



Tree Cookies

Understanding massive avalanches through tree records

by Devon O'Neil

In the early morning hours of April 30, 2011, an avalanche of epic fury and dimensions naturally ripped free outside Montezuma, Colo. Investigators with the Colorado Avalanche Information Center (CAIC) later measured the fracture at 800 feet wide and 10 feet deep, and the debris rumbled into the run-out zone with such force that it obliterated a high-voltage transmission tower that had been erected in the 1970s, torquing it like a pipe cleaner.

The slide's magnitude put backcountry travelers throughout the state on edge, but for snow scientists, it presented a unique opportunity to study avalanche cycles through the flora it destroyed, a lost art of sorts in disaster mitigation called dendrochronology. The practice has been used in the avalanche world since at least the 1970s and is still practiced in the western U.S., Switzerland and Canada, among other locales. Because it requires a great deal of time and work to yield useful findings, it is not particularly common. But when applied correctly and paired with GPS data and aerial photographs from past decades, it can give forecasters and engineers information they can't get anywhere else: namely, how often abnormally large slides

hit the areas where they work—and, for backcountry skiers, where they play.

Once the snow melted in 2011, Colorado State University researcher Sara Simonson and longtime CAIC forecaster Scott Toepfer hiked into the "High Voltage" slide's run-out zone with a chainsaw. They cut three-inch-thick discs out of dozens of trees killed by the slide—"tree cookies," in the parlance—and later sanded them down to examine the individual rings.

They weren't just interested in how old the trees were, although such data is revealing in its own right. (Toepfer found one snapped tree that had stood for more than 240 years, making it older than the Declaration of Independence.) Their primary focus was to identify tiny scars and reaction wood: signs of past trauma that could help them establish when the path had last seen an avalanche of similar magnitude—and when they might see one again.

"If a large avalanche happens in this spot more than once every 100 years, you might not want to build your cabin and sleep there," explains Simonson, an avid backcountry skier who has been practicing dendrochronology for 10 years.

For forecasters, extrapolating historical data that far exceeds their own tenure in a given zone can be crucial to understanding the bigger picture. Someone who has roamed the same range for 25 years, like Toepfer, may have only observed a quarter of the relevant events if he is concerned about 100-year slides.

"It's a lot of work for your return on information. But it is science, so there's always a return," Toepfer says. "These are big avalanches; they killed people in some cases. You can study the tree that the victim ended up against. It's very sobering. I can become complacent because this is what I do for a living, but this keeps me on my toes."

Toepfer and Simonson followed up their research in the High Voltage path by studying a handful of other big slides in 2012 and 2013. This past summer, they began work in the Black Widow path on Highway 6 in Summit County, which,

last season, ran larger than it had in decades.

Their findings reveal similar secrets to studies conducted elsewhere. CAIC forecaster Blase Reardon, who used tree discs to study a 4,000-foot avalanche path along Montana's Going-to-the-Sun Road in 2009, found that a Class 5 slide had taken out 150-year-old conifer stands and widened the path by 30 percent. Scars in the downed tree rings indicated there had been other large slides in the preceding century, he says, but nothing quite so destructive.

"We had GPS locations of where the trees were snapped so we could draw maps and say, 'Well, in 1979 the slide went no farther than this, because only the trees above this location show damage,'" Reardon says. "But in 1956 there was a big event because all the trees down the path show damage."

In addition to the engineering applications—where to build roads and railways and erect transmission lines—and the visual reminder that comes from trudging through annihilated forests, Toepfer uses the discs to teach elementary students about an avalanche's force and, just maybe, make them think twice about a future decision in consequential terrain.

"When these kids grow up and they're chasing their buddies or their mom or their dad into the backcountry, they have a greater appreciation for the fact that avalanches are destructive," Toepfer says. "I truly believe that. When they put their hands on these tree cookies, they understand."

[photo] Cookie monster Sara Simonson in front of the High Voltage slide. **Scott Toepfer**