Research & Science Note 7

Microbial Source Tracking of Fecal Coliform Bacteria in the Milk River

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Background

The MRWCC initiated the project to address the increased public concern regarding potential sources of fecal contamination in a few locations on the Milk River.

The most visual and publicly scrutinized site has been at Writing on Stone Provincial Park (WOSPP); being a public beach site operated by the provincial government, it is sampled weekly by park staff and analyzed at the Provincial Health Lab where it's monitored for total coliform. The beach has been subject to occasional health risk advisory due to E. coli concentrations which exceed recommended guidelines for recreation.

The local farming and ranching community has been implicated for the perceived problems, though little to no work had been previously done to characterize the concerns.

In response, the MRWCC approached Alberta Agriculture and Rural Development (ARD) to look into a potential project to investigate the concern, and research fecal contamination concerns within the watershed. This discussion lead to the establishment of a Microbial source tracking project to determine the main sources of E.coli along the Milk River, and to "fingerprint" the fecal sources detected.

The objective of this study is to identify and quantify the major sources of fecal contamination in the Milk River.

Given that water quality guidelines are driven by E. coli concentrations, this study will utilize E. coli fingerprinting as a microbial source tracking method.

Traditional water quality monitoring methods only measure the amount of fecal indicator bacteria.
They do not identify the source of the contamination.

E. coli are generally not harmful, but if high levels of these organisms are found in water, other bacteria that are harmful to humans may also be present.

Study Area and Sample Sites

The Milk River is a tributary of the Missouri River. Both the North Milk River, a major tributary of the Milk River and the Main stem Milk River originate in Northwestern Montana and flow easterly across southern Alberta. The North fork of the Milk River receives a boost in flow from a diversion of the St. Mary's River located in Montana. The confluence of the North Milk River and the Main stem Milk River is located approximately 20 km west of the Town of Milk River and is the beginning of the 240 km stretch of the Milk River . From the confluence, the Milk River then extends approximately another 230 km east where it eventually crosses back into Montana on the eastern border.

Four sites were monitored along the river as part of the project:

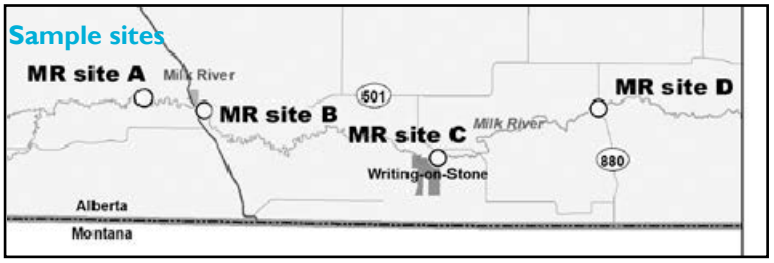
Site A - 10km west of the Town of Milk River.

Site B - lower stream below the town of Milk River.

Site C - in front of the beach at Writing On Stone Provincial Park.

Site D - above the Highway 880 bridge.

Locations were selected based on a broad range of land management practices and potential fecal sources. These locations also represent areas of interest where source tracking results would be valuable for public information or future study/investigation.



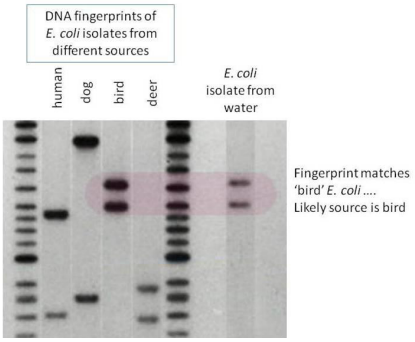
Escherichia coli (E. coli): A type of fecal indicator bacteria used to quantify fecal contamination

Methods

Microbial Source Tracking methods look for genetic matches/similarity between fecal indicator bacteria from different hosts and a contaminated site (water).

During the Summer of 2012 volunteers collected fresh, known, fecal samples in order to build a fecal DNA marker library for both livestock and wildlife sources including: Wildlife (deer, antelope, elk, geese, cliff swallows, shore birds), Cattle, Horses, Sheep, Hogs, Chickens, Humans, and Dogs.

Water samples were then collected and DNA fingerprinting was completed to determine the host species.



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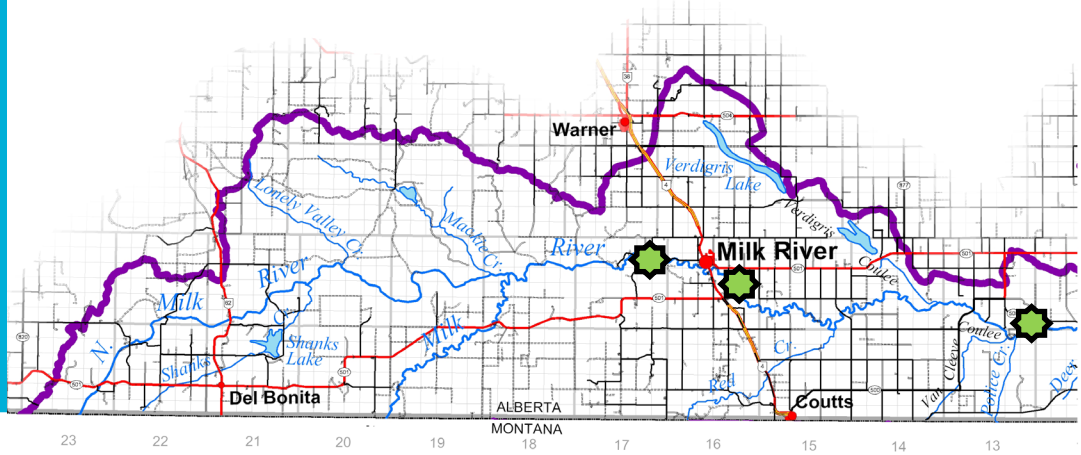
Map 1. Milk River watershed fecal source tracking water monitoring locations.



Key Findings

Results have demonstrated that the E. coli communities are not overly different throughout the 4 sample sites along the river. 'A' group, primarily Domestic Poultry and semi aquatic birds, such as shore birds and geese are very low contributors, though high numbers were being reported at the Down Stream Milk River Site. 'B2' contributors, primarily Human/Dog markers, were not a major influence below Milk River or at Writing on Stone. Over 70% of E. coli are of the 'B1' group which does contain markers for cliff swallows and livestock species groups.

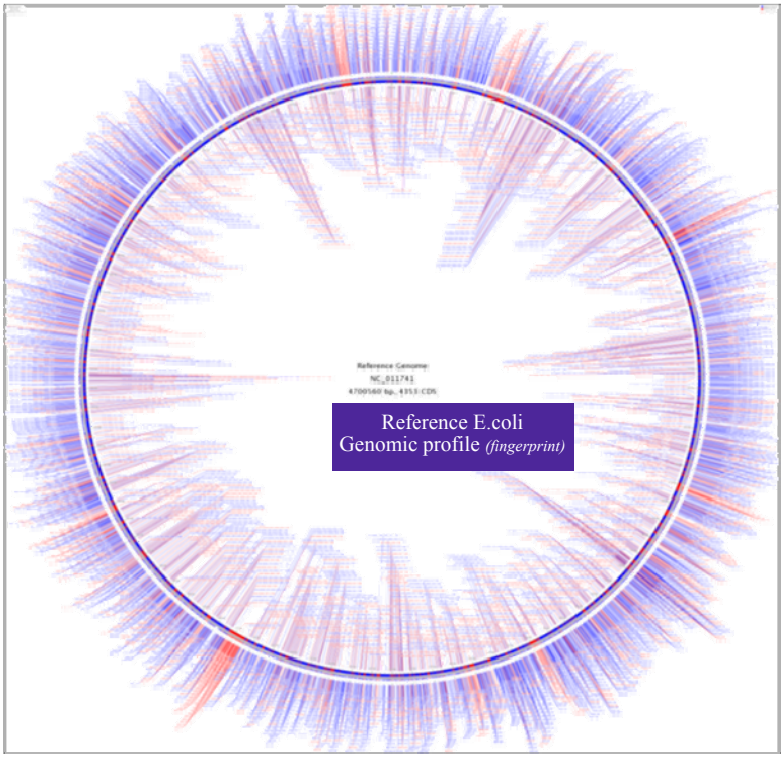
Dr. Lisa Tymensen, of Alberta Agriculture reports: of this larger group approximately 34% of environmental E. coli contamination is attributed to cattle and cliff swallows as fecal E. coli; Fecal E. coli found in the environment are indicative of recent fecal contamination. This research reassures us that less than 1/3 of fecal sources in the Milk River can be attributed to livestock and that wildlife especially cliff swallows are significant sources.

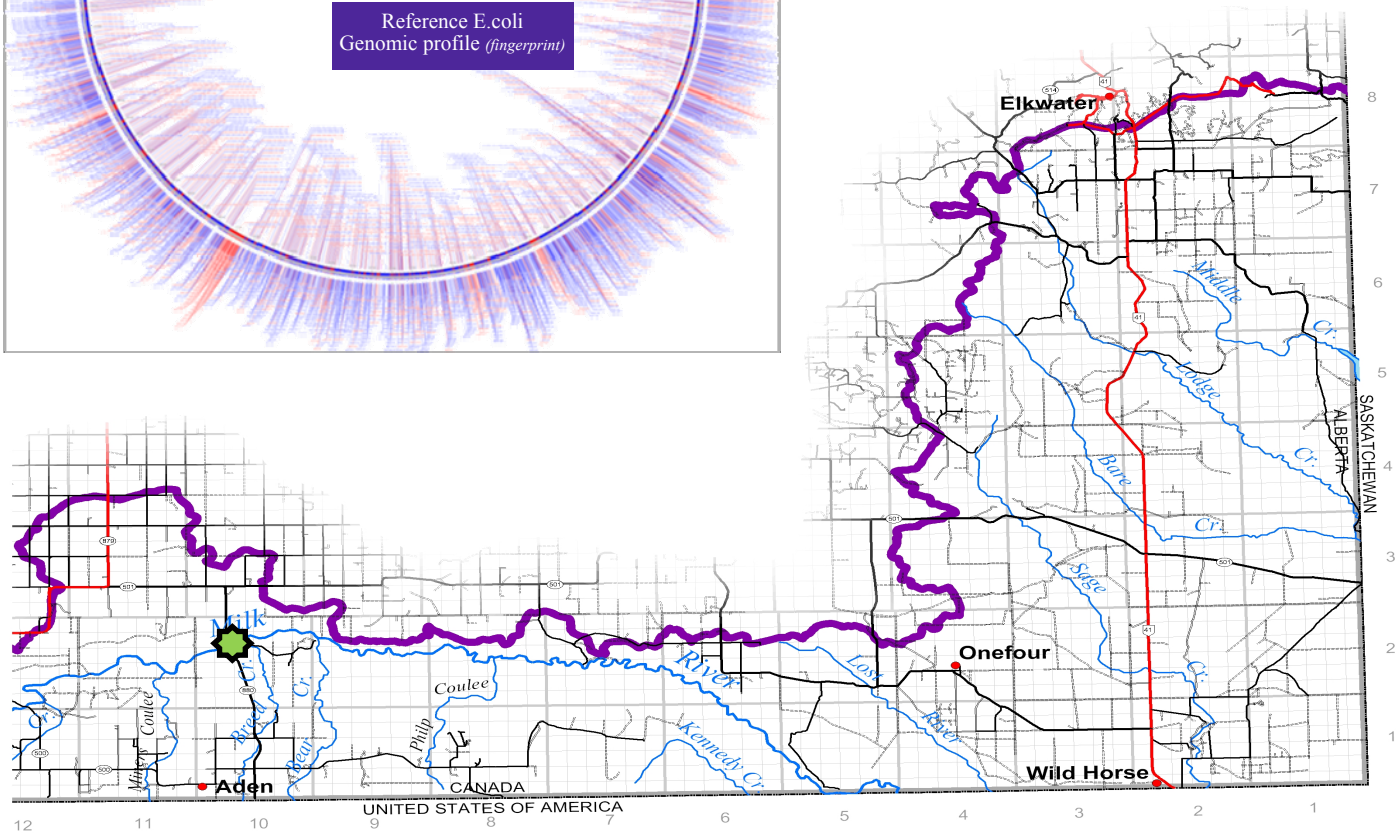
Most interesting in the sample results were the presence of over 55% of the E. coli as no host source naturalized E. coli.

It is likely that a portion of these E. coli without a host source have adapted to the water environment, and are demonstrating extended survival and possibly even growth within the turbid conditions of the Milk River.

As River temperatures increase and flows reduce in late summer months, these E. coli are expressed in higher concentrations possibly not reflecting actual contamination concerns.

Naturalized E. coli have been known to exist for over a decade, but E. coli is still considered the most reliable fecal indicator. In turn, these E. coli are not reflective of human health risk and risk to health through recreation may be over estimated.





Next Steps

The next steps in the project are to further explore the prevalence of naturalized environmental E. coli within the Milk River. The development of more timely tools to identify E. coli sources will benefit adaptive management and may have ramifications for the establishment and review of water quality guidelines based on bacterial counts.

Fecal source tracking within the Milk River watershed may also prove to be an effective tool to effectively and accurately monitor implementation of Beneficial Management Practices in targeted areas of the watershed and will address non-point source water quality concerns.

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