Fish Kills in the South Branch of the Potomac River

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Division of Water and Waste Management
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South Branch of the Potomac Valley, West Virginia

Approximately 110 miles due West of Washington, DC
South Branch Watershed

- Drainage – 1372 square miles
- Population – 22 individuals/sq. mile (Kanawha 221)
- Land use – mainly forested and agricultural
- Discharges – NPDES permits
  - 4 Sewage > 100,000 gpd
  - 20 Sewage <50,000 gpd
  - 3 aquaculture
  - 3 car wash
  - 4 water trtmt. plant backwashes
  - 2 Industrial Individual Permits
Fish Kill Investigation History

• May 2002 – 1st large kill; smallmouth bass, redbreast sunfish (previous years reports of low numbers of suckers) Memorial Day

• May 2006 – large numbers of suckers dying; fallfish - again Memorial Day

• April – May 2007 – Small number of suckers dying Upper Tract/Smokehole area, later other species Petersburg/Moorefield

• April 2007 – Bass, Suckers and sunfish dying in Virginia’s North Fork and South Fork of Shenandoah

• April/May 2007 Kills in James River, Virginia
South Branch Fish Kill
May 24, 2006
Possible Causes of the Kills:

<table>
<thead>
<tr>
<th>Virginia’s</th>
<th>West Virginia’s</th>
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</thead>
<tbody>
<tr>
<td>- Algae</td>
<td>- Most of Virginia’s list +</td>
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<tr>
<td>- Bacteria</td>
<td>- Gypsy moth spraying</td>
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<tr>
<td>- Ammonia</td>
<td>- Poultry disinfectants</td>
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<tr>
<td>- Sediment contaminants</td>
<td>- Roxarsone</td>
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<tr>
<td>- Aquatic macrophytes</td>
<td>- Fire suppression foam</td>
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<tr>
<td>- Pathogens</td>
<td>- Antibacterial ingredients</td>
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<tr>
<td>- Parasites</td>
<td>- Mercury</td>
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<tr>
<td>- Water temperature</td>
<td>- Caterpillars</td>
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<tr>
<td>- Ag chemicals</td>
<td>- Point Source</td>
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<tr>
<td>- Ag density</td>
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<td>- Manure applications</td>
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<td>- Biosolids</td>
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<td>- Immune suppression</td>
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<td>- Chronic stressor</td>
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<td>- Body burden</td>
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<td>- Fish density</td>
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<td>- Fish health</td>
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<td>- Meth labs</td>
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</tbody>
</table>
Possible causes of the kills

- Pathogens
- Toxic algae
- Endocrine disrupters / immune suppression
- pH
- Nutrients
pH highs and swings

• pH’s often reach 9.3
• pH swings of >1 unit/day
• But, some WV rivers have similar patterns
Possible causes of the kills

- Pathogens
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- Nutrients
Sediment bound ammonia

• Ammonium binds to negatively charged sediment particles because of its own positive charge

• It remains tightly bound until...
  – Nitrogen fixing bacteria
  – Chemically stripped away (high pH)
Sediment ammonium data

- South Branch at Moorefield = 215 ppm
- South Branch at Upper Tract = 145 ppm
- WWTP outfall near Charleston = 46 ppm
- South Branch above Franklin = <20 ppm (mdl)
- Davis Creek = <20 ppm (mdl)
- Elk River = <20 ppm (mdl)
- Opequon Creek = 236 ppm

- But, very little ammonia in the water column
How would it kill fish?

• Nesting fish would introduce ammonium laden sediment into the surrounding water
• Ammonium would be changed to the more toxic unionized ammonia which has no affinity to the sediment
• Nesting fish would constantly be in contact with this toxic layer of sediment
Fish Kill Observations

• Timing suggests relationship with spawning

• Dimorphism of kill events

• No juveniles or YOY’s

• Suckers
  • Both sexes are affected

• Stonerollers, fallfish, and minnows
  • Only males are affected
The perfect storm

- High levels of ammonium in the sediment
- Actively spawning fish
- High pH’s in the water column

Equals

- Localized unionized ammonia exposure
Possible causes of the kills

- Pathogens
- Toxic algae
- Endocrine disrupters / immune suppression
- pH
- Nutrients
What next -- 2008

- Toxic algae
- Pathogen studies
- Water chemistry
- Histopathology
- Parasitology
- Sediment sampling
- Sediment pore water
Groups Involved

- WV DNR
- WV DEP
- WV Dept. of Agriculture
- USGS
- USFWS Fish Health lab
- EPA Region 3 Office
- EPA CADDIS
- VA DEQ
- Friends of the Shenandoah River
- Tetra Tech Inc.
- Chesapeake Bay Foundation
- WVU
- WV Bur. For Public Health

- ICPRB
- VA DGIF
- Virginia Commonwealth Univ.
- James Madison Univ.
- Virginia Tech.
- Tennessee Tech. Univ.
- Potomac Water Watch
- Cacapon Institute
- Shenandoah River Keeper
- TN and Associates
- And others
Questions ?