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UVM leads $5.5M Arctic research project

By Candace Page, Free Press Staff Writer

Breck Bowden's latest research project was born during a helicopter ride up the Toolik River on Alaska's North Slope in 2003.

Below him, he was startled to see the pristine Toolik running a dirty gray. The chopper flew upstream until Bowden spotted the cause: On a slope above the river, tundra had collapsed into a muddy chasm. A little creek ran out of the hole, carrying a load of dirt down to the Toolik.

Bowden, a University of Vermont watershed scientist, had stumbled over more evidence of the warming Arctic climate.

"Literally, the ground opened up in front of us," he recalled of that first encounter with a thermokarst — a land collapse caused by permafrost melting deep below the tundra's surface.

This autumn, the National Science Foundation awarded Bowden and 16 colleagues at 10 institutions a $5.5 million, four-year grant to study thermokarsts in the Alaska landscape.

They'll study the frequency and patterns of thermokarsts, their effect on land and water ecosystems, and ways to predict places susceptible to land collapses. In the end, Bowden hopes, the scientists will be able to draw a picture of what the Arctic will look like in 50 or 100 years if climate warming continues unabated.

Bowden is the project's lead investigator; $1 million of the grant will come to UVM. He will study how the tons of dirt carried into rivers from thermokarsts change river ecosystems.

"Melting permafrost is a canary in the coal mine, evidence of climate change," Bowden said one day last week. "We are seeing more intense and rapid change in the Arctic than in any other biome on earth."

While thermokarsts are a natural part of the Arctic landscape, Bowden said the land collapses are happening more frequently, and are more widely spread, in the last 20 years.

In his UVM office, Bowden scrolled through photographs of buildings in Siberia, their fronts cracked like an egg by the melting of the ground beneath them.

Other photographs showed a mile-long land slip on an Alaskan hillside; in another, ground the size of a football field had been ripped away, as though by a flash flood.

"These landslides can move hundreds of thousands of tons of soil," Bowden said.

As a watershed scientist, Bowden studies the interaction of land and water. In Vermont, his research includes studies of stormwater-damaged streams in Chittenden County.

In the Arctic project, he will gather data on two ways that runoff from thermokarsts can change rivers: by adding nutrients and by burying the river bottom in silt.

When land slips redistribute trainloads of earth, they also move carbon, nitrogen and phosphorus that had been locked in the soil.

On land, the nutrients will feed new plant growth. Microbial activity in the water-soaked ground may release large amounts of methane, a potent greenhouse gas.

Nutrients will change the streams as well. Phosphorus levels in many Arctic waterways are so low they are undetectable. In earlier research, Bowden and colleagues studied what happened when they added small amounts of fertilizer to the Kuparuk River.

The results were dramatic. First, algae growth exploded; then insect life proliferated, reducing the presence of algae. But the real surprise came seven years into the experiment. Aquatic moss took over the river, growing so vigorously that in a few years it covered 80 percent of the bottom in the phosphorus-enriched reach.

Will the nutrients in runoff from thermokarsts have the same effect? That's possible, Bowden said. More likely, he said, research will show that the fertilizer effect of phosphorus and nitrogen in the runoff will be overwhelmed by the sheer volume of dirt that ends up in the river, smothering its bottom.

Bowden will be working in a place that doesn't make research easy. "You're standing on a refrigerator," he says of Alaska's North Slope, where the Toolik Lake Research Station is located.

Temperatures on a summer day can plummet from 60 degrees to below freezing in a few hours. Research sites are often a long hike over hummocky ground. Mosquitoes swarm — researchers hold contests to see who can swat the most with one blow; the Toolik Lake record is 275, Bowden said.

Nevertheless, Bowden talks in enthusiastic run-on sentences about the more than 20 years he has worked at Toolik Lake.

"You are working in one of the most beautiful places on earth with intellectually challenging peers on questions relevant to society's interests," he said.

"We hope to answer the question, if global warming continues, what will be the reaction of the landscape?" he said. "We're not making a value judgment, but if there are consequences people would rather avoid, we'll tell you what will happen if you don't take steps now."

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