ASARC Retrospective – Sequel to the Prequel

Bruce Jamieson

"So what is the risk?" I asked?

It was 1998 and ASARC's first two graduate students, Greg Johnson and Crane Johnson, and I were on the Connaught Creek trail and ready to cross the Grizzly Slide runout. One said "Low" and the other said "Very low".

"But is it 1 in 1000, 1 in 100,000? What is the probability of one of us getting hit or killed crossing this runout?" None of us knew the answer, but it signalled ASARC's interest in risk-based decisions and quantifying backcountry avalanche risk. The closest we came to answering that question was in an ISSW 2009 paper (Jamieson et al., 2009). However, that paper simplified terrain so much that the results only applied to "centre-punching" start zones. (The associated video is called: Considerable avalanche danger – How much riskier is it?) Nevertheless, the risk framework in that paper is useful. Alexandra Sinickas, Pascal Haegeli and I are currently using it to analyze data from backcountry skiing operations.

Perimeter cracks, about 5 cm high, caused by skiers causing a thick weak layer to collapse in the Rockies. Antonia Zeidler in the foreground, Dave Gauthier in the background.

Deep pit with Greg Johnson (upstairs) and Crane Johnson (downstairs).

In March 2000, a volunteer travelling with ASARC staff was caught in an avalanche. He was not injured but it identified shortcomings in our risk control procedures, both in the field and in our morning meeting. Soon after, I was fortunate to be part of the CAA committee re-working the Level 2 curriculum. I soaked up lots of ideas from the committee and other operations and implemented many changes that improved ASARC's risk control plan. In addition to restricting our use of volunteers, some of the changes that made a difference were:

1. At the morning meeting, it was not good enough to thoughtfully review the recent and forecast weather, snowpack observations and recent avalanches, we needed to specifically identify low risk routes ("green" routes) under the forecasted conditions. If any individual had concerns

about a route, we rejected it. If we dismissed a route that was later recognized to be low risk, that was an important and acceptable part of making consistent cautious decisions.

2. When we arrived back at the trailhead at the end of each field day, we would ask three questions (adapted from other operations): What was our best decision? (Start with a positive pat on the back!) What was our biggest risk? Was that risk adequately mitigated? Most days the biggest risk was either driving or skiing down to the valley bottom, and was considered to be low or negligible.
3. In the early years, ASARC staffers had a few epic drives, some of which occurred while driving to one of the field stations on the last of several days off. The changed policy was: If anyone for any reason had concerns about the road conditions or their alertness, stop; call the others at the field station to say you'd be late; get a motel room. Even if the person was on his or her last day off, start charging expenses to ASARC. This was radical, effective and cheap! This only happened about once per winter and typically cost about $100. Aside from being very inexpensive, it sent a strong message about our low-risk culture to those new to ASARC.
4. Peer Incident Narratives: We needed to share – without blaming – the narratives, including the human factors that contributed to the incident or close call (Jamieson, 2008). We recognized that people get better at sharing the human factors days, weeks or months after the event. During December training we would review incidents and close calls from previous winters, including those that occurred during recreation, along with the 2000 incident that involved the volunteer.

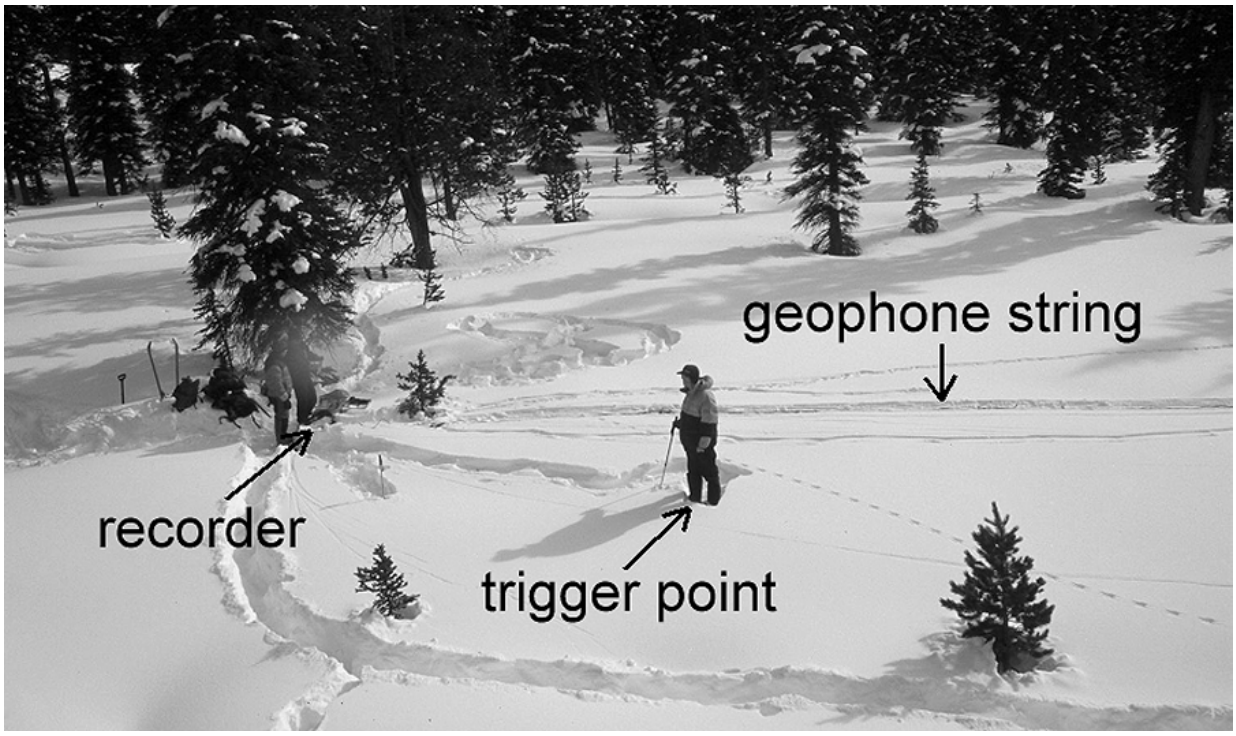
These and other changes were very effective. Nevertheless, in the following 15 years we did experience several mostly minor injuries, including a few knee injuries from skiing – one of which required surgery – and a couple of tweaked backs while getting sleds unstuck.

Rule-based approaches (such as *no travel in complex terrain today because the regional danger is rated considerable*), would also have reduced the avalanche risk. Certainly, there was some pressure to implement rule-based decisions. Although we later introduced rules as a check, around 2002 we chose to implement knowledge-based decisions initially because that is what other operations were doing. (Later, we were also early adopters of the Conceptual Model of Avalanche Hazard Forecasting.) Keeping the research technicians and graduate students involved with forecasting the daily avalanche hazard and selecting low-risk routes contributed to their success after working for ASARC. Also, the practice of knowledge-based decisions – within a structured framework – added to the relevance of our research.

James Floyer after a balloon pack inadvertently inflated on the back of a snowmobile.

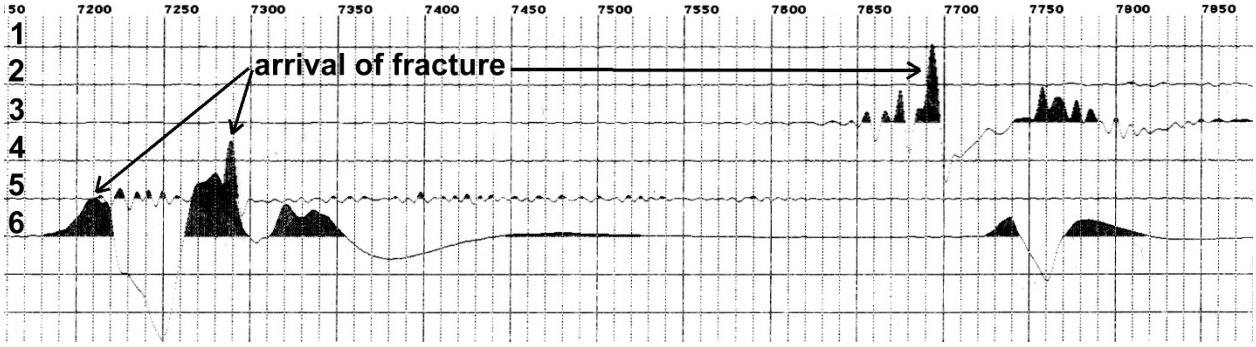
James Floyer hauling a toboggan of equipment for measuring the snow temperature near the snow surface.

Fracture propagation and weak layer collapse were recurring topics in ASARC field studies. In fall 1998 Crane Johnson selected whumpfs and remote triggering as the topic for his MSc research. As part of his studies, he wanted to measure the speed of a propagating fracture. In the February 2000, we got a call from Marc Ledwidge in Banff National Park saying people were triggering whumpfs around Bow Summit. A couple of days later Crane picked up a seismic recorder from an exploration company in Calgary and met Greg Johnson and Tom Chalmers at Bow Summit. For two days, they walked around the meadows on touring skis and snowshoes. When they triggered a whumpf in one meadow, they threw a rock attached to a cord across the adjacent meadow (high tech!), then used the cord to pull a climbing rope with a string of geophones across the meadow (see photo). Once the seismic recorder was recording the string of geophones, one of the them would snowshoe into the meadow. For two days, they did not trigger a whumpf while the geophones were recording. They decided on a third and final day of experiments by which time I had arrived. Our experiments the next morning were also unsuccessful. We decided on one more experiment in the afternoon before accepting that we had missed the cycle of whumpfs. In that last attempt we triggered a whumpf in a meadow and set up the string of geophones in the adjacent meadow. With the recorder collecting data, Tom stomped into the meadow. We all heard and felt a whumpf and froze in silence while Crane checked the recorder. When he called out “We got it,” we whooped! (We sounded like the Ghostbusters getting their first call.) To get a photo of the scene, Greg climbed a tree in what is likely the only time someone climbed a tree to study fracture propagation in the snowpack.



Seismic measurement of fracture speed at Bow Summit (photo from tree).

The fracture speed was about 20 m/s in sharp contrast to the 100s of, or even 1000, metres per second proposed for shear fractures by previous theoretical studies. While this result didn't prove that weak layer collapse was a different and important mechanism of fracture propagation, it came to form part of the argument. Crane's paper about this surprisingly slow fracture involved an unusual experimental method and an unexpected result. The paper was initially rejected by one journal but we persisted. We re-wrote the methods section and submitted the paper to a different journal, which accepted it (Johnson et al., 2004). The paper has since been widely cited. I mention the publication difficulty to encourage others with unorthodox experimental methods or unexpected results.

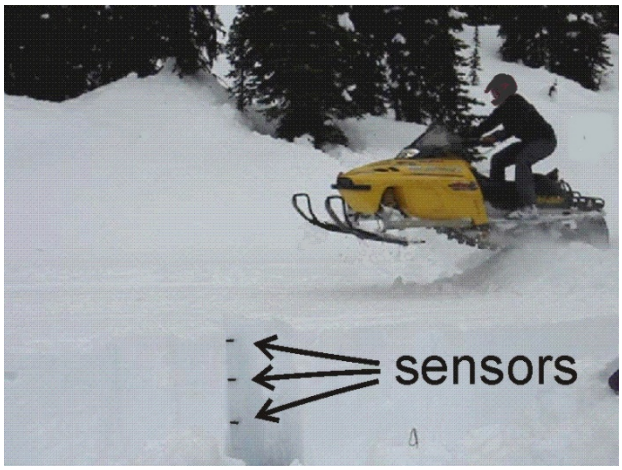


Trace of geophone signals showing arrival of flexural wave due to collapsing weak layer at Bow Summit.

There are many other stories behind ASARC's field studies, which I encourage ASARC folks to write. To keep this retrospective short, here is a list of topics with key contributors (the folks in italics were

collaborators): snowpack tests and fracture propagation (Crane Johnson, Cam Campbell, Colin Johnston, Alec van Herwijnen, Dave Gauthier, Cameron Ross), spatial variations of snowpack properties and stability (Kyle Stewart, Cam Campbell), stability of non-persistent weak layers (Catherine Brown, Dave Gauthier), effects of warming (Adrian Wilson, Laura Bakermans, *Jürg Schweizer*, Thomas Exner), vulnerability and risk in backcountry travel (Alan Jones, Cora Shea, *Jürg Schweizer*), climate trends (Sascha Bellaire, Alexandra Sinickas, Scott Thumlert), penetrometers (James Floyer), runout estimation (Alan Jones, Donna Delparte, Katherine Johnston, Alexandra Sinickas), thermal imaging of snow surfaces (Cora Shea, Michael Schirmer, *Karl Birkeland*), improved forecasting for deep slab avalanches (Torsten Geldsetzer, *Chris Stethem*, Dave Tracz, Mike Conlan), quick field observations and localizing avalanche danger (Cam Campbell, Alan Jones, *Pascal Haegeli*, Dave Gauthier, Shane Haladuick), stress below skiers and sledders (Thomas Exner, Scott Thumlert), formation, properties and evolution of surface hoar and facets (Greg Johnson, Alec van Herwijnen, Thomas Chalmers, Paul Langevin, *Sam Colbeck,* Antonia Zeidler, Cora Shea, Simon Horton), formation, properties and evolution of melt-freeze crusts (Mike Smith, Ryan Buhler, Simon Horton), modelling the snowpack with weather data (Sascha Bellaire, *Charles Fierz*, Simon Horton, Michael Schirmer). Those contributions are summarized in over 100 conference papers, about 75 papers in ISI journals and about 50 videos, all listed or linked at www.ucalgary.ca/asarc.

Laura poses with a singed sled. The bad news: the sled was borrowed! The mitigating news: the owner admitted he had ignored a recall on the fuel line.



Mike Smith lands a sled on stress sensors placed in the snowpack.

Over the years, ASARC received many compliments from practitioners about our presentations and videos. There were at least two factors: 1. In the latter years, I was only accepting about one in 10 applications for graduate studies, i.e. the graduate students were bright and diligent. 2. We practised each presentation in front of the ASARC team, critiqued it, revised it to better communicate to the target audience and then repeated the cycle. Often we developed two versions of a presentation: one for practitioners at training sessions or CAA spring meetings and one for researchers at scientific conferences. Our effort to “drink with any tinker in his own language” improved the impact of the research, the communication skill of ASARC staffers, and likely contributed to their subsequent employment success.

Laura Bakermans using a jig to precisely place thermistors near the snow surface.

Dome of a radiometer using to measure incoming radiation.

I like to think the ASARC program also contributed expertise to the avalanche profession. Following a couple of winters with their heads and hands in the snow, many of the research technicians have gone on to become guides, avalanche technicians, forecasters, and operations managers. Many of the graduate students and post docs now work as consultants, engineers, geoscientists, forecasters, guides, and researchers. A few are now supervising graduate students. I believe their years with ASARC contributed to their subsequent success and impact.

In many cases, there were two versions of our papers: one for practitioners and one for scientific journals. Both were extensively revised, reviewed by fellow ASARC staffers and revised again. Dave Gauthier's article *Puzzling over Propagation Propensity* is a fine example of writing for practitioners - Mary Clayton called it "A thing of beauty."

To track the relatively fast changes in non-persistent weak layers, we made some measurements at night.

Bruce replaces a temperature sensor on a weather station near Valemount. Curtis Pawliuk photo.

If you were in a tree and looking down at two ASARC staffers touring uphill or in a pit, you could not distinguish a grad student from a research technician. ASARC's research technicians were inquisitive, experienced ski tourers and great workers! Some of the ones that, I think, worked at least two winters include: Leanne Allison, Deanna Andersen, Sebastian Balerin, Ken Black, James Blench, Aaron Cooperman, Joe Filippone, Michelle Gagnon, Ryan Gallagher, Torsten Geldsetzer, Brian Gould, Sue Gould, Jason Guptil, Ali Haeri, Jill Hughes, Mark Kolasinsky, Spencer Krkosky, Paul Langevin, Lydia Marmont, Ken Matheson, Greg McAuley, Rodden McGowan, Gord Ohm, Jennifer Olson, Willy Rens, Braden Schmidt, Lucas Shubin, Mark Shubin, Michael Shynkaryk, Jordan Stiefvater, Mike Wheater. Apologies to those I have forgotten to include.

Around 2000, Asarc staff were trying out balloon packs. We would throw ourselves off small rolls and pull the trigger, often tumbling once or twice down the roll. Here is Bruce at the bottom of a roll.

In addition to those who worked with ASARC, it is important to recognize some “movers” in the supporting organizations including Jack Bennetto, Colani Bezzola, Mike Boissonneault, Walter Bruns, Jeff Goodrich, Brad Harrison, Phil Hein, Clair Israelson, Mark Kingsbury, Karl Klassen, Bruce McMahon, Jon Neufeld, Joe Obad, Rob Rohn, Jimmie Spencer, Ian Tomm, Bob Sayer, Dave Skjonsberg, Grant Statham, Chris Stethem and Mike Wiegele. They provided advice on grant applications, funding through their respective organizations, and stuck with ASARC through numerous challenges.

Why did I choose to not apply for another term of an industrial research chair in 2014 (and consequently retire in 2015)? My desire to be a hands-on supervisor of field studies combined with academic responsibilities like teaching undergraduate courses resulted in too many six and seven day weeks between September and April. In 2013 I was in my early sixties and didn’t want to work so hard for another five-year term of a research chair. Sure, my work-life balance would have improved if the research group discontinued the field studies and focussed on modelling or reanalyzing existing field data, but my passion was for field studies, which could no longer be combined with growing academic demands of the office and classroom. After 25 years and 25 graduate students, it was time for a change.

Over the 25 years, ASARC staff conducted over 6000 person-days of field measurements, shovelled aver 8000 tonnes of snow (not including shovelling to extricate “misaligned” snowmobiles), observed over 5000 snow profiles, did more than 20,000 snowpack tests, and ate more than 10,000 chocolate bars.

Did ASARC start with a long term plan? Well no, but I came to realize that if you put inquisitive people in the mountains in winter, and sprinkle with advice from operational folks who manage avalanche risk, those inquisitive people will produce useful – sometimes important – applied research.

I’ll finish with the formative advice that Peter Schaerer gave me around 1998 (at least as I remember it): “Field studies are slow, expensive … and the results are often worthwhile.”

References

Gauthier, D. 2006. Puzzling over propagation propensity. Avalanche News 76, 44-46.

Jamieson, B. 2008. ASARC's experience with incident peer narratives, Avalanche.ca - The Journal of Canada's Avalanche Community, Canadian Avalanche Association, Revelstoke, BC, Canada, 48-49.

Jamieson, B., Schweizer, J., Shea, C. 2009. Simple calculations of avalanche risk for backcountry skiing, Proceedings of the 2009 International Snow Science Workshop in Davos Switzerland, 336-340. (The associated video is called: Considerable avalanche danger - How much riskier is it? https://vimeo.com/50900661).

Johnson, B.C., Jamieson, B., Stewart, R.R. 2004. Seismic measurement of fracture speed in a weak snowpack layer. Cold Regions Science and Technology, 40(1-2), 41-45.

The quote “drink with any tinker in his own language” is from Shakespeare, W., Henry IV, Part 1. Act 2, Scene 4.

Bio

Since Bruce did not get the role of guitar player for Mad Max, he is now works as an avalanche consultant and trainer. When no one is looking, he does field studies on measuring snow surface temperature and photogrammetry.

Asarc folks at Dec 2005 training session. Left to right, back row: Cam Campbell, James Floyer, Ali Haeri, Thomas Exner, Willy Rens, Laura Bakermans, Paul Langevin. Front row: Lydia Marmont, Dave Gauthier, Bruce Jamieson, Catherine Brown.

Training December 2013 at Rogers Pass. Left to right: Shane Haladuick, Bruce Jamieson, Scott Thumlert, Deanna Andersen, Simon Horton, Michael Schirmer, Mike Conlan.

Some Asarc folks, including the first and last graduate student, gathered at the ISSW 2014 banquet. Back row from left to right: Scott Thumlert, Ryan Buhler, Cam Campbell, Alec van Herwijnen, Mike Conlan. Middle row: Greg Johnson, Sascha Bellaire, Michael Schirmer, James Floyer, Dave Tracz, Simon Horton, Alex Sinickas. Front row: Mike Smith, Bruce Jamieson, Shane Haladuick.