Unearthing the flow

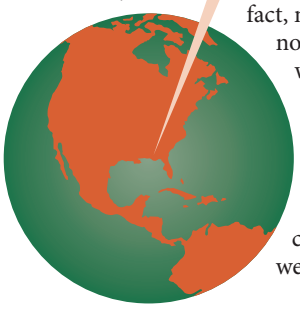
Daniel Rothman and colleagues imaged underground water and made friends with a hatchet-wielding prisoner during their attempt to understand the mechanics of stream development.

What was the objective of the work?
Most studies of stream growth concern how channels develop following the flow of water over land. However, when groundwater seeps through to the surface it can also create channels. We initially went to our Florida field-site to better understand how this often neglected process of groundwater seepage affects the shape of individual channels. Our goal of comparing our theoretical predictions and experimental results with field observations was quickly met. Yet, the beauty of the site immediately motivated investigations into how entire networks of channels evolve.

Why did you choose this particular location for the fieldwork?
We were seeking the simplest possible large-scale manifestation of channels generated by groundwater seepage. After reading a paper by Stan Schumm, of Colorado State University, on seepage channels in the Florida Panhandle, we decided to head there. We found some of the nicest examples in The Nature Conservancy's Apalachicola Bluffs and Ravines Preserve. This was especially fortunate because The Nature Conservancy provided unfettered access to the preserve.

What sorts of data were you after?
First and foremost we needed topographic data. The usual digital elevation maps were insufficiently resolved for our purposes, so we asked the National Center for Airborne Laser Mapping to construct a map of the region with a 1-metre horizontal resolution. However, we also required another kind of topographic map — one that gives the shape of the water table. For that we conducted our own ground-penetrating radar survey.

Did you encounter any difficulties?
Absolutely: a lack of field experience. In fact, most of us had no idea what we were doing! But, we had the great fortune of working with some highly experienced colleagues, and we learnt rapidly.



Daniel Rothman (left) and Kyle Straub during an early attempt to obtain ground-penetrating radar data to map the water table.

Did you have any dangerous encounters?
Almost. Inmates from a nearby prison often work on the site. We hardly ever saw them, but once one of the inmates approached some members of our group with a hatchet. As it happened, he only wanted to chat.

Any lowpoints, close misses?
Most of the data we collected are useless. Sometimes the problem was faulty equipment — our first attempt to collect ground-penetrating radar data recorded only the sign of the reflected radar wave, not its amplitude. Other times we encountered the time-honoured problem of natural variability; for example, measuring the water flux coming out of the ground in a way that is not strongly influenced by local, small-scale heterogeneities turned out to be very difficult. If the work wasn't fun we would have quit from frustration long ago.

What was the highlight of the expedition?
For a group mostly based in Cambridge, Massachusetts, it is hard to beat the pleasures of Florida in January.

Did you learn anything new about yourself or your team members?
Those of us who hadn't done fieldwork before learnt how much fun it can be, but how awfully hard it is to obtain results worth showing anyone else. The more experienced members of our group cultivated patience when working with inexperienced theoreticians.

Did the trip give you any ideas for future research projects?
Although we've learnt how to reconstruct the growth of a highly branched channel network, we do not yet understand the mechanisms through which the branching process is initiated. The Florida network provides an abundant supply of active branching events. At present we are refining our theoretical and experimental models to better understand the conditions that favour branching. We will then take our predictions to Florida to see how they stack up against the real world.

This is the Backstory to the work by Daniel Rothman and colleagues, published on page 193 of this issue.