



Microbial Source Tracking at Goderich Beaches

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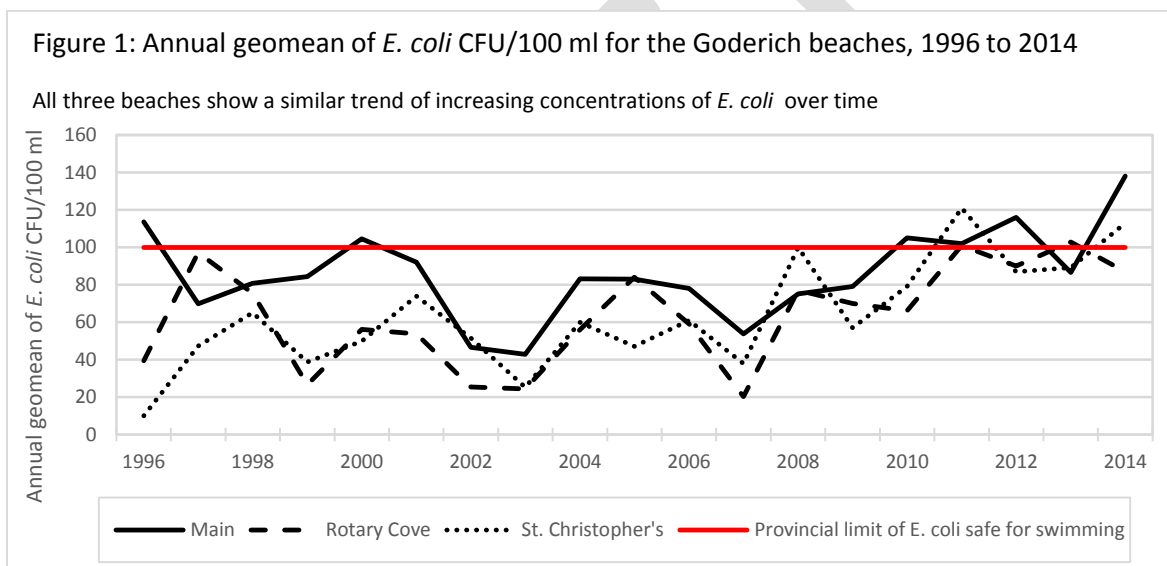
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Summary

In a survey to determine the source(s) of *E. coli* in the water at the three Goderich beaches, the Huron County Health Unit submitted six water samples taken in August 2014 to Source Molecular Corporation for microbial source tracking. Six hosts (gulls, geese, birds, cows, dogs and humans) were selected as possible contributors of *E. coli* in the beach water. The results of the microbial source tracking identified gulls as major contributors. The other five hosts were not identified as contributors, however, they cannot be ruled out as possible contributors because only six water samples were tested. Other hosts not tested for, such as chickens or deer, may also contribute to the *E. coli* in the beach water. Based on the findings of the survey, measures implemented to reduce or prevent the presence of gulls at the three Goderich beaches would contribute to the reduction in the concentration of *E. coli* in the beach water.

Background

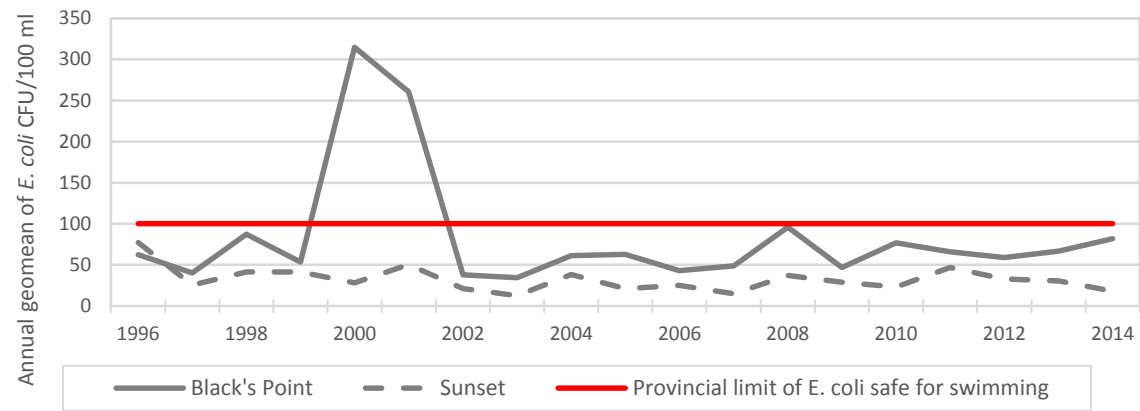
Water quality at the three Goderich beaches has been deteriorating; the concentration of *E. coli*, an indicator organism, is increasing (see Figure 1), indicating a need to identify and address the source(s) of *E. coli*. The presence of *E. coli* in beach water indicates the possible presence of other disease-causing organisms. The Goderich beaches are popular swimming destinations for Huron County residents and tourists. Improving water quality at the beaches is important to ensure swimmers do not become ill. To help form a plan to improve water quality, more information was needed on the source(s) of the *E. coli*. The Huron County Health Unit used microbial source tracking to identify whether humans and/or animals were contributing to the concentration of *E. coli* in the water at the Goderich beaches.



Examining the trend in *E. coli* concentrations at Goderich and neighbouring beaches provides useful information. The increasing *E. coli* concentration was similar at all three Goderich beaches. This indicates the *E. coli* at the Goderich beaches may be coming from similar sources and influenced by similar factors. Neighbouring beaches (Black's Point and Sunset) do not have the same trend of increasing *E. coli* concentrations (see Figure 2). This suggests that the combination of *E. coli* source(s), and factors influencing its concentration, may be unique to the Goderich beaches.

Figure 2: Annual geomean of *E. coli* CFU/100 ml for beaches south (Black's Point) and north (Sunset) of the Goderich beaches, 1996 to 2014

Black's Point and Sunset beaches do not have the trend of increasing *E. coli* concentrations seen at the Goderich beaches



Research literature indicates possible sources of *E. coli* at the beaches and factors that can influence its concentration. Possible sources include,

- Storm drains
- Septic systems
- Rivers
- Groundwater
- Birds
- Swimmers
- Naturally occurring *E. coli*

Some of the factors that can influence *E. coli* concentration include,

- Water clarity (turbidity)
- Rainfall
- Shape of the coast line
- Lake level

For more information on sources of and influences on *E. coli* concentration in beach water, refer to the 2014 Huron County Health Unit Beach Water Monitoring Report at www.huronhealthunit.ca. Sources and factors were examined to determine the cause(s) of the rise in the concentration of *E. coli* at the Goderich beaches.

Birds, animals, and humans identified as possible contributors to the increasing *E. coli* concentrations at the Goderich beaches. Bird were identified as the most likely contributor. Observations made by Huron County Health Unit beach water monitoring students over several years indicate the gull and Canada goose populations may be increasing at these beaches. Although it is likely that the other sources listed in Table 1 contribute to the *E. coli* concentrations, there is no evidence to suggest that their contributions have been increasing over the years. This analysis informed the selection of hosts for the microbial source tracking.

Funding

Funding for the survey was provided by the Ontario Ministry of Health and Long Term Care through its Enhanced Safe Water Initiative.

Microbial Source Tracking Method

Microbial source tracking involves extracting DNA from bacteria in a water sample and comparing it to DNA from possible hosts such as gulls and cows (see Figure 3).

Water samples collected throughout August 2014 from the three Goderich beaches were couriered to ALS Global Laboratory located in Waterloo, ON where they were filtered and stored at a temperature of minus 80 degrees Celsius. At the end of the swim season, six samples (Table 1) with elevated concentrations of *E. coli* were sent to Source Molecular Corporation located in Miami, Florida, USA for microbial source tracking (Very few laboratories conduct microbial source tracking of beach water). The number of water samples and the numbers of likely contributors chosen for microbial source tracking were limited by the available funding.

Figure 3: Overview of microbial source tracking method used by Source Molecular Corporation, 2014

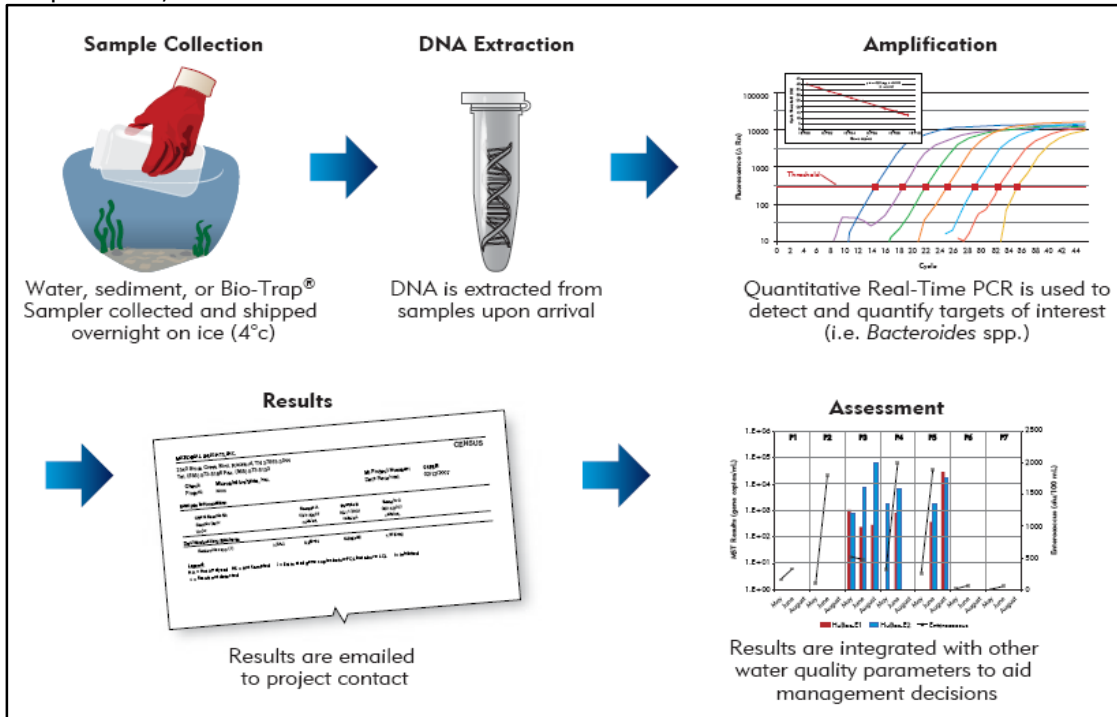


Table 1: Water samples used for microbial source tracking

Date	Beach site (5 sample sites at each beach)
Aug 13	Main - site 3
Aug 13	Rotary Cove - site 3
Aug 13	St. Christopher's - site 3
Aug 20	Main - site 3
Aug 25	Main - site 3
Aug 27	St. Christopher's - site 3

Selection of Hosts

Six hosts were selected as possible contributors of *E. coli* at the three Goderich beaches. Three bird hosts were chosen because our records indicate that the gull and Canada goose populations are likely increasing as the water quality is deteriorating. Human and dog hosts were selected because, if identified as contributors, they would indicate possible impacts through storm drains and/or septic systems within Goderich that were not properly decommissioned. The cow host was selected because, if identified as a contributor, it would indicate whether farm runoff into the Maitland River was impacting the Goderich beaches. The cow host was selected instead of another

farm animal host because it would include runoff from pasture land and runoff from fields on which cow manure was spread.

Results

A host could be a major or minor contributor of *E. coli*, or not be identified as a contributor (absent.) The results of the microbial source tracking indicate that gulls were the only hosts contributing to *E. coli* at the three Goderich beaches for the samples analysed. Canada geese, birds (generic), cows, dogs, and human contributors of *E. coli* were identified as absent (Tables 2 to 7).

Table 2: Results of tests to detect whether *E. coli* from gull feces was present and whether it was a major or minor contributor to the *E. coli* concentration

Date	Beach site	Contribution of fecal matter to <i>E. coli</i> concentration
Aug 13	Main - site 3	Major contributor
Aug 13	Rotary Cove - site 3	Major contributor
Aug 13	St. Christopher's - site 3	Major contributor
Aug 20	Main - site 3	Major contributor
Aug 25	Main - site 3	Major contributor
Aug 27	St. Christopher's - site 3	Major contributor

Table 3: Results of tests to detect whether *E. coli* from Canada goose feces was present and whether it was a major or minor contributor to the *E. coli* concentration

Date	Beach site	Contribution of fecal matter to <i>E. coli</i> concentration
Aug 13	Main - site 3	Absent
Aug 13	Rotary Cove - site 3	Absent
Aug 13	St. Christopher's - site 3	Absent
Aug 20	Main - site 3	Absent
Aug 25	Main - site 3	Absent
Aug 27	St. Christopher's - site 3	Absent

Table 4: Results of tests to detect whether *E. coli* from bird feces was present and whether it was a major or minor contributor to the *E. coli* concentration

Date	Beach site	Contribution of fecal matter to <i>E. coli</i> concentration
Aug 13	Main - site 3	Absent
Aug 13	Rotary Cove - site 3	Absent
Aug 13	St. Christopher's - site 3	Absent
Aug 20	Main - site 3	Absent
Aug 25	Main - site 3	Absent
Aug 27	St. Christopher's - site 3	Absent

Table 5: Results of tests to detect whether *E. coli* from cow feces was present and whether it was a major or minor contributor to the *E. coli* concentration

Date	Beach site	Contribution of fecal matter to <i>E. coli</i> concentration
Aug 13	Main - site 3	Absent
Aug 13	Rotary Cove - site 3	Absent
Aug 13	St. Christopher's - site 3	Absent
Aug 20	Main - site 3	Absent
Aug 25	Main - site 3	Absent
Aug 27	St. Christopher's - site 3	Absent

Table 6: Results of tests to detect whether *E. coli* from dog feces was present and whether it was a major or minor contributor to the *E. coli* concentration

Date	Beach site	Contribution of fecal matter to <i>E. coli</i> concentration
Aug 13	Main - site 3	Absent
Aug 13	Rotary Cove - site 3	Absent
Aug 13	St. Christopher's - site 3	Absent
Aug 20	Main - site 3	Absent
Aug 25	Main - site 3	Absent
Aug 27	St. Christopher's - site 3	Absent

Table 7: Results of tests to detect whether *E. coli* from human feces was present and whether it was a major or minor contributor to the *E. coli* concentration

Date	Beach site	Contribution of fecal matter to <i>E. coli</i> concentration
Aug 13	Main - site 3	Absent
Aug 13	Rotary Cove - site 3	Absent
Aug 13	St. Christopher's - site 3	Absent
Aug 20	Main - site 3	Absent
Aug 25	Main - site 3	Absent
Aug 27	St. Christopher's - site 3	Absent

Discussion

The results of the survey indicate that gulls are a likely contributor of *E. coli* in the water at the three Goderich beaches, however, other sources cannot be ruled out because only six samples were analyzed. Other sources of *E. coli* may be identified at the Goderich beaches if more samples were analyzed throughout the swim season under different weather conditions.

Reducing or eliminating the presence of gulls at the beaches would contribute to the reduction of *E. coli* in the beach water. Municipalities in North America have used a variety of methods to try and reduce the number of gulls at their beaches. These methods can be categorized as harassment, exclusion or population reduction.

Harassment techniques such as predator and distress calls, predator models and pyrotechnics have had limited success (Koski & Knzelman, 2010). While they may be effective for a short period of time, the gulls quickly adapt and ignore the harassment. Harassment using dogs or remote controlled planes only work while the dog or the plane is active. As soon as the dog or plane leaves, the gulls return.

Artificial exclusion techniques such as fencing around a beach, a buoy system in the water, and/or elevated overhead wires have been successful in reducing the gull population at beaches (Koski & Knzelman, 2010). The Cities of Ottawa and Hamilton have seen improved water quality at beaches after the installation of overhead wires and/or buoys (Koski & Knzelman, 2010). Natural exclusion techniques involving the restoration and preservation of dunes and dune grass have also been successful in reducing gull populations at beaches. Gulls are more likely to avoid areas that may hide a predator. Racine, Wisconsin found fewer birds in areas with more dunes and dune grass (Koski & Knzelman, 2010).

Chicago Park District used oiling of gull eggs to reduce the number of gulls at their beaches (Hartmann, Beckerman, Engeman, and Seamans, 2013). Oiling eggs prevents them from hatching, leading to fewer gulls. Chicago saw a reduction in the number of gulls, and an improvement in water quality, at their beaches. Although this method prevents gull eggs from hatching, it will not prevent the presence of gulls from other areas on the beaches.

Population reduction can be achieved by hunting gulls or oiling eggs in the nest, however, permits are required. Gulls are a protected species in Canada and in the United States. so permits must be obtained from several levels of government before hunting or egg oiling can take place.

The Goderich beaches are an ideal location for gulls because of the food availability (grain elevators, beach patrons feeding them) and the break wall protection. This means any efforts to remove or deter gulls from the beaches will need to be sustained every year throughout the swim season.

Limitations

The results of the microbial source tracking only apply to the six samples analysed and the six hosts selected. One or more of the hosts listed as absent in this survey (dogs, humans, Canada geese, cows, generic birds) may have been present on days not tested. One or more hosts not tested for (e.g. chickens, pigs, raccoons, and deer) may have been present in the six samples analyzed for this survey.

References

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Report to the Chicago Park District on conflicts with ring-billed gulls and the
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- Koski, A. and Kinzelman, J. (2010). A review of best management practices
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Commission. Report available upon request.

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