# Susquehanna River Smallmouth Bass:

## Background, Theories, Actions

River Rescue
January 31, 2009
Harrisburg, Pennsylvania

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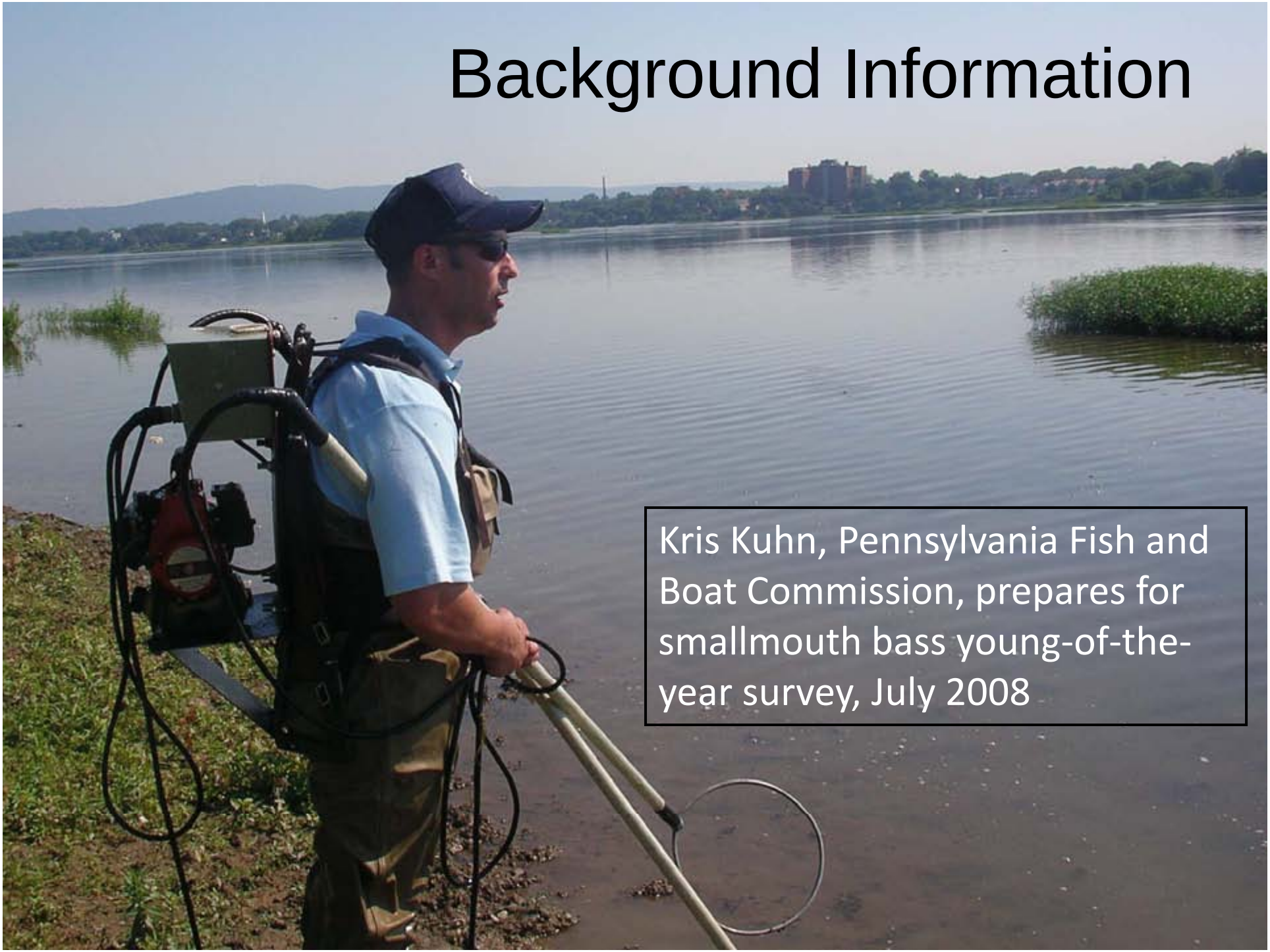
# The Problem

- Large-scale smallmouth bass disease (2005, 2007, and 2008)
- Young-of-the-year fish only
- Susquehanna River Basin only
- June – July

# Background Information

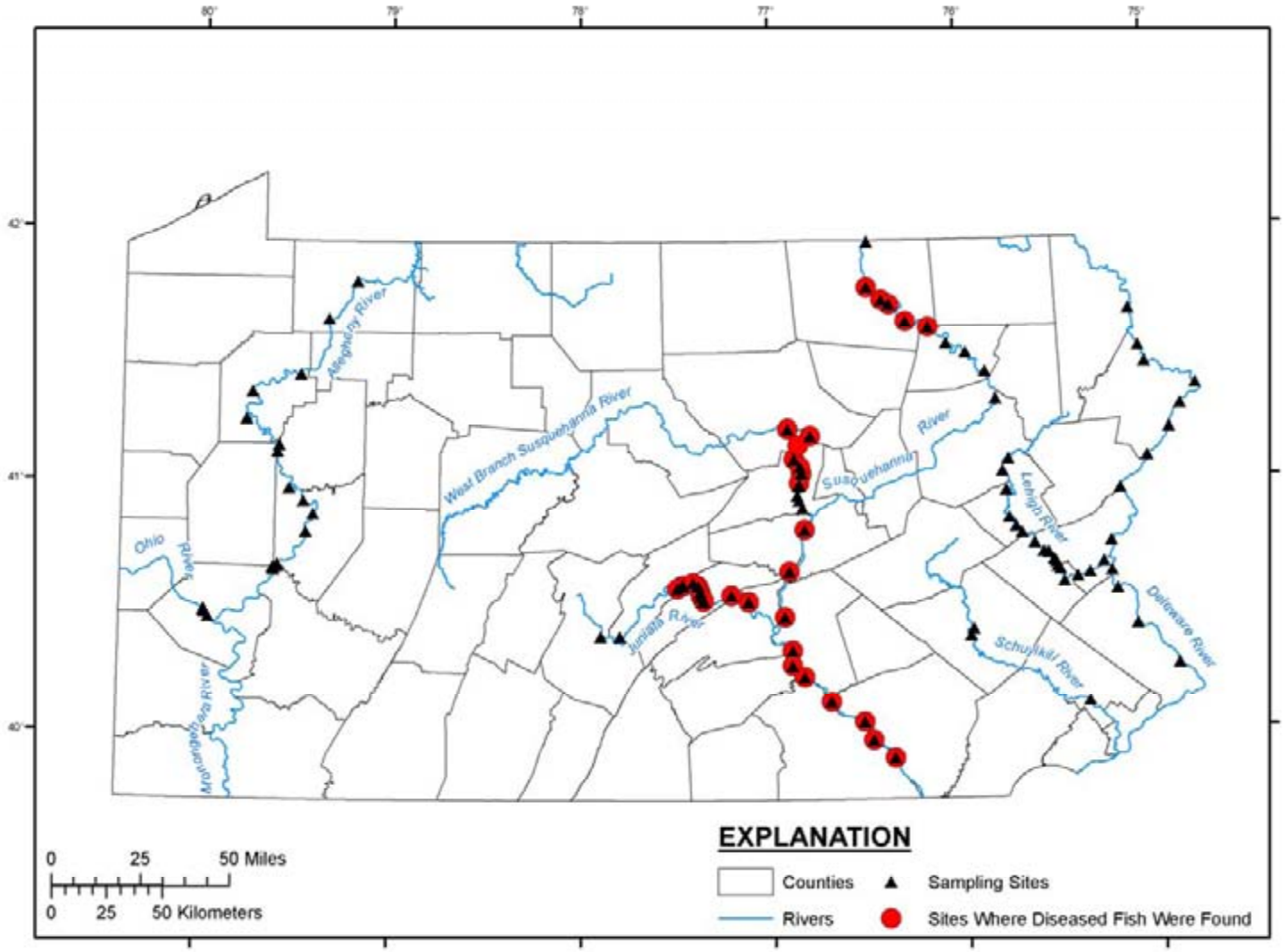


Kris Kuhn, Pennsylvania Fish and Boat Commission, prepares for smallmouth bass young-of-the-year survey, July 2008

# PFBC Young-of-the-Year Surveys of Smallmouth Bass


"Columnaris bacteria (*Flavobacterium columnare*) appears to be the primary pathogen" (Ken Stark PFBC, 2008)

# Diseased or Dead YOY SMB – July 2007



# Smallmouth Bass Bacterial Infections
# -- Questions --

- Why in the Susquehanna River, but not in the Delaware River or the Allegheny River?
- Why only the young-of-the-year smallmouth bass and not the adults?
- Why in June-July rather than August?
- Why in some years, but not others?
- How does the situation in the Susquehanna River relate to fish kills in the Shenandoah and Potomac Rivers?
- Is there a relation between the bacterial infections and the large *Cladophora* (algae) growths?

Why are the bass getting these bacterial infections

???

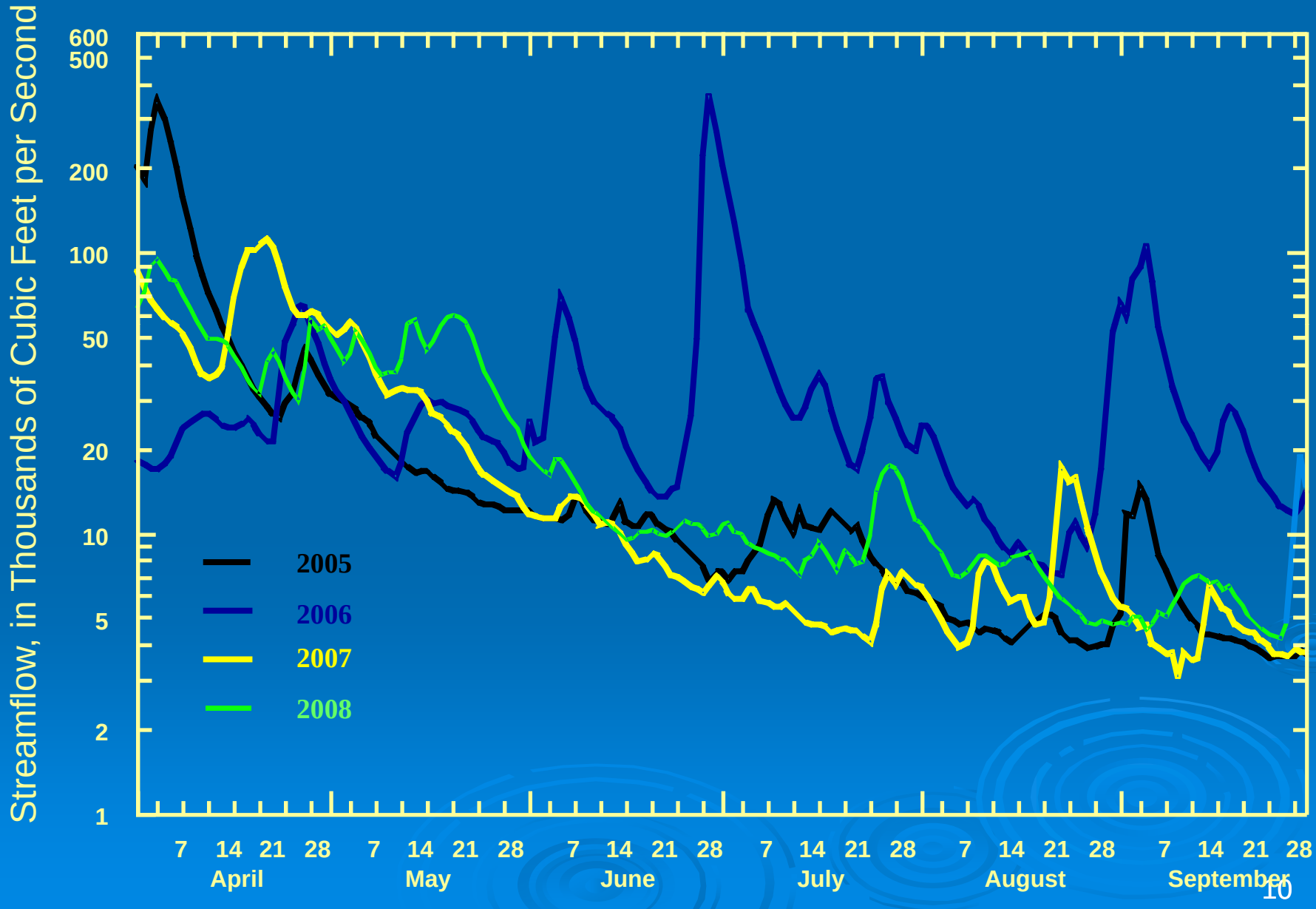
# Our Hypothesis

Smallmouth bass in the Susquehanna River
are stressed by low dissolved-oxygen concentrations,
making them susceptible to bacterial infections.

# Background Information

- Fish and Boat Commission measured low nighttime dissolved-oxygen concentrations in 2007.
- Long-term nutrient concentrations in the Susquehanna River are decreasing.
- Recent nutrient concentrations may be trending slightly upward.

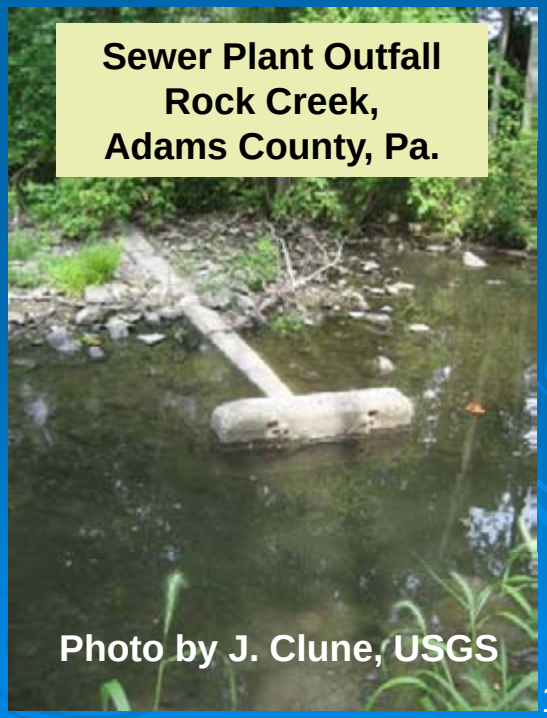
# Streamflow: Susquehanna River at Harrisburg



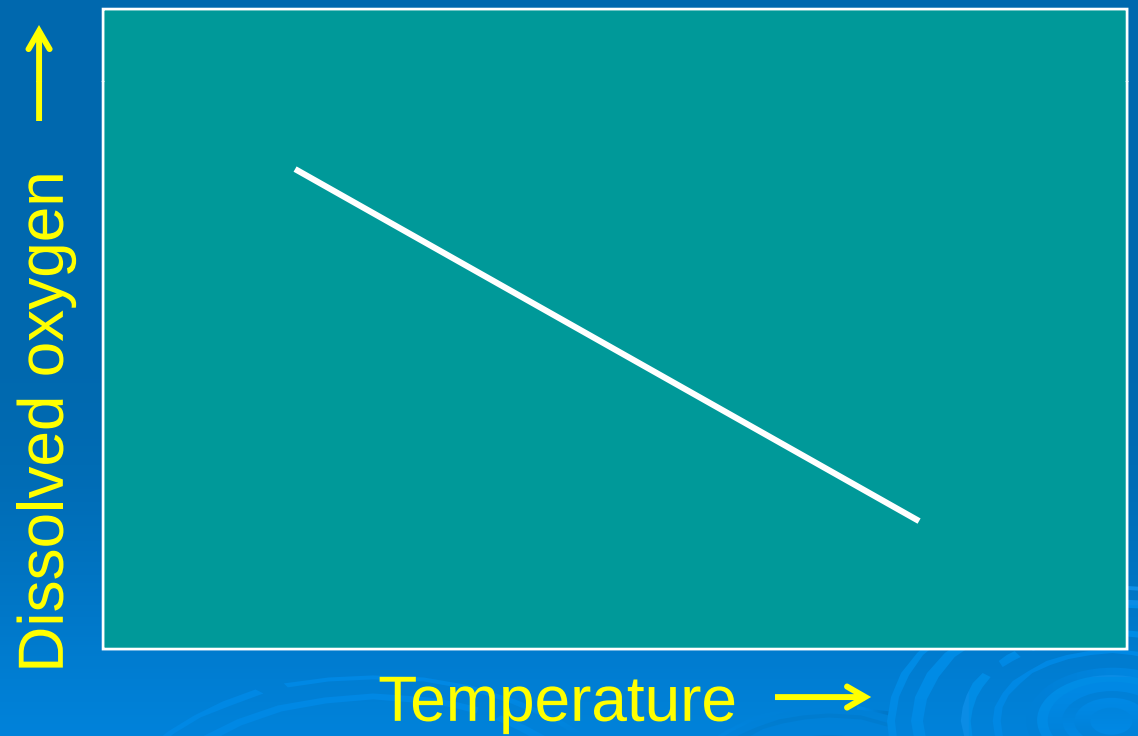
# Oxygen in Water

Affected by:

- In-stream oxygen-demanding materials (BOD)
- Exchange of oxygen between water and air
- Inputs from tributaries, effluents
- Sediment oxygen demand
- In-stream photosynthesis
- In-stream respiration
- Stream temperature

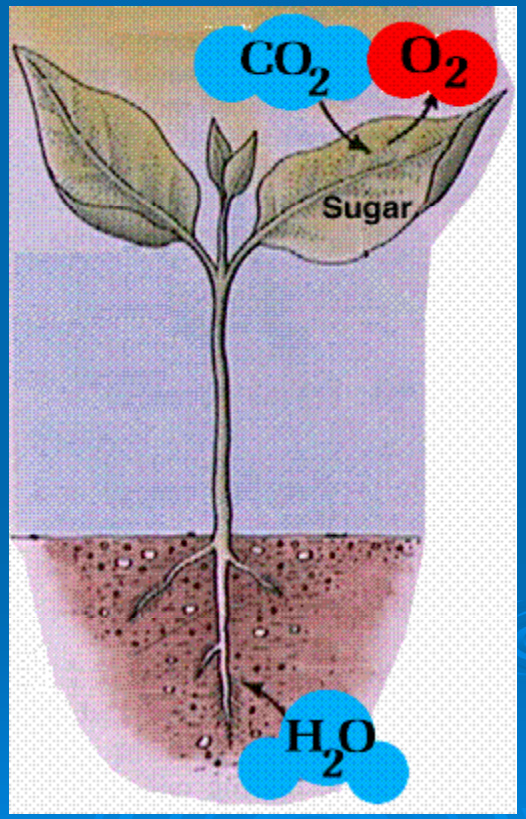


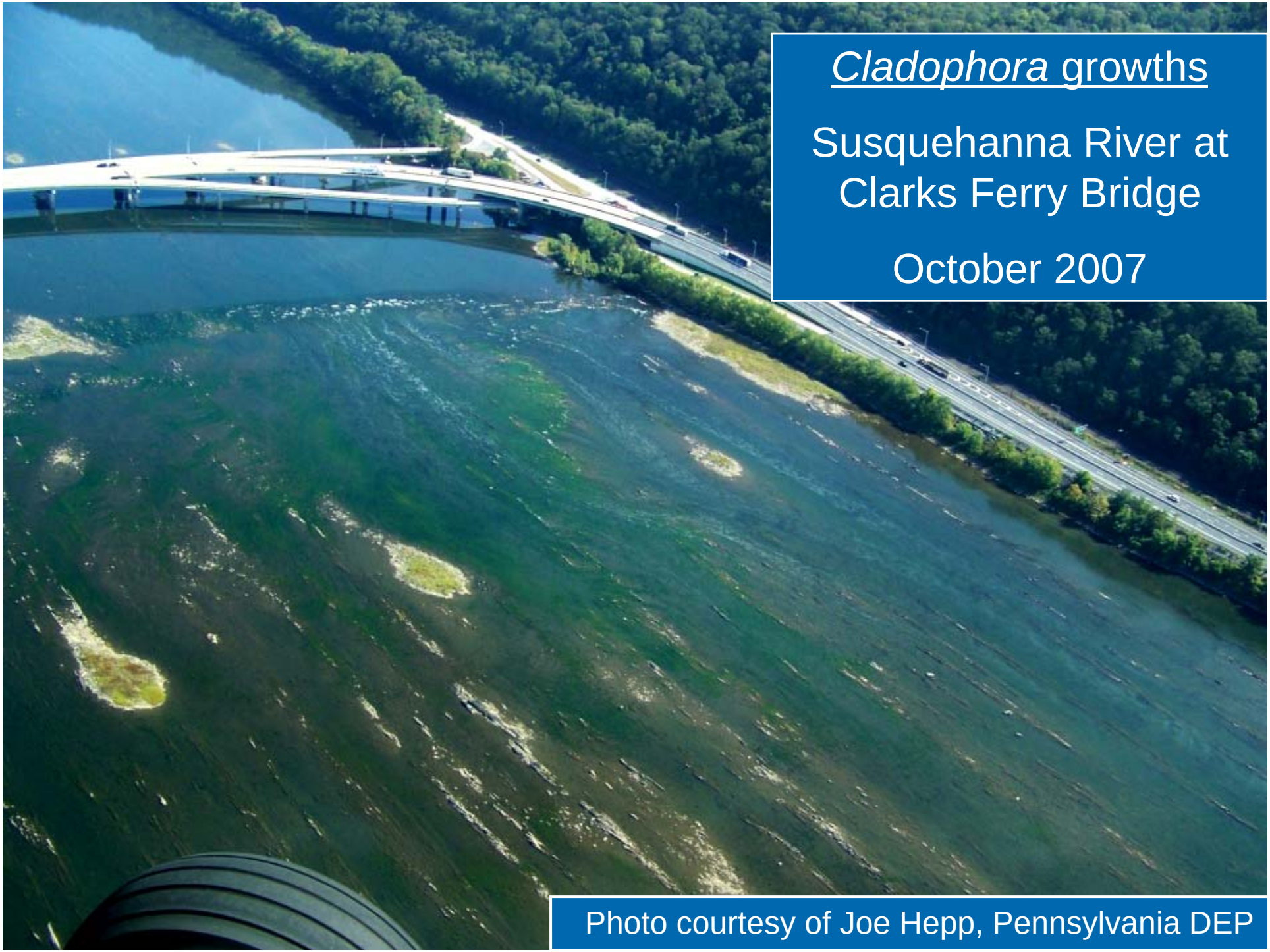
The ability of water to hold oxygen is inversely related to the temperature of the water



# Photosynthesis

- Green plants (including algae in a river) conduct photosynthesis.
- Photosynthesis is a chemical process that plants use to build body material.
- The process of photosynthesis produces oxygen as a by-product.




*Cladophora* growths
Susquehanna River at Clarks Ferry Bridge
October 2007
Photo courtesy of Joe Hepp, Pennsylvania DEP

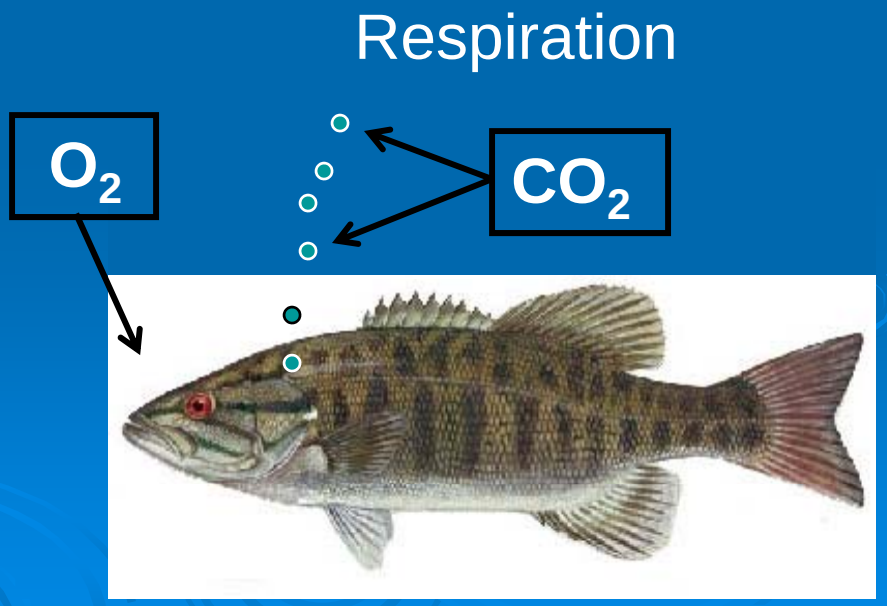
# Photosynthesis

Light energy is needed to drive the chemical reaction.

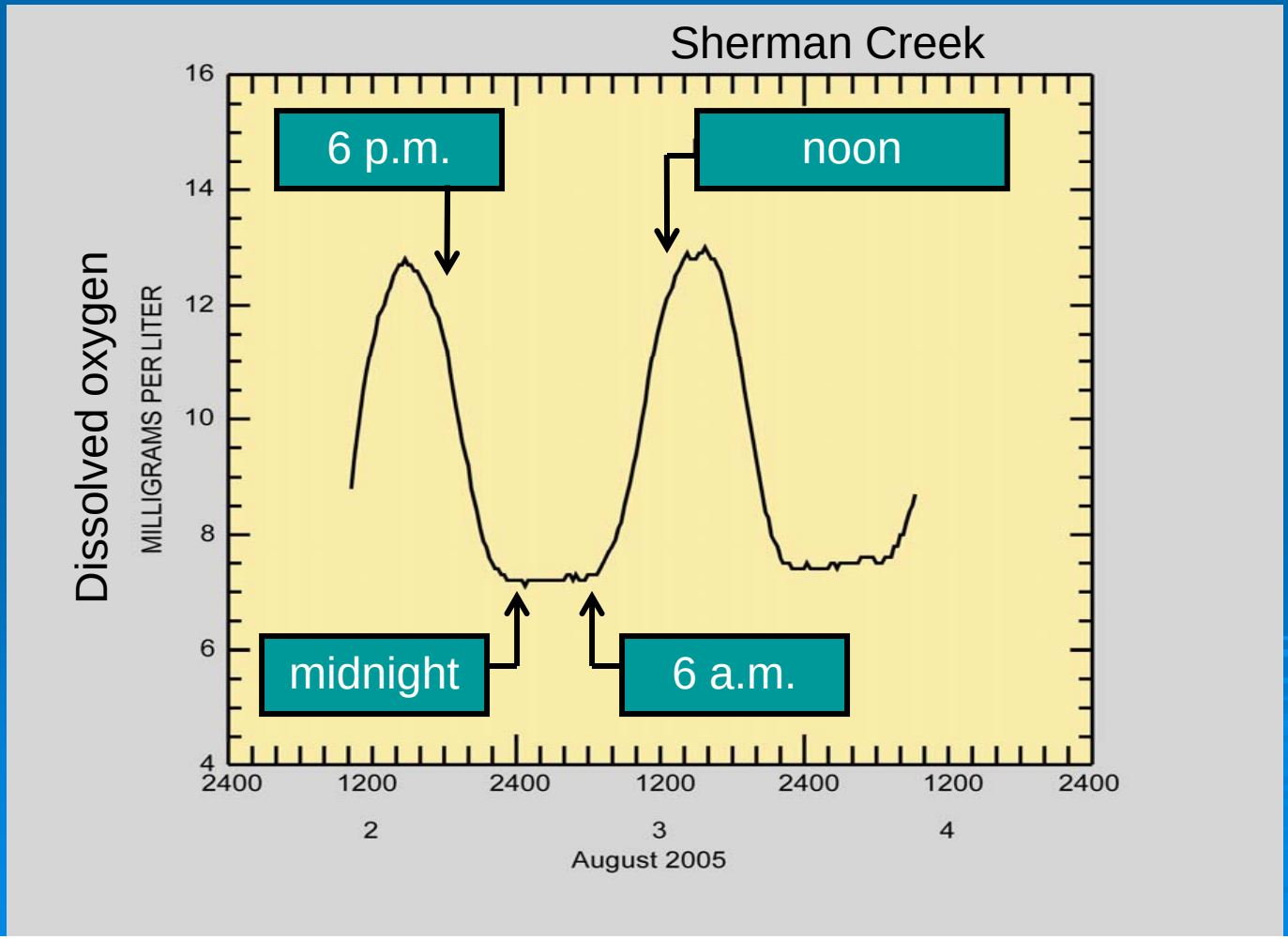
Photosynthesis happens only during the day.

# Respiration

- Respiration is the process by which chemical energy is released from food.
- Respiration occurs in plants and animals.
- Respiration consumes oxygen and releases carbon dioxide.
- Respiration occurs all the time, both day and night.



# The combination of photosynthesis and respiration produces a daily swing of dissolved oxygen in a water body



# Pennsylvania Water-Quality Standard for Dissolved Oxygen

Minimum of 4.0 milligrams per liter
for the protection of warm water fishes

( Currently under review )

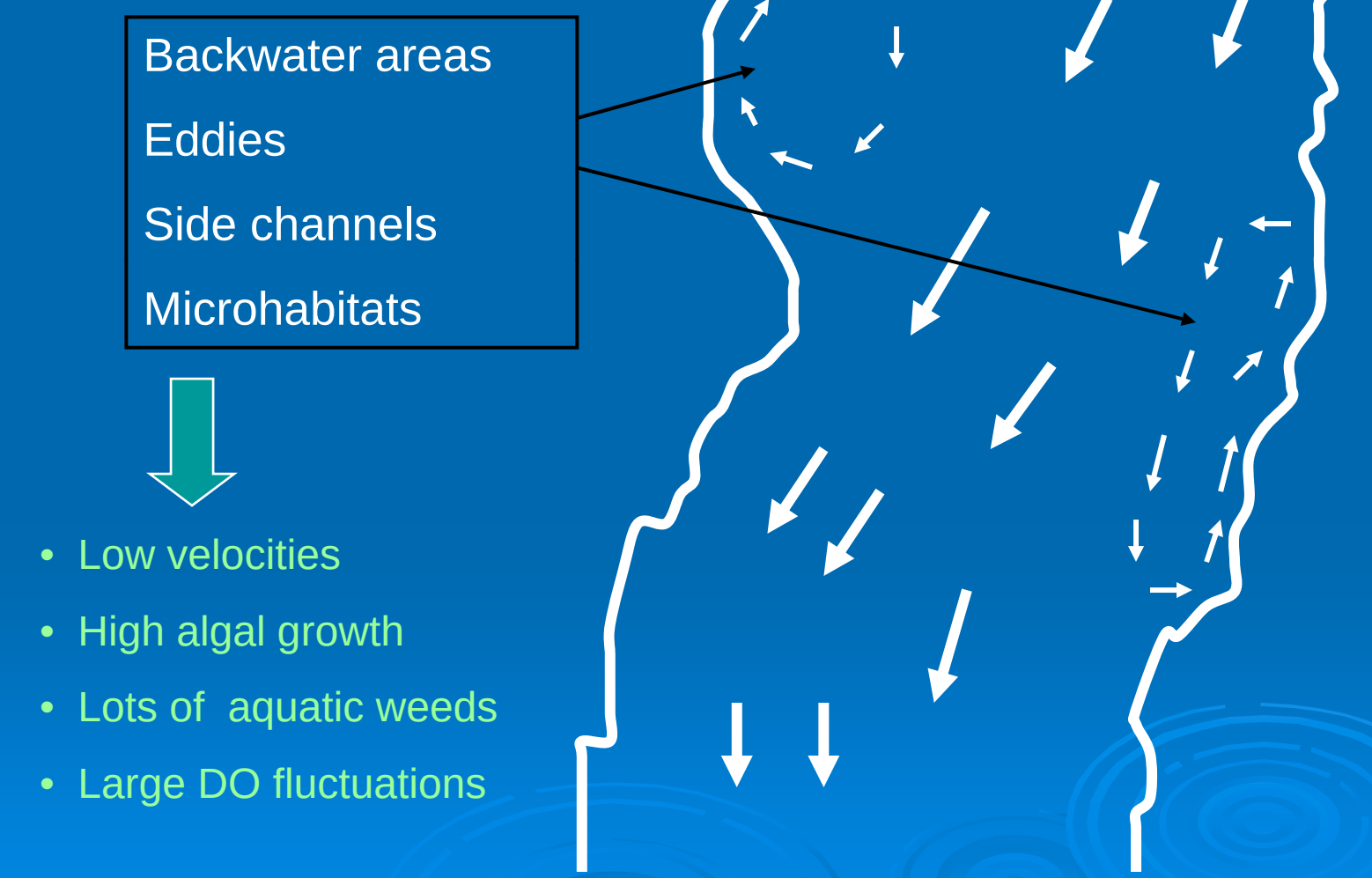
# Fish Kills –The Theory

Backwater areas

Eddies

Side channels

Microhabitats



- Low velocities
- High algal growth
- Lots of  aquatic weeds
- Large DO fluctuations

# Hypotheses

- Summertime temperatures and dissolved-oxygen concentrations in microhabitats of the Susquehanna River are stressful to YOY SMB
- Stressful conditions pre-dispose YOY SMB to colonization by columnaris bacteria

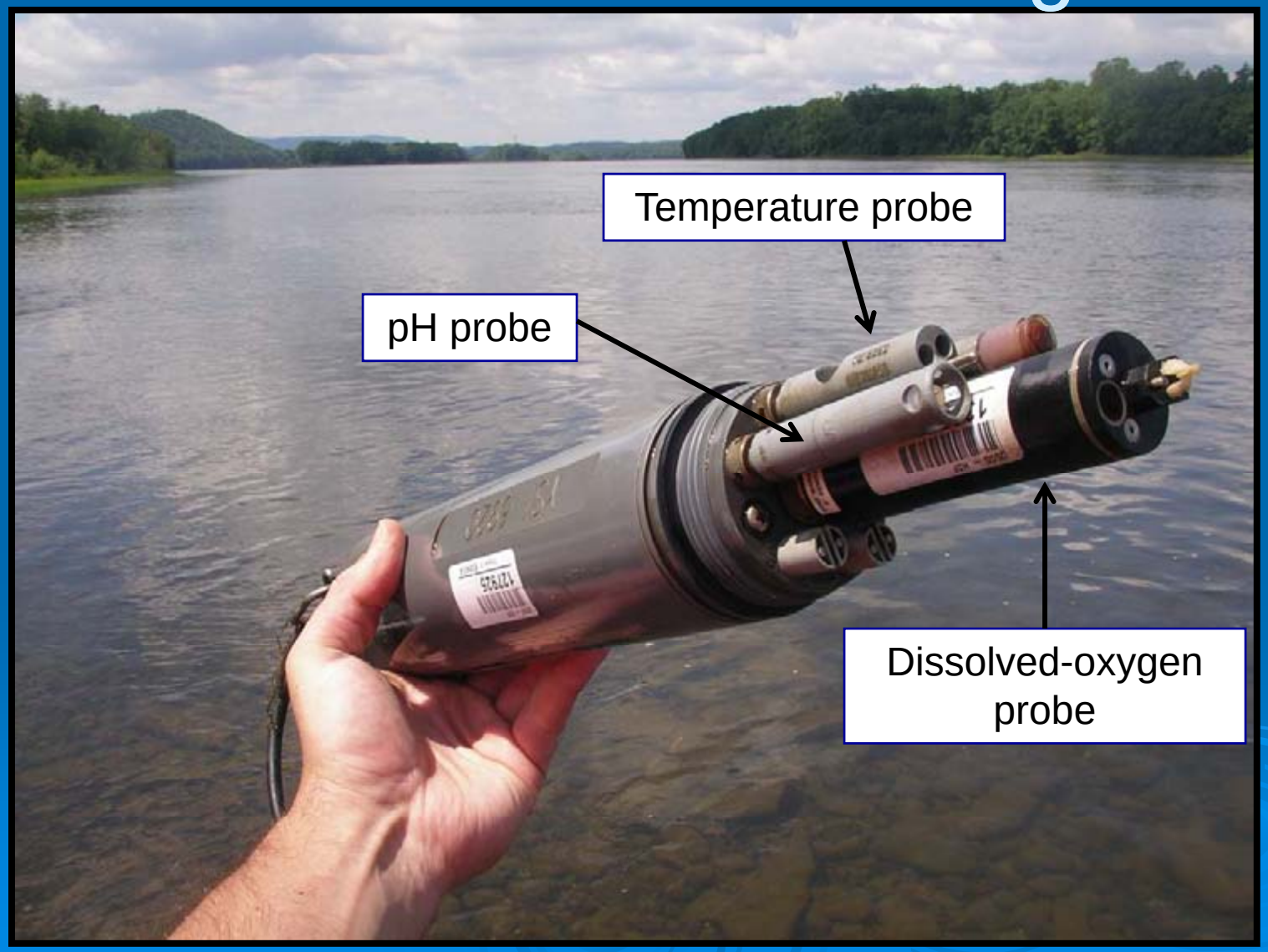
# Study in 2008:

Collect information to:
either support or refute our hypothesis

1. Continuous dissolved-oxygen monitoring
2. Comparisons of dissolved oxygen and temperature in Susquehanna River with Delaware River, Allegheny River
3. Compare main-channel sites with backwater sites
4. Nutrient survey in Susquehanna River main stem and major tributaries

Jeff Chaplin will describe the study results

# Study in 2008: Continuous Monitoring



# Study in 2008: River Comparisons

Susquehanna River at Dauphin, Pa

Photo courtesy of Kris Wolpert , Blue Mountain Outfitters

Delaware River

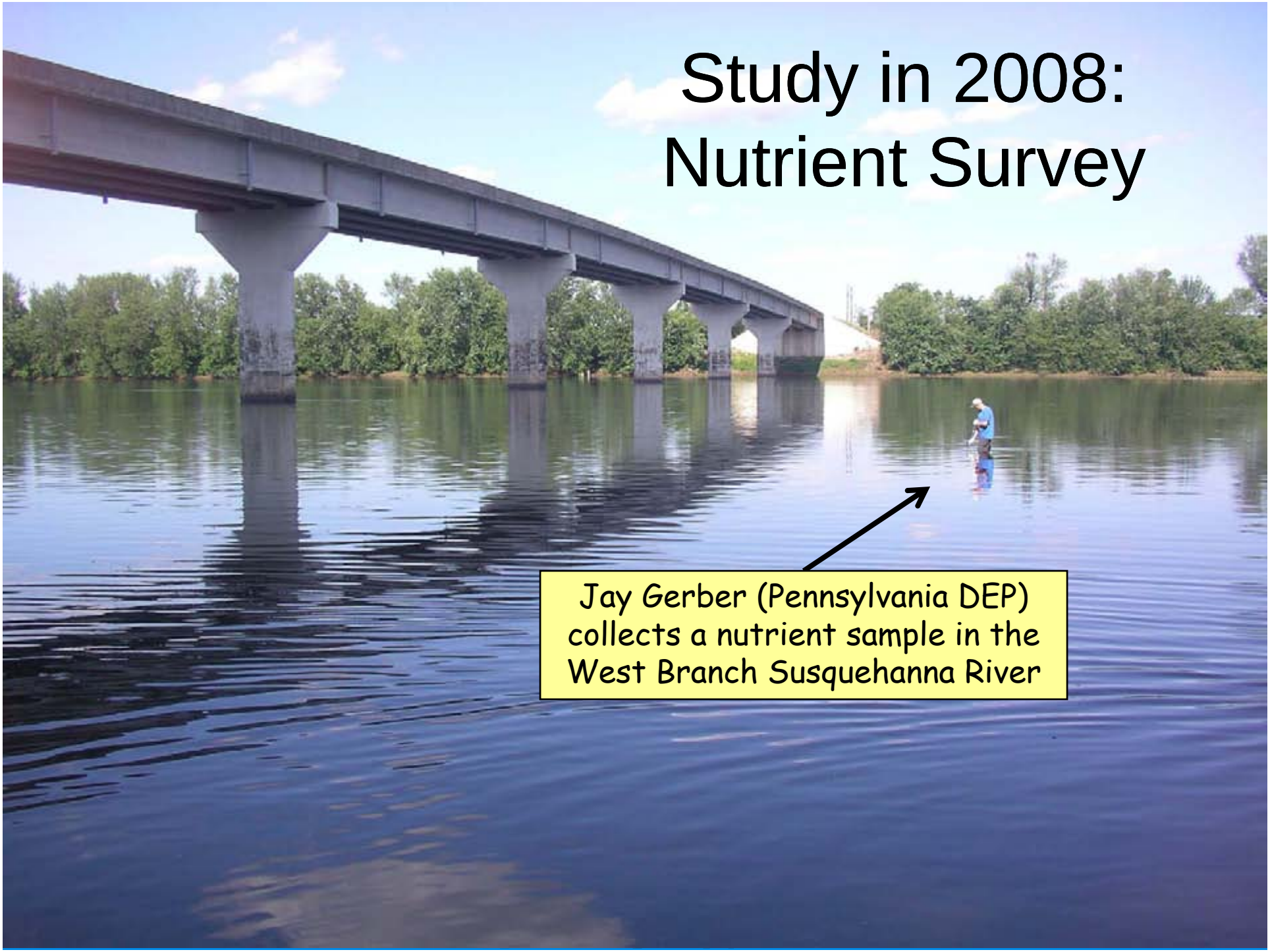
Photo by Jen Lavery, courtesy of the Pennsylvania Sierra Club

# Study in 2008: Main Channel Versus Backwater

Juniata River
Main Channel

Juniata River
Backwater Area

# Study in 2008: Nutrient Survey



Jay Gerber (Pennsylvania DEP) collects a nutrient sample in the West Branch Susquehanna River

# Collaboration

Pennsylvania Fish and Boat Commission

Pennsylvania Department of Environmental Protection

Pennsylvania Power and Light

Pennsylvania Bass Federation

# End

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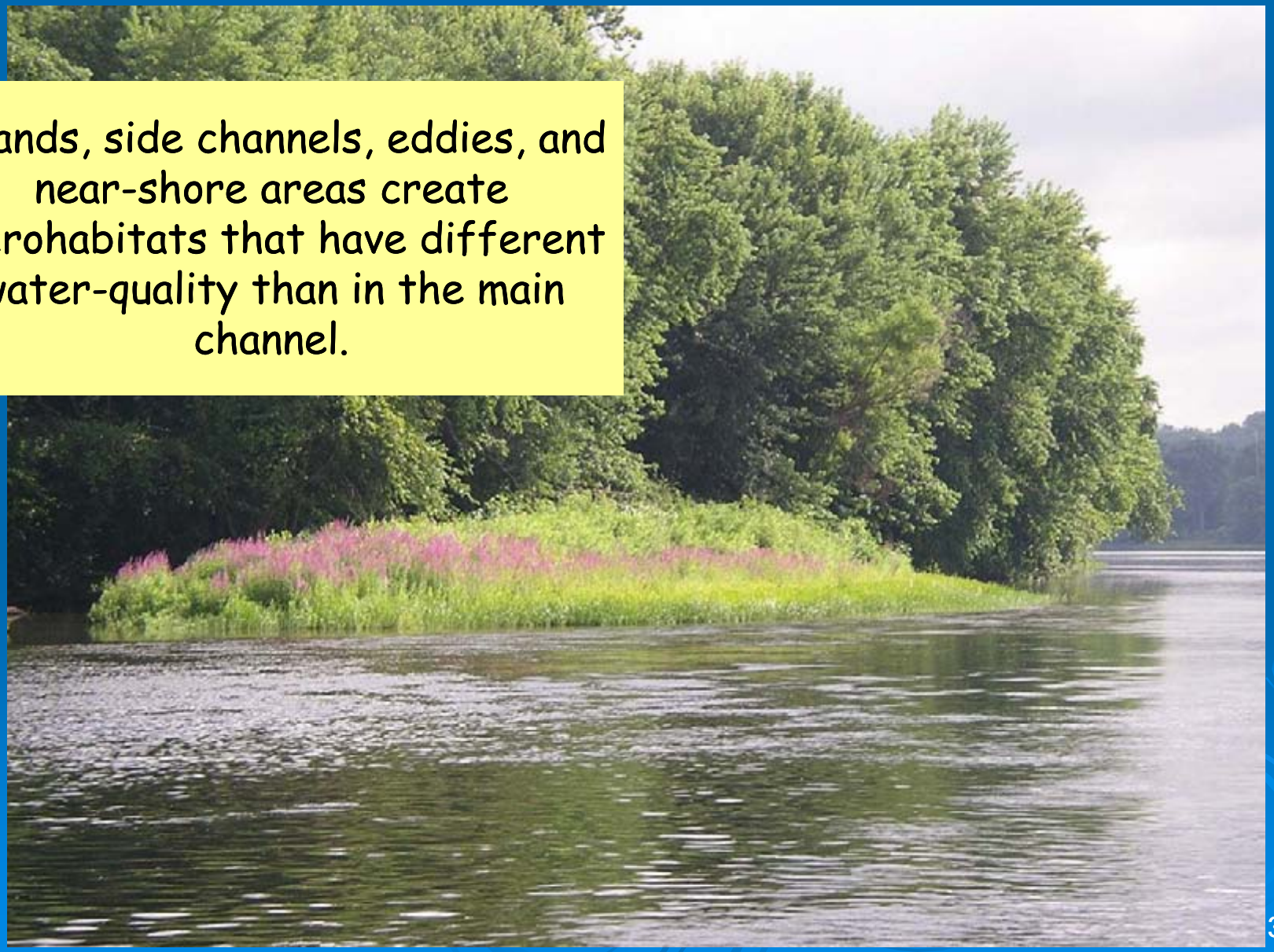
# Topics for this Talk

- Overview of the problem
- Background information
- Our hypothesis
- Overview of 2008 study


Monitor installation

# Compare Main Channel Sites with Backwater Sites

Islands, side channels, eddies, and near-shore areas create microhabitats that have different water-quality than in the main channel.



# Installation at Ungaged Locations (May – June, 2008)

Backwater Microhabitat (Howe Twp.)

# Nutrient Synoptic Sampling
# June 11-12, 2008


# Some Things We Don't Know

1. What's causing the *F. columnare* infections?
2. Where does 2008 rank?
3. Are DO and temperature different in years with SMB mortality than in years with no mortality?
4. Why was there only minimal *Cladophora* growth in 2008?
5. Is *Cladophora* related to the SMB mortality?
6. What were nutrient concentrations like at the beginning of the growing season?
7. Is the first low-flow period in late spring the critical time for DO concentrations?
8. What is the role of temperature in causing stressful conditions?
9. Which is most important, DO concentrations or DO fluctuations?
10. Does the duration of low dissolved-oxygen concentrations play a role?
11. Do pH swings contribute to stressful conditions?
12. Are other factors involved?

# Sonde Servicing

Field cleaning -- weekly

Field calibration -- weekly