



## Predicting summer stream flows requires dangerous high-altitude expeditions in late winter and early spring.

By Hal Herring

**T**he lynx was a smoke-colored spirit-figure, perched on the bleached yellow carcass of the old bull elk, which lay on the ice of the North Fork of the Sun River. As we skied closer up the wind-scoured surface of the river, the ghostly cat detached itself from the carcass and disappeared in fluid leaps up an overhanging wall of snow and into a small copse of firs. We stopped on the ice to admire the bull, dead of starvation or old age, and to study the torn hide and deep furrows in the neck muscles where the lynx had been rasping away the frozen meat with its tongue. The bull's antlers were massive, mahogany and ivory, spattered with the white guano of jaybirds and magpies that had perched there, waiting for some stronger predator to open the hide to the nourishing meat and spider-web patterns of fat within. I tried to take a photo, but my camera was frozen.

We were on the first day of the annual Bob Marshall Wilderness snow survey in late February, and the temperature was staying steady at minus 12 degrees F. during the middle of the day. All around us, the great valley of the

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**TRUDGERY** Snow surveyors follow a backcountry "snow course." At sites along the way, they stop and measure snow depth and snow water content—information federal forecasters will later use to determine summer stream flows for fish and irrigation.

North Fork yawned, an arctic vastness locked beneath more than 4 feet of snow beginning to blow and billow before the razor-slash of a bitter north wind. We crossed the river, side-stepped up the banks, and kept moving, single file, following Russ Owen—in his early 40s the strongest and youngest among us—breaking trail through wind-crusted powder. Nobody spoke, since all breath was needed for driving the skis forward across the expanse. It was 12 miles or so up Goat Mountain to the survey site and then back across the valley to Cabin Creek, where a U.S. Forest Service cabin waited like a friendly island with food, woodstove, and sleeping bags. We had a 75-mile loop to make, three snow courses to sur-

vey, and five days to do it all.

For safety, wilderness snow surveys require at least four people. This one had Kraig Lang, the longtime backcountry ranger for this part of the wilderness; Bill Avey, supervisor of the Helena and Lewis & Clark National Forest, who was seeing this part of his work area for the first time; trailbreaker Russ of Choteau, a wildland fire specialist; and me, a volunteer and writer/layabout who lives in the group's launch point of Augusta. Kraig had done this survey loop almost 40 times, three times per year, in February, March, and April, for the past 13 years. The surveyor before him, Ray Mills of Choteau, completed his 100th loop the year he retired.

Our job was to help determine how much water will come down the North Fork of the Sun River, go into Gibson Reservoir, and be available for maintaining fish survival as well as irrigating the agriculture that turns the wheels of this part of Montana's economy. In particular, this wilderness snowpack will provide the water for the 83,000 acres or so of the Greenfields Irrigation District, which in turn makes the small town of Fairfield the celebrated "Malting Barley Capital of the World." Anheuser-Busch is the major buyer of the crop, so every American who hoists a cold Budweiser at the end of the workday can toast the visionaries who, in 1897, created one of the nation's first

national forests here, and also toast the wild and jumbled Rocky Mountain Front itself, as well as the howling blizzards like the one we found ourselves caught in.

The Goat Mountain snow survey site predates the 1964 creation of the Bob Marshall Wilderness and was originally accessed by helicopter. Because wilderness designation prevents motorized use, this survey turned into a cross-country skiing adventure. In the half-shelter of the timber, I stopped to put on my skins (long strips of fabric backed with glue that you stick to the bottoms of your skis so you can climb uphill without slipping). I soon found myself left far behind by my more experienced, skin-less companions, who had backcountry ski skills I had yet to master. By the time I caught up, Kraig and Russ were assembling a 10-foot, 1.5-inch-diameter tube from the survey kit. The tube, called a "corer," has a serrated lip that cuts a core sample through the snow to the ground below. The snow depth is recorded, but more important is the water content of that snow, determined by how much the core sample weighs. We hung a little scale from a ski pole and recorded the sample, giving us a good idea of how much water was in the snowpack. We proceeded on to a series of nine more stations, called the "snow course," Russ making notes and calculations in a small waterproof notebook, hunching over the pages to shield them from wind and blowing snow.

### "Bitter water war"

The snow-sampling system is an idea of simple genius, invented by a visionary pragmatist. In 1906, James E. Church was an athletic Michigander with a wandering intellect and

feet to match. Church was educated in Germany, and made his living as a professor of Latin, German, and the fine arts, but his true passions lay in the studies of science and weather. While teaching at the University of Nevada, he established one of the nation's first high-altitude weather stations, at 10,785 feet on the summit of Mount Rose, the tallest peak in Nevada's Carson Range. At the time, California and Nevada were engaged in what was described as "a bitter water war" over rights to the Truckee River and Lake Tahoe. Church was among the first to try to understand, before the irrigation season began, how much water could be expected from those critical irrigation sources. His tools, which he invented, were the corer (marketed as, and still called, the "Mount Rose Snow Sampler"), the scale, and "the snow course," a series of measuring sites that vary by aspect and elevation, exposure, and shade. Taken as a whole, the tools create a critical picture of the coming flood and irrigation season.

Church's system was adopted across the West. In 1935 the USDA's Natural Resources Conservation Service (NRCS) created the Snow Survey and Water Supply Forecast. It now includes 900 manual snow courses as well as 750 automated Snowpack Telemetry Weather Stations (SNOTEL) across 13 western states including Alaska, mostly in high mountain watersheds. SNOTEL stations automatically deliver snowpack and water equivalent information to the NRCS via VHF radio signals, but manual snow courses in wilderness areas are still monitored by humans (which is what my companions and I were doing). Church's system adds up to a huge collection of information about the one thing the arid West cannot survive without. For snow surveyors, it means a lot of time in high mountain weather during late winter and early spring. Following snow courses in wilderness areas



**WATER FORECAST** Backcountry snow surveyors follow set courses, using corers and scales invented by James E. Church in the early 1900s to sample snowpack.

like the Bob Marshall requires skiing and snowshoeing in February and March, and then hiking and horseback riding in April during low-snow years. It's a job many people come to love—despite the hard work and unpredictable, even dangerous weather. As Kraig once told a reporter who asked about his winter work, "I spend three weeks of the month dreaming about one week of the month."

### Mashed potatoes

On day four we left Gate's Park for Wrong Creek, dawn light under strange skies and tendrils of clouds traveling at warp speed on a south wind. The upper snowpack went to heck under a grim sun and 40-degree temperatures, and it was like trying to ski in coarsely mashed potatoes, our clothes soaked from sweat and melted snow. We worked the snow course without talking, ate too lightly in the heat, and scattered out on the return, our hunger sucking away all grandeur from the landscape, rendering it a lonesome monotone of white and gray. The barometer must have been on a roller coaster, as we watched and felt the cold front move in.

By dawn it was minus 22 degrees, and blowing hard from the north again. The track we'd made coming up the valley was wiped away, the mashed potatoes now a fine powder that moved in hallucinatory patterns around our knees. I zipped up my windjacket and tightened my hood. When I exhaled, my trapped breath frosted my sunglasses with blinding rime. We had another survey site to visit that day, and it was 16 miles away. 🐾



**GENIUS** Left: James E. Church in 1920. Above: USDA snow course markers are posted at all 750 snow course sites in western states.

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