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May 21, 2012

Molly Pulket
Division of Water Quality Standards
Bureau of Point and Non-Point Source Management
Pennsylvania Department of Environmental Protection
PO Box 8774
Harrisburg, PA 17105-8774

Re: Draft 2012 Pennsylvania Integrated Water Quality Monitoring and Assessment Report

Dear Ms. Pulket:

The Pennsylvania Fish and Boat Commission (PFBC) is concerned that the Susquehanna River was not listed by the Pennsylvania Department of Environmental Protection (DEP) to be an impaired and threatened water in the recently published *Draft 2012 Pennsylvania Integrated Water Quality Monitoring and Assessment Report.* We request that the DEP reconsider your assessment and list the Susquehanna River from the confluence of the West Branch Susquehanna River downstream to the Holtwood Dam as impaired and threatened. The basis for this request is summarized in the following discussion.

Water Quality Standards and Protected Water Uses

Water Quality Standards (WQS) are the combination of water uses to be protected, the criteria (i.e., levels of substances) that need to be maintained or attained to support the uses, and an antidegradation policy. WQS are important elements of Pennsylvania's water quality management program because they set the general and specific goals for the quality of our waters. WQS are instream water quality goals that are implemented by imposing specific regulatory standards, such as treatment requirements and effluent limitations on individual sources of pollution and best management practices on nonpoint sources (2012 Draft Pennsylvania Integrated Water Quality Monitoring and Assessment Report, Clean Water Act Section 305(b) and 303(d) List, PA DEP, 2012).

The Susquehanna River's aquatic life protected use is Warm Water Fishes which is defined as the maintenance and propagation of fish species and additional flora and fauna which are indigenous to a warm water habitat (25 PA Code §93.3. Protected Uses). Pennsylvania's General Water Quality Criteria (25 PA Code § 93.6.) states that: "Water may not contain substances attributable to point or non-point source discharges in concentration or amounts sufficient to be inimical or harmful to the water uses to be protected or to human, animal, plant or aquatic life. "

Beyond these general narrative criteria, there are many specific criteria intended to protect designated uses. PFBC staff and other state and federal agencies have provided data to the DEP staff that show exceedances of numerical water quality criteria that may negatively impact aquatic life uses. Both the minimum daily dissolved oxygen concentration and pH failed to meet the established criteria for the protected use of warm water fishes on more than one percent of the available records at Susquehanna River locations during the assessment period.

During initial consultation with DEP staff, it was reported that the pH values submitted for consideration (daily maximum values) were not used and as such not available for the analysis. Subsequent PFBC data analysis, including all available records (2008 - 2010, 30-minute measurements) from the U.S. Geological Survey sondes, found that the values exceeded the pH criterion in 1.22% and 4.28% of the records for the Susquehanna River at Harrisburg and the Susquehanna River at Clemson Island, respectively (data enclosed). This indicates that the pH is in violation of the criteria expressed in 25 Pa Code § 93.7 for protection of warm-water fisheries. High pH values are indicative of high and possibly excessive levels of primary productivity. We note that extraordinary noxious algal growth has been documented in the recent past on the river. A fly over of the river was done on October 4, 2007, as part of a creel survey that the PFBC was conducting at that time. Filamentous algae (identified as Cladophora) can be seen to fill the river in the photos taken in the area of McKees Half Falls to Clarks Ferry. These photos have been provided to DEP's technical staff in the past and they are aware of them by way of the Susquehanna River Technical Committee meetings. We can provide you with additional copies upon request.

Additionally, we have previously cited exceedances of the criterion for daily minimum dissolved oxygen (DO) concentration at the Susquehanna River at New Buffalo, PA in one of the near-shore locations used to track conditions in young-of-year (YOY) smallmouth bass habitats. We are pleased that the DEP has proposed increasing the current daily minimum dissolved oxygen concentration from 4.0 mg/L to 5.0 mg/L as part of the triennial review process. However, we note that increasing the criterion will result in more locations and greater frequency of exceedance of DO criteria if conditions remain unchanged (Table 1-2). These exceedances of DO water quality criteria designed to protect the warm water fishes use of the river, in our opinion, are sufficient evidence to reach the conclusion of impairment.

Table 1: Number and percentage of exceedances of daily minimum dissolved oxygen (DO) criterion (4.0 mg/L) and EPA-recommended daily minimum dissolved oxygen criterion (5.0 mg/L) protective of early life stages of warm-water fishes at the Susquehanna River in channel margin habitat at Clemson Island, New Buffalo, PA during 2008 and 2009.

	DO minima exceedance 4.0 mg/L	DO minima exceedance 5.0 mg/L	No. of measurements	% of exceedances 4.0 mg/L	% of exceedances 5.0 mg/L
2008	5	27	123	4.07	21.95
2009	0	1	147	0.00	0.68

Table 2: Number and percentage of exceedances of daily minimum dissolved oxygen (DO) criterion (4.0 mg/L) and EPA-recommended daily minimum dissolved oxygen criterion (5.0 mg/L) protective of early life stages of warm-water fishes at the Susquehanna River in main channel habitat at City Island, Harrisburg, PA during 2008 - 2010.

	DO minima exceedance 4.0 mg/L	DO minima exceedance 5.0 mg/L	No. of measurements	% of exceedances 4.0 mg/L	% of exceedances 5.0 mg/L
2008	0	4	143	0.00	2.80
2009	0	0	155	0.00	0.00
2010	0	20	146	0.00	13.70

A recent United States Geological Survey (USGS) report by Chaplin et al. 2009 was principally funded by the PFBC and concluded the following key points:

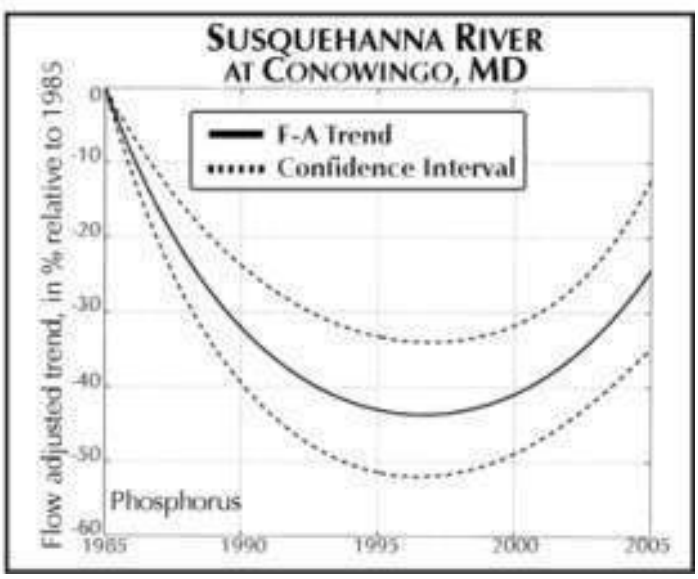
- **Smallmouth Bass Nursery microhabitats had lower oxygen than the main channel:**
    - Oxygen levels fell below the applicable national criterion (5.0 mg/L) for up to 8.5 hours on more than 30 percent of days at one nursery microhabitat, compared to no days in the nearby main-channel habitat.
    - Oxygen levels at a second nursery microhabitat fell below the criterion in about 20% of days, compared to only 6% in the nearby main channel.
- **Conditions in 2008 were more stressful than they were in the 1970's:**
    - In the Susquehanna River at Harrisburg, daily mean dissolved oxygen levels averaged 1.1 mg/L lower and daily mean water temperatures averaged 1.4°F warmer in 2008 compared to historical datasets from 1974 through 1979.

- **The Susquehanna had higher temperatures than nearby rivers in 2008:**

    - During the monitoring period of May through September, the average daily mean water temperature of the Susquehanna River at Harrisburg was 3.2 °F warmer than the Delaware River at Trenton, N.J., and 6.1°F warmer than the Allegheny River near Pittsburgh, PA

Nutrients

Increasing trends in dissolved phosphorus and ortho-phosphorus support the hypothesis that the DO declines measured by USGS in 2008 are being caused by excessive algal respiration at night in the microhabitats that are being used for nursery areas by YOY smallmouth bass. Phosphorus has been identified as the limiting nutrient for Cladophora, which was observed to blanket the river from east bank to west bank in certain areas during the fall of 2007 as mentioned above. To our knowledge, algae blooms of this nature and extent have never previously occurred on the river. Unfortunately, water quality was not being monitored during this event. Although this event did not coincide with the juvenile bass mortality we are seeing in the critical period (May 1 – July 31), it can be used as an example of another bioindicator as to how the river is changing. The following graph from USGS shows increasing trends of phosphorus since 1995 in the lower river.



The Chesapeake Bay Foundation (unpublished, 2006) reported the following:

"Overall, nutrient loads to the Chesapeake Bay from the 1980's through 2006 show a modest downward trend. However, if one looks at the data from the late 1990's to 2006 – the last eight or so years – the trend is decidedly upward. There are several oft-cited explanations: (1) these later years have been wetter than normal; and (2) there is a significant lag time, perhaps a decade or more, between the implementation of pollution reduction practices (sewage treatment plant upgrades, improved permit limits, agricultural BMPs) and pollution response in surface waters.

However, others have hypothesized that accelerating increases in urban development (and associated turf grass fertilization) and agricultural soils reaching phosphorus saturation in some watersheds, are indeed the main drivers for an upward trend in nutrient pollution."

Most concerning are the increasing trends in dissolved and ortho-phosphorus since these are the nutrient fractions that tend to drive algal growth in flowing waters like the Susquehanna River. The focus of the Chesapeake Bay TMDL has been on total nutrients, which determine the productivity of lentic waters like the Bay which act as a sink for these substances. Rivers typically transport the bulk of these nutrients which get deposited in the Bay for future use by noxious weeds and algae. However, a new phenomenon seems to be occurring in the river where long-term, lower doses of dissolved phosphorus are being delivered to the river on a rather constant basis which drives periphyton (attached algae) and water column algae populations to dangerous levels during critical time periods when juvenile smallmouth bass are in refuge areas along the river's edges.

The Susquehanna River Basin Commission reported this increased trend in dissolved ortho-phosphorus at 5 of the 7 sites in the Susquehanna River that were monitored in 2005 (McGonigal 2006).

Table 41. Summary of 2005 Flow-Adjusted Concentration Trends at All Sites

Parameter	Towanda	Danville	Lewisburg	Newport	Marietta	Conestoga
TN	IMPROVING	IMPROVING	IMPROVING	IMPROVING	IMPROVING	IMPROVING
*TN	IMPROVING	IMPROVING	IMPROVING	IMPROVING	IMPROVING	IMPROVING
DN	IMPROVING	IMPROVING	IMPROVING	NS	IMPROVING	NS
TON	IMPROVING	IMPROVING	IMPROVING	IMPROVING	IMPROVING	IMPROVING
DON	IMPROVING	IMPROVING	IMPROVING	IMPROVING	NS	NS
DNH_3	NS	IMPROVING	NS	IMPROVING	NS	IMPROVING
TNH_3	IMPROVING	BMDL	BMDL	BMDL	IMPROVING	IMPROVING
DKN	IMPROVING	IMPROVING	BMDL	BMDL	IMPROVING	IMPROVING
TKN	IMPROVING	IMPROVING	IMPROVING	IMPROVING	IMPROVING	IMPROVING
TNOx	IMPROVING	IMPROVING	IMPROVING	DEGRADING	IMPROVING	NS
DNOx	IMPROVING	IMPROVING	IMPROVING	DEGRADING	IMPROVING	NS
*DNOx	IMPROVING	IMPROVING	NS	DEGRADING	NS	NS
TP	IMPROVING	IMPROVING	IMPROVING	IMPROVING	NS	IMPROVING
*TP	IMPROVING	IMPROVING	IMPROVING	IMPROVING	IMPROVING	IMPROVING
DP	IMPROVING	IMPROVING	IMPROVING	IMPROVING	NS	IMPROVING
DOP	DEGRADING	DEGRADING	BMDL	DEGRADING	DEGRADING	IMPROVING
TOC	IMPROVING	IMPROVING	NS	IMPROVING	IMPROVING	IMPROVING
SS	IMPROVING	IMPROVING	BMDL	IMPROVING	IMPROVING	-
*SS	IMPROVING	IMPROVING	NS	IMPROVING	IMPROVING	IMPROVING

* These results were reported by USGS after additional analysis

Assessment Methods

Although not explicitly stated, it is assumed that benthic macroinvertebrate data were used for the Susquehanna River to satisfy the assessment requirements for the Integrated Monitoring and Assessment Report and subsequently its characterization as an attaining water body. While the science behind use of benthic macroinvertebrates is a sound, time-tested method for assessing streams, its application for assessment of a large river is not in line with the intended purpose of Pennsylvania's *Benthic Macroinvertebrate Index of Biotic Integrity for Wadeable Freestone Riffle-Run Streams* dated April 2009. Within the guidance document for the index, it is stated that "Any management decision should evaluate all pertinent, available

data, not just rely on this index if other information is available to help assess water quality." This serves as recognition that these methods may not sufficiently represent the benthic or overall biotic communities in the largest of Pennsylvania's streams and rivers. Application of large river invertebrate data under an index of biotic integrity developed for stream systems does not allow for a comprehensive and scientifically defensible evaluation of the condition of Aquatic Life Uses for the Clean Water Act (Flotemersch *et al.* 2006). Further, in review of data for the Susquehanna River, Wilson *et al.* (2012) found inverse relationships between some metrics, suggesting that traditional IBI approaches might not be applicable. Similarly, the Delaware River Basin Commission found that its benthic invertebrate data alone was only sufficient to indentify attaining status for the upper 10th percentile of their records; the remaining locations would be assessed using multiple types and source of data (Silldorff and Limbeck 2009). Furthermore, DEP's own survey protocol manual acknowledges that "in cases of large (4th order or larger) wadeable warm water streams and rivers …., use of benthic macroinvertebrates to assess aquatic life uses may not be practical or appropriate. For these wadeable streams and rivers, fish sampling methods can be employed to assess the attainment of aquatic life uses" (DEP 391-3200-001, 2009). PFBC staff have worked closely with DEP staff over the last 10 years on the development of a Fish Index of Biotic Integrity (PaFIBI) but unfortunately DEP has not formally adopted such a method for wadeable or non-wadeable streams or rivers. When a formal FIBI method cannot be used, the DEP methods recommend that a Qualitative Fish Sampling Protocol be used instead.

Our discussions with DEP staff have indicated that a dedicated effort to develop a large river-specific fisheries bioassessment tool for assessing aquatic life uses for large rivers is underway. We applaud this effort as we believe that it is a crucial step for understanding the problems affecting these waters and working on solutions to identify causes and sources. The PFBC staff stand ready to continue to assist DEP staff towards this end. Until that time, however, we believe that it is inappropriate, consistent with the DEP's own guidance on this matter, to solely assess the determination of the Susquehanna River's attainment of its designated uses by benthic macroinvertebrate data alone.

Smallmouth Bass as an Indicator for Impairment

U. S. EPA's Integrated Listing guidance requires states to gather and use all existing and readily available data generated by sources outside DEP. This data must meet quality assurance and procedural guidelines outlined by DEP. This federal requirement provides a mechanism for the PFBC to offer the following data for the application and integration into the use assessment process.

As stated in 25 Pa Code §93.4a(b), *"existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected."* At this level of protection, which is applicable to all surface waters, water quality may not be degraded below levels that protect the existing uses. Existing uses are defined in §93.1 as *"those uses actually attained in the waterbody on or after November 28, 1975, whether or not those uses have been included in the water quality standards."*

PFBC historical data for both YOY (Figures 1 and 2) and adult smallmouth bass populations (Figure 3 and 4) show a declining trend in abundance in the past seven years. We believe that this data shows that the river's population of smallmouth bass is not being maintained but rather in serious decline when compared to historical numbers. This precipitous decline supports a listing as an impaired and threatened river from Sunbury to Holtwood since the basic definition of a warm water fishes use is being violated.

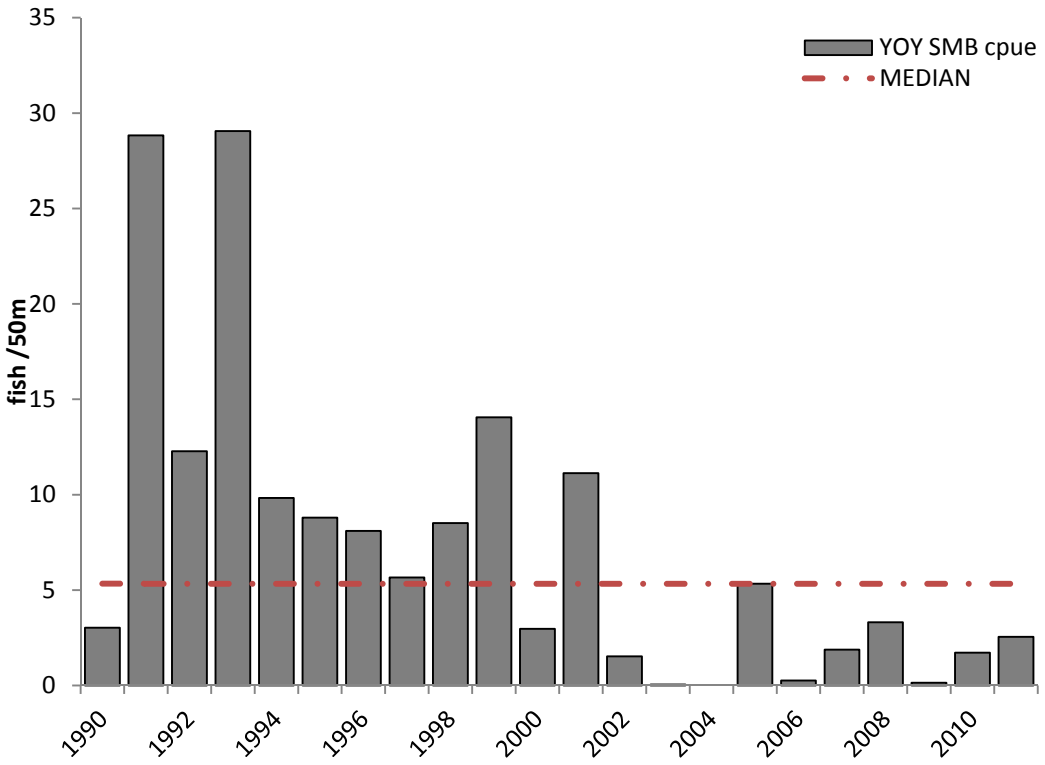


Figure 1. Electrofishing catch rate of young-of-year smallmouth bass at the Susquehanna River between Sunbury, PA and York Haven, PA. Blank value indicates year when no survey was conducted, not a zero value.

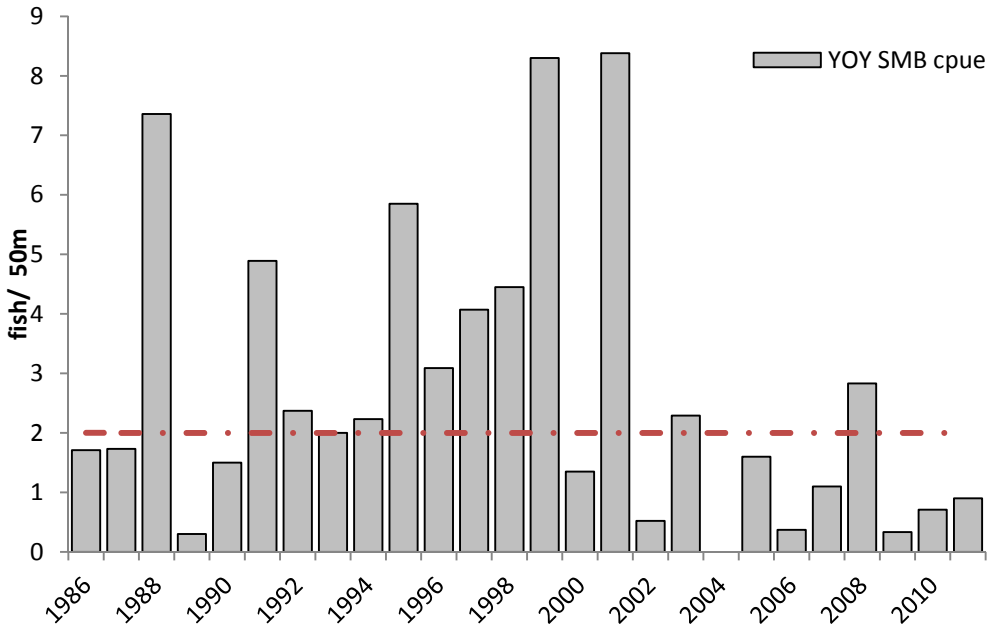


Figure 2. Electrofishing catch rate of young-of-year smallmouth bass at the Susquehanna River between York Haven, PA and Holtwood, PA. Blank value indicates year when no survey was conducted, not a zero value.

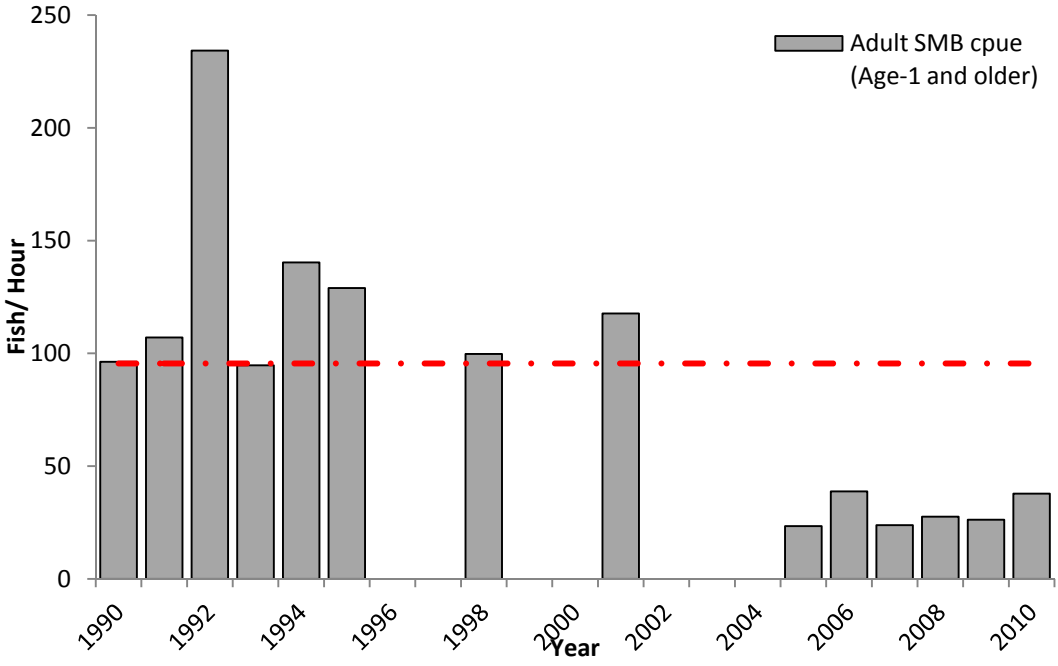


Figure 3. Electrofishing catch rate of adult smallmouth bass at the Susquehanna River between Sunbury, PA and York Haven, PA. Blank values indicate years when no survey was conducted, not zero values.

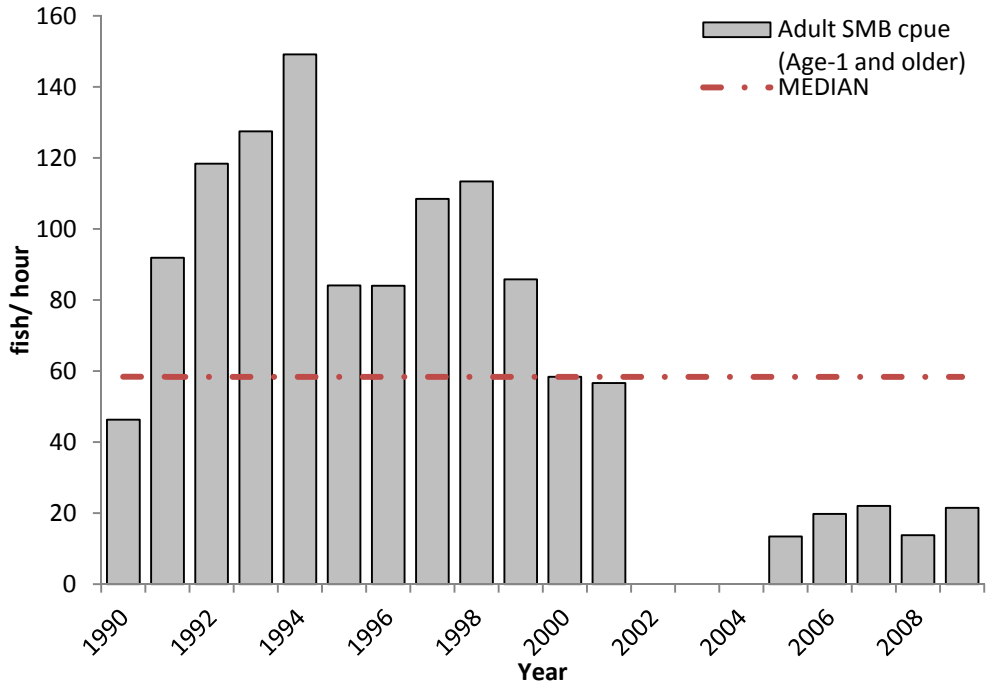


Figure 4. Electrofishing catch rate of adult smallmouth bass at the Susquehanna River between York Haven, PA and Holtwood, PA. Blank values indicate years when no surveys were conducted, not zero values.

Sources and Causes of Pollution

In correspondence to me from DEP Secretary Michael Krancer dated April 16, 2012, Secretary Krancer suggests that an additional reason for not listing the Susquehanna River as an impaired water under the Integrated Listing Report was that the studies have not identified a specific pollutant and source of pollution; however, we would note that a thorough review of the streams listed in basins 4a, 4b, 4c, and 5 in the 2012 Integrated Water Quality Monitoring and Assessment Report demonstrates that "cause unknown" is the eighth most frequent cause cited for impairment of streams, and accounts for more 1,137 stream miles (> 4%) that do not meet their designated aquatic life use. Furthermore, 806 stream miles (approximately 4%) that do not meet their designated aquatic life use where a source is provided, cite either "Source Unknown" or "Other" as the source. Excerpts of the report's statewide numbers for unknown sources and causes are shown below and illustrate the fact that a source and cause need not be known for a water to be listed under 303d.

Table 3

Statewide Assessment Summary
Sources of Impairment: Streams
Totals Include List 4a, 4b, 4c, and 5
(Mile totals will not equal Table 2 because a waterbody can have multiple impairments)

	Designated Use (Miles)				
Source	**Aquatic Life**	**Fish Consumption**	**Recreation**	**Water Supply**	**Total**
Agriculture	5,603		65	37	5,705
Abandoned Mine Drainage	5,517			79	5,596
Source Unknown	502	1819	1120	41	3,482

Table 4

Statewide Assessment Summary
Cause of Impairment: Streams
Totals Include List 4a, 4b, 4c, and 5
(Mile totals will not equal Table 2 because a waterbody can have multiple impairments)

	Use Designation (Miles)				
Cause	**Aquatic Life**	**Fish Consumption**	**Recreation**	**Water Supply**	**Total**
Siltation	8,712			2	8,714
Metals	5,031			12	5,043
pH	2,847				2,847
Nutrients	2,615			34	2,649
Water/Flow Variability	1,559				1,559
Organic Enrichment/Low D.O.	1,309				1,309
Pathogens			1,227	39	1,266
Cause Unknown	1,137		3		1,140

Thus, DEP's own report substantiates that it is indeed an accepted DEP practice to list a water for impaired and threatened status when the specific source of its impairment has not been determined. Therefore, we assert that the DEP should list the Susquehanna River as impaired and threatened since the symptoms of the problem are clear but the precise source(s) or cause(s) are not known.

Secretary Krancer suggested that the interagency workgroup had reviewed the same data and had not made a recommendation that the river be impaired. While it is true that the Technical workgroup has not made an impaired listing recommendation, the charge for this group was to design, implement and guide studies to try to determine the factors leading to disease outbreaks in smallmouth bass. These data would then be provided to policy makers for other decisions. The data have been discussed by the Susquehanna River Policy Committee, but the focus of that committee to date has been to review the Technical Committee's study recommendations and discuss ways to amend, fund and implement the studies and thereby

identify the sources of the already mentioned problems and concerns regarding the river. The data and findings included for consideration as part of this listing recommendation are a direct result of studies vetted and implemented through the interagency workgroups. It is solely the DEP's duty and responsibility to identify, list and ultimately repair impaired and threatened waters within the Commonwealth.

Recreational Uses

In Pennsylvania, water uses that are protected statewide include warm water fisheries aquatic life; public, industrial, livestock, wildlife, and irrigation water supply; and boating, fishing, water contact sports, and esthetics recreational uses. Other uses, such as cold-water fisheries, High Quality or Exceptional Value waters, navigation, and others, are protected as applicable to site-specific conditions. DEP decided to use aquatic surveys as the primary assessment tool for maximum coverage in their initial statewide wadeable stream assessment but recognizes that recreational uses as well as other uses are necessary and were not properly assessed. All uses carry equal weighting for protection in 25 PA Code Chapter 93.

The decline in recreational fishing is one of the principle reasons for the PFBC's and the public's concern about the changes in the health of the Susquehanna River. Angler complaints are common and our biologists' forecasts about the near-term future of the smallmouth fishery are dismal. Our Board of Commissioners passed a resolution that directed me, as Director, to work with DEP and EPA on identifying and finding solutions to the problem. I have enclosed a copy of that resolution to this letter.

25 PA Code Chapter 93 defines various statewide protected water uses in §93.4 (a). The Code does not discriminate among uses and specifically states that all uses shall be protected. Accordingly, the warm water fishes aquatic life use, the recreational fishing and boating uses as well as the potable water supply use and all other statewide uses deserve equal protection. Therefore, DEP, as the agency responsible for enforcing and administering the Chapter, is responsible for insuring equal and complete protection of all uses. Typically, if one of the most sensitive uses is protected, the other less sensitive uses are also protected. This usually means that applying water quality criteria to protect aquatic life or water supply would result in protecting other statewide uses. However, in DEP's guidance, methods for measuring some of the uses are not well-defined or not defined. For example, the aquatic life use and potable water supply uses have been fully developed and implemented over time. However, the fishing use has not been and there is a definite lack of guidance on how that use is protected and maintained. It is obviously necessary to measure the use to determine whether or not it has changed and if it has changed sufficiently to trigger an "impaired and threatened use" determination. As the recognized Commonwealth experts on fisheries, the PFBC staff can assist DEP about how a fisheries use should be evaluated.

In the case of other recreational uses, DEP's guidance suggests that bacteria be measured for protecting the recreational swimming and boating uses. While this makes sense for these water contact sports, it cannot account for other water quality impacts to recreational fishing as are occurring on the Susquehanna River. If indeed the aquatic life protection use was being protected, one would assume that the fishing use would also be protected; however in the

Susquehanna's case, we have an outdated water quality protection criteria for dissolved oxygen, the lack of a large river fish bioassessment technique, and an assessment technique (benthic macroinvertebrates) that fails to measure impacts to the sensitive use—in this case recreational fishing. The guidance does mention that one can use aquatic macrophyte occurrence as a measure of eutrophication of lakes that would impact fishing because of aquatic nuisance vegetation. In fact, DEP staff have actually applied this approach and have listed Cadjaw Lake (Wayne County) on the 303(d) impaired waters list due to increased nutrients causing excessive aquatic macrophyte growth which in turn impairs the recreational fishing use of the water body. This should also suggest that one could use algae and periphyton bioindicators which can foul riverbeds, consume oxygen at night, and impact the year class strength of an important fishery (and fishery use) such as the nationally recognized smallmouth bass fishery that previously existed in the Susquehanna River. The following review of other state programs indicates that algal densities have been used by other states such as California, Oregon and Washington to make impairment decisions for streams supporting Pacific salmon:

States which list Streams with depressed Fish Communities, diversity and abundance, as Impaired and Requiring a TMDL	
Maryland[1]	Roth, N. E., M. T. Southerland, J. C. Chaillou, P. F. Kazyak, and S. A. Stranko. 2000. Refinement and Validation of a Fish Index of Biotic Integrity for Maryland Streams. Columbia, MD: Versar Inc. with Maryland Department of Natural Resources, Monitoring and Non-Tidal Assessment Division. CBWP-MANTA-EA-00-2. Also Available at http://www.dnr.state.md.us/streams/pubs/ea00-2_fibi.pdf
Michigan	Procedure 51 to identify numbers of individuals and taxa to score the health of the fish community. A fish community that scores "poor" is considered for inclusion on the 303d list for TMDL development. For any detailed questions about P51, I'd suggest contacting Kevin Goodwin (Water Bureau) at 517-335-4185 or Goodwink@michigan.gov, and for 303d listing criteria, Sarah LeSage at 517-241-7931 or Lesages@michigan.gov.
California	Salmonid; increased nutrient loading (NA1) -- elevated periphyton/macrophyte growth (NB1) and elevated suspended algae and blue-green algal growth (NB2)--increased polychaete habitat (NB4) -- increased polychaete population and Ceratomyxa shasta (C. shasta) population and dosing (NB9). This pathway is not complete without consideration of the combination of increased parasite densities with stressful water quality conditions (e.g., high temperatures, low DO) which results in an increased incidence of disease and mortality.
Oregon	Salmonid; Similar to CA
Washington	Salmonid; Similar to CA
Wisconsin[2]	
Vermont	"*Wadeable Stream Biocriteria Development for Fish and Macroinvertebrate Assemblages in Vermont Streams and Rivers"* and *"Procedures for Determining Aquatic Life Use Status in Selected Wadeable Streams Pursuant to Applicable Water Quality Management Objectives and Criteria for Aquatic Biota Found in Vermont Water Quality Standards (VWQS) Chapter 3,section 3-01, as Well as Those Specified in 3-02(A1 and B3), 3-03(A1 and B3), and 3-04(A1 and B4: a-d).*
New Hampshire	Cold Water Fish Index of Biotic Integrity http://des.nh.gov/organization/divisions/water/wmb/swqa/2008/documents/appendix_35_cw_ibi.pdf

Recreational use attainment decisions for Pennsylvania's surface waters are made using bacteriological indicator data collected by government agencies (including DEP, the Pennsylvania

[1] Nontidal Streams. Fish assemblage is part of the tidal water impairments for the Chesapeake Bay.
[2] Under development

Department of Conservation and Natural Resources, the Pennsylvania Department of Health, and the USGS) and citizen/volunteer groups. In addition, information on aquatic macrophyte densities is considered for lakes. Fecal coliform bacteria are used as indicators of possible sewage contamination because they are commonly found in human and animal feces. Although fecal coliforms are generally not harmful themselves, they indicate the possible presence of pathogenic (disease causing) bacteria, viruses and protozoa that also live in human and animal digestive systems. Therefore, their presence in a waterbody suggests that pathogenic microorganisms may be present as well, and that water contact recreation such as swimming may be a health risk. The presence of dense growths of aquatic plants can impair recreational uses like boating or water contact sports and may be indicative of excessive nutrient inputs.

Important recreational areas and aquatic life use-impaired waterbodies with obvious potential sources of bacteria, nutrients and/or sediments (e.g., municipal point sources, combined sewer overflows, and agricultural sources relating to manure application, livestock grazing, and animal feeding) are targeted for recreational use assessment. Sampling is conducted during the swimming season (May 1 through September 30) when the waterbody is most likely to be used for boating, or water contact sports. Nutrients can effect recreational use support by fostering noxious algal blooms and plant growth. Recreational use attainment status is also determined by mapping the location and density of aquatic plant growth (lakes, ponds, and reservoirs only) and determining the impacts of those plants.

Since DEP recognizes the need to do recreational use assessments on “important recreational areas,” the PFBC is recommending that DEP consider the Susquehanna River an important recreational fishing area. Although little quantitative information is available about changes in recreational fishing and boating uses in this reach of river, the great public and agency concern about the negative and dramatic declines in the smallmouth bass fishery support an impaired and threatened recreational use designation. Anyone familiar with the use of the river knows that parking lots that used to be filled with trucks and boat trailers are vacant for most the summer. A PFBC recreational fishing use survey estimated that recreational angling associated with the 136 miles of the Juniata River (from Port Royal to the mouth) and Susquehanna River (from Sunbury downstream to Holtwood Dam) had an annual estimated economic contribution of more than $2.734 million in 2007. After considering multiplier effects, this activity generated $2.096 million in unique *value added* activity in the state, supporting 59 full time equivalent jobs in the economy through direct (45 jobs) and ripple effects (14 jobs) (Shields 2010). The public comment to DEP’s exclusion of the river from the 303(d) list will show that many out-of-state and local anglers who fished the river along with local guides who used to make a business off of the river’s fishery can no longer do so because the bass are no longer present in numbers that attracted them to recreationally fish the river.

Public Concern/Intersex Fish and Blotchy Bass

American Rivers, a national environmental group, named the Susquehanna River "America's Most Endangered River" for 2005. PFBC staff and the public also first observed diseased and dying juvenile smallmouth bass in the Susquehanna in 2005. The basis for American Rivers' listing was due to excessive pollution from animal manure from farming, agricultural runoff, urban and suburban stormwater runoff, and raw or inadequately treated sewage. It was estimated in 2003 that the Susquehanna contributed 44% of the nitrogen, 21% of the phosphorus, and 21% of the sediment flowing into the Chesapeake Bay.

More recently, in autumn 2009, it has been reported the Susquehanna River ranked first in Pennsylvania for cancer-causing chemicals with over 4,000 pounds discharged in 2007 (2009 report by the Penn Environment Research & Policy Center titled "Wasting Our Waterways--Toxic Industrial Pollution and the Unfulfilled Promise of the Clean Water Act). The increase in natural gas drilling in the basin lead to the Susquehanna being listed once again as America's Most Endangered River by American Rivers in 2011.

Although the primary focus for the impaired aquatic life use argument has been on nutrients causing DO stress which weakens the immune system of the juvenile smallmouth bass to allow for infection by Columnaris and other bacteria, there are certainly other potential stressors in the environment such as toxic chemicals in very low concentrations which could be either additive or synergistic to the fishes response to decreased DO levels. In fact a USGS press release states "There are many other water-quality factors and pathogens that were not evaluated in the study that may be putting additional stress on the fish in the Susquehanna River leading to the bacterial infections." The PFBC staff have been working with USGS fish pathologist Dr. Vicki Blazer on evaluating the high incidence of intersex in smallmouth bass in the Susquehanna River. The frequency and severity of testicular oocytes, or egg precursor cells, in the testicular tissue of male smallmouth bass from the Susquehanna and Juniata rivers are among the highest documented by Dr. Blazer. Further, high concentrations of vitellogenin, a egg precursor protein typically undetectable in male smallmouth bass, has been observed at measureable concentrations and in some cases as high as observed in female smallmouth bass. Analysis of select tissues has also found the presence of contaminants of emerging concern including15 PCB congeners, 13 flame retardant compounds, two personal care products, 14 organochlorine pesticides, and nine pesticides. The presence of intersex is evidence of endocrine disruption and further efforts to better understand the dynamics of these parameters and their effects is of utmost importance.

Most recently the PFBC has received reports of a condition called blotchy bass syndrome or hyperpigmented melanosis which has been widely publicized in the media but does not appear to have lasting effects on either the host fish or the consumers of fish. The condition is characterized by accumulations of melanin-producing cells in the dermis and the epidermis of the fish that result in irregular, black markings on the fish. Scientists are uncertain as to what causes this condition and it could be evidence of viral infection, endocrine disruption, or genetic factors. However, more study will be necessary to evaluate the cause of this condition.

The PFBC has lead an American shad restoration effort in the Susquehanna River basin including stocking hatchery-raised fry in the Susquehanna River and select tributaries since 1976. Part of the assessment of the efficacy of these efforts is an annual evaluation of the number of emigrating fingerling American shad in the autumn to determine the contribution of hatchery fish to the overall population. In recent years, there has been a decline in the catch rates of emigrating juvenile American shad, including both hatchery-reared and river-born individuals, in the Susquehanna River drainage (Figure 5). This indicates that there is some local impact that has been limiting survival of larval and fingerling American shad while still in the Susquehanna River system. We currently have no explanation for these declines but believe that it is water quality related. The behaviors of juvenile American shad differ from those of smallmouth bass in terms of habitat usage; preferring main-channel, deep water habitat, suggesting that the impacts of water quality degradation may be more far reaching than the near-shore YOY smallmouth bass microhabitats.

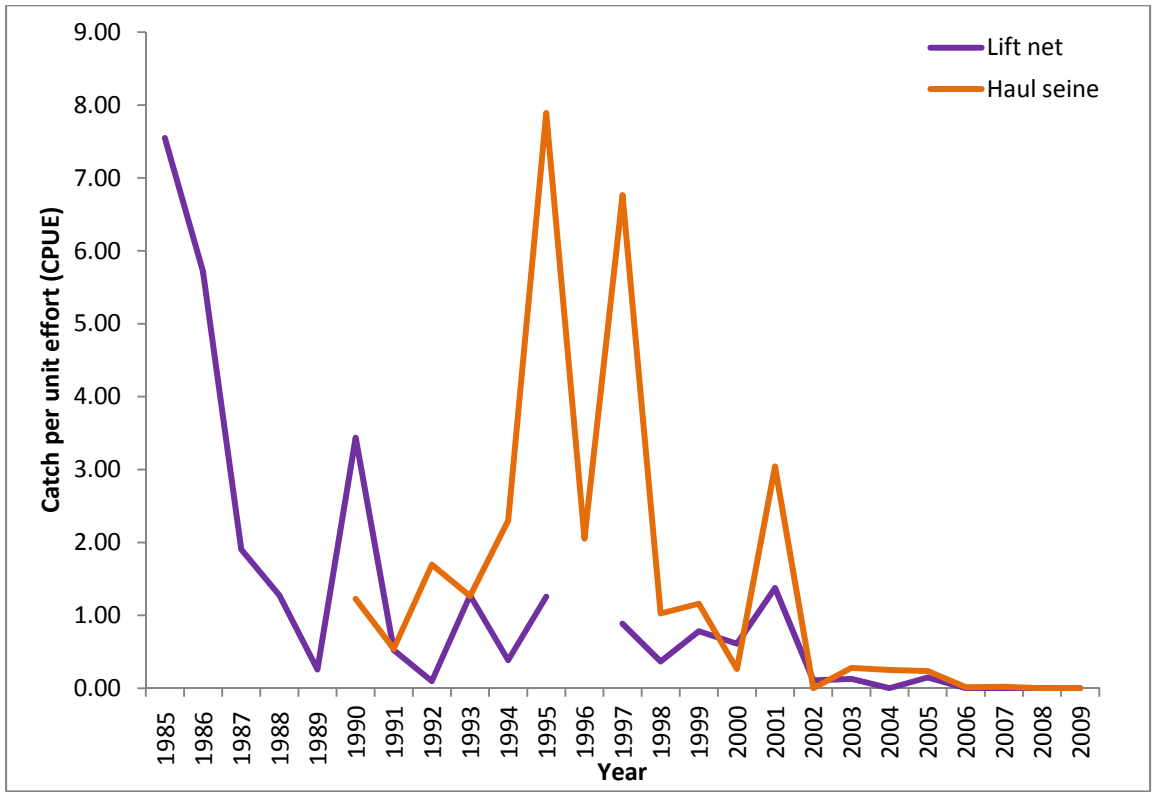


Figure 5. Catch per unit effort (CPUE) of emigrating, juvenile American shad *Alosa sapidissima* from seine hauls and lift nest at the Susquehanna River, 1985 through 2010.

We must remember that "DEP has the responsibility of identifying the impairments, determining the necessary objectives, and requiring that point source discharges meet the TMDL requirements. DEP also leads local groups or agencies in implementing the TMDL to correct nonpoint source impairments." (Draft 2012 Pennsylvania Integrated Water Quality Monitoring and Assessment Report, Clean Water Act Section 305(b) and 303(d) List, PA DEP, 2012)

A High-Priority Impaired and Threatened Water

Once a water is identified as impaired and threatened, federal regulations require states to determine schedules for the development of TMDLs (40 CFR 130 7(d)(1)). EPA recommends that an implementation schedule be developed or a ranking system applied such as high, medium or low. Under Section 303d (1) of the Clean Water Act, states must consider the severity of the pollution as well as the protected uses of the water in setting priorities. Factors such as the following may be considered:

- Risk to human health and aquatic life.
- Degree of public interest and support.
- Recreational, economic and aesthetic importance.
- Vulnerability or fragility as an aquatic habitat.

The states must identify high-priority waters that will be "targeted for TMDL development in the next two years" (40 CFR 130.7(b)(4)). While there is no time frame established by statute or the regulations for completion of TMDL development for other waters, EPA guidance recommends an 8-to-13 year time frame that runs from the waters initial listing as impaired or threatened.

Conclusions

The PFBC respectfully submits that the information contained in these comments support the listing of the Susquehanna River from Sunbury to Holtwood as a high-priority impaired and threatened river.

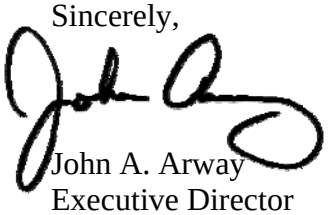
The Susquehanna River, and in particular its smallmouth bass fishery, are in trouble. Lesions on juvenile and adult fish, intersex conditions, and successive lost year classes of smallmouth bass over the past seven years have required the PFBC to significantly restrict fishing by promulgating more restrictive regulations on fishing leading to lost recreational opportunities. This in turn leads to lost tourism and economic opportunities. Unprecedented blooms of noxious algae fueled by increasing trends of dissolved phosphorus reduce dissolved oxygen and increase pH to dangerous levels. We can continue to argue about what we don't know or agree upon what we do know. If we do not list the river as impaired and threatened now based upon what the river is telling us, it may be too late to repair the damage once the older bass are gone. We request that DEP use the information contained in this response and list the Susquehanna as a high-priority impaired and threatened water.

Thank you for your consideration of these comments. In addition to the PFBC's own comments, we have enclosed a series of letters and articles that support the listing. The additional commentary includes perspectives from businesses, anglers, and media personnel who have witnessed the decline of the Susquehanna and who collectively support steps to develop a plan

for correcting the ongoing water quality issues. The PFBC feels it is important to enter these perspectives into the public record.

We continue to regard DEP as an ally in the challenge to keep our waters clean to insure a fishable/swimmable use and we look forward to working collaboratively to diagnosing the problem once the river is listed and restoring it to a world class fishery that it once was.

Sincerely,



John A. Arway
Executive Director

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Enclosures