Disappearing kettle ponds reveal a drying Kenai Peninsula

by Ed Berg

Photo of a kettle pond by the National Park Service.

When the glaciers left the Soldotna-Sterling area some 14,000 years ago, the glacier fronts didn't recede smoothly like their modern descendants, such as Portage or Skilak glaciers.

Rather, the flat-lying ice sheets broke up into numerous blocks, which became partially buried in hilly moraines and flat outwash plains. In time these giant ice cubes melted and formed the hundreds of lakes, ponds and shallow depressions of today's Kenai lowland. Geologists call this pitted landscape "kettle moraine" topography, and prime examples can be seen along Mackey Lake Road and along the Swanson River and Swan Lake roads on the Kenai National Wildlife Refuge.

I am trying to use the small kettle holes as barometers of global warming on the Kenai. I can see on the 1950 aerial photographs that many of the kettle small ponds are grassy pans today. Indeed, many kettles still had ponds on the 1975 air photos, and some even on the 1996 photos. It appears that the rate of drying is accelerating, especially in the 1990s.

In order to track this drying process, my vegetation crew and I started this summer to establish permanent survey plots in typical kettle holes on the refuge. We use a 5-meter-wide (16-foot) belt transect which runs from one side of the kettle to the other, generally 100- or 200-meters long. We describe the vegetation zones along the transect and collect all the plant species for identification and permanent voucher specimens.

A typical transect starts at the forest edge, passes through a grass (*Calamagrostis*) zone, into *Sphagnum* peat moss, and then into wet sedges, sometimes with pools of standing water, and then back through these same zones on the other side of the kettle. Three of the four kettles we surveyed this summer were quite wet in the middle (especially after the July rains), and we had to wear hip boots.

These plots can be resurveyed in future decades and, if I am correct, they will show a succession of drier and drier plants as the water table drops lower and lower, due to warmer summers and increased evapotranspiration. If I am wrong, and the climate trend turns around toward cooler and wetter, these plots will be under water again, as they were on the old aerial photos.

By far the most striking feature that we have observed in the kettles is a band of young spruce seedlings popping up in the grass zones. These seedlings can form a halo around the perimeter of a kettle. In a large kettle along the Funny River horse trail, we mapped the exact locations of 969 black and white spruce seedlings in the grass zones of the transect.

Seedling densities ran as high as 18 seedlings per square meter. The seedlings were mostly less than 1 foot tall, and were several years old. They probably represent a drop in the water table of several inches since the mid-1990s.

It would be nice to have some water level recording gauges in these kettles to observe seasonal water fluctuations, but woody plants like spruce and birch may be more dependable gauges in the long run. For example, July was a wet month, with rainfall being 45 percent above normal. In some kettles we could see sundew plants growing 6 inches under water. Sundews don't like this. They normally grow on moss hummocks several inches above the water, and this temporary flooding may damage or kill them.

Many tree species, however, can tolerate a few weeks of flooding with no problem, although they generally can't tolerate submergence for more than the entire growing season.

This last point leads me to an important observation about many climate-related processes on the Kenai Peninsula. I call this "the observation of unidirectional (or one-way) change." The local glaciers are an excellent example: Kachemak Bay's Grewingk Glacier has pulled back steadily from its 1858 terminal moraine by about two miles. It has never re-advanced in this period.

Similarly, as you approach spruce treeline in the Kenai Mountains, the trees become younger and younger. Treeline is rising, and seedlings can establish in places where it was too cold 100 or even 50 years ago. Furthermore, you don't see any cohorts of dead trees near treeline, which would indicate that a cold period pushed treeline back down at some point.

Likewise, of the hundreds of seedlings that we mapped in four kettles this summer, we saw very few dead ones. The seedlings were all doing real well and had never been knocked back by flooding. On a larger scale, if you hike through the peninsula muskegs, you will see small stunted black spruce trees two to three feet high.

These runt trees are usually 20 to 40 years old with very tight annual rings, indicating that they are growing on the very edge of their water tolerance.

Nevertheless, they are alive, and you see only a few dead ones. This, too, is unidirectional change, and I think that it represents a steady decade-scale drying of the muskegs.

People sometimes object to my claim that the Kenai muskegs are drying out. "Isn't this just a natural process of succession?" they ask. "Shouldn't we expect lakes and wetlands to be constantly filling in with vegetation and soil, and ultimately becoming grassy meadows or forests, regardless of climate change?"

My answer is that muskegs on the Kenai have been available for 14,000 years since deglaciation. Why is the spruce moving in today, and not yesterday? If muskegs had been recruiting trees over the last 300 years, we would see old trees (dead or alive) out in the muskegs. But we don't see them out there, and that is why I argue that something new is happening. We're drying out, and it is a one-way process, at least for now.

Ed Berg has been the ecologist at the Kenai National Wildlife Refuge since 1993. For more information about the Refuge, visit the headquarters on Ski Hill Road in Soldotna, call 262-7021 or see the website at http://www.fws.gov/refuge/kenai/.