Upper Susquehanna River Water Quality Monitoring:

Monitoring water quality and fecal coliform bacteria in the upper Susquehanna River, summer 2014

Morgan Freehafer

INTRODUCTION

The Susquehanna River begins in Cooperstown, NY, in Otsego Lake. After traveling 444 miles through New York, Pennsylvania, and Maryland, the Susquehanna River empties into the Chesapeake Bay at Harve De Grace, MD. It is the largest tributary of the Chesapeake Bay; fifty percent of the freshwater entering the bay is sourced from the Susquehanna River. The Susquehanna River is both the longest, commercially non-navigable river in North America and the largest river lying entirely within the United States (SRBC 2014).

Each year, the Susquehanna River is tested for temperature, pH, dissolved oxygen, specific conductivity, nitrites+nitrates, total nitrogen, total phosphorus, and fecal coliform. These parameters are used to develop an accurate assessment of the Susquehanna River and ensure that unauthorized discharges or pollutants do not threaten its water quality. Regular monitoring of the Susquehanna River also assures that secondarily treated sewage released into the river by the Village of Cooperstown does not negatively impact the river’s health.

METHODS

From 10 Jun to 23 July, nine sites along the Susquehanna River were monitored weekly (Figure 1, Table 1). Water samples were collected from each site in 125mL Nalgene® bottles and stored in a cooler for subsequent nutrient analysis. A Lachat® QuickChem FIA + Water Analyzer was used to determine nitrate+nitrite (Pritzlaff 2003), total nitrogen (Pritzlaff 2003) and total phosphorus (Liao and Marten 2001). Temperature, conductivity, pH, dissolved oxygen, and turbidity were assessed using a YSI® 6820 V2-2 multi-probe at each site.

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Figure 1. Upper Susquehanna sample sites, summer 2014.

Additional water samples were also collected at each site and tested for fecal coliform bacteria using the membrane filter technique (APHA 1992). Testing was done on a total of six subsamples for each site, comprised of two triplicates of 10mL and 100mL respectively. Samples were run through a sterile filter using a low-pressure vacuum pump. The use of multiple volumes of water helps to assure that an ideal range of fecal coliform colonies (20-80) results at one of the dilutions. Filters were then placed on a nutrient-soaked media pad in a Milipore® dish, and incubated in a water bath at 44.5 degree Celsius for 24 hours. Fecal coliform colonies were then counted and were reported as colonies per 100 mL. To avoid contamination, all lab equipment used was sterilized in 70% ethanol, washed in hot water and rinsed with de-ionized water between different sites.
Table 1. Locations and descriptions of nine upper Susquehanna sample sites.

<table>
<thead>
<tr>
<th>Site</th>
<th>Distance from source</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>144m</td>
<td>Under the Main Street Bridge; accessed via slope beside the bridge.</td>
</tr>
<tr>
<td>6a</td>
<td>1012m</td>
<td>Below the dam at Bassett Hospital; accessed from the northern corner of the lower parking lot at Bassett Hospital.</td>
</tr>
<tr>
<td>7</td>
<td>1533m</td>
<td>Below the dam at Bassett Hospital; accessed from the southern corner of the lower parking lot at Bassett Hospital.</td>
</tr>
<tr>
<td>8</td>
<td>1724m</td>
<td>Under the Susquehanna Ave. bridge west of the Clark Sports Center; accessed via the slope beside the bridge.</td>
</tr>
<tr>
<td>12</td>
<td>4119m</td>
<td>Just above the sewage discharge of the Cooperstown Wastewater Treatment Plant, near Cooperstown High School. Accessed by an opening in the fence.</td>
</tr>
<tr>
<td>16</td>
<td>5460m</td>
<td>Small bridge perpendicular to the road on Clark Property. Accessed by crossing a gated bovine grazing area (cow field).</td>
</tr>
<tr>
<td>16a</td>
<td>5939m</td>
<td>Distinct bend in river alongside road on Clark Property, in field directly across from large house with hay rolls in front. Accessed by long path found on the right side of the field. Be cautious of barbed wire.</td>
</tr>
<tr>
<td>17</td>
<td>8143m</td>
<td>Abandoned bridge on Phoenix Mill Road.</td>
</tr>
<tr>
<td>18</td>
<td>9867m</td>
<td>Railroad trestle about 200m north of the railroad crossing on Rt. 11 going out of Hyde Park, accessed by walking on the railroad tracks.</td>
</tr>
</tbody>
</table>

RESULTS & DISCUSSION

Temperature

The average temperature of the upper Susquehanna River this summer was 20.59 degrees Celsius, the lowest recorded since 2004. Mean temperature for each of the nine sample sites (+/- standard error) is given in Figure 2. Figure 3 compares mean temperature over 2014 with the summers 2004 through 2014.
Figure 2. Average temperature profile for upper Susquehanna River, summer 2014.

pH

pH measures the acidity or basicity of a solution. Average pH values at each site were lower this year than they were last year, with the exception of site 16a. Mean pH at each site (+/- standard error) over 2014 is given in Figure 4. Figure 5 compares mean pH over 2014 to mean pH from summers 2004 through 2013.

Figure 4. Mean pH values for upper Susquehanna River, summer 2014.

Conductivity

Conductivity is the capability of water to transmit electricity and is based on its concentrations of dissolved ions (Wetzel and Lichens 1991). While the geological characteristics of the upper Susquehanna River are a primary influence in its conductivity measurements, radical variation in conductivity values could indicate contamination. Mean conductivity at each site (+/- standard error) is given in Figure 6. Figure 7 compares mean conductivity for 2014 to mean conductivity for years 2004 through 2013.

![Conductivity Profile](image)

Figure 6. Conductivity profile for upper Susquehanna River, summer 2014.

Dissolved Oxygen

Dissolved oxygen is necessary to the survival of fish and other aquatic life. Water flow, oxygen demand, and external factors all affect levels of dissolved oxygen. Dissolved oxygen concentrations for this summer were higher than they were last summer, though they are still within the range that is typically observed. Figure 8 shows mean dissolved oxygen levels (+/- standard error) for the upper Susquehanna River this summer. Figure 9 compares mean data from this summer to years 2004-2014.

Figure 8. Mean dissolved oxygen profile for the upper Susquehanna River, summer 2014.
Turbidity is a measurement of water clarity based on light scattering due to suspended matter. Over the summer of 2013, the turbidity of the upper Susquehanna River was tested for the first time; the results from this summer are a continuation of those efforts to monitor turbidity. At all sites along the upper Susquehanna this year, turbidity readings were lower than they were last year. This indicates a marked improvement in water clarity. Mean turbidity at each site (+/- standard error) is given in Figure 10. A graph comparing this summer’s mean turbidity at each site with last year’s averages is given in Figure 11.
Figure 10. Average turbidity along upper Susquehanna River, summer 2014.

Figure 11. Average turbidity in the upper Susquehanna River, summers 2013 (Bianchine 2013) and 2014.
Total Phosphorus

Phosphorus is an essential nutrient that contributes to algal growth when found in high concentrations. Monitoring the upper Susquehanna River for total phosphorus helps reduce the risk of nutrient loading, algal growth, and depleted oxygen. Common sources of nutrients like phosphorus include agricultural and urban runoff and sewage effluent. Mean phosphorus for each site (+/- standard error) over 2014 is given in Figure 12. Mean total phosphorus for summers 2004 to present is shown in Figure 13.

Figure 12. Average phosphorus concentrations along the upper Susquehanna River, summer 2014.
Nitrogen

Nitrogen, like phosphorus, is an essential nutrient that can contribute to the growth of algae. Organic nitrogen is found in proteins and is constantly being recycled by plants and animals, while inorganic nitrogen can exist as a gas N2, or as nitrate NO3-, nitrite NO2-, or ammonia NH3+ (Bianchine 2013). Common anthropogenic sources of nitrogen include agricultural and wastewater runoff. Mean nitrite+nitrate at each site (+/- standard error) for summer 2014 is given in Figure 14. Figure 15 compares mean nitrites+nitrates for summer 2014 with historical mean values from years 2004 to present. Mean total nitrogen at each site (+/- standard error) for summer 2014 is given in Figure 16. Figure 17 compares mean total nitrogen for summer 2014 with historical mean values from years 2004 to present.
Figure 14. Average nitrite and nitrate concentrations of the upper Susquehanna River, summer 2014.

Figure 16. Total Nitrogen profile of the upper Susquehanna River, summer 2014.

Fecal Coliform

Fecal coliform are bacteria that live in the digestive tracts of warm-blooded animals (Zurmuhlen 2007). Testing for the presence of fecal coliform bacteria helps in discerning whether or not an area has been subject to fecal contamination. Fecal coliform bacteria, while indicating the presence of contaminants, are not pathogenic themselves. Fecal coliform are counted in colonies/100mL. Mean fecal coliform at each site (+/- standard error) over 2014 is given in figure 18. Figure 19 compares mean fecal coliform levels for this summer with mean values from years 2004 to present.

Figure 18. Mean fecal coliform levels along the upper Susquehanna River, summer 2014.

REFERENCES


