Analysis of fecal coliform concentrations in Otsego Lake's northern tributaries, summer 2001

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INTRODUCTION

Fecal coliform bacteria are classified within the family Enterobacteriaceae. The most common species of fecal coliform is *Escherichia coli*, prokaryotic, gram-negative, rod-shaped bacteria. They range in size from 1.1-1.5 μm in width and from 2-6 μm in length. *Escherichia coli* is facultatively anaerobic and may be nonmotile or motile with peritrichous flagella (Breed et al., 1957). These bacteria are very abundant within the intestinal tracts of warm-blooded mammals. Therefore, their presence in aquatic environments is indicative of contamination with animal wastes. Although most *E. Coli* bacteria are harmless, some strains may be highly pathogenic (Joklik, 1972).

The value of determining fecal coliform concentrations in a water source is to establish the extent to which the water has been polluted with fecal wastes. Its presence is indicative of the potential for other pathogenic microbes, including those that cause typhoid fever, bacterial or viral gastroenteritis, or hepatitis A (Joklik, 1972). In the Otsego Lake watershed, in which this investigation was based, the primary sources of contamination are believed to include agricultural runoff and faulty septic systems (Miller, 1997). Wild animal wastes running off into the watershed are a secondary factor. In addition to obvious health concerns, there are also environmental ones. Also, since fecal material is extremely rich in nutrients, coliform bacteria indicate a nutrient source. Controlling nutrient inputs, primarily phosphorus, to Otsego Lake is the primary objective the Plan For the Management of the Otsego Lake Watershed (Anon., 1998). The basins draining into the studied streams have been involved in the Environmental Quality Incentive Program (EQIP) (Pullano, 2001). This Federally-funded program provides a 75% cost share to agricultural producers to implement best management practices (BMPs). Those projects, which are generally intended to reduce nutrient runoff from the land, are expected to reduce levels of fecal coliform in receiving waters.

METHODS

Water samples were collected weekly, from 2 July to 31 July 01, from 23 study sites located along the northern tributaries of Otsego Lake (Figure 1). (The study was limited to one month because of the failure of incubating equipment). Streams from which water was taken included White Creek, Cripple Creek, Hayden Creek, Shadow Brook, and the stream draining Mount Wellington. The samples were collected in autoclave-sterilized bottles and brought back to the lab in coolers with ice for immediate analysis using the membrane filter technique (APHA, AWWA, WPCF, 1989). To process the samples, water was passed though sterile .45-micron membrane filters using a low pressure vacuum pump and sterile filter

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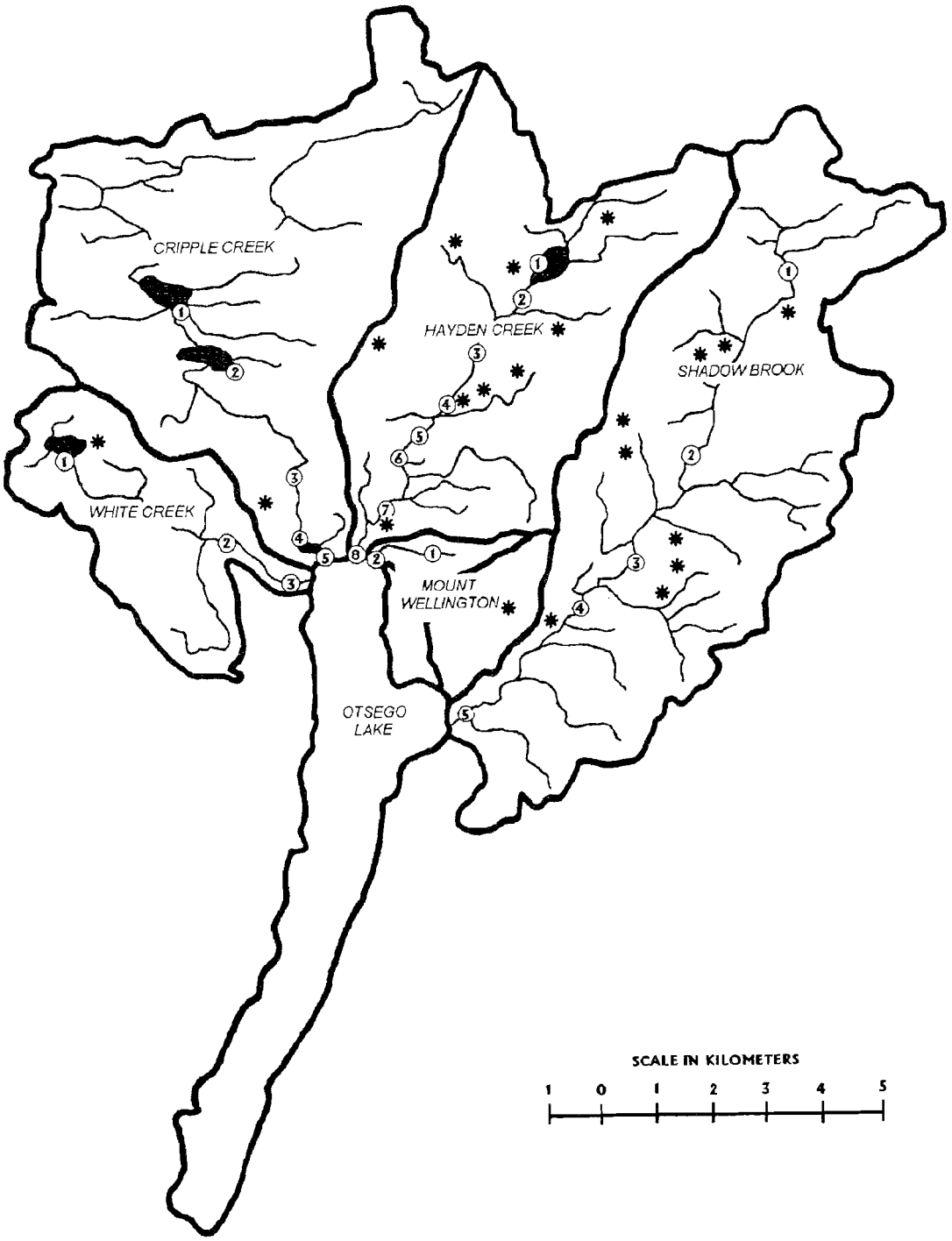

Figure 1. Northern Otsego Lake watershed showing drainage basins, sampling sites (numbers) and completed agricultural BMPs (asterisks).

funnels. Filters were handled with forceps sterilized in 90% ethyl alcohol, which was then burned off. These filters were then placed in sterile culture dishes along with absorbent pads saturated with culture medium made from a commercial dehydrated broth base (Bacto™ m FC Broth Base) specific for this procedure. For the first week's sampling, 1 ml, 10 ml, and 50 ml samples of water were filtered in triplicate for each site. In addition to these nine cultures, an additional blank culture was run at the beginning of each series to demonstrate aseptic conditions. In between the filtering of each series of sample water, the filtering apparatus was sterilized in alcohol, which was then rinsed with tap water and again with dilution water. The quantities of water filtered were adjusted for each site in the second week to maximize the probability that optimal results, 20 – 80 colonies per filter (Miller, 1997), would be yielded.

After completion of the filtering process, all culture dishes were wrapped in parafilm to prevent leakage and then placed in a Precision™ coliform water bath for 24 hours, plus or minus two hours. The water bath was maintained at a temperature of 44.5 +/-0.2° C. At the end of this incubation period, the dishes were removed from the bath and individual colonies on the cultures were counted. These quantities were recorded as colonies per 100 ml and later analyzed. Before disposal the cultures were sterilized in an autoclave for safety reasons.

RESULTS

Results are provided in full in Table 1. Graphical representations of the data from individual streams are shown in Figures 2-6. The results of associated studies from 1996, 1997, and 1998 are also displayed on these graphs for the purpose of comparison (Miller, 1997; Pasquale, 1998; Ingraham, 1999). Unfortunately, fecal coliform concentrations at these sites were not analyzed in 1999 or in 2000, with the exception of the work done along Hayden Creek in 2000 (Green, 2001). Therefore, no clear trends can be established since the data are interrupted. However, concentrations this year were generally lower than they have been since 1996. This is most evident in Hayden Creek and the stream draining Mount Wellington. Agricultural BMPs have been implemented in both those basins.

DISCUSSION

Generally, fecal coliform concentrations at these sites showed little variability over time. The only weekly trend that can be found is that the fecal coliform concentrations on July 31st were quite low, with the exception of the stream draining Mount Wellington. This is probably due to the extended dry period that took place late in July.

The study would have been extended by two more weeks into August, but technical difficulties were experienced. The vast majority of the culture dishes from the week of 6 August were devoid of bacterial colonies. After multiple batches of culture dishes including a couple of test series turned out blank, it was discovered that the hot-water bath had malfunctioned. Although the digital display read 44.5º C, the actual temperature of the water was approximately two degrees higher. In addition to this, de-ionized water, which had passed through copper pipes, was being used in the lab. Copper is highly bactericidal, so any copper which had leeched into the water could have affected the experimental results. The

site	Distance from source (km)	07/02/2001*	07/10/2001*	07/18/2001*	07/24/2001*	07/31/2001*	Overall Summer Average*
CC1	6.75	18	13.7	14	10	14	13.94
CC2	8.2	17.4	36	11.7	22.5	8	19.12
CC3	13.27	188	142.6	154.6	893	108	297.24
CC4	14.51	152.6	300	330	373	473	325.72
CC5	14.85	487	170	127.4	4.6	21	162
CC-avg		*172.6*	*132.5*	*127.5*	*260.6*	*124.8*	*163.6*
HC1	2.2	45.4	10.3	7.3	10.7	29	20.54
HC2	2.87	143.4	76.7	70.7	95	183	113.76
HC3	3.46	540	573	673	970	373	625.8
HC4	5.44	223	277	437	1223	820	596
HC5	6.22	283	430	1023	186	203	425
HC6	6.96	250	303	540	247	180	304
HC7	8.08	290	617	383	543	173	401.2
HC8	9.2	483	427	623	158	193	376.8
HC-avg		*282.2*	*339.3*	*469.6*	*429.1*	*269.3*	*357.9*
MW1	0.8	240	162.6		400	1517	579.9
MW2	1.18	11900	36300	4730	6070	5570	12914
MW-avg		*6070*	*18231.3*	*4730*	*3235*	*3543.5*	*7162*
SB1	2.05	370	320	677	703	254	464.8
SB2	7.09	1570	500	920	5530	640	1832
SB3	9.99	1057	1003	1237	202	114	722.6
SB4	11.71	1900	883	3000	3370	2200	2270.6
SB5	14.07	2300	483	2670	160	185	1159.6
SB-avg		*1439.4*	*637.8*	*1700.8*	*1993*	*678.6*	*1289.9*
WC1	1.1	28.6	8	11	2.3	1	10.18
WC2	4.22	327	273	287	927	680	498.8
WC3	6.4	64.6	57.7	111.4	92	40	73.14
WC-avg		*140.1*	*112.9*	*136.5*	*340.4*	*240.3*	*194.04*

** Colonies per 100 ml*

Table 1. Fecal coliform concentrations in Cripple Creek (CC), Hayden Creek (HC), Mount Wellington (MW), Shadow Brook (SB) and White Creek (WC), summer 2001.

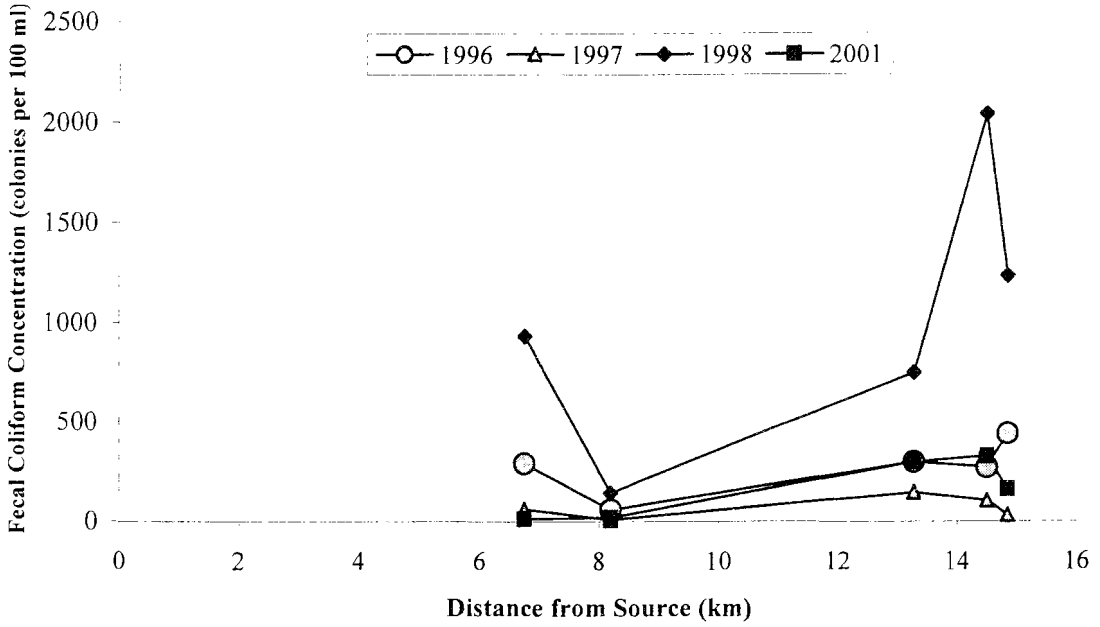

Figure 2. Mean summertime fecal coliform concentrations in Cripple Creek, 1996 (Miller, 1997), 1997 (Pasuale, 1998), 1998 (Ingraham, 1999) and 2001.

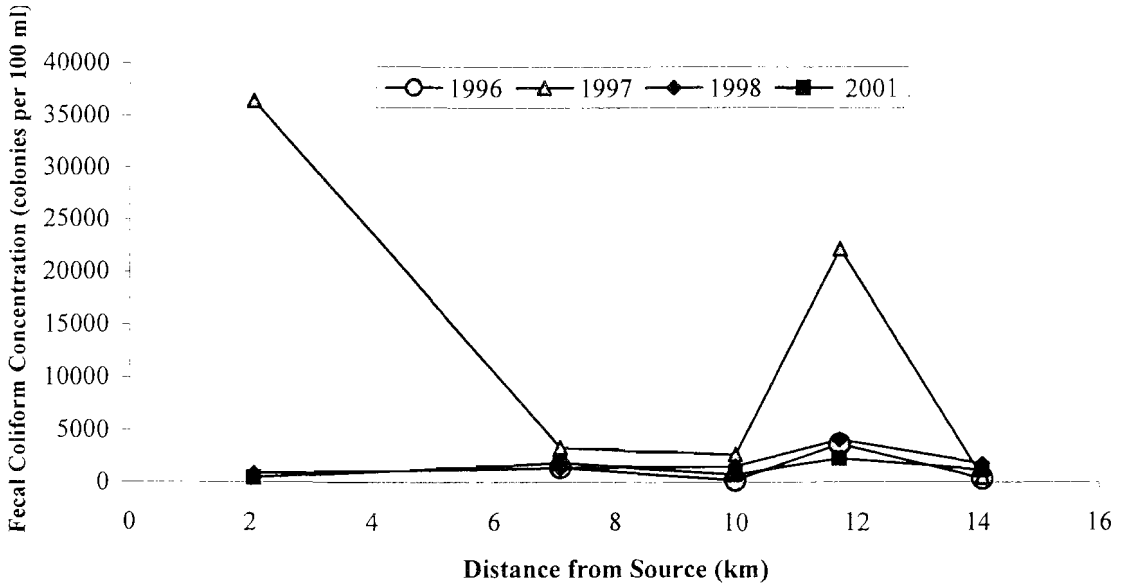

Figure 3. Mean summertime fecal coliform concentrations in Shadow Brook, 1996 (Miller, 1997), 1997 (Pasuale, 1998), 1998 (Ingraham, 1999) and 2001.

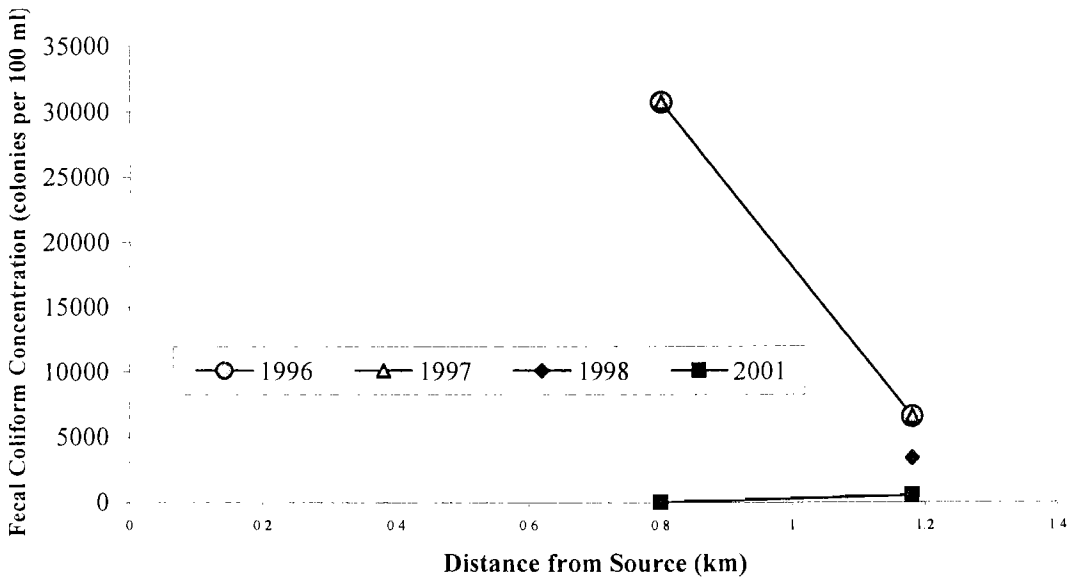

Figure 4. Mean summertime fecal coliform concentrations in Mount Wellington, 1996 (Miller, 1997), 1997 (Pasuale, 1998), 1998 (Ingraham, 1999) and 2001.

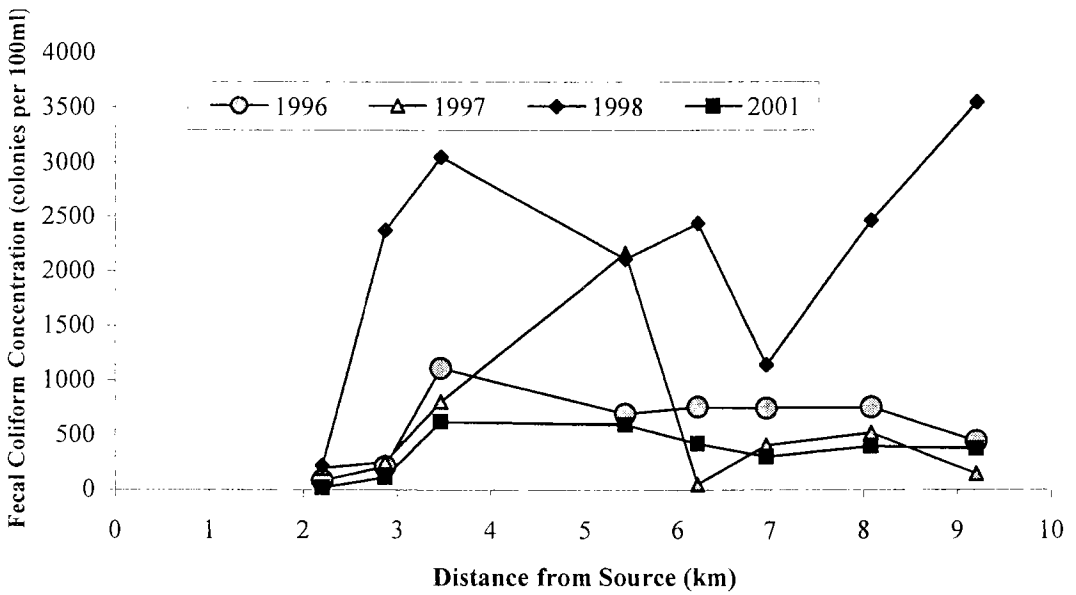

Figure 5. Mean summertime fecal coliform concentrations in Hayden Creek 1996 (Miller, 1997), 1997 (Pasuale, 1998), 1998 (Ingraham, 1999) and 2001.

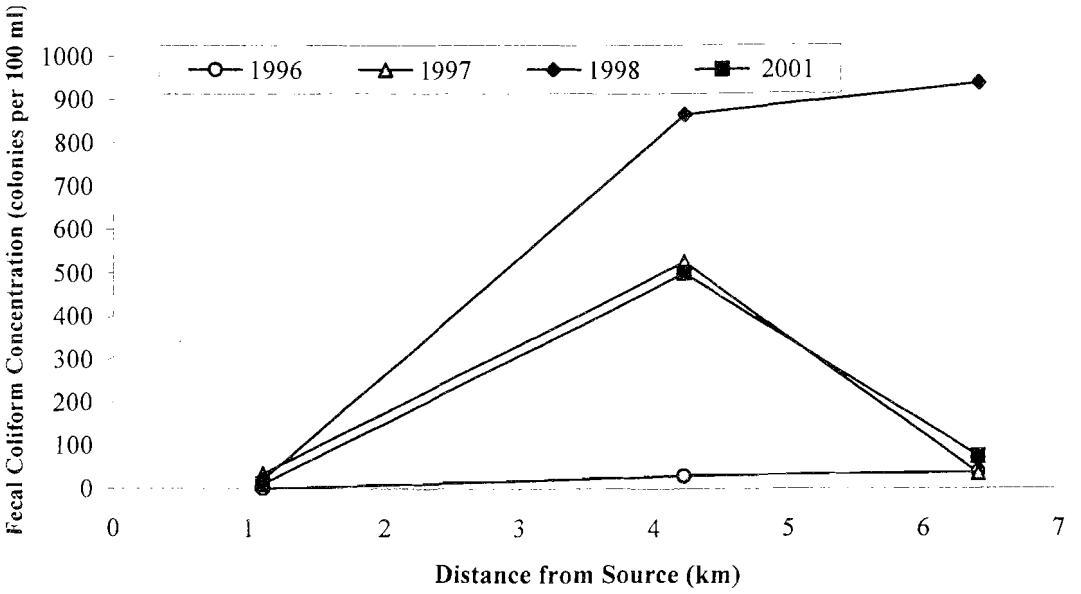

Figure 6. Mean summertime fecal coliform concentrations in White Creek, 1996 (Miller, 1997), 1997 (Pasuale, 1998), 1998 (Ingraham, 1999) and 2001.

problem was corrected when the water bath was re-calibrated, but by that time it was too late to collect any more data for the project.

The primary purpose of this project was to monitor the watershed for specific pollution sources that are controllable through mitigation. These include malfunctioning septic systems or manure runoff. Left unchecked, those sources could contribute substantially to nutrient loading to Otsego Lake. This summer, concentrations were relatively stable, both spatially and temporally. However, fecal coliform levels should continue to be monitored in the future in case something requiring attention does occur.

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