

Susquehanna River Water Quality Monitoring:

Monitoring the water quality and fecal coliform bacteria in the Upper Susquehanna River, summer 2003

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ABSTRACT

During the summer of 2003, the Upper Susquehanna River was monitored as part of an ongoing Biological Field Station study to ensure that the Village of Cooperstown's sewage discharge is not reducing water quality below acceptable limits. Monitoring was conducted weekly, the river being tested for different physical and chemical attributes as well as fecal coliform bacteria. This was done at 12 sites from Otsego Lake to the river's confluence with Oak's Creek. This year saw lower temperature and phosphorous levels but higher pH, conductivity, fecal coliform and dissolved oxygen levels.

INTRODUCTION

The Village of Cooperstown sits next to the source of the Susquehanna River at the outlet of Otsego Lake. The village discharges its treated sewage from a wastewater plant into the river, about 2 miles from its source. While the Village of Cooperstown has a small permanent population, its population swells substantially during the summer tourist season. The industries which cater to tourists, such as restaurants and hotels, produce large quantities of wastewater, as does the Mary Imogene Bassett Hospital. As a result, the Village of Cooperstown treats and discharges up to 800,000 gallons of sewage per day during the summer months. The Susquehanna River has a limited capacity to assimilate nutrients and organic wastes, so the village must maintain strict control over its discharge. The village's discharge permit states that they must maintain a water flow of at least 11 cubic feet per second and a dissolved oxygen level of at least 5 mg/l below the point of discharge (Schliermann 2003). Besides Cooperstown's sewage, the river stands a chance of receiving pollution from unauthorized sources. With these facts in mind, the SUNY Oneonta Biological Field Station has been conducting monitoring along the river since 1992. The purpose of this is to provide early warning to the village if there is a problem with their discharge as well as to detect other unauthorized pollution sources, with the idea being that any problems can be quickly alleviated. Water quality sampling was conducted at twelve sites along the river (Figure 1) ranging from the river's source (SR1) to Hyde Park, where the river meets Oaks Creek (SR18). These sites have been sampled during the summers since 1992. The village waste water point of discharge is

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located between SR12 and SR16. At each site, the river was tested for physical parameters (dissolved oxygen, temperature, pH and conductivity) as well as total phosphorus, nitrate+nitrite and fecal coliform levels. All these characteristics reflect levels of pollution reaching the river.

METHODS

The twelve river sites (Figure 1) were visited weekly between 24 June and 4 August during the summer of 2003. Field work consisted of collecting a water sample from every site using a sterilized 1000ml Pyrex container, as well as using a Hydrolab Reporter[®] or Scout 2[®] to measure dissolved oxygen, pH, temperature and conductivity in the river.

Lab work consisted of nitrate+nitrite, total phosphorous and fecal coliform analysis. All glassware used in the tests was either autoclaved for 15 minutes at 121 °C and 12 PSI or acid washed for 24 hours in a 10% HCl acid bath to ensure cleanliness and sterility. Nitrate+nitrite levels were measured using the cadmium reduction technique (APHA 1992). Total phosphorus was analyzed using persulfate digestion followed by single reagent ascorbic acid method (APHA 1992).

The river samples were tested for fecal coliform bacteria by using the membrane filter technique (APHA 1992). This was done by filtering the samples in volumes of 10 ml, 50 ml, and 100 ml in order to provide counts of 20 to 80 bacteria per filter at one volume. Typically samples filtered at 50 ml produced proper bacteria counts. Following filtering, the filters were placed in petri dishes which contained 2.3 ml of growth media. The dishes were then placed in a plastic container which was incubated for 24 hours in a circulating water bath at 44.5 °C +/-0.2 °C. Once removed from the bath, the fecal coliform colonies had a bright blue color (Miller 1996). They were counted and recorded as a number of colonies per 100 ml, then autoclaved and disposed.

During the fecal coliform analysis it was necessary to keep all equipment sterile. All petri dishes and filters were pre-sterilized when produced at the factory. In between the filtering of samples all filtering equipment was sterilized by dipping in ethyl alcohol, rinsing with warm water, and rinsing with dilution water (distilled water with trace amounts of potassium dihydrogen phosphate and magnesium chloride; APHA 1992). Forceps were dipped in ethyl alcohol and then flamed on a Bunsen burner. Finally, a blank filter was processed with dilution water to flush the filtering system. If all was aseptic, there would be no bacteria colonies on that filter.

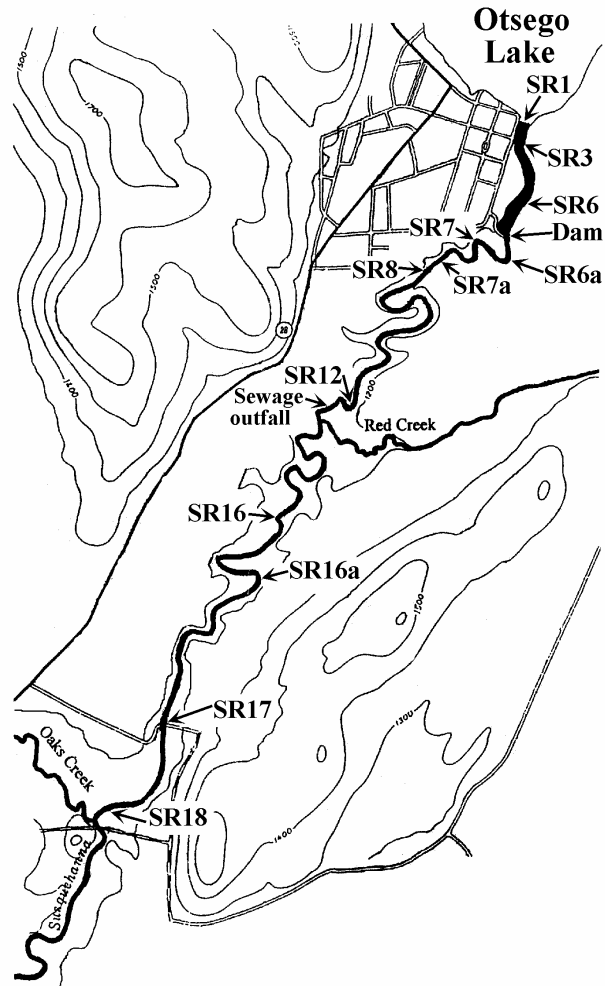


Figure 1. Upper Susquehanna River showing collection sites.

RESULTS AND DISCUSSION

Temperature

Figure 2 summarizes temperature profiles for the summers of 1998-2003. The average temperature of the Susquehanna River for the summer of 2003 was 20.83 C°, 0.75 C° lower than last summer's. The low temperature for this summer was 17.27 C°, recorded on 24 June at sites SR16 and SR17. The high temperature was 23.54 C°,

recorded on 7 July at site SR1. Both these readings were lower than last years, which could be attributed to cool, wet weather.

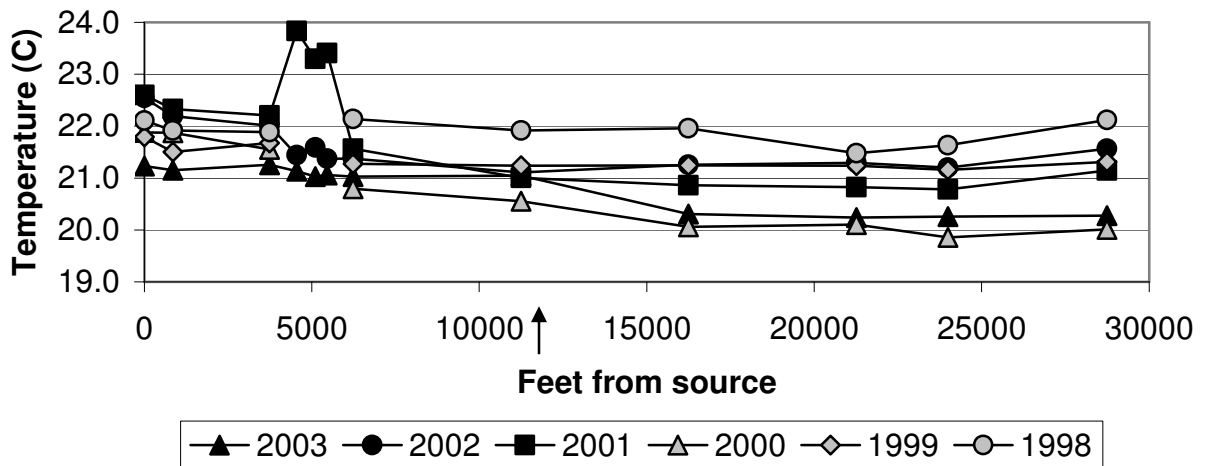


Figure 2. Profiles of mean temperature along the Susquehanna River, summers of 1998 (Dewey 1999), 1999 (Deitz 2000), 2000 (Hill 2001), 2001 (Hill 2002), 2002 (Schlierman 2003) and 2004. The arrow indicates the location of the village’s sewage outfall.

pH

Figure 3 summarizes pH profiles for the summers of 1998-2003. The average pH reading for this year was 8.15, which was higher than last year’s reading of 7.86. The high pH reading was 8.47 recorded on 24 June at site SR6. The low pH recording was 7.62, recorded on 21 July at site SR17.

Conductivity

Figure 4 summarizes conductivity profiles for the summers of 1998-2003. The average conductivity of the Susquehanna River was 304 umho/cm, which is slightly higher than last year’s average of 283 umho/cm. Conductivity levels this year were higher than any year since 1998. Conductivity was highest on 7 July, with a reading of 334 umho/cm at site SR12. It was at its lowest on 4 August, with a reading of 282 umho/cm at sites SR3 and SR6.

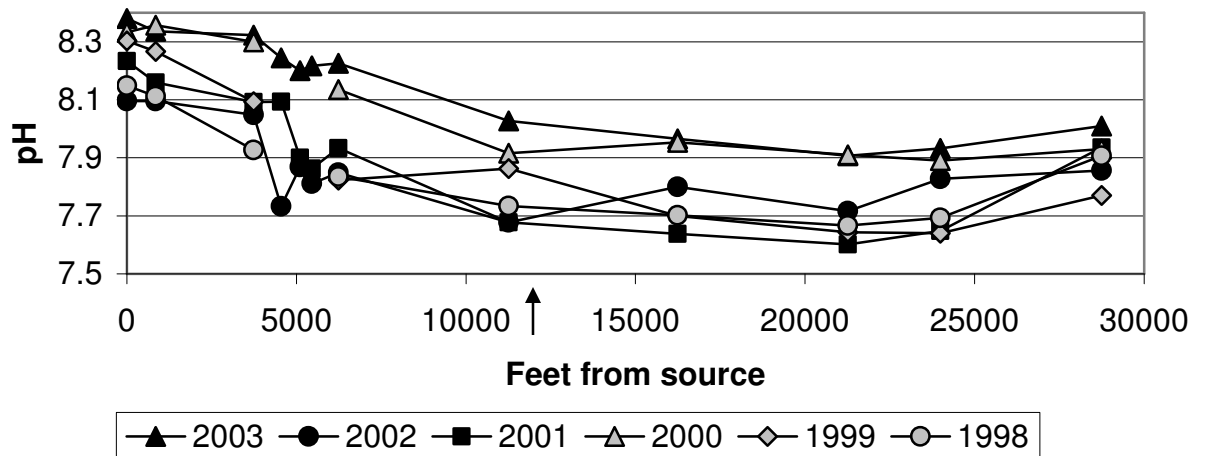


Figure 3. Profiles of mean pH along the Susquehanna River, summers of 1998 (Dewey 1999), 1999 (Deitz 2000), 2000 (Hill 2001), 2001 (Hill 2002), 2002 (Schlierman 2003) and 2004. The arrow indicates the location of the village’s sewage outfall.

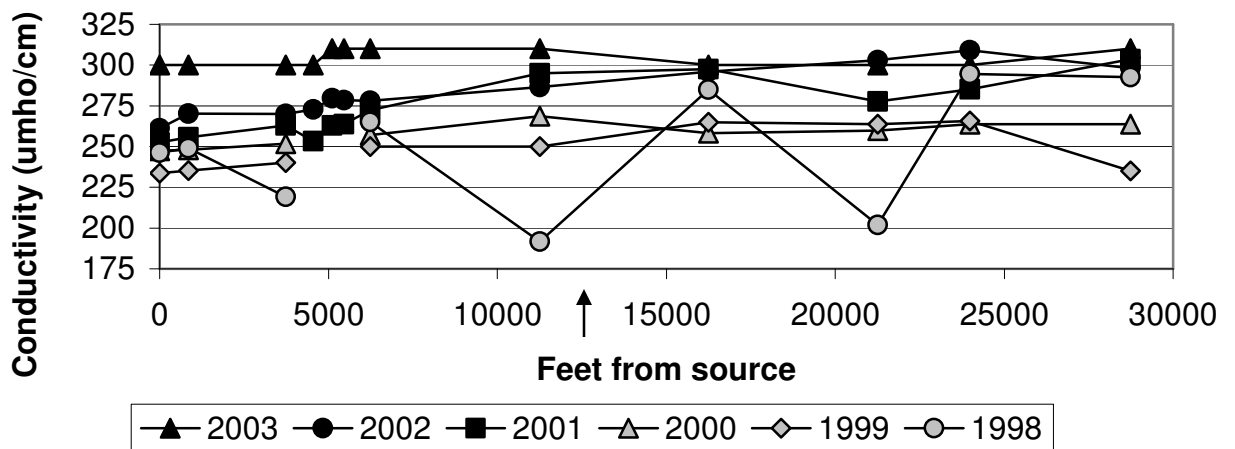


Figure 4. Profiles of mean conductivity along the Susquehanna River, summers of 1998 (Dewey 1999), 1999 (Deitz 2000), 2000 (Hill 2001), 2001 (Hill 2002), 2002 (Schlierman 2003) and 2004. The arrow indicates the location of the village’s sewage outfall.

Dissolved Oxygen

Figure 5 summarizes dissolved oxygen profiles for the summers of 1998-2003. The average level of dissolved oxygen in the Susquehanna River this summer was

8.54 mg/l, which is higher than last year's average of 7.84 mg/l. The highest level of dissolved oxygen was 15.53 mg/l, recorded on 24 June at site SR17. The lowest level of was 5.79 mg/l, recorded on 7 July at site SR12. The site with the lowest dissolved oxygen concentration was SR12, with an average of 7.21 mg/l. Site SR16a was second lowest, while SR16 seemed relatively typical. These sites are located directly below the sewage outflow. Since the village is responsible for maintaining a dissolved oxygen level of at least 5 mg/l, the readings for sites SR16 (8.46 mg/l) and SR16a (7.77 mg/l) are well within the required range. Site SR12, above the outfall, typically revealed suppressed concentrations, indicating an unauthorized pollution source immediately upstream.

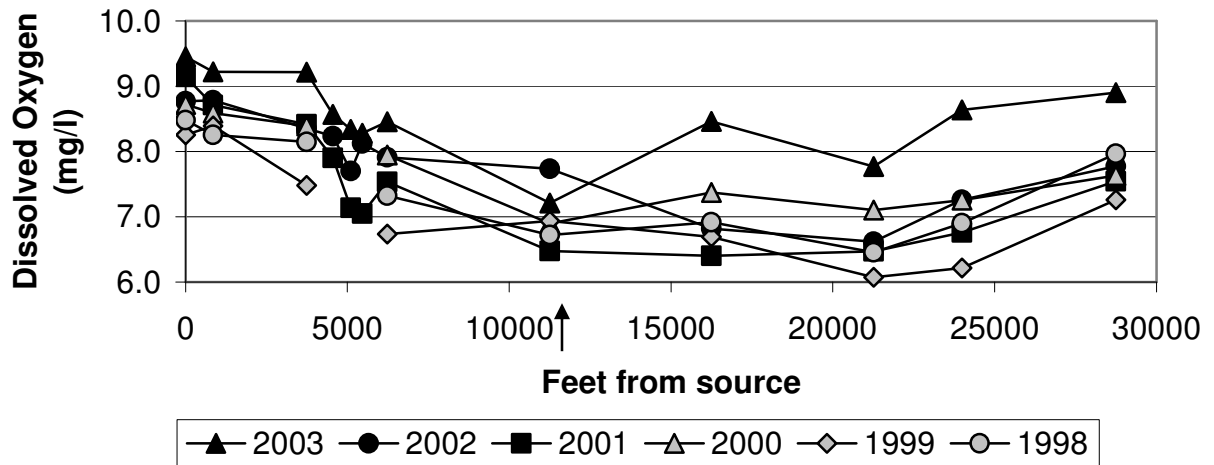


Figure 5. Profiles of mean dissolved oxygen along the Susquehanna River, summers of 1998 (Dewey 1999), 1999 (Deitz 2000), 2000 (Hill 2001), 2001 (Hill 2002), 2002 (Schlierman 2003) and 2004. The arrow indicates the location of the village's sewage outfall.

Total Phosphorous

Figure 6 summarizes total phosphorous profiles for the summers of 1998-2003. The average phosphorous level this year was 31.5 ug/l, 33.4 ug/l lower than last year's average. The river exhibited the lowest concentrations of phosphorous this year since 1998. This could be attributed to high flows, resulting from frequent rains over the summer. Increased flow tends to dilute pollutants originating from point sources (Brown undated). The highest level of phosphorous this summer was 123.6 ug/l, sampled from site SR16 on 22 July. Last year SR16 posted a high of 209 ug/l. The lowest level of phosphorous this summer was 2.4 ug/l, sampled from site SR1 on 19 August.

Nitrate+Nitrite

Figure 7 summarizes dissolved nitrate+nitrite profiles for the summers of 1998-2003. The average nitrate+nitrite level this year was 1.11 mg/l. This is higher than last

year's average of 0.44 mg/l. The high for this year was 5.91 mg/l, which was recorded on 14 August at site SR1. The low for this year was 0.31, which was recorded on 28 July at site SR7a. It is interesting to note that while phosphorus levels were lower this year, nitrate+nitrite levels were up.

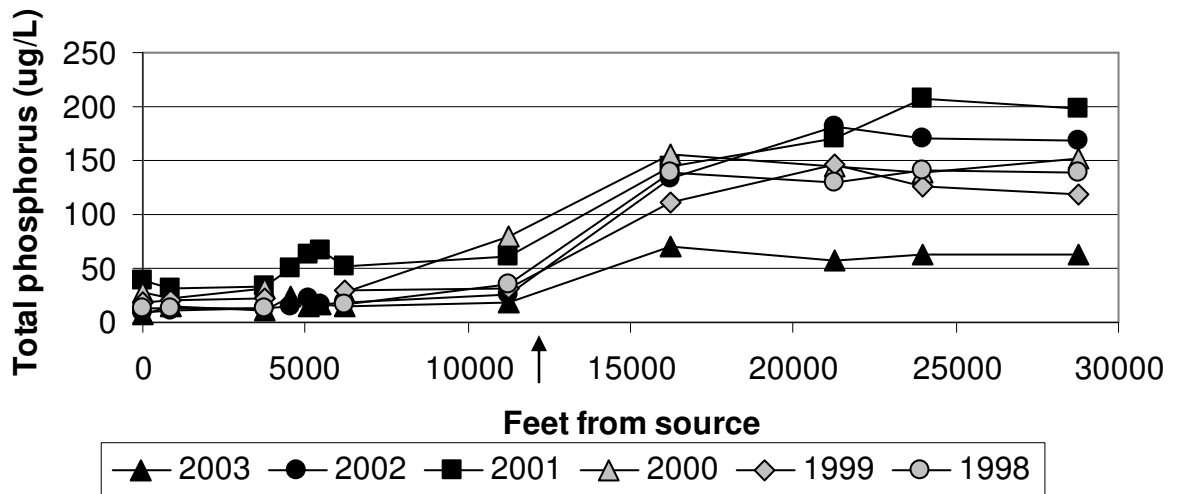


Figure 6. Profiles of mean total phosphorus along the Susquehanna River, summers of 1998 (Dewey 1999), 1999 (Deitz 2000), 2000 (Hill 2001), 2001 (Hill 2002), 2002 (Schlierman 2003) and 2004. The arrow indicates the location of the village's sewage outfall.

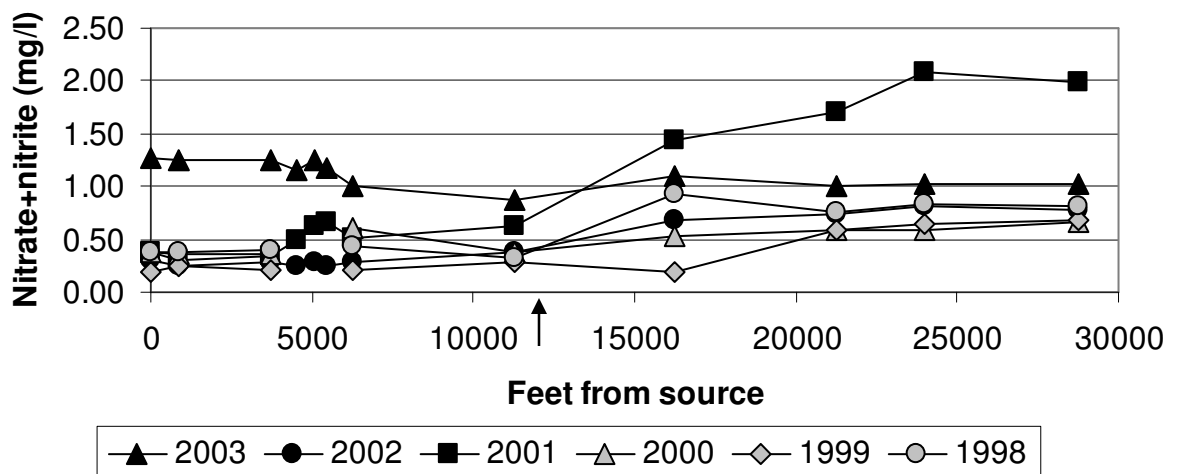


Figure 7. Profiles of mean nitrate+nitrite along the Susquehanna River, summers of 1998 (Dewey 1999), 1999 (Deitz 2000), 2000 (Hill 2001), 2001 (Hill 2002), 2002 (Schlierman 2003) and 2004. The arrow indicates the location of the village's sewage outfall.

Fecal Coliform

Figure 8 summarizes dissolved fecal coliform profiles for the summers of 1998-2003. The levels of fecal coliform bacteria in the Susquehanna River during the summer of 2003 had an average of 299 colonies/100ml. While higher than last year's average of 195 colonies/100ml, it seems to be similar to or less than the counts of most previous years. For example, the river had an average of 607 colonies/100ml in 2001 (Hill 2001). The elevated counts for this year could be explained by the heavy rains, which could increase levels due to wildlife and/or livestock sources. The high fecal coliform bacteria count for this year was 2904 colonies/100ml at site SR16 on 21 July. The low for this year was 4 colonies/100ml, recorded at site SR1 on 15 July.

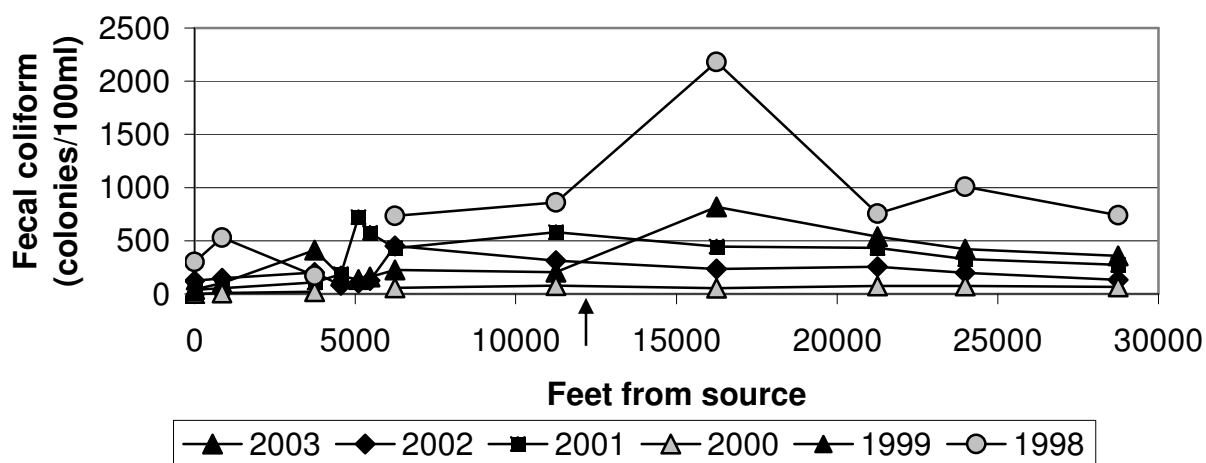


Figure 8. Profiles of mean fecal coliform along the Susquehanna River, summers of 1998 (Dewey 1999), 1999 (Deitz 2000), 2000 (Hill 2001), 2001 (Hill 2002), 2002 (Schlierman 2003) and 2004. The arrow indicates the location of the village's sewage outfall.

SUMMARY AND CONCLUSION

Monitoring this year revealed lower temperature and phosphorous levels but higher pH, conductivity, fecal coliform, and dissolved oxygen levels compared to summer 2002. Most of this should be attributed to the extremely wet and cool summer this year. As in previous years, oxygen began declining and total phosphorus increasing at site SR12, which is above the sewage outfall. If the pollution sources responsible for this were abated, expendable oxygen would increase, easing the ability by the village to keep oxygen above regulated concentrations below the outfall.

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