Working together for a healthy Elbow River Watershed

Eyes on the Elbow Vol. 2017 (3) September 2017

Research Helps Identify Sources of Old Water in the Elbow River

By Ann Sullivan

NSERC Undergraduate Research Assistantship holder Carly Doig takes measurements for velocity/depth to determine surface discharge of the Big Elbow.

Rae Glacier melts and the Elbow River runs faster. Stop the flow and the river must stop too, correct? Well, no. Although glacial extent has become smaller due to changes in climate, stream flows in the Elbow have remained similar. To Éowyn Campbell, this means that water in the river is coming not only from glacial melt but from other places as well. Finding those places is the subject of Campbell's PhD research at the University of Calgary.

Working with supervisor Dr. Cathy Ryan and funded by an NSERC Discovery Grant, Campbell is studying the "role of the river-connected alluvial aquifer (RCAA) of eastern-slopes rivers in storing and releasing water to the open stream." She hopes her research will allow for a better understanding of river water and water sustainability. For example, how many drought years can the Elbow River sustain? What is the approximate volume of stored water in the RCAA? And is water storage capacity large enough that it will adjust to varying river flow rates? Given that the Elbow supplies water to about one-sixth of Albertans, this is critical information.

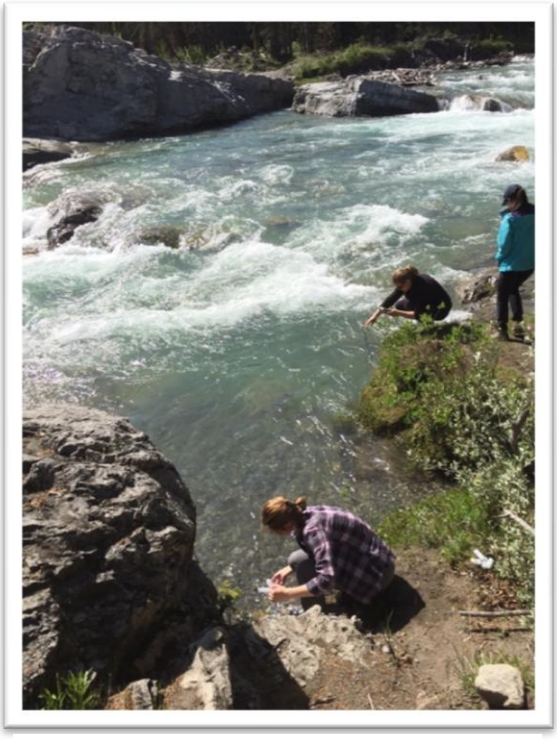
So far, Campbell has identified three places where water is likely being stored and released into the main streamflow of the Elbow: alluvial rocks, deep cracks in the mountains and hill-slope soils. "Once I know what proportion is coming from different sources," she said, "I can estimate the volume of water stored in those sources and how long those sources would last."

Since the spring of 2016, Campbell and her assistants have been collecting water samples from sites at or near the confluence of the Big and Little Elbow rivers (just downstream from Little

Elbow campground). They also sample from water pumps at Little Elbow, Beaver Flats and Gooseberry campgrounds. In May and June, they visited each site twice weekly, then returned once a week during the summer and into the late fall of 2016. This year, Campbell hopes her team will be able to sample regularly until December and then several times during the winter. After that, they'll return to the field for at least one more season to complete their data set. This spring, students in the ERWP's field school program also helped with data collection for the study, as did a citizen scientist near the hamlet of Bragg Creek. Campbell is grateful for the support.

A piezometer measures groundwater levels at the base of the Forgetmenot Ridge.

Weather and water levels have varied significantly in 2016 and 2017. Last spring the team could cross the Little Elbow in hip waders at the Little Elbow campground. This year, due to the heavy snowpack, spring water levels were so high and fast-flowing that Campbell and her team sometimes had trouble accessing their sites. High water flows even sent part of a stilling well down the Elbow River, a frustrating and expensive loss. (The equipment is marked with U of C professor Cathy Ryan's name and email address in case anyone comes across it…) After a wet early spring, though, 2017 was hot and dry. In fact, the team's sampling sites along the Elbow's tributaries, including the Big Elbow, dried up one to two months earlier than usual. One site at Ford Creek had very low flow on July 25, 2017 and none after that date. In 2016, it flowed until November 23.



Research team members Nicole Jensen, Carly Doig and Yixuan Zhou work at the sampling site at Elbow Falls.

Back at the university, Campbell uses equipment lent to her by U of C professor Scott Jasechko to analyze isotopes and determine the age and source of river water. Working with the high-tech equipment is fascinating, she said. "I work with it all the time and it still blows my mind."

So far isotopic analysis has shown water from the Big Elbow and the Little Elbow to be distinct, with different levels of sulphur and other elements. Isotopes in the Little Elbow are more negative, which means that precipitation came either from a higher altitude or colder temperatures. The Big Elbow is a lower-altitude, warmer source of water.

Campbell's initial analysis also shows very different chemistry between water stored and released from hill slopes versus flowing water. One of the best sample points in the study, she added, is at Elbow Falls, where there's no alluvial aquifer, just bedrock. "This gives us an integrated signal of everything upstream. It's a fantastic natural point."

Recent work by Dr. Jasechko and his team (2015) shows that 95 percent of water in mountain rivers is "old," meaning that it fell as rain or snow more than three months earlier. (By contrast, prairie rivers have only 70 percent old water.) Early analysis shows a similar pattern for the Elbow, although Campbell said it's too early to draw conclusions. In fact, as she said in a message in late August, "The chemical and isotopic analyses are helping me sort out where the different waters are coming from, and of course as always happens, the new data from this year are muddying last year's seemingly clear cut answers."

But, she added, "That's where the exciting part of science lies – figuring out mysteries."

Photos by Éowyn Campbell

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