



# Factors affecting smallmouth bass populations in the Susquehanna River

*Susquehanna River Clean-up Campaign*

*December 11, 2012*

**Mission:** To protect, conserve, and enhance the Commonwealth's aquatic resources and provide fishing and boating opportunities

# Issues of concern

- **Concerns over decline of the smallmouth bass fishery**
  - **Disease in YOY smallmouth bass**
    - **Water quality concerns**
      - **Nutrient-related issues**
        - **Low dissolved oxygen**
        - **High pH**
      - **Endocrine disruption**
- **Ramifications of these declines**
- **Call for action**



# Historical significance

- Widely considered one of the best smallmouth bass destinations in the country
  - In 2005, Bassmaster Magazine listed as one of top 5 rivers
- American Rivers listed as the *America's Most Endangered River* in 2005 (nutrients) and 2011 (Marcellus)



Photo: A. Shiels



# Onset of disease outbreaks

- **First appeared in 2005**
- **West Branch Susquehanna, Susquehanna, and Juniata rivers**
- **Affected young-of-year (YOY) smallmouth bass**
- **Disease prevalence as high as 70%**



Photo: J. Cukjati - USGS PA Water Sci. Center



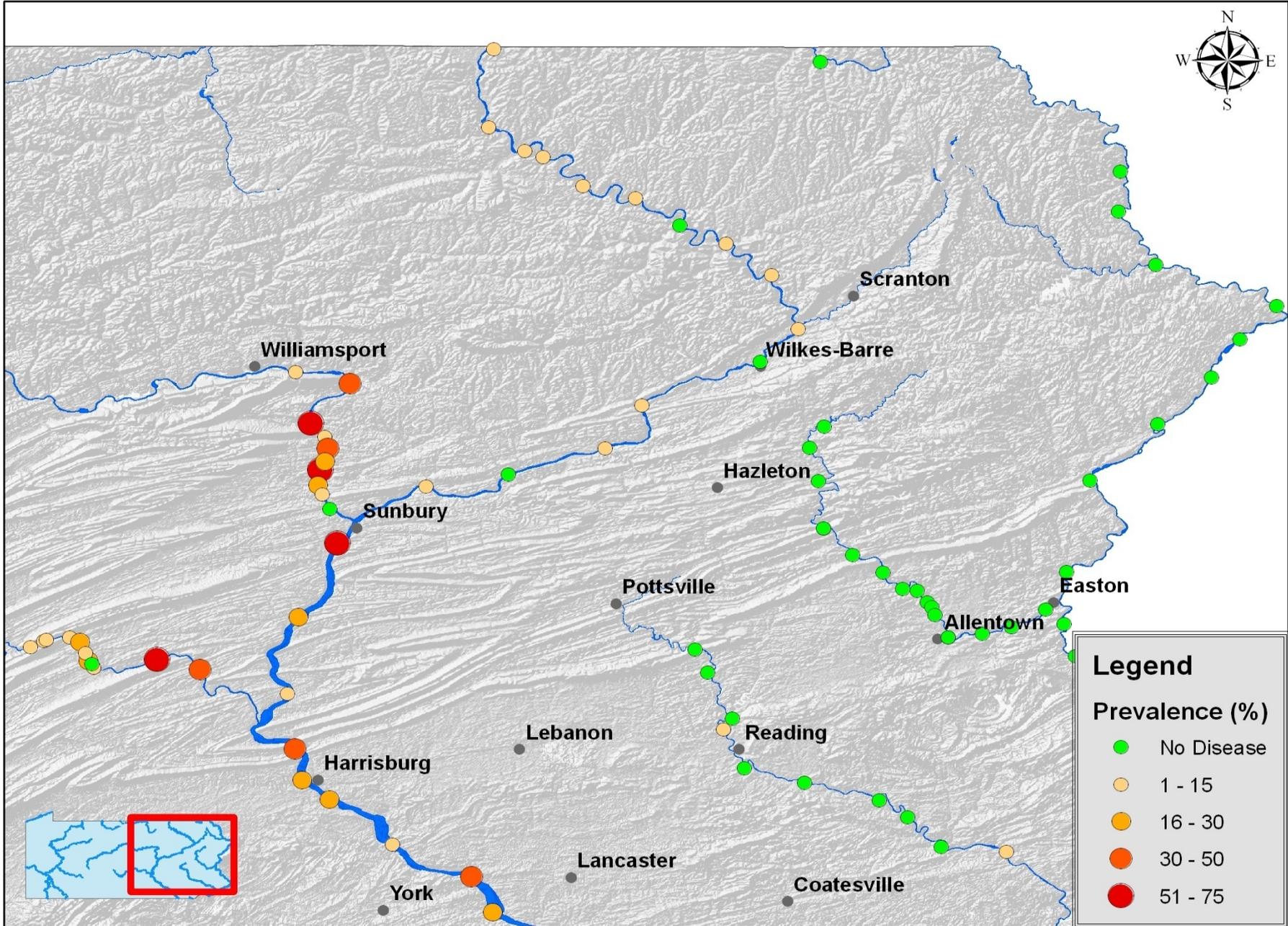
# Onset of disease outbreak

- **Varies temporally and spatially**
- **Most prevalent during years with high water temperature**
- **First documented in tributaries in 2010**
- **First documented outside of Susquehanna Basin in 2011**
  - **Still awaiting pathological confirmation**



Photo: J. Chaplin - USGS PA Water Sci. Center





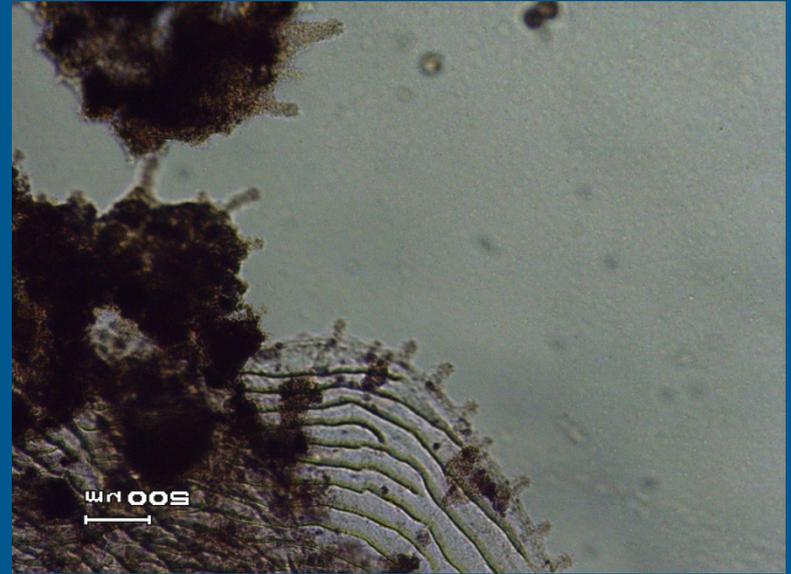
**Legend**

**Prevalence (%)**

- No Disease
- 1 - 15
- 16 - 30
- 30 - 50
- 51 - 75

# Initial diagnosis

- Bacterial infections by *Flavobacterium columnare* or “columnaris”
  - A common bacteria found in soil and water
- So why now?



Photos: K. Stark – PFBC retired



# Initial hypothesis

- Stressful water quality conditions are compromising immune systems and allowing bacterial infection
- Why only one life stage of one species?
  - Conditions were most severe in the habitats they reside in at that life stage



# Water quality

- Paired main channel and microhabitat study conducted by USGS (2008 – 2010)
  - dissolved oxygen
  - pH
  - specific conductance
  - temperature



Photo: J. Chaplin - USGS PA Water Sci. Center



# Susquehanna River at Clemson Island (near New Buffalo, PA)



Figure: J Chaplin – USGS PA Water Sci. Center

# Susquehanna River at Clemson Island (near New Buffalo, PA)

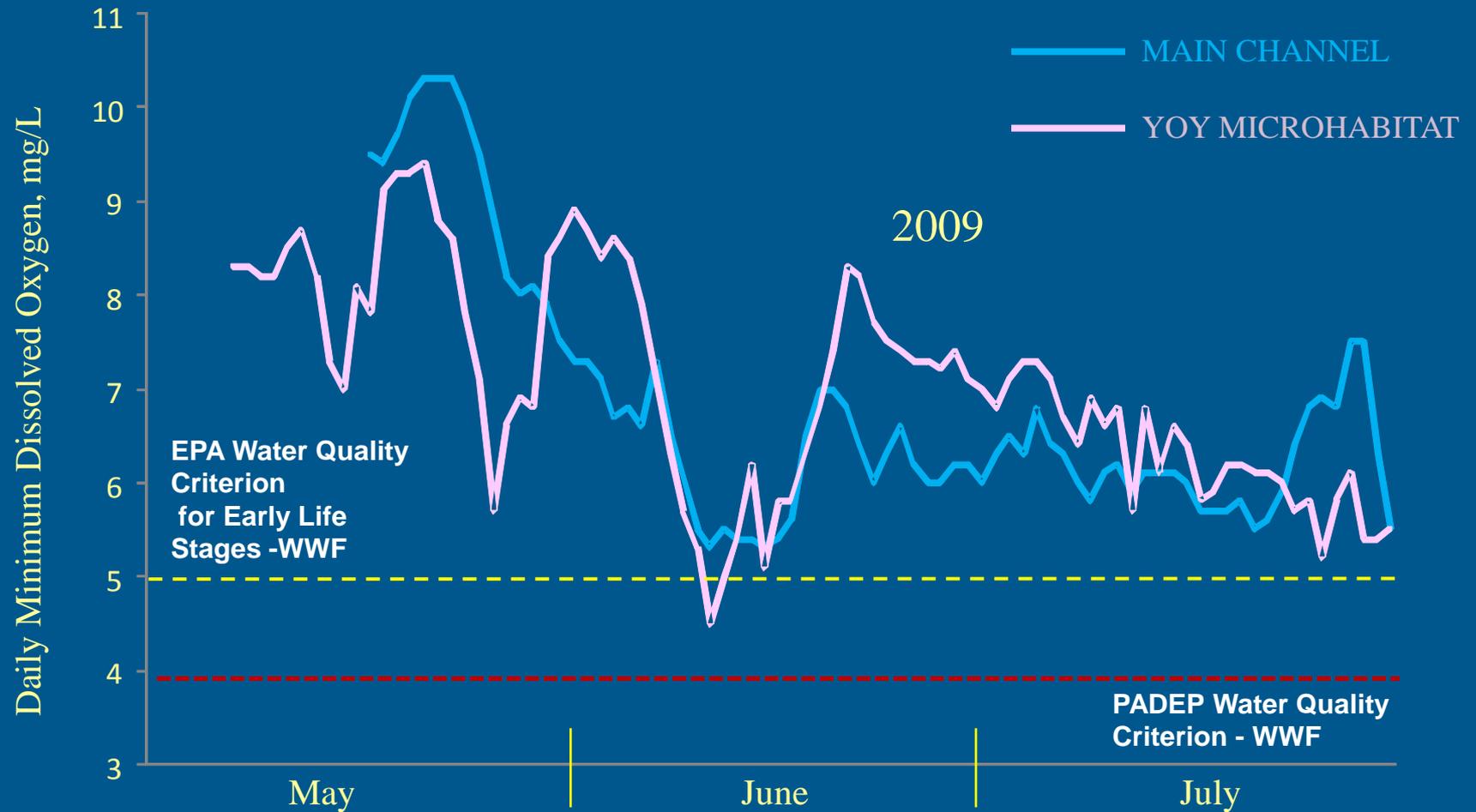


Figure: J Chaplin – USGS PA Water Sci. Center

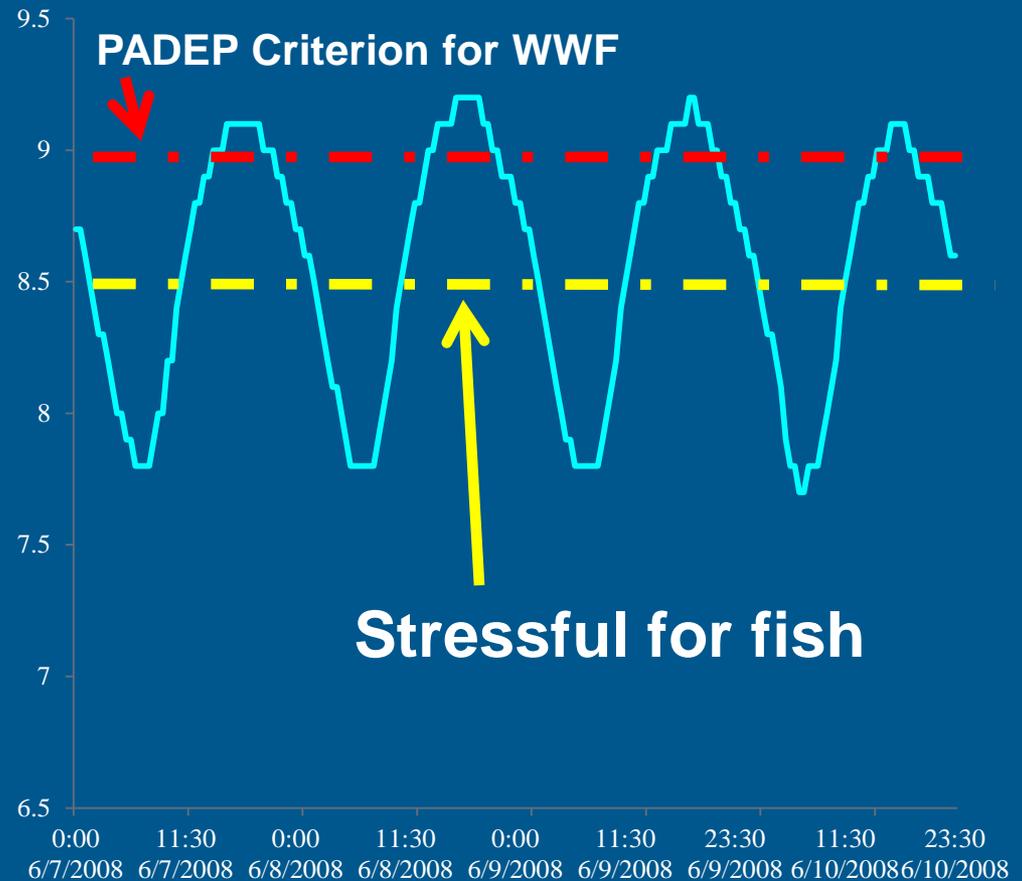
# Why low DO?

- **Respiratory demand by aquatic plants**
  - **Coincident with longest photoperiod of the year and warmest water temperatures**
  - **Saturation values also the lowest**



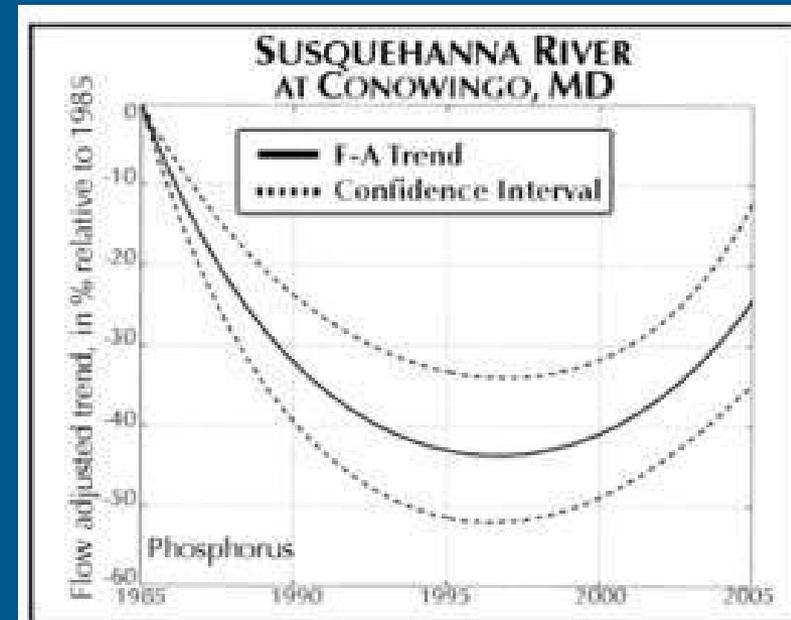
# High pH

- A product of excessive photosynthesis
  - Wide daily variation
  - Stressful max values
    - Affects osmoregulatory function of fish
  - Many metals and other contaminants become soluble again



# Why increases in algal productivity?

- Recent increases in dissolved phosphorus
  - Despite decreases in total phosphorus
- Limiting and most easily usable nutrient for aquatic plants
- Different from other nutrients
  - Constant input even during low flow periods



# Evidence of contaminants

- **Endocrine disruption**
  - **Frequent and severe cases of intersex**
    - **As high as 90-100%**
  - **High concentrations of vitellogenin in adult males**

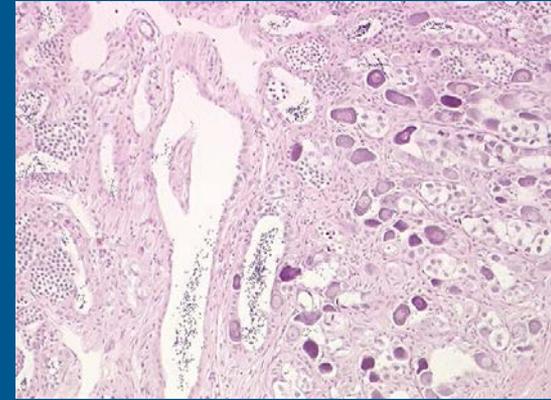


Photo: V. Blazer – USGS National Fish Health Research Lab



# Evidence of contaminants

- **Endocrine disruption**
  - 15 PCB congeners
  - 13 flame retardant compounds
  - 2 personal care products (triclosan)
  - 14 organochlorine pesticides
  - 9 other pesticides



# *“Blotchy Bass” syndrome*

- Frequently observed by anglers this spring
- Picked up by local media outlets
- Questions and concerns to PFBC and legislators



*Angler submitted photos*

# "Blotchy Bass" syndrome

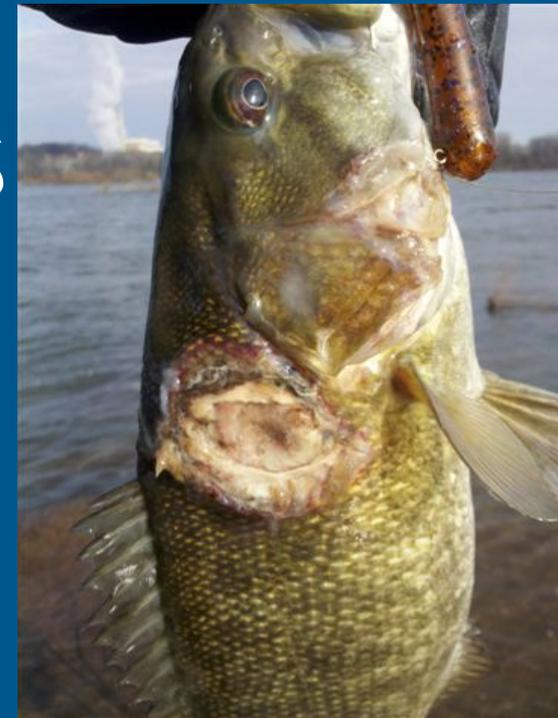
- **What we know**

- **Melanocytes and melanosomes in the dermis and epidermis of the fish.**
- **Melanin is under control of the endocrine (hormone) system**
- **All fish observed in cold weather but apparently healthy**
- **Observed at numerous locations in PA in the past and during 2012**
- **Not definitively water-quality related in previous studies**



# Gross Lesions in adults

- **Began Autumn - Winter 2012 in lower Susquehanna River**
  - **Between York Haven and Safe Harbor**
- **Submitted one fish for analysis in June 2012**
- **Was limited in Autumn 2012 collections**

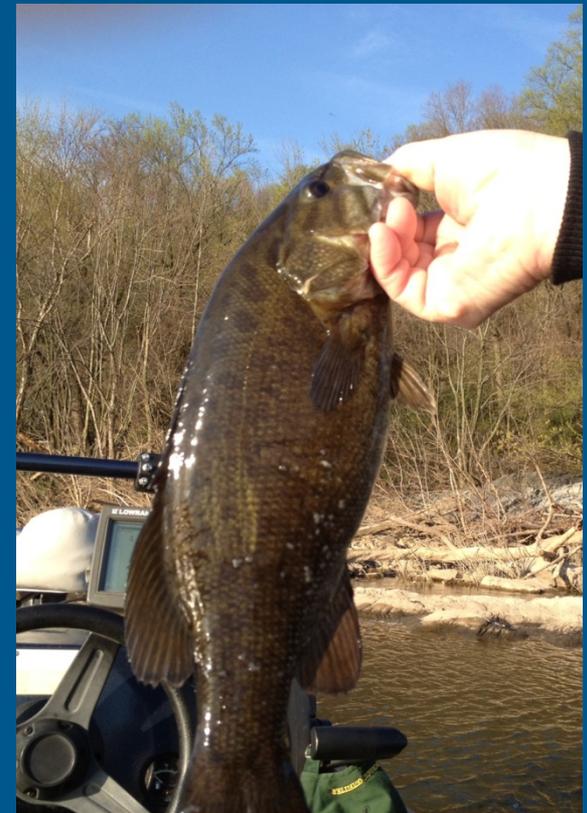


*Angler provided photo*



# Papillomas

- **Very small number of fish since March 2012**
  - **Small, gray lesions**
- **Been documented in number of fish species**
- **Related to water quality or virus**
  - **Industrial/ sewage effluent**
- **More analysis is needed**



*Angler provided photo*



# The “Perfect Storm” is occurring

- **Stressful water quality**
  - **Temperature**
  - **Nutrients**
    - **Dissolved oxygen**
    - **pH**
  - **Contaminants**
- **Bacteria**
- **Viruses**
- **Parasites**



Photo: J. Tryniewski - PFBC

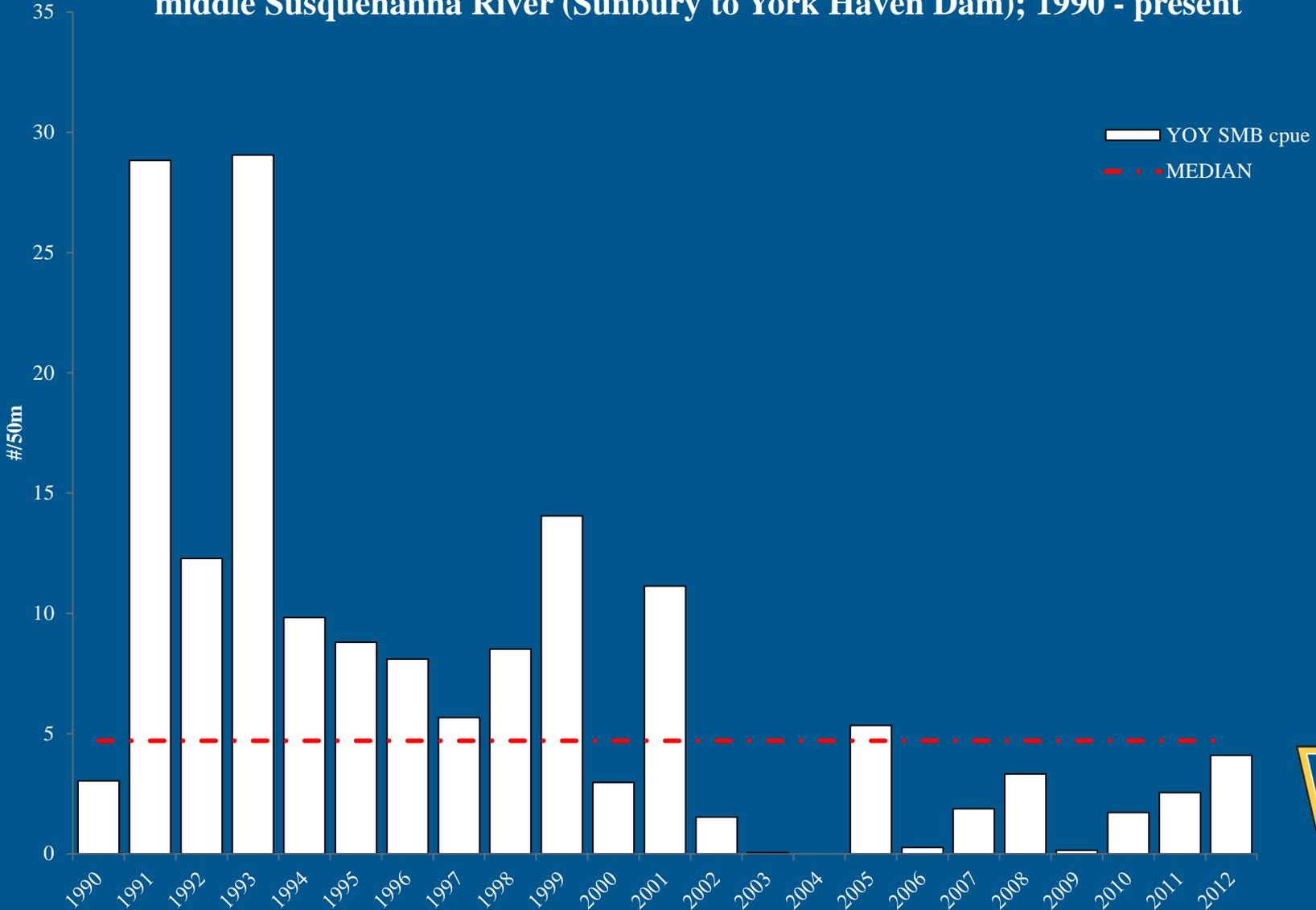


# What do we know?

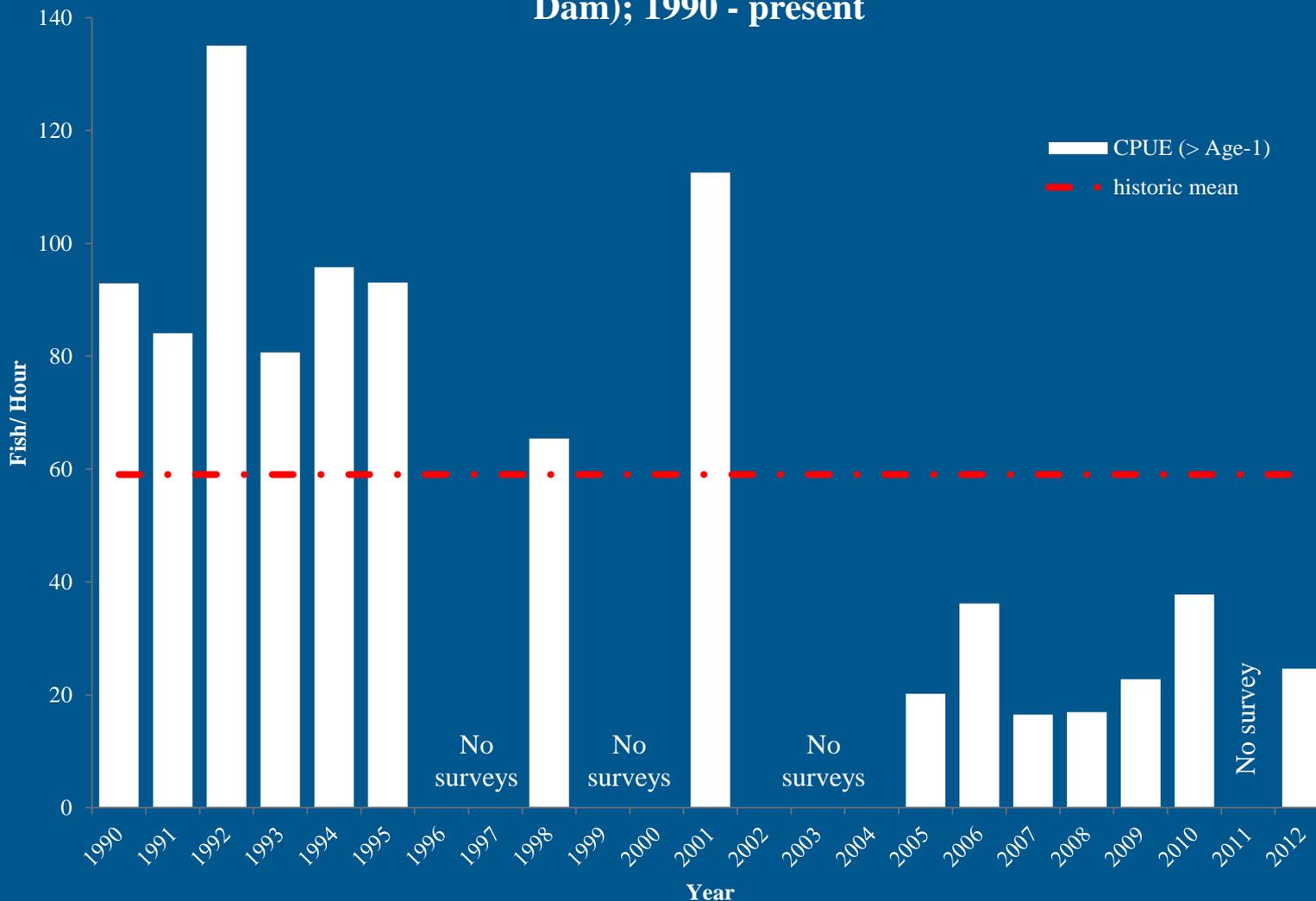
- **Several factors seem to be driving the condition**
- **No single factor seems to be responsible**
  - **Changing the paradigm of fish mortality events**
- **Appears to be expanding in range**



# Catch rate of young-of-year smallmouth bass *Micropterus dolomieu* at the middle Susquehanna River (Sunbury to York Haven Dam); 1990 - present



## Catch per unit effort (CPUE) of adult smallmouth bass *Micropterus dolomieu* at the middle Susquehanna River (Sunbury to York Haven Dam); 1990 - present



# Reason for urgency

- Takes 5 - 6 years to reach 15" (legal-length)
- Each poor year class translates to poor fishery 5 or 6 years later.



# Big business

- **Fishing and Boating are big business in Pennsylvania**
  - \$3.4 billion to PA economy, annually
  - 18,000 jobs
  - \$120 million in state and local tax revenue, annually
- **Major recreational resource**
  - **Susquehanna River smallmouth bass (2007)**
    - Nearly 69,000 trips (April – October)
    - 286,144 hours



Photo: J. Raymond



# Big Business

- Major recreational resource
  - Nationally, black bass most popular game fish species (USFWS 2006)
  - Black bass second to trout in terms of total anglers and days spent angling in Pennsylvania (both residents and non-residents; USFWS 2006)



Photo: Chad Foster



# Public outcry

- Numerous public meeting over the last several years
  - Approximately 1,000 attendees
  - Hundreds of comment letters



Photo: PFBC Archives



# Public outcry

- **Press coverage**
  - **Newspaper articles, Editorials, Op-Eds**
    - **Numerous local articles (Harrisburg, Sunbury, Lancaster, Williamsport)**
    - **Baltimore Sun**
  - **Magazine articles**
    - **Mid Atlantic Fly Fishing Guide**
    - **Outdoor News**
    - **Flyfishing magazine**
    - **Outdoor America**
  - **Television programs and radio stories/ programs**
  - **Countless blogs and web forums**



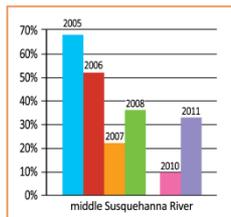
# B.A.S.S. TIMES



Photo: Bob Rosemond

Many of you have hopefully heard by now about the problems that plague the smallmouth bass and the Susquehanna River. It is very frustrating to me as you director to sit in my office in Harrisburg knowing that the river, at the very footstep of the capital city of our Commonwealth, is in very serious trouble. Even more frustrating is the fact that those who are in the position something about it won't even admit that there is a problem. I will confess that if one doesn't fish or hasn't had the chance to enjoy the river when it supported a world-class fishery, it may be difficult to understand the changes that have occurred. You can drive over any bridge to the city and the river looks the same as it did decades ago. However, to understand the issues, one has to look below the surface of the water to see the change.

Frankly, my agency may also be at fault for not recognizing the problem earlier. Anglers who fished the Juniata and Susquehanna rivers from Sunbury to Maryland told me 20 years ago that rock bass and redbreast sunfish were disappearing.



Prevalence of disease among young-of-year smallmouth bass *Micropterus dolomieu* since discovery in 2005 at different sites at the middle Susquehanna River (Sunbury to York Haven Dam).

In response, we lowered the daily limit for rock bass on the Juniata River and the Susquehanna River to 50 per day, and we still have a daily limit. This seemed to be the angle of the complaint and we're looking for reasons why the population was occu-



lem. It doesn't seem like a complicated decision to me since our data show that the world-class smallmouth bass fishery has collapsed due to disease and is in danger of extinction. Sick fish mean a sick river. This condition is called ecological impairment.

The decline of the smallmouth bass population has led to a decline in fishing which is termed recreational use impairment. However, there are others in positions of authority in state government that disagree. It is my job to convince them that the river is in trouble and we need to act now before it is too late. I don't want to be the Director of the Fish and Boat Commission when the last bass is caught in the river!

The public response to our call for help has been impressive. However, I want to tell you about one person who has gone above and beyond expectations. Her name is Grace Lustig, an 8 year old from Biglerville. Grace has written an article in her local newspaper, published an opinion article in the Harrisburg Patriot and started an online petition to designate the river as impaired which has 418 signatures as of June 6th.

I believe that it may be time that we step back from the politics, the economics and the social issues and look at this issue through the eyes of a child. After all, Xander and Grace may be in the best position to advise us all about the real issues we face since they will be the ones most affected by the results of our decision.

# Policy-level activity

- **Legislator complaints from constituents**
- **Presentations to House and Senate Game and Fisheries Committees**
- **Emergency Action to change regulations to immediate catch-and-release and no fishing during the spawn**
- **Formal regulation changes**
- **Request for PADEP impairment**



Photo: S. Gearhart - PFBC



# Request for PA DEP Impairment

- Submitted data and letter to PADEP requesting listing in the *Integrated Water Quality Monitoring and Assessment Report* as an impaired water
  - Violates minimum daily DO and pH for WWF
    - Exceeds minimum daily DO (4 mg/L) criterion
      - Susquehanna at Clemson Island (microhabitat; 1.9% of records)
    - Exceeds pH (6.0 – 9.0, inclusive) criterion
      - Susquehanna River at Harrisburg (1.22% of records)
      - Susquehanna River at Clemson Island (4.28% of records)
  - Signatories include PennFuture, Trout Unlimited (PA), Chesapeake Bay Foundation, and American Rivers



# Request for PADEP Impairment

- **Draft Report does not include Susquehanna River**
  - Resubmitted data
  - Prepared comment letter
  - Requested public support



Photo: M. Hendricks



# Request for PADEP Impairment

- **What impairment means**
  - **Identify sources and causes of exceeded criteria**
  - **Development of a TMDL**
    - **A pollution “diet” to remediate the conditions**
    - **Prescription for Susquehanna River different from Chesapeake Bay**



# Summary

- 1. Declines in smallmouth bass population**
  - Loss of multiple year-classes because of disease-related mortality
- 2. Identified water quality issues**
  - Nutrient-related issues
    - Increased algal productivity
      - Low Dissolved Oxygen
      - High pH
  - Endocrine disruption
- 3. Economic and recreational importance of fishery**
- 4. Need for action**



# Acknowledgements

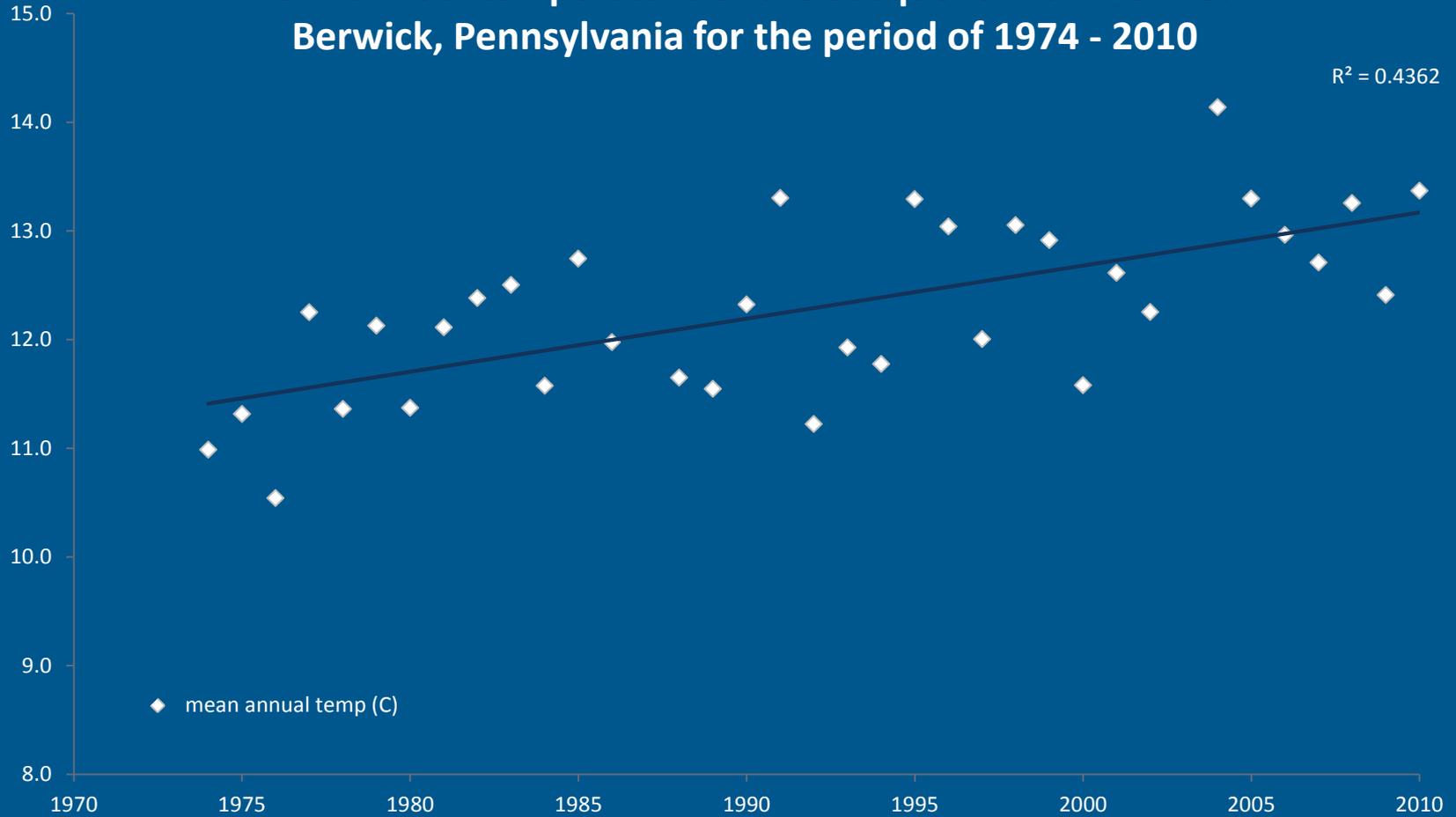
- **USGS Leetown Science Center, National Fish Health Research Laboratory**
  - Vicki Blazer
  - Luke Iwanowicz
  - Heather Ellery
- **USGS PA Water Science Center**
  - Jeff Chaplin
- **PFBC Staff**
- **U.S. Fish and Wildlife Service, Northeast Fishery Center**
- **Susquehanna River Technical and Policy Committees**



# Questions?



# Mean annual temperature of the Susquehanna River near Berwick, Pennsylvania for the period of 1974 - 2010



$R^2 = 0.4362$

◆ mean annual temp (C)



