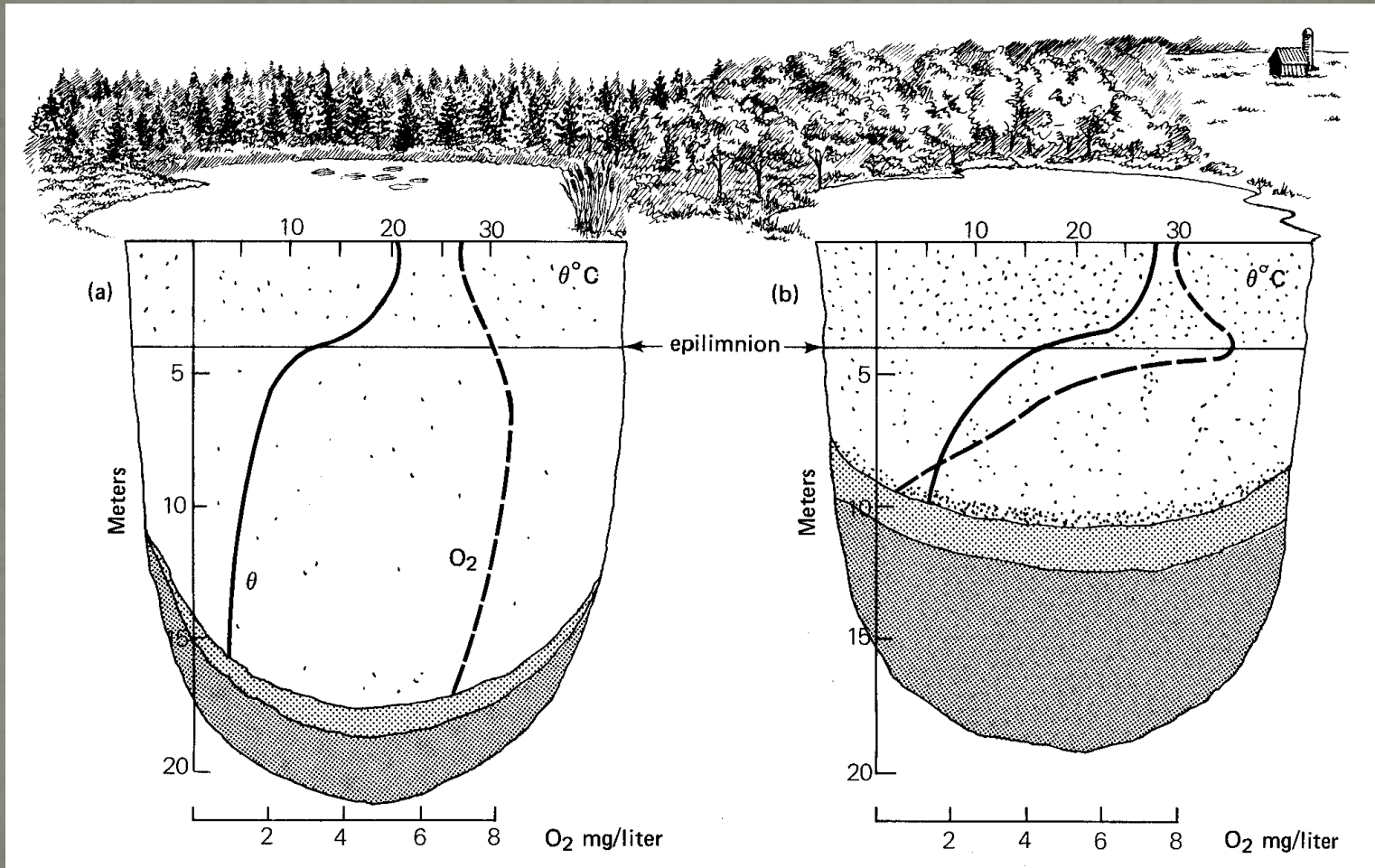
Secondary Consumers



Tertiary Consumers



Lake Succession



Water colors

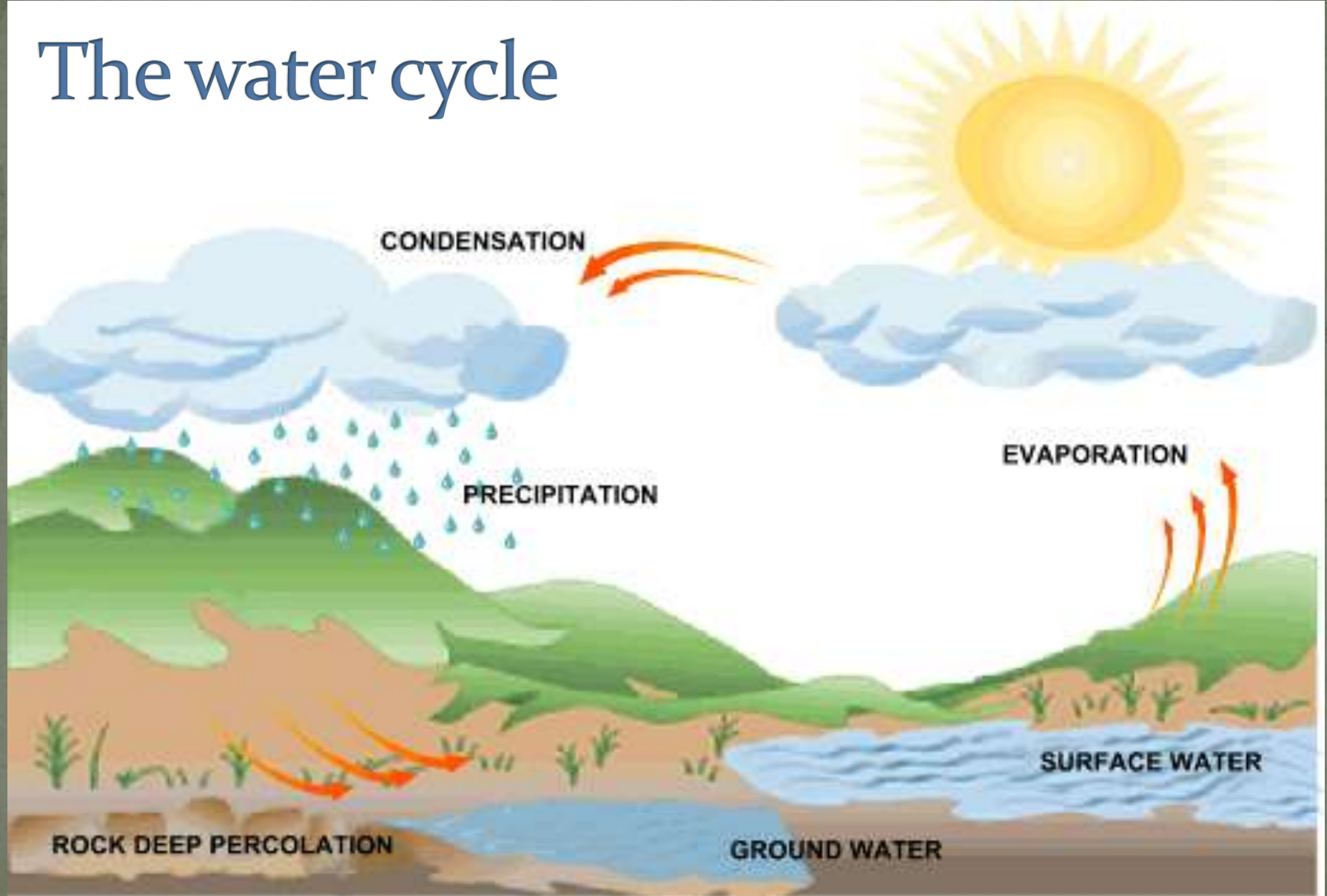
- Clear water appears blue:
Uneven absorption of wavelengths
- Impurities and suspended particles affect color
 - Algae
 - Organic matter/tannins
 - Calcium
- Color from shore vs. in a bottle



Properties of water...

- Universal Solvent (solids and gases)
- Density vs. Temperature Properties
- Heat storage
- Erosional forces of fluid and ice

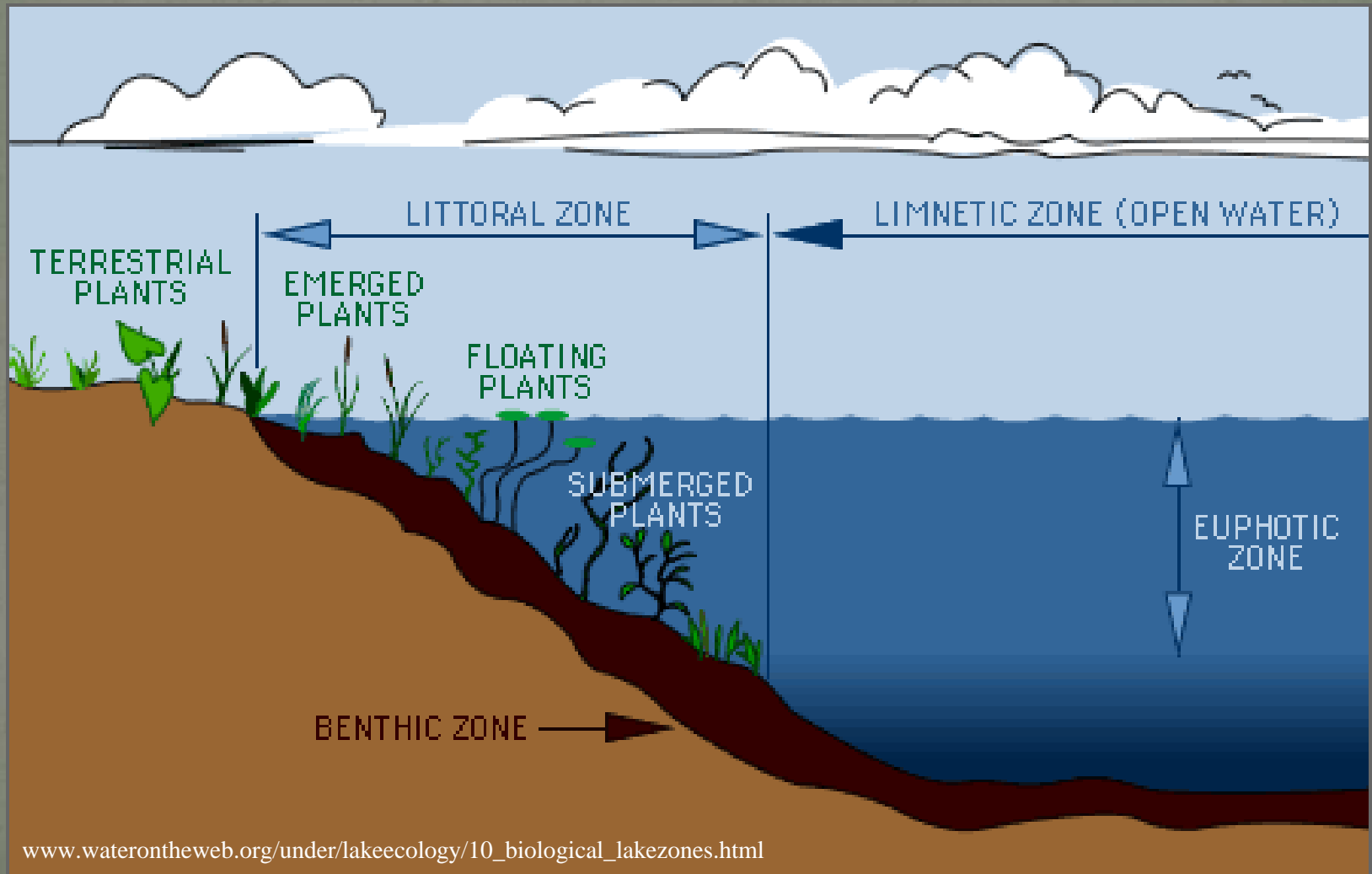
The water cycle



At the base of the ecosystem

- Energy Transfer
 - Solar Energy → Photosynthesis → Respiration
→ Respiration...
- Respiration consumes oxygen
 - Consumption may lead to anoxia
 - Extreme diel shifts may occur in shallow productive systems
- pH Effects & Alkalinity
 - Photosynthesis increases pH
 - Respiration decreases pH

Lake Habitats

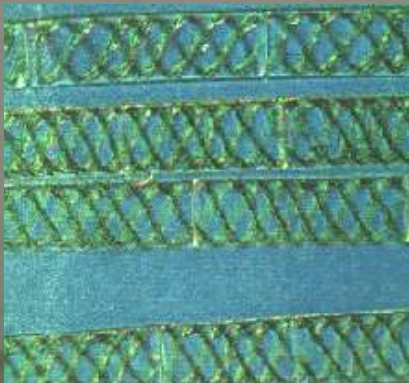
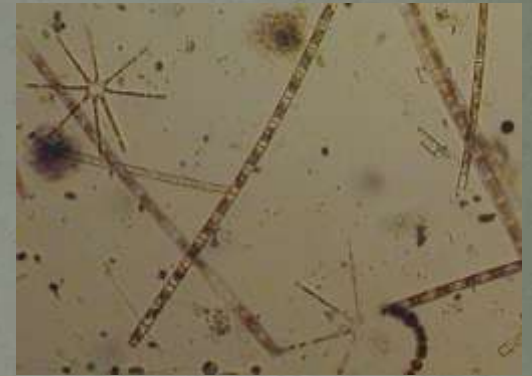


Cycles of the elements

- Necessary nutrients (carbon, oxygen, nitrogen, phosphorus)
- Limiting nutrients (as a limiting factor) to algae
 - usually P, sometimes N
- Abiotic sources of nutrients
- Producers (Green Plants & Algae - Autotrophs)
- Consumers (Animals - Heterotrophs)
- Decomposers (Bacteria & Fungi - Saprotrophs)

Algae Forms

- Phytoplankton (microscopic, free-floating)
- Periphyton (attached to surfaces)
- Epiphyton (attached to macrophytes)
- Filamentous (scum algae)

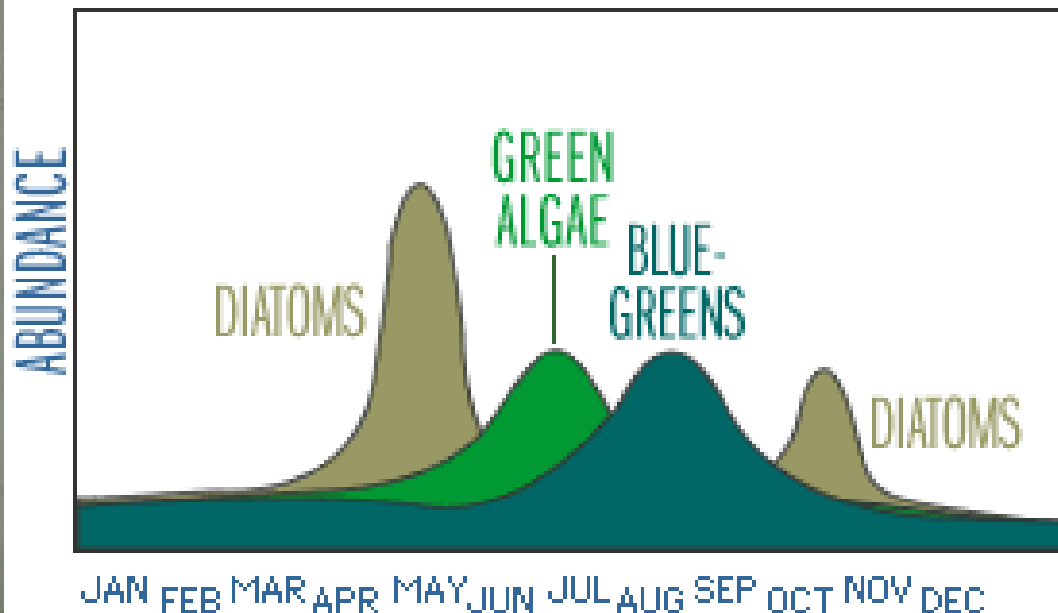


Images from: Water on the Web

Main Algae Types

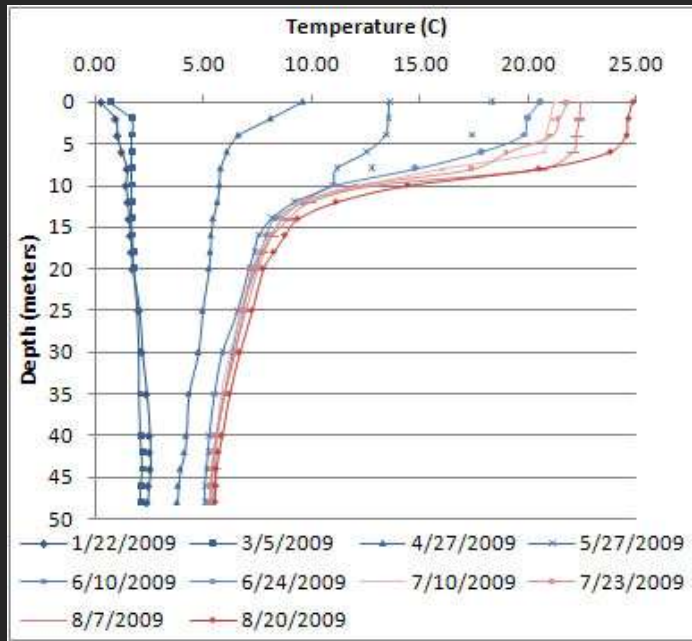
- Diatoms (cold conditions)
- Green Algae (high N)
- Blue-Green (N-fixation, high P)

SEASONAL SUCCESSION OF PHYTOPLANKTON POPULATIONS

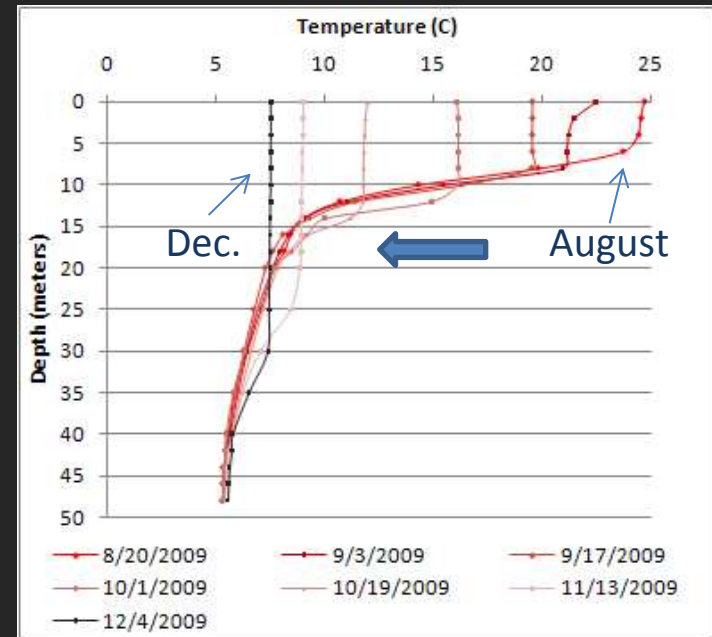


Otsego Lake 2009 Temperature Profiles

January to August



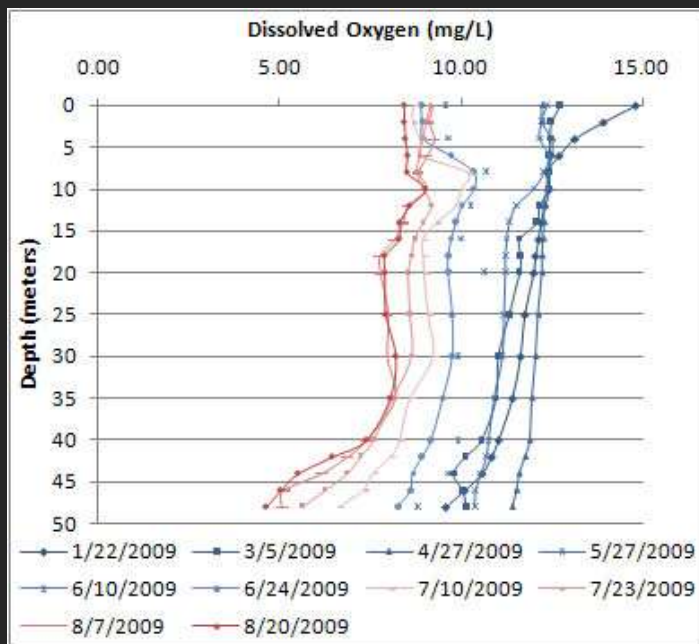
August to December



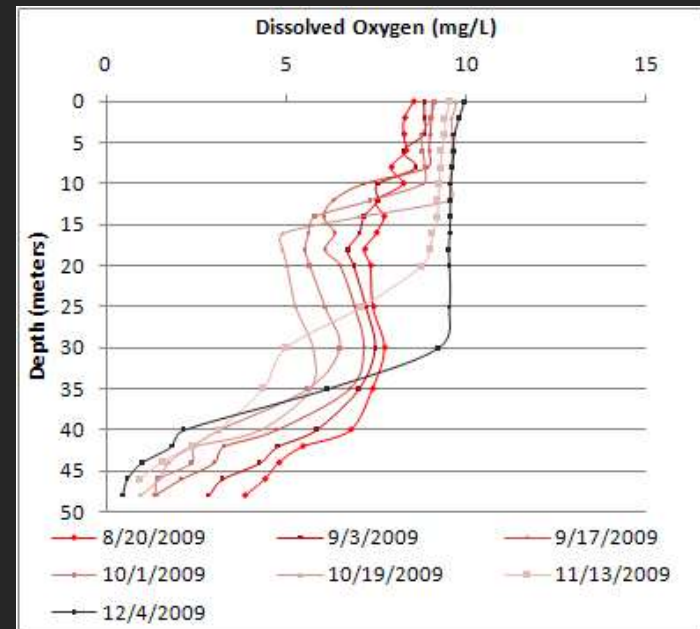
Otsego Lake

2009 Dissolved Oxygen Profiles

January to August



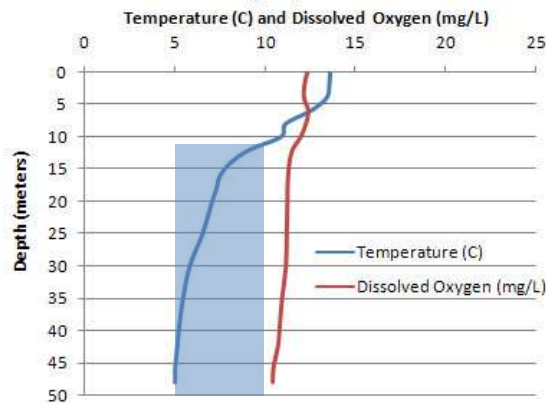
August to December



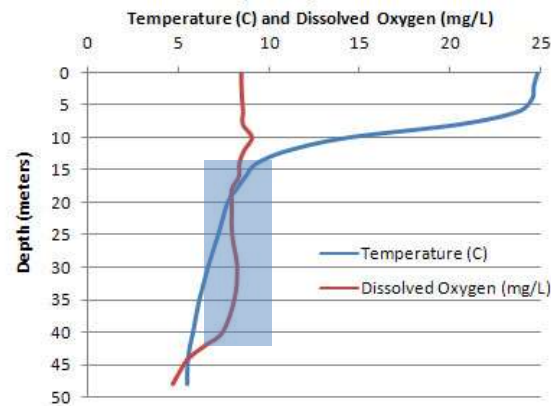
Otsego Lake

Available Lake Trout Habitat

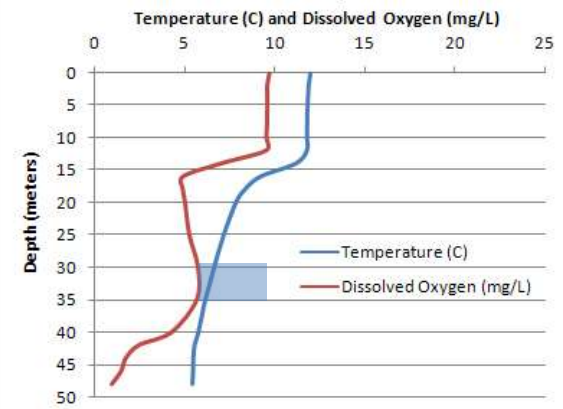
Otsego Lake Temperature & Dissolved Oxygen
May 27, 2009



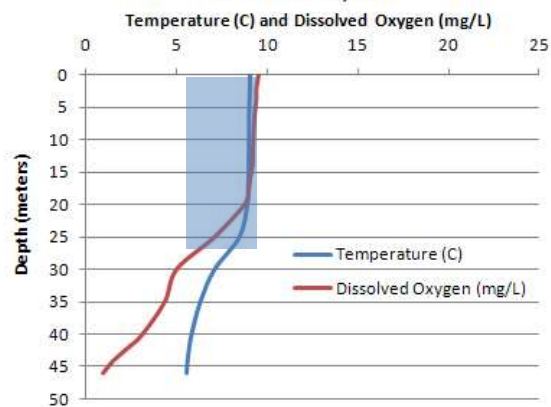
Otsego Lake Temperature & Dissolved Oxygen
August 20, 2009



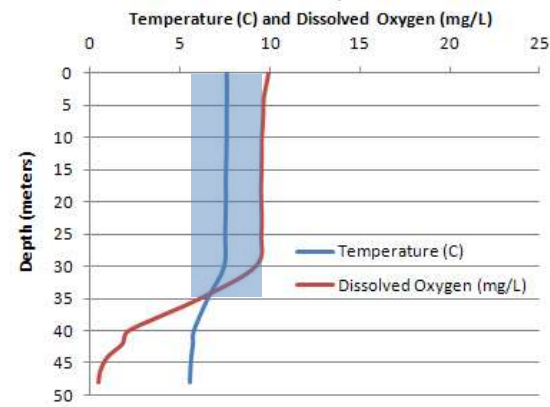
Otsego Lake Temperature & Dissolved Oxygen
October 19, 2009



Otsego Lake Temperature & Dissolved Oxygen
November 13, 2009

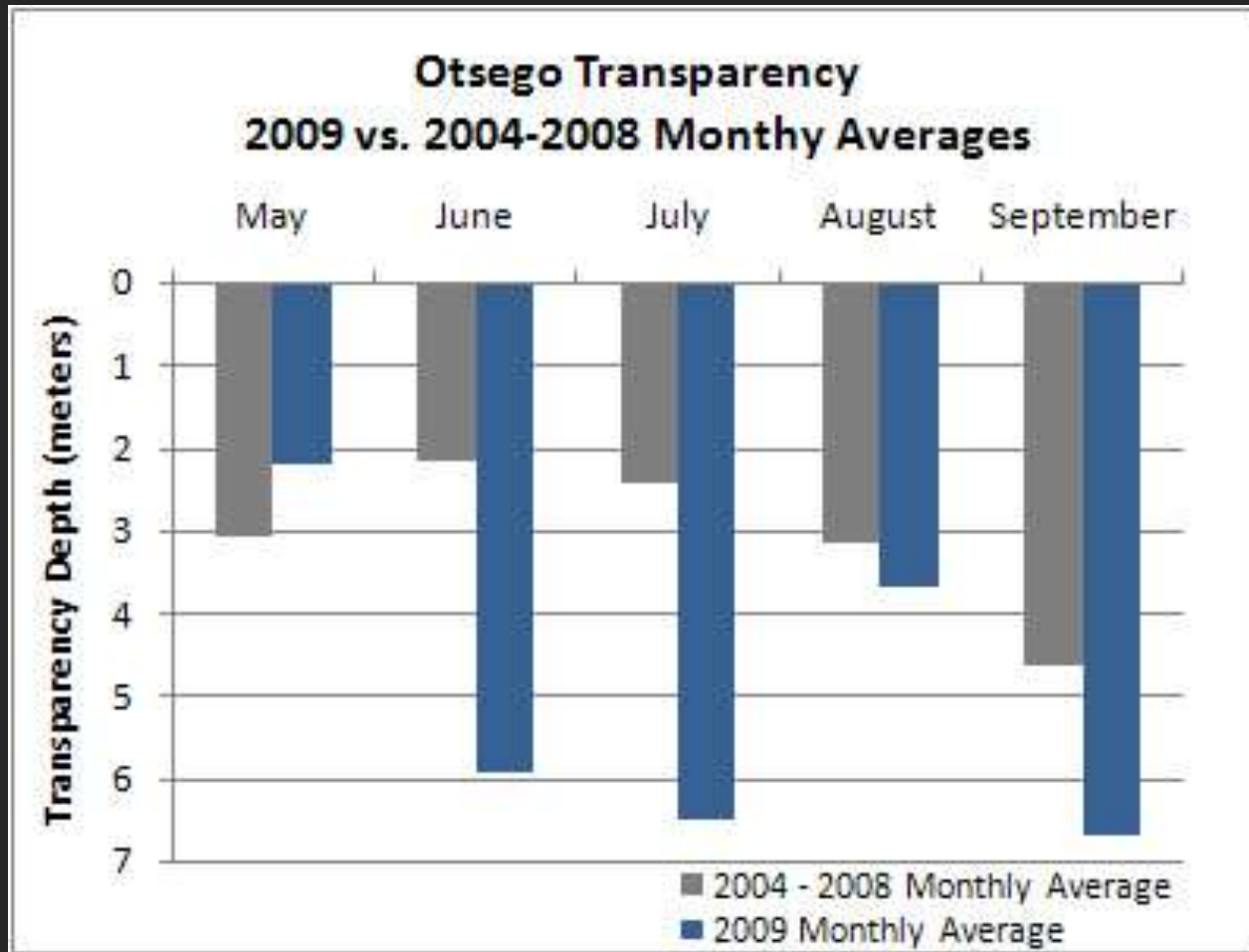


Otsego Lake Temperature & Dissolved Oxygen
December 4, 2009



Otsego Lake

2009 Secchi Transparency



Otsego Lake: Secchi Transparency

1935 – 2009

