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Eirik Sharp
CAA President

CAA President's Message

ENGAGING OUR MEMBERS

meals, rides, or climbs is one of the unique elements that truly make our community special. The wealth of collective wisdom and experiences we bring together is truly unparalleled. So, I would like to open this issue of *The Avalanche Journal* by expressing thanks on behalf of all members to the staff of the CAA—with a special mention to Joe, Rosie, and Brent—for their incredible efforts in making this year's conference a resounding success.

Once again, the mixed participation format let us use technology to enhance the unique spirit that defines our industry. It was inspiring to witness avalanche workers from all corners of Canada (and abroad) come together to share their insights and perspectives. For those who were unable to join us, the significant news from this year's AGM was the approval of bylaw changes to allow for two new membership categories for avalanche educators. I want to extend my sincere appreciation to everyone who actively participated in the discussion pertaining to these special resolutions. It was refreshing to see the power of inclusive, open-minded, and engaged discussion in resolving differing points of view and moving toward a meaningful consensus about the future direction of our association.

I RECENTLY HAD the opportunity to chat with CAA Past President Bill Mark about the decision made in the early days to host our AGM in Penticton instead of the cheaper and easier option of a venue in Revelstoke. As I reflect on this year's Spring Conference, I want to commend the vision behind that choice. Every spring, I arrive in Penticton a little weary after a long winter, but the event and the connections made or re-made there never fail to leave me revitalized. The chance for us to gather at the end of a demanding avalanche season and share ideas and stories between meetings, presentations,

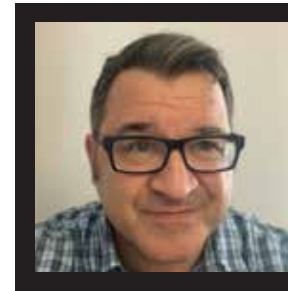
The development of these new membership categories marks a significant step forward in our ongoing efforts to enhance professional standards. It supports the growth of our industry by addressing the needs of avalanche educators who are underserved by our existing membership model. The bylaw changes create a framework for two new membership classes designed for avalanche workers focused on providing recreational avalanche education. Our intention is to elevate the standards of avalanche education and safety in Canada while streamlining the membership processes by ensuring the required competencies can be developed through course-based learning.

While the board remains dedicated to implementing these categories in a timely manner, we also acknowledge the concerns raised by several members regarding the level of engagement in the development process so far. Please be assured that we take these concerns seriously. We recognize the importance of inclusivity in fostering a sense of ownership among our members and commit to broader community engagement as we move forward in designing the policy and procedures that will define these new membership categories. Your input is valued and we want to ensure your voices are heard and considered throughout this process as we shape the future of this important facet of avalanche work.

I would also like to take this opportunity to welcome our two new board members: Lea Green and Jill Donaldson. We are fortunate to have such talented individuals join our team and I am excited to work alongside them as we navigate the opportunities and challenges that lie ahead. Additionally, I want to acknowledge all the candidates who ran for director positions this year. My biggest takeaway from the AGM is the active participation of our members truly speaks to the health and vibrancy of our organization.

The Spring Conference in Penticton has become an important touchstone in my life. Another winter season is behind us. The long-range forecast suggests a transition from La Nina to El Nino is on the horizon. Who knows what challenges next winter will bring, but I do hope you all get to enjoy this issue of *The Avalanche Journal* on a sunny deck during a long and restful summer. You deserve it.

Eirik Sharp, President



Joe Obad
CAA Executive Director

Executive Director's Report

A CHALLENGING SEASON, A WELCOME GATHERING

risk that cannot be eliminated, but standards within the industry, including those from the CAA, offer a framework for reviewing and improving risk management processes and decisions.

Standards are one part of the vision the CAA's founders had when they established our association in 1981. Another was to gather members for important conversations to help improve practice. This season's Spring Conference epitomized the best the avalanche community has to offer and would have pleased Peter and his colleagues. May 2–4 was an inspiring week of connection, engagement, debates, and education.

The week began with a spirited annual general meeting. Members quite rightly had many questions about the proposed bylaw changes to allow for new avalanche educator membership categories. We responded to questions online in the lead-up to the AGM, and still more came in Penticton. It is a testimony to the membership these questions were as thoughtful as they were challenging. As President Eirik Sharp remarked at the AGM, the membership was clear it wanted more opportunities for input as we move towards implementation from the framework we presented prior to the AGM. More details can be found on page 11.

THE 2022-23 WINTER marked the first season since the death of the CAA's first President, Peter Schaerer. The events of the season reinforced the need for the CAA and the vision Peter and the founders had in the early 80s when they formed the association.

The high number of fatalities this year—both recreational and commercial—is a reminder of the need for the exchange of avalanche hazard information and standards. As tough as investigations are, 40+ years of work towards standardization allows both operations and investigators to refer to the same standards, guidelines, and best practices when reviewing the circumstances that led up to these incidents. Avalanche risk management will continue to face residual

Following the AGM, the week shifted into gear with an exceptionally strong program of case studies and research presentations. We saw extreme circumstances examined by Greg Johnson up in Kemano, and extreme snow volumes explored by Mark Staples, Chris Bremer and Johanna Kelly in Utah. The highly anticipated panel on helicopter avalanche control did not disappoint either as it explored different operational needs and conditions affecting explosives control from helicopters. The list of excellent presentations continued on and on such that one member expressed his "complaint" by email that there was so much good content he couldn't tear himself away to ride his bike.

A mix of new and old hands mastered our emerging needs to run this year's conference. Rosie Denton assumed the role of Operations Manager just in time to manage this year's proceedings, and organized all of us staff into our respective roles and duties. Rosie renewed our confidence in her by delivering for the membership in Penticton.

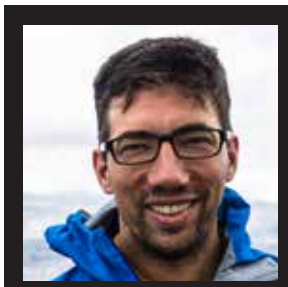
I also can't say enough about Brent Strand. In 2020, when we first proposed to move the conference online during the pandemic, Brent stepped up to manage the online component of the conference. When we came back in 2022, aspiring to offer a hybrid affair with attendees and presenters in-person and online, he took the lead. We improved on that delivery this year with Brent's steady hand—and fierce whistle that got participants back into the room after coffee breaks!

The organizing and technical efforts by staff are our part to set the stage for your interactions as members. What makes the avalanche community so great is the dialogue we have across these ranges of experience and practice types, with everyone learning and sharing with each other. After a challenging year, part of what allows folks to bounce back is the mutual support, dialogue, and sense of community that we see at the Spring Conference.

For us staff, it is invigorating to be with you and see your work and energy. We hope your sails have been lifted by seeing your colleagues and friends. To revisit the great content from the conference, please visit our CPD video page at www.avalancheassociation.ca/page/CPDVideo, where you will be able access the presentations from 2023, as well as earlier conferences and CPD events.

We look forward to being in touch with you over the summer as we plan and move on the initiatives talked about in Penticton. On behalf of all staff, we wish you a great summer to recharge your batteries and get ready for the next season.

Joe Obad, CAA Executive Director



Alex Cooper
Managing Editor

From the Editor

DEEP PERSISTENT PROBLEMS

it brought about. The problem was showing signs of being dormant, but we all respected the decision given the stress our guides were most likely feeling.

Fortunately, we enjoyed a week of sunny skies, cool temps, and great snow. We had plenty of great skiing and only saw distant signs of one small avalanche all week. I gained a new respect for the challenges of guiding and decision-making when a group has put themselves in your hand.

The deep persistent slab problem was the dominant feature of the winter in much of western Canada. For the next issue of *The Journal*, I want to explore this winter in depth. There are many angles to consider, such as operational decision-making, risk management, notable incidents or close calls, and communications challenges (be it the public, guests, or stakeholders). I'd also like to explore the mental health aspect of dealing with the stress of being out every day amidst such uncertainty, knowing even industry veterans were caught by surprise and injured; and coping with the trauma resulting from fatal incidents.

My goal is to create an issue that will serve as a resource the next time you're presented a winter like this one—something that you might pull off the shelf 10 or 20 years from now as a reference when you ask: "How did they handle this last time?"

If you have something to share, please email me at aacooper@avalancheassociation.ca

IN EARLY MARCH, I was a last-minute replacement on a trip to Selkirk Lodge. This was my first time on a guided ski touring trip. Three days before we flew in, three heli-skiers died in avalanche at RK Heliski in the Purcells. The avalanche happened a few hundred kilometres away and in what sounded like a spookier snowpack, but it was definitely on all of our minds as we got ready to go.

Before we stepped outside for our first ski, our very experienced lead guide sat us down and explained he would be sticking to a conservative program due to the ongoing deep persistent slab problem. He was considering stepping out, but the fatalities at RK scared him. I could sense the impact the most recent tragedy had and the stress

This issue is another longer one than usual, with 56 pages of diverse content. At its heart is an article from Mark Grist and his colleagues at the Columbia Avalanche Program on a very large avalanche during a January 2022 control mission. It explores the lead-up, event, and aftermath in depth, and answers the question, "Is it a Size 5?" Given the discussion at this year's Spring Conference on avalanche size, it's a timely article.

Another interesting article that I think will prompt discussion is Aidan Goldie's article on intersectional heuristics—shortcuts to decision-making driven by unbalanced power structures. In it, he proposes an addition to Ian McCammon's six basic heuristics that have dominated discussions of human factors, and looks at how societal power structures could impact backcountry decisions. The CAA is forming a Diversity, Equity, and Inclusion Committee, and I hope this article influences some of its work.

Elsewhere, Alex Baechler provides advice to his younger self as he reflects on a ski cutting incident early in his career, and Jerry Isaak looks at avalanche education through the "curse of the expert." Heather Hordowick from the Simon Fraser University Avalanche Research Program summarizes her research into how public forecasters assess avalanche problems, and Willy Trinker writes about his experience working one winter in western China.

I'm also happy to announce the return of Rob Buchanan's *Flakes* cartoon. He was badly missed in the last two issues, but we were able to coax him back to the fold. Enjoy his work at the back of the magazine.

Did I mention yet we need more photos? If you attended the Spring Conference, you heard the call several times. A few of my own photos are in this issue, but I would much rather publish your pictures. Your photos not only fill out pages in *The Journal*, they are used in our ITP presentations, course manuals, technical documents, and so much more. You can email them to me or Brent.

It was brought to my attention that our archives on Issuu are no longer displaying properly. The problem is Issuu changed the terms of its free account. We're working on a solution and we hope to have something in place shortly. In the meantime, if you're looking for a specific article from our archives, please let me know and I will dig it up for you.

Alex Cooper, Editor

Moving Ahead with Educator Membership Categories

Eirik Sharp, President, and Joe Obad, Executive Director

AT THIS YEAR'S CAA ANNUAL general meeting, CAA members voted to approve changes to the bylaws that add two new categories of membership:

- *Basic Avalanche Educator*
- *Advanced Avalanche Educator*

This decision allows the CAA to work to move from the framework presented this spring towards implementation. That said members were clear that as the board and staff move forward, there must be more consultation with the membership. This article looks at the rationale for educator membership categories, how we reached this point, and the work ahead.

THE NEED FOR AVALANCHE EDUCATOR MEMBERSHIPS

In 2014, the CAA began a journey towards competency-based membership, culminating in the Avalanche Practitioner and Avalanche Professional¹ categories in 2020, and their revised membership requirements. These changes were intended to meet the needs of a broad range of avalanche workplaces. This was a significant step forward, but other challenges persisted including developing pathways for avalanche educators across Canada.

Guidelines for Instruction in Avalanche Terrain (GIAT) was developed to help address some challenges for educators, but it did not address barriers which were identified by several stakeholders, that prevent applicants from various backgrounds from becoming members, a requirement to teach Avalanche Canada's recreational avalanche courses.

Challenges identified to the CAA in the last few years include:

- growth in demand for public avalanche education across Canada, including regions where obtaining the experience needed to become a CAA member is not possible;
- large and small education organizations frustrated that very qualified individuals such as guides were deterred from becoming members because of the CAA's membership structure and application process;
- frustrations from individual guides that they faced unnecessary barriers to attain CAA membership to teach recreational avalanche courses despite being qualified by other organizations to lead clients through avalanche terrain;
- widespread concern CAA membership requirements are biased towards experience readily acquired in Western Canada, but not elsewhere like Quebec, Newfoundland, and the Yukon, where it is difficult to obtain the necessary experience and mentorship, which reduces the public's access to recreational avalanche education; and

- concern about the absence of clear pathways to membership for snowmobilers, snowshoers, and others wishing to become educators to serve non-skier recreationists who require avalanche education.

Avalanche Canada (AvCan) echoed several of these concerns. They historically required licensed course providers and individual instructors to hold the CAA membership in order to teach its AST curriculum. In 2021, AvCan loosened its requirements in response to the shortage of available instructors. This was to be a temporary change; however, these measures have persisted in part because of the CAA's ability to respond.

RESPONSE: INVESTIGATING THE CHALLENGE AND EXPLORING SOLUTIONS

Through 2021 to the present, the Board, the Membership Committee, and staff have taken a multi-pronged approach to address the challenges listed above. While incremental work on the application process and establishing equivalencies has offered progress, the board decided additional work was required to review the membership category framework and identify opportunities to better meet the needs of the industry.

A COLLABORATIVE APPROACH TO DESIGNING OPTIONS

In fall 2022, the Board contracted Laura Adams, Avalanche Professional and principle of Luminare consultancy, to undertake a survey of CAA stakeholders, identify challenges and opportunities related to the membership process, and propose reasonable steps the CAA could take that balance the interests of current members, our stakeholders, and the public interest. Laura worked with a CAA membership working group consisting of: Steve Conger (Vice-president), Kerry MacDonald (Director/Membership Committee Chair), Sofia Forsman (Director), Joe Obad (Executive Director), and Rosie Denton (Membership Services Manager).

Additionally, CAA President Eirik Sharp invited people from 12 CAA member organizations to collaborate in the design process: Mike Adolph (ACMG); Gilles Valade, James Floyer, and Nancy Geismer (AvCan); Curtis Pawliuk (Canadian Motorized Backcountry Guides Association); Erin Tierney (Canadian Ski Guide Association); Philippe Gautier (La Fédération québécoise de la montagne et de l'escalade); Erik Dumerac (Mountain Skills Academy); Terry Palechuk (Thompson Rivers University); Paul Chiddle (University of Calgary Outdoor Centre); Dave Stark (Yamnuska Mountain Adventures); and Drew Lynes (Yukon Avalanche)

¹ Avalanche Practitioner was formerly Active Member and Avalanche Professional was formerly Professional Member. For simplicity, this document uses the new titles for brevity and clarity.

Association). These individuals and groups participated when they were able.

- Together with Laura's facilitation, the invitees found:
- avalanche education is a specialty of avalanche workers in Canada with its own unique competencies and needs that are not all addressed by GIAT;
 - Canada's proven system of public avalanche safety training may erode if it cannot meet increased demand for courses due to the shortage of qualified educators;
 - a widely shared view all avalanche workers should be members of the CAA to ensure best practices in avalanche risk management;
 - a widely shared view the CAA should recognize avalanche education through a clear scope of practice and education membership category(ies);
 - existing categories are appropriate for many avalanche work situations, and these categories should not change; however, the application process was viewed as complicated and deterred aspiring members from applying; and
 - the current membership structure presents unnecessary barriers to 'basic' educators and to highly qualified advanced educators due to the lengthy application process.

Most critically, there was consensus the situation has reached a tipping point and must be addressed quickly to avoid diminishing confidence in the CAA and reducing the effectiveness of the Avalanche Canada Training program.

INITIAL OPTIONS

Several options were explored, but a clear preferred option emerged to establish two new membership categories for avalanche educators.

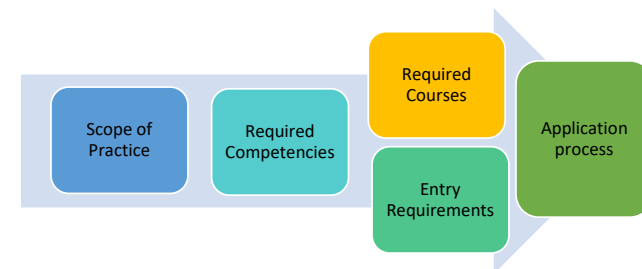
On balance, the working group, board, and staff were of the view that the clarity presented by new categories presented significant advantages for implementation, as well as communication to members, applicants, and stakeholders. This option allowed for a clear and limited scope of practice. These benefits contrasted with the complexity and communication challenges raised by the other options.

The board and the membership working group supported moving ahead with a more in-depth exploration of Basic and Advanced Avalanche Educators membership categories as the preferred solution. The board was clear that proposed scopes of practice for these categories should:

- limit work to avalanche education and not enable the member to offer other avalanche services; and
- use GIAT to define parameters for bringing students through avalanche terrain.

With board support to proceed, Ms. Adams worked with stakeholders to design a framework for implementation. Iain Stewart-Patterson, CAA GIAT implementation Coordinator, was contracted based on his extensive experience, GIAT expertise, and work at Thompson Rivers University on the ACMG guide training program.

The framework was explored by developing drafts of essential components, each of which is dependent on the previous one in the sequence.



Draft concepts of the scope(s) of practice, required competencies, and required courses were explored in pre-AGM information sessions and at the AGM. Members can access these presentations via the Members-only section of the CAA website under Member consultation. These elements will be formally put out for consultation separately from this article.

CURRENT STATUS—TAKING TIME TO GET THINGS RIGHT

Several members expressed concern the process has moved too quickly. Up to this point this has been true. Without providing a framework, the board would not have been positioned to seek approval from the membership to change the CAA's bylaws as required. The board did not want to wait until 2024 to make these changes.

While this work was rushed, the board wants to meet member and stakeholder needs to have input on the draft components of the new categories. The work ahead looks something like:

1. Communicate to members, applicants, and stakeholders throughout the process ahead.
2. Based on feedback, revise and finalize Basic and Advanced

Educator elements:

- Scope(s) of Practice
- Required competencies
- Required courses
- Entry requirements

3. Complete equivalencies for trusted partner organizations (ACMG, CSGA, etc).
4. Develop and run beta courses.
5. Set appropriate CPD requirements.
6. Create application procedures.
7. Monitor implementation with continuous improvement processes.

We've heard members need to be involved as we move forward. We look forward to engaging you as we progress on addressing the need for these educator categories. 📌

A New Path for ITP Avalanche Search & Rescue Training

Changes Coming to Professional AvSAR Training in Canada

Maris Fraser, ITP Manager

THE CAA INDUSTRY TRAINING PROGRAM (ITP) is revamping its avalanche search and rescue (AvSAR) training in an effort to better prepare students for entry into the avalanche profession. This includes a new AvSAR Level 1 course that will be a prerequisite for Avalanche Operations Level 1, and an AvSAR Level 2 course that will be prerequisite for Avalanche Operations Level 2.

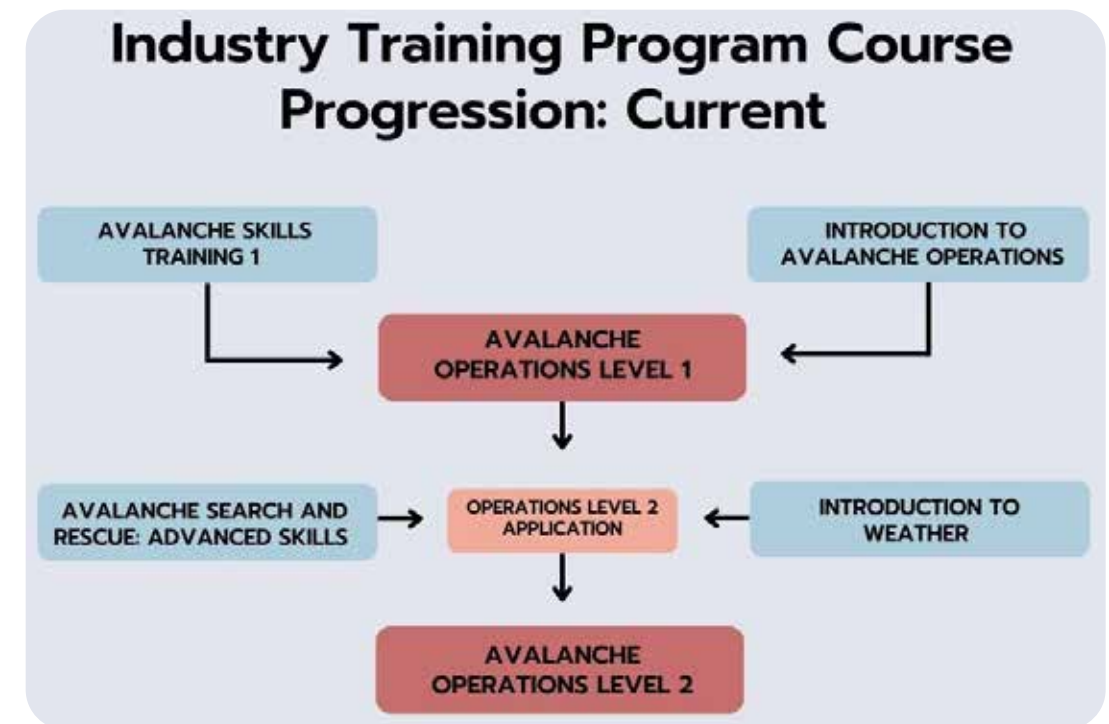
ITP is dedicated to providing world-class professional avalanche training courses to meet the evolving needs of individuals tasked with managing the safety of people and property in avalanche terrain. This includes those employed in avalanche hazard control operations in Canada.

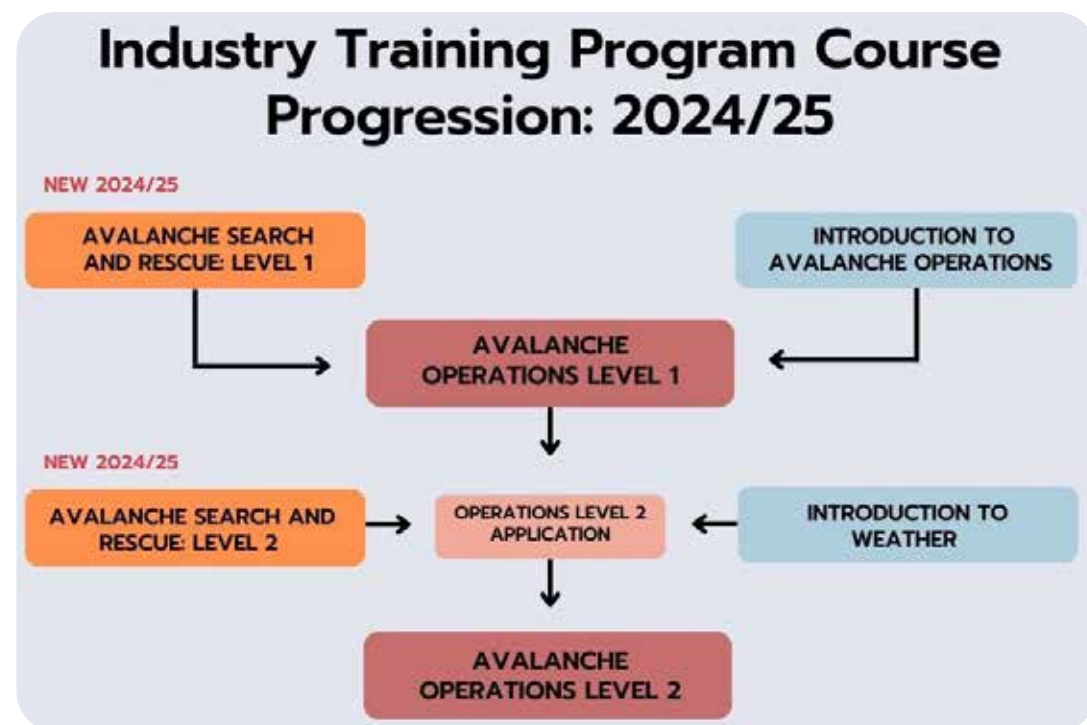
ITP provides courses to over 800 students annually. Students are new or current professional avalanche workers, volunteer SAR team members, or individuals who move through avalanche terrain and require both avalanche risk management and AvSAR skills. Students work in a variety of roles, such as professional public safety services at Parks Canada, forecasting for Avalanche Canada, patrolling at ski resorts, guiding with backcountry

recreational operations, and conducting avalanche control for highways and industries. They are all involved in AvSAR call outs in some capacity.

STATUS OF AVSAR LEARNING PROGRESSION

Currently, the initial learner takes courses in the sequence shown below. While this learning sequence has generally supported the goals of the CAA and AvSAR stakeholders, instructors and students have been challenged with the placement of AvSAR Advanced Skills within the AvSAR learning progression for professionals. In particular, the students arrive with inconsistent AvSAR skills at Avalanche Operations Level 1. Currently, students often struggle with the professional avalanche rescue exam in Avalanche Operations Level 1. Previously, the solution was to provide recommendations on how students could better develop their skills and prepare for the exam through readings, videos, and practice prior to attending the course. Unfortunately, little improvement was seen. Industry feedback has been that these students have a low-level of AvSAR skills, despite having completed AST 1.





In other words, the current prerequisites do not sufficiently or consistently prepare students for Avalanche Operations Level 1, who make up the majority of CAA students. Graduates from the course do not meet the expectations of employers to have strong AvSAR skills. Additionally, the current CAA learning progression is not designed to address these student weaknesses.

FUTURE STATUS OF AVSAR LEARNING PROGRESSION

In June and July 2021, a working group of avalanche professionals, and Avalanche Canada and CAA staff came together to form a consensus on an appropriate learning progression of AvSAR skills from the recreational to the professional level of training. The goal was to achieve a logical sequence of skills learned on courses, ensuring avalanche rescuers are properly trained given their experience level and their employer's expectations.

The working group recommended restructuring the CAA AvSAR curriculum into two courses, delivered at more appropriate stages of student development, understanding, and experience. These changes are intended to allow students to acquire the AvSAR skills necessary for success in the CAA's training program, in workplace practice, and, most importantly, during actual AvSAR callouts.

Effective 2024-25, the initial learner will take courses in the sequence shown above.

The focus of AvSAR Level 1 will be on fundamental skills for participation as a SAR team member in avalanche incidents. This includes the application of search and rescue techniques and the use of the incident command system. AvSAR Level 1 will be the first professional-level course in the ITP course progression.

AvSAR Level 2 will be focused on more advanced scenarios for team leaders. The focus will be on advanced scenarios and techniques, including tactical and medical triage

strategies, and larger-scale rescues. The working group recognizes the learning progression identified above adds complexity. However, the progression will provide greater assurance that students will be ready to assume AvSAR functions in the workplace. It was clearly the best solution to resolve the issues inhibiting essential learning that is detrimental to student success.

To achieve this significant change, the CAA was approved for a National Security Secretariat Search and Rescue New Initiatives Fund grant.

AVSAR WORKER COMPETENCIES

The changes to the AvSAR program will not impact competencies because learning objectives will not be removed but rather included within the two different AvSAR courses. In fact, Avalanche Practitioner members will gain more AvSAR-related competencies under the proposed learning progression than in the existing one as a result of having taken AvSAR Level 1 earlier in their training.

TRANSITION PLANS

Effective winter 2024-25, students entering Avalanche Operations Level 1 will be required to complete AvSAR Level 1 first. Students who completed Avalanche Operations Level 1 prior to 2024-25 will not be required to take AvSAR Level 1 and are eligible to move straight into AvSAR Level 2.

The addition of a new ITP course will result in increased demand for ITP instructors. As a result, the CAA will be recruiting 20–25 new instructors in the west and 5–10 new instructors in Quebec. New instructors will be invited to attend a training session. Those interested in applying should contact Maris Fraser, ITP Manager, at mfraser@avalancheassociation.ca.

More information can be found at <https://www.avalancheassociation.ca/page/AvSAR-L1-L2>. 📄



Level 1 Down Under

Iain Stewart-Patterson

THE FROTH LEVEL WAS HIGH. Froth is defined as excitement; to love something so much you foam at the mouth; to intensely enjoy something.

Teach an avalanche course in Australia in September? But there are no avalanches in Australia.

With a huge amount of effort, the Industry Training Program collaborated with David and Pieta Herring of Alpine Access Australia to offer the country's first Avalanche Operations Level 1 course. Alpine Access is the largest AST provider in Australia, and Dave and Pieta, Arc'teryx Ambassadors, persuaded Arc'teryx to support the course financially.

Australia has experienced tremendous growth in the popularity of backcountry touring. With this has come the realization that Australia does have avalanches, along with other hazards. The leading causes of accidents in the backcountry are: 1) blizzards and hypothermia; 2) falls on icy slopes; and 3) avalanches. The Mountain Safety Collective (MSC) was formed in 2014 after a season filled with backcountry rescues, including a fatal avalanche. MSC is currently led by Craig Sheppard, a CAA Avalanche Professional and former forecaster at Lake Louise Ski Resort. MSC produces a daily conditions report that factors in weather, visibility, surface conditions, and avalanche danger.

Craig, Dave, and Pieta investigated the viability of a Level 1 course. Who will take it? Why will they take it? Can a cohort of 12 be found who meet the prerequisites? Where is the best place to run it? When should it run? Who will teach it? How much will it cost?

It all came together. The location selected was Charlotte Pass, a small ski resort with easy ski touring access. It is 6.5 kilometers east of Mount Kosciuszko, mainland Australia's highest mountain, and is reached by over-snow transport.

Craig and I had a few Zoom calls to adapt the curriculum to the Australian context. Craig scouted the terrain and built a terrain catalogue. I flew out four days before the course. We had three days on the ground to assess terrain and make the final preparations. As we neared go-time and all the pieces of the puzzle were coming together, we got a call from the

managers of the lodge that were hosting the course—they had both tested positive for COVID! Fortunately, all was not lost. They arranged for our dinners at a nearby lodge, and breakfast and lunch were easily arranged. Three days into the course, they tested negative and we were back on track.

The students were well prepared. They had excellent travel skills and all had experience with snowpack and weather data collection. Most were ski patrollers or guides, plus a couple of Arc'teryx Ambassadors.

We had easy access to terrain. The ski hill has a massive 125 m of vertical drop, so it was easy to get out-of-bounds. The bigger objectives in the Main Range of the Snowy Mountains were five to six kilometers away and made for a good travel day. September is springtime in the Snowies, so snowpack properties and crystal identification focussed on wet grains and melt-freeze crusts under a brilliant sunny sky. Mornings were cold at -10 C, so we had some surface hoar development. Fortunately, from an avalanche course delivery perspective, a storm moved in on day five. The forecasts called for up to 80 cm of snow with moderate to strong winds. There was much debate within the group as to what the actual amounts might be. By the last day, we had 27 cm of snow on the storm board, but due to the exposure of the weather plot to the prevailing wind, some of it likely blew away.

The course generated considerable interest within Australia's backcountry community. Many students had high levels of social media savvy and were pumping out the posts. There is a growing number of backcountry and ski hill professionals that desire more training. The greatest challenge is there are very few mentors. Along with the growth in backcountry riding in the Australian Alps, Japan is a frequent destination for Australian skiers and boarders. There is a need for continued and expanded avalanche education at both the recreational and professional levels.

A huge thanks goes out to Dave and Pieta Herring and Craig Sheppard. This course would not have happened without their incredible efforts. 📄

The End of an Era

Kristin Anthony-Malone

IT IS WITH A HEAVY HEART that we bid farewell to Audrey Defant after 25 years of dedicated service to the Canadian Avalanche Association. Audrey began her journey with the CAA in the late 90s, when the organization was in a different place, even occupying a different building. Throughout her tenure, Audrey worked in almost every capacity within the CAA, handling both member and student services. She worked with five executive directors and many more staff, instructors, and students.

Audrey's commitment to her work and the community she helped shape is unparalleled. For the past 10 years, Audrey's focus has been on students and her efforts have resulted in the growth of the Industry Training Program and the CAA. Audrey's contributions have left a permanent mark on the organization, and her departure is a great loss to the CAA.

As we reflect on Audrey's time with the CAA, we realize that she not only taught us the ropes but was a friend and a confidante. Her presence will be missed, and I personally will always remember the hallway hellos, The Modern Café Euro coffee runs, and the countless hours spent digging through student files in the basement. At the time, these were just our day-to-day work life but in hindsight, I remember them fondly.

Audrey, we are grateful for your contributions, your leadership, and your dedication to the CAA. The friendships you forged and the people you helped will never be forgotten. We wish you all the best in your future endeavors and hope that you will always remember the impact you made on the CAA and the people you worked with. 📌



CAA Welcomes New Staff to ITP

Kristin Anthony-Malone

ANNE KELLER

Anne has joined the CAA as the new Industry Training Program Coordinator. She feels privileged to be part of the world-class team at the CAA. Anne brings a diverse background to the position, with 20 years in the guiding, patrolling, and avalanche education world. Most recently, she was working in healthcare, both on the front lines and in program coordination. When not at work, you might find Anne out on the trails, off to the hills, gardening, or just spending quality time at home with her sweetie and her persnickety Persian cat. 📌



GEORGIA CROWTHER

Georgia has joined the CAA in the role of ITP Student Services. Originally from the UK, Georgia has followed her love for the mountains and moved to Canada, where she enjoys skiing, mountain biking and hiking. She is excited about the opportunity to learn more about the avalanche industry and be a part of this incredible organization. She was previously a detective constable in the UK and brings excellent organizational and communication skills to the role. 📌



Staff Promotions

WE ARE PLEASED TO ANNOUNCE the promotion of two staff members. Rosie Denton has expanded her role to Operations and Membership Services Manager. Rosie began with the CAA in 2020 and has impressed staff and board with her ability to take on new complex tasks and get things done. Rosie looks forward to working with members in her new capacity. Maris Fraser was elevated to the role of Industry Training Program Manager following the departure of Andrea Lustenberger from the CAA. Maris joined the CAA in June 2021 as the ITP Coordinator and has been a great asset to the ITP team. 📌

Fuse News: Helicopter Avalanche Control

Steve Brushey

IS HELICOPTER AVALANCHE CONTROL risky business? Perhaps due to the checks and balances our NW Avalanche Program has in place and my experience base, I think that driving dark, stormy, under-maintained highways carries more risk. Therein lies my bias. Full disclosure, yes, I have had close calls. Our processes have changed and will continue to evolve. The hazards of helicopter avalanche control remain present, and I definitely recognize I've accepted those hazards are within my comfort zone. I definitely feel vulnerable about my perception of acceptable risk, and I am very cautious that can lead to complacency. All phases of helicopter avalanche control require careful evaluation.

There have been two incidents doing helicopter control work since 2009 and the unfortunate part is that not all the learning outcomes from the 2009 incident were implemented. This winter, the EAC was brought into the discussion when a well-respected and very experienced Avalanche Professional reached out to the CAA and suggested a proper risk assessment should be done. Since quantifying the risk of helicopter control would require significant effort and be challenging with limited data, the EAC decided that the best place to start would be through membership engagement using a panel discussion at the Spring Conference.

The EAC spent a considerable amount of time looking into just how our group does avalanche control and it quickly became apparent that despite approved blasting procedures, we all have our nuances. While this provides operational flexibility tailored to specific contexts, some standardization of certain aspects of control may be beneficial.

What seems apparent is we need to adjust to change. I see the legacy effect from operational supervisors who have passed down their inherited methodology to their crew and, as a result, "This is the way we were taught," regularly comes up in discussions. In my time, I have witnessed considerable change in the industry. Perhaps it is time for all of us to have open conversations about how we do control work.

The panel discussion at the Spring Conference proved to be an excellent start to this conversation. Changing processes include pre-flight safety assessments, modernizing restraint systems, and adapting closure notification and sweeps to ensure the danger area is secure. The latter is becoming more difficult as there is now overlapping commercial and recreational interest in the areas we do avalanche control. Every mission demands high attention to detail, and protocol should be consistent and well-documented.

There are learning outcomes from both helicopter incidents—let's adopt them. Talk to other operations and see how they do things. There may be better ways that are even safer and more efficient. Perhaps it is time to stop being so entrenched in our ways that we can't evolve. Having a younger crew with an open mind, we begin to see that "my way" may not be the best way. Change is good, let's not allow ourselves to repeat the same mistakes.

The EAC has recommended the CAA Avalanche Control Blasting course as the platform to make this change through the inclusion of helicopter avalanche control guidelines in the course manual. Industry training to a bench-level standard is a good start. The EAC has benefited through discussion with several industry leaders and, although we do not have a data set for a risk assessment, there is enough collective experience to share—both good and bad—that can carry high value if included in the blasting course. Training has always been the foundation from which experience follows. WorkSafeBC has done a good job of revamping its blasting exam, which is dependant on the candidate showing up with the required experience. However, not all avalanche control experience is equal, which brings us back to the legacy comments above.

The CAA blasting course could set the standard for helicopter avalanche control. Similar to aviation safety programs, which set minimum safety standards for high-reliability organizations, the CAA is in a position to establish guidelines and minimum standards for helicopter avalanche control.

The Spring Conference panel brought forward several takeaways, including the standardization of procedures, securing blast areas, and the benefits of pre-flight hazard assessment prior to the control mission. As the EAC suggested, there was strong support for self-regulation through the CAA establishing guidelines. If you missed it, a video of the panel will be posted on the CAA website alongside other Spring Conference presentations.

As I watched virtually, one of the themes I noticed was making control missions efficient. I do think we need to ask ourselves, "Does efficiency make the control mission safer?" In my opinion, some practises do, and some do not. The EAC will now reconvene to discuss ideas presented during the panel and elsewhere, then determine what are the required next steps to move toward standardization.

Thank you Wren McElroy, Eric Chevalier, Craig McGee, Grant Statham, Anton Horvath, and Scott Garvin for participating in the panel, and Marc Ledwidge for his comments ahead of time. A special thanks goes to Chris Argue for moderating the event. 📌

The Mountain Community CISM Team

Aurora Borin, ACMG Diversity, Equity, Inclusion and Mental Health Services Manager

WORKING IN THE MOUNTAINS is a job that comes with real risks every day. This winter, especially, none of us needed reminders of the dangers we all work to mitigate. Whether we end up injured by an incident, assisting in a rescue, or were involved in a near miss, the experience can deeply affect us. On one thing, our knowledge of trauma is clear: early intervention (in the first 24–72 hours) significantly reduces the chance of long-term mental health troubles such as PTSD.

In September 2022, 23 mountain professionals met to train together and learn how to provide peer support to those involved in critical incidents in the mountain industry. They became the Mountain Community Critical Incident Stress Management (CISM) team, ready to respond and provide compassionate witness to those who may be suffering.

What makes the CISM team so uniquely effective is that it is comprised of peers—fellow mountain professionals. They speak the same language, have done the same work, and have felt the same fears. The CISM team is made up of mountain professionals, for mountain professionals. CISM team members are not mental health professionals, and they aren't supposed to be. They are supportive ears, a bit of sage wisdom, a reminder of hope for the future, and a key step on the post-crisis path.

The CISM team can respond on either an individual or group basis depending on the nature of the incident and how many folks are involved. Visits can be done in-person or through videoconferencing, but in-person is greatly preferred when possible. We know that sometimes distances, schedules, and costs may prevent an in-person meeting, but every effort will be made to meet this request.

It has been a difficult winter and the team has been busy. Since the fall of 2022, the CISM team has responded to

six calls for intervention. Four of these calls have been for 1-on-1 support and two for group debriefings. In total, these responses provided support for 34 people who experienced a critical incident this winter alone. Although the CISM team is set up to respond to calls across Canada, all calls were to locations in British Columbia.

WHAT YOU CAN EXPECT IN A CISM RESPONSE

What do CISM team members actually do? If you are met by the CISM team, what might it look like? While the details will change based on the people involved and the nature of the incident, there are things you can expect.

The CISM team member won't be there for an operational debrief or to extract technical details. They're going to be interested in the person or people in front of them, what they're thinking, how they're feeling, and how they're responding to what happened. CISM team members will listen a great deal and validate the difficult, overwhelming emotions that others will doubtlessly be feeling. They will give a bit of guidance for the days ahead. They may offer to reach out one or two more times, but they'll create a boundary around a longer-term relationship.

HOW TO ENGAGE WITH AND SUPPORT THE CISM TEAM

The Mountain Community CISM team is always looking for new members who are interested in undergoing the training and being ready to support peers in their times of need. If you are interested in learning more, reach out to Corrina Stafford at info@helicat.org or Aurora Borin at dei@acmg.ca.

If you or someone you know was recently involved in a critical incident, you can activate the CISM team by writing to either Corrina or Aurora, or by calling (604) 270 – 2772.

Find out more details at www.helicat.org/cism-team



PASCAL HAEGELI (CENTRE) RECEIVES THE GORDON RITCHIE SERVICE AWARD FROM AVALANCHE CANADA FOR HIS WORK TO PROMOTE PUBLIC AVALANCHE SAFETY IN CANADA. ALSO PICTURED IS GILLES VALADE, EXECUTIVE DIRECTOR OF AVALANCHE CANADA, AND GORDON RITCHIE.



EVERETT CLAUSEN (LEFT), PRESIDENT OF CIL EXPLOSIVES, PRESENTS AN \$18,110.38 DONATION TO JOE OBAD, EXECUTIVE DIRECTOR TO THE CAA. THE DONATION REPRESENTS A PORTION OF ALL SALES BY CIL TO THE CANADIAN AVALANCHE INDUSTRY.



MENTEES AND MENTORS CONVERSE DURING THE LINK UP & LEARN SESSION AT THE CONFERENCE.



ROGER ATKINS PRESENTS ON HOW CMH GALENA HANDLED THE DEEP PERSISTENT SLAB PROBLEM LAST WINTER. THE PRESENTATION INCLUDED GPS DATA ON HOW THEIR TERRAIN CHOICES CHANGED AS A RESULT OF THE PROBLEM.



THE BOARD OF THE CAA DURING THE AGM. FROM LEFT: KATE SNEDEKER, SOFIA FORSMAN, PENNY GODDARD, KERRY MACDONALD, JESSE PERCIVAL, STEVE CONGER, EIRIK SHARP, AND EXECUTIVE DIRECTOR JOE OBAD. MISSING WERE JEFF SURTEES AND MATT MACDONALD.



FROM LEFT: JESSE PERCIVAL, CHRIS DYCK, KEVIN MARR, AND ANDY GABRYS PLAY THE BLASTHOLE GAME DURING THE MEMBER SOCIAL.



THE MOUNTAIN COMMUNITY CISM TEAM CONSISTS OF A DIVERSE GROUP OF MOUNTAIN PROFESSIONALS FROM ACROSS CANADA. THEY GATHERED IN FERNIE LAST SEPTEMBER FOR TRAINING. // PHOTO CONTRIBUTED

CAA Service Award Winners

JULIE LEBLANC AND DOUG LUNDGREN WERE CO-RECIPIENTS of the CAA Service Award at the 2023 Spring Conference in Penticton.

Leblanc is a forecaster with Avalanche Québec and Avalanche Canada, and an ITP instructor. She was recognized for her work in building professionalism in the Québec avalanche sector, translating material for AvCan and the CAA, volunteering on the Membership Committee, and her role connecting Canada's avalanche sector nationally.

Lundgren was a pioneering snowboarder who went on to become one of the first snowboard guides in the world. He worked for Mike Wiegele Heliskiing and is currently the lead avalanche forecaster for Big White Ski Resort. He was recognized for his leadership throughout his career, his history of providing quality mentorship to students, and his contributions to mountain operations safety.

Julie LeBlanc

HOW DOES IT FEEL TO RECEIVE THE CAA SERVICE AWARD?

I was quite surprised to receive this award, as I thought it was granted to end-of-career professionals. I am honored to receive this recognition from the CAA as I continue my journey in this fantastic industry. As a woman and an east-coaster, I am pleased to be recognized for my ongoing work in the industry.

HOW DID YOU GET STARTED IN THE AVALANCHE INDUSTRY?

After completing adventure guide studies at Thompson Rivers University in early 2000, I came back east to undertake a bachelor in science. On weekends, I was actively looking for opportunities to ski and get involved in the emerging backcountry skiing industry in the Chic-Chocs. I volunteered for Avalanche Awareness Days and got rapidly involved as an Avalanche Skills Training instructor with the Avalanche Québec team. I also helped set up Auberge de Montage des Chic-Chocs safety operations, the first backcountry ski lodge in Eastern Québec.

WHAT DO YOU ENJOY MOST ABOUT YOUR WORK?

Being able to combine science and skiing was a dream job for me, and still is. I enjoy the variety of tasks: avalanche forecasting, education, risk management, and mentoring. It keeps me inspired over the years. I am also grateful to have had the chance to work in western Canada for the Industry Training Program and Avalanche Canada, where I meet awesome individuals who contribute to my professional development.

WHAT'S YOUR NUMBER ONE PIECE OF ADVICE YOU'D LIKE TO SHARE WITH SOMEONE NEW TO THE INDUSTRY?

Take every work opportunity to learn a new skill set. It is often intimidating to accept to work with new professionals and undertake challenging tasks, but it is incredibly rewarding. Great technical skills, innovative processes and effective teamwork will emerge and be developed. These assets are the stepping stone to a great career in the industry. 📌

Douglas Lundgren

HOW DOES IT FEEL TO RECEIVE THE CAA SERVICE AWARD?

It was a little overwhelming to receive this award as I was totally blindsided by it. I think it speaks to the CAA's commitment to its members that it recognizes the people on the front lines and in the trenches. I totally blame Patrick Shier for starting what apparently became an overwhelming letter-writing effort. Steve Conger told me they felt like they were at Santa's workshop with all the letters they were receiving.

HOW DID YOU GET STARTED IN THE AVALANCHE INDUSTRY?

I think I took my Avalanche Operations Level 1 at Island Lake Lodge in 1995 in preparation for my guiding career. I had always been an industry kid because my father managed Mt. Norquay and then was head-hunted to run Sunshine. He always had great stories from those days in Banff.

WHAT DO YOU ENJOY MOST ABOUT YOUR WORK?

This may sound weird, but the way Big White is set up, we can do a four-hour control mission and then I get to ski to my home for lunch. It still puts a smile on my face every time.

WHAT'S YOUR NUMBER ONE PIECE OF ADVICE YOU'D LIKE TO SHARE WITH SOMEONE NEW TO THE INDUSTRY?

Make the effort to connect with the older members. They are wise in so many ways and they are not going to be around forever. Most of them are not as gruff as they seem. LOL. 📌



Contributors



Coming from a background in engineering, **HEATHER HORDOWICK** completed a master's degree in Resource and Environmental Management as part of the Simon Fraser University Avalanche Research Program in 2022. Since graduating, she has been working with 6 Point Engineering and is based out of the West Kootenays, where she is also an active member of the search and rescue community.

42 IS IT A PROBLEM? EXPLORING AVALANCHE PROBLEM ASSESSMENTS IN PUBLIC AVALANCHE FORECASTING



DAVE MCCLUNG is a Professor Emeritus at the University of British Columbia. He has conducted more than 50 continuous years of snow and avalanche research, which is still ongoing. He is a founder and member for the last 33 years of the Technical Committee of the CAA. He is a skier, expedition mountaineer (formerly), and an avid swing dancer.

24 THE AVALANCHE HANDBOOK, 4TH EDITION



AIDAN GOLDIE (he/him/his) was born in Chile and spent much of his childhood living in South America before immigrating to the United States. In the latter half of his childhood, Aidan called Colorado home and grew up exploring his rugged backyard peaks. He is now settled in the Roaring Fork Valley where he works as a Physics teacher to best support his community through equitable and intentional education practices. Aidan teaches, climbs, and backcountry skis on the traditional lands of the Nuu-ahga-tuvu-pu (Ute) tribe in the Rocky Mountains.

34 INTERSECTIONAL HEURISTICS IN BACKCOUNTRY DECISION-MAKING



JERRY ISAAK is an Associate Teaching Professor in the Adventure Studies at Department Thompson Rivers University. His research interests are in the areas of outdoor education, social influences on risk tolerance levels and decision-making, and educational expeditions. He can be contacted at jisaak@tru.ca.

38 KNOWLEDGE, THE CURSE OF THE EXPERT



ALEX BAECHLER has had an unorthodox career path, but his avalanche work has been a consistent influence in his life arc. He has benefited from itinerant periods of education and applied experience, and has followed an informal pattern where progressive knowledge is enhanced with extensive practical experience, appropriate supervision, and selective mentorship. Born in Campbell River, he currently lives in Revelstoke with his wife Michelle and daughter Autumn, and regularly visits Vancouver Island to be with his son Avery.

32 TEMPERAMENT OVER TIME

patagonia



BCAs Andy Wamborg pants on in the northern San Juans. Photo: @jeffracco

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front lines

25

COULD IT BE A SIZE 5?

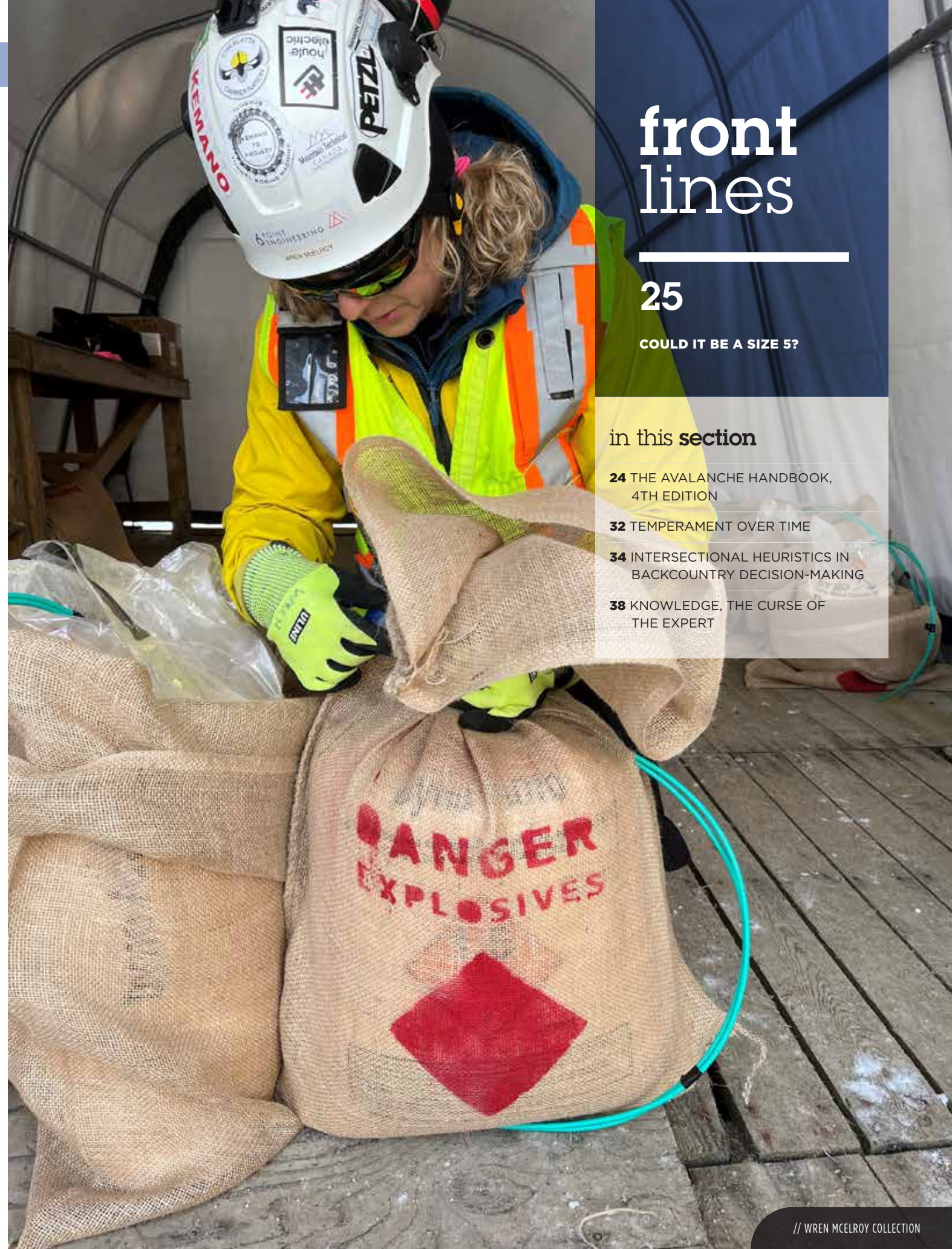
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24 THE AVALANCHE HANDBOOK, 4TH EDITION

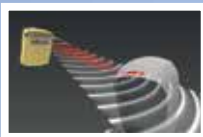
32 TEMPERAMENT OVER TIME

34 INTERSECTIONAL HEURISTICS IN BACKCOUNTRY DECISION-MAKING

38 KNOWLEDGE, THE CURSE OF THE EXPERT



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The Avalanche Handbook, 4th Edition

David McClung

THE 4TH EDITION of *The Avalanche Handbook* was published in December 2022. It is the legacy of a tradition that began in 1961 as US Department of Agriculture (USDA) Handbook 194, titled *Snow Avalanches* and written by Professor Ed LaChapelle. The next edition was titled *Avalanche Handbook*, with authors Ron Perla and Pete Martinelli. It was published in 1976 as USDA Handbook 489.

Following the closure of the avalanche research stations at Alta, Utah, and at the Rocky Mountain Forest and Range Experiment Station in Colorado, myself and Peter Schaerer here in Canada revived the book in 1993 under the title, *The Avalanche Handbook* (called the 2nd Edition). It was published by Mountaineers Books in Seattle. The 3rd Edition was published in 2006. The thread linking back to Professor LaChapelle continues since 1961, since both Ron Perla and me, as lead authors of the last four editions, were doctoral students of his.

The new edition contains many changes reflecting the evolution of avalanche research and technology over the last 16 years. Some of these changes may seem subtle to readers. There has been a virtual explosion of published papers, not just in the proceedings of ISSW, but also in peer reviewed papers. The choice of what to include among these contributions was, in order of priority:

1. Field observations and field measurements
2. Laboratory measurements
3. Models (models come and go but good data are immortal)

In each of the three categories, there were limitations to consider that generally increased with category number. Even though the book is technical, the focus is still on diagrams and photos rather than equations, and the audience is still wide. With a similar view as Dr. Perla, we felt there should be at least one book in which technical concepts should be adhered to and not oversimplified, while still maintaining relevant issues important for general safety.

A few important changes are listed below:

1. Emphasis that, in fracture, alpine snow is a quasi-brittle material that requires a finite-sized weak zone within the weak layer before avalanche initiation, which we cannot normally locate or measure. This fundamental property forms the risk (probabilistic) basis for all slab avalanche forecasting and it implies a number of other important, fundamental aspects about avalanche release and motion. It is the reason that the book is almost entirely risk-based.
2. A new chapter on risk management that features an introduction to subjective probability and its use, with a link to Bayesian updating regarding decisions. The chapter includes a number of applications, such as

- updating the Conceptual Model of Avalanche Hazard, a time-based system for decisions in guided helicopter skiing, and a hazard analysis for rider triggering based on fatality statistics. The latter suggests the highest hazard is for buried weak layers between about 0.6–1 m.
3. Updated the time series on Swiss, Canadian, and American fatalities. All three nations show declining fatalities with time, which is a testament to the good work from avalanche courses and avalanche bulletins. Updated avalanche fatalities on the 8,000 m peaks in high mountain Asia.
4. A heavily revised chapter on safety and rescue, helped immensely with input from Manuel Genswein from Switzerland.
5. The section on the application of explosives was revised with important help from Braden Schmidt of CIL Explosives.
6. The effect of El Niño and La Niña on snow and avalanche patterns is discussed based on 30,000 recorded avalanches over 30 years in British Columbia. The contrast gives clues to climate change since El Niño and La Niña present two different climate scenarios—warmer with less snow and colder with more snow respectively.
7. Incorporation of the revised international classification of snow from 2009.
8. Inclusion of the extended column test, propagation saw test (PST), and deep tap test, and their limitations. The limitations are especially important for the PST.
9. Discussion of fracture mechanics applied to avalanche release, including the important concept of bridging, which is fracture-mechanics based; and also dynamic fracture mechanics once the shear fracture initiates. The discussion on fracture mechanics is intended to provide a readable summary of important results for people with no background in mechanics.
10. A revised discussion of wet slab avalanche release based mainly on new information from Switzerland.
11. A revised discussion of return periods for avalanches and implications for land-use planning in snow avalanche terrain. 📌



Could it be a Size 5?

A Large Avalanche in the Ministry of Transportation and Infrastructure's Jack MacDonald Path

Mark Grist and the MOTI Columbia Avalanche Program Team

THE LEAD UP

The winter of 2021-22 got off to a good start in the Selkirk Mountains. There was abundant snow throughout November, especially towards the end of the month when an atmospheric river (AR) flowed over the region. The snowpack at the highway (weather station 1 in Fig. 1) doubled from Nov. 25–28, reaching a healthy 113cm. The weather station on Mount Fidelity in Glacier National Park (GNP), located at 1,905 m elevation, (weather station 5 in Fig. 1) recorded 72 cm of snow (73.1 mm of precipitation) over the last three days of the month, and the height of the snowpack increased to 252 cm from 206 cm.

But, as the river warmed up and snow turned to rain, everything changed.

At the highway, temperatures peaked at +5.5 C, while 83.1 mm of rain fell over 97 hours, wiping out half the snowpack. Notably, the average rate of snowpack decline was quite steady at 7 cm/12 hrs over an 84-hour period. At treeline, 34.8 mm of rain fell over 25 hours and temperatures peaked at +2.1 C; the snowpack decreased by 21 cm.

The rain-soaked layer was eventually buried either Dec. 1 or 2, depending on elevation and location, and the resultant hard crust was found as high as 2,200–2,300 m throughout the Columbia Mountains. In our paths, the crust was

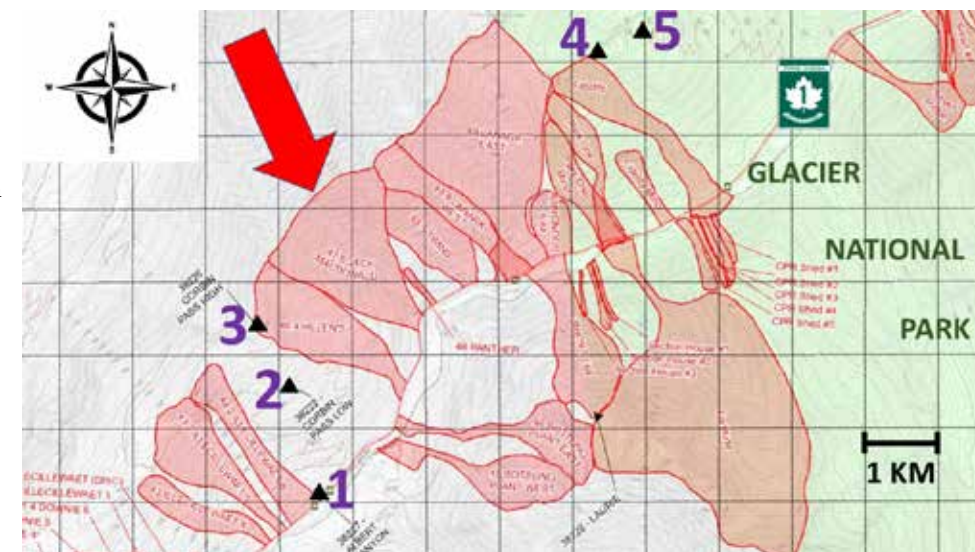


FIG. 1: OVERVIEW OF MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE (MOTI) (RED POLYGONS) AND PARKS CANADA (ORANGE POLYGONS) AVALANCHE PATHS NEAR THE WESTERN BOUNDARY OF GNP, ALONG THE TRANS-CANADA HWY. MOTI PATH NUMBERS ARE DISTANCES FROM REVELSTOKE, B.C. THE LARGE ARROW POINTS AT JACK MACDONALD (PATH 47.8). PURPLE NUMBERS CORRESPOND TO WEATHER STATIONS: 1. ALBERT CANYON (MOTI ROAD WEATHER STATION, 999 M); 2. CORBIN PASS LOW (MOTI REMOTE AUTOMATED WEATHER STATION, 1,615 M); 3. CORBIN PASS HIGH (MOTI REMOTE AUTOMATED WEATHER STATION, 2,135 M); 4. ROUND HILL (PARKS CANADA, 2,100 M); AND 5. FIDELITY (PARKS CANADA, 1,905 M).

especially prominent below 1,700–1,900 m. In character, it was more like an ice formation rain crust with a surface glaze than the typical melt-freeze crust; and similar to the November rain crust of 2002, which became very problematic in the tragic early months of 2003.

Due to the substantial November snowpack, the crust was located above most terrain roughness features. We found it ranged from 70–160 cm above ground (the average was 140–150 cm) in our various study plots. Interestingly, strong winds during the rain event (Round Hill, at ridge crest, reported sustained southwest winds of 53–74 km/hr, gusting 105 km/hr) drove heat and rain into the snowpack,

WEATHER STATION	ELEVATION	HRS ABOVE ZERO	HOURS W/ PRECIP LIKELY AS RAIN	TMAX (OC)	MM PRECIP FALLING AS RAIN	HS BEGIN	HS END	DELTA HS
ALBERT CANYON	999m	104	97	5.5	83.1	113 CM	59 CM	-54 CM
CORBIN LOW	1615m	51	34	3.7	69.1	N/A	N/A	N/A
FIDELITY	1905m	26	25	2.1	34.8	253 CM	232 CM	-21 CM
ROUND HILL	2100m	16	UNKNOWN	0.8	UNKNOWN	N/A	N/A	N/A
CORBIN HIGH	2135m	2	UNKNOWN	0.4	UNKNOWN	N/A	N/A	N/A

TABLE 1: KEY PARAMETERS OF THE LATE-NOVEMBER/EARLY-DECEMBER AR FROM FIVE WEATHER STATIONS BRACKETING THE JACK MACDONALD AVALANCHE PATH. SEE FIGURE 1 FOR WEATHER STATION LOCATIONS. MOTI STATIONS ARE IN BLUE AND GNP STATIONS ARE IN GREEN.



JACK MACDONALD PATH STATS

Path area: 1.9 km² (190 hectares)

Path length: 2.6 km (to Illecillewaet River)

Start zone area: approximately 800,000 m² (80 hectares)

Vertical fall: 1,495 m

Avg start zone angle: 32 deg

Avg track angle: 24 deg

Largest recorded avalanche (1909–1976): 3.06 x 10⁸ kg (Feb. 11, 1937)

Limit avalanche: 2.9 x 10⁹ kg

Frequency of avalanches reaching the highway shed: 0.9/year (48 years of record)

Frequency of avalanches affecting the railroad (1909–1976): Once every 7.5 years

Frequency of avalanches affecting the railroad (1977–2022): Once every 7.5 years

¹Data from Fitzharris (1981)

²Data from the MoTI Snow Avalanche Weather System (SAWS) database.

WEATHER STATION	ELEVATION	CM AMT ON DEC 1 MF _{CR}	MM AMT ON DEC 1 MF _{CR}	HS DEC 1	HS JAN 22	DELTA HS
ALBERT CANYON	999m	352	263.4	59 CM	159 CM	+100 CM
CORBIN LOW	1615m	N/A	370.7	N/A	N/A	N/A
FIDELITY	1905m	526	401.3	232 CM	327 CM	+95 CM
ROUND HILL	2100m	N/A	N/A	N/A	N/A	N/A
CORBIN HIGH	2135m	N/A	N/A	N/A	N/A	N/A

TABLE 2: ACCUMULATED PRECIPITATION (IN MM AND CM) OVER THE DEC. 1 CRUST FROM DEC 1 TO JAN. 22. MOTI WEATHER STATIONS ARE IN LIGHT BLUE AND PARKS CANADA STATIONS ARE IN GREEN. NOTE: CORBIN LOW HAS ONLY A GLYCOL PRECIPITATION GAUGE, AND NO SNOW DEPTH MEASUREMENTS. RIDGE CREST STATIONS (ROUND HILL AND CORBIN HIGH) MEASURE TEMPERATURE, HUMIDITY, AND WIND ONLY.

We performed control work in early January to test the reactivity of deeper layers and for snowpack reduction. On Jan. 10, control results from 19 shots (13 kg each) in the large paths, including two shots in path 47.8, Jack MacDonald, were limited to size two avalanches.

The first indication the early-December layer had become active was on InfoEx on Jan. 14. Our nearest-neighbour evidence came on Jan. 17 from GNP, when they reported a natural size four persistent slab avalanche with a two-metre crown on a southwest aspect. Over the next few days, several surprisingly large natural and controlled results, with up to one kilometre propagation, appeared on InfoEx. The layer was reactive in propagation saw tests, as demonstrated in a Jan. 19 video recorded by Avalanche Canada near our Corbin Pass Low weather station (vimeo.com/671324845). There was a lot of uncertainty regarding this layer, but it was on our

resulting in significantly thicker crusts on southerly aspects. The crust was 15 cm thick on a southeast aspect at 2,050 m near Lookout Col, while only two centimetres thick on a north aspect at the same elevation (Kate Ryan, personal communication).

Not surprisingly, we tracked this layer closely over the following weeks. A snow profile conducted on Dec. 9 at Corbin Low revealed the crust was 15 cm thick and located 116–131 cm up from the ground. In another profile in Helen's (path 46.4), located near Corbin High, we found the crust was 12 cm thick, with a very thin layer of one-to-two-millimetre facets above it (Fig. 2). We had no significant test results at this time, largely due to a lack of slab properties above the crust.

Profiles by GNP field teams between Dec. 5 and Jan. 21 revealed the crust was 10–20 cm thick at treeline elevation. Only one notable result (a hard result on a deep tap test) came back from 18 GNP and MoTI snowpack tests, while several tests on this layer came back with no result. As time went by, there was a slight trend towards a thicker layer of facets and slightly larger faceted grains above the crust, especially at lower elevations (Fig. 4).

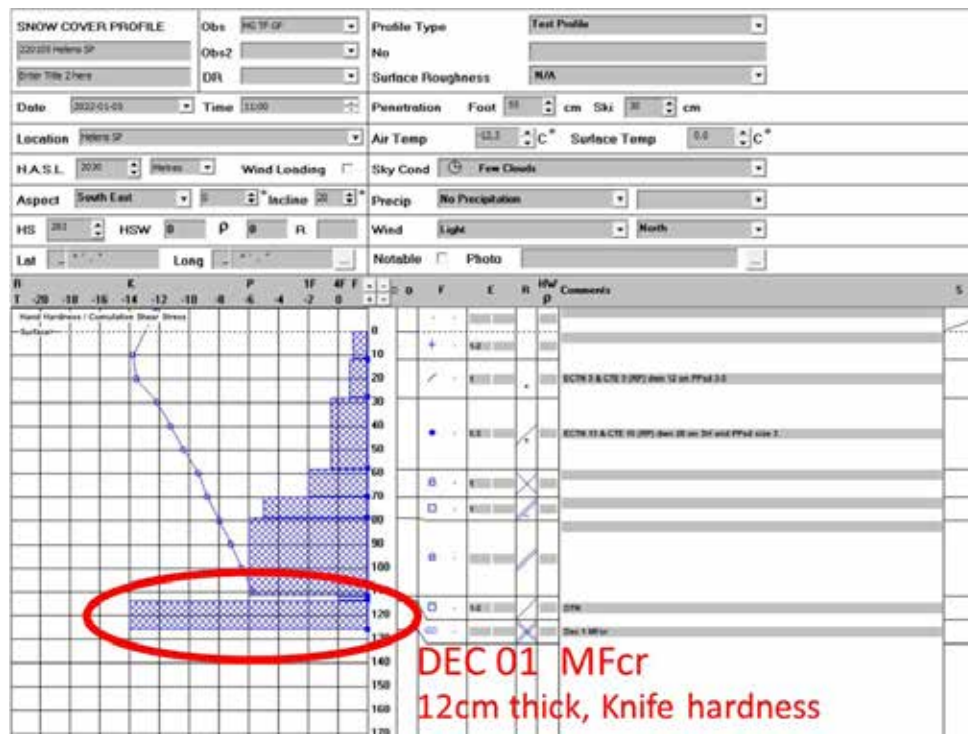


FIG. 2: A SNOW PROFILE FROM JAN. 5, 2022, AT 2,050 M ELEVATION, NEAR THE START ZONE OF PATH 46.4 (HELEN'S), WHICH IS ADJACENT TO JACK MACDONALD. THE DEC. 1 CRUST WAS LOCATED 157–169 CM UP FROM THE GROUND.

radar for rapid loading and rapid warming events. Given the evidence, it was obvious the potential for large avalanches was there, and we wondered which of our paths might produce similarly large and surprising results. We noted many atypical fracture lines with wide propagations during this period.

On Jan. 21, a GNP snow profile conducted at 1,905 m showed no results on the Dec. 1 layer. It was up 140 cm from the ground and down 189 cm from the surface. Over a metre of high-density slab lay above the crust, with measured densities ranging from 215–390 kg/m³. Table 2 outlines the load on the Dec. 1 crust when we performed control work on Jan 22. Precipitation amounts increased with elevation; however, the snow-to-liquid-water ratios remained similar between low and mid elevations. Note that one millimetre of precipitation adds one kilogram of load per horizontal square metre of surface area.

THE EVENT

We finally had a weather window for a helicopter control mission on Jan. 22. Deploying 13 kg charges, we produced mostly size 2.5–3 avalanches in our larger paths near GNP, but nothing ran over the Lanark or Twins snow sheds and the closest stopped about 100 m from the highway. The first five shots placed in Jack MacDonald resulted in four size three and one size 2.5 avalanches, which stopped 100–800 m from the highway. The penultimate shot was placed as high as possible under the communications shell at the summit (Fig. 3). The resulting avalanche propagated significantly across the path, while wrapping around to produce a size three in Helen's and a size 3.5 to the north that ran into the Tangier River. The connected crowns had wrapped almost 220 degrees



FIG. 3: START ZONE DETAIL OF JACK MACDONALD. THE RED "X" MARKS THE 13 KG ANFO SHOT LOCATION. ROUGHLY HALF THE ENTIRE CROWN WIDTH IS DEPICTED.

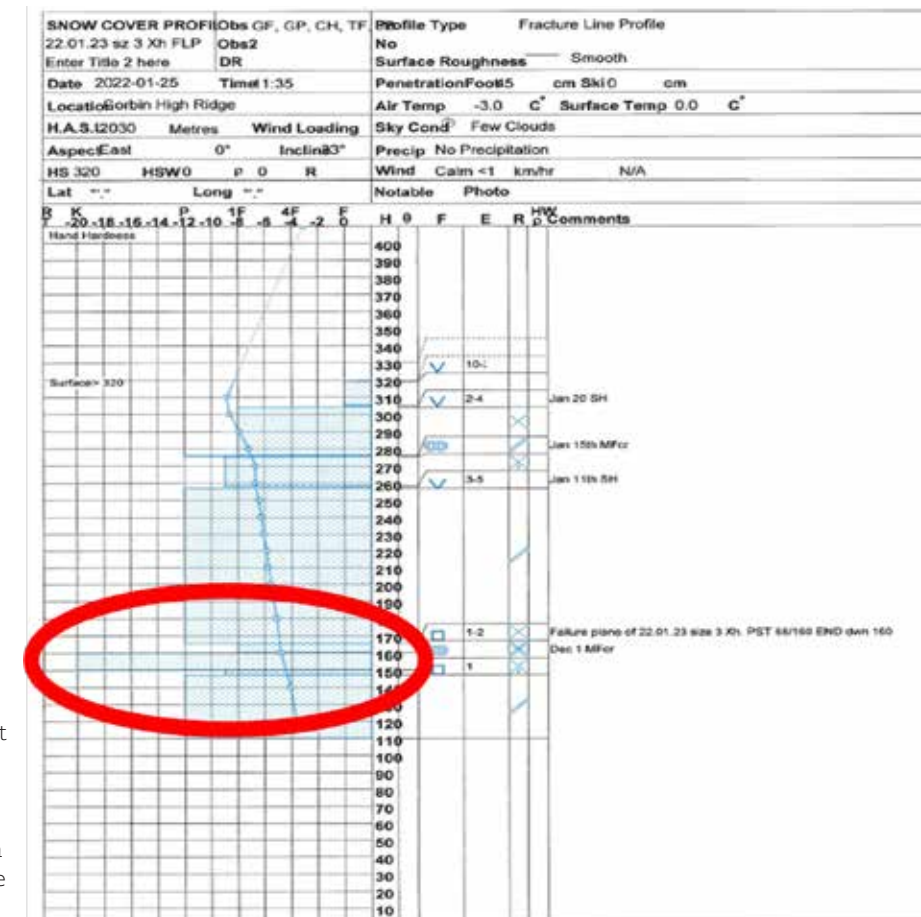


FIG. 4: THE FRACTURE LINE PROFILE FOR THE WRAPAROUND AVALANCHE IN HELEN'S. THE DEC. 1 CRUST IS CIRCLED IN RED.



around the mountain! Long-time staffers in the Columbia Avalanche Program commented how they were surprised to see such a large result and were not expecting something that big to pull out of the path.

The comment in our SAWS database for this avalanche read: "Pulled entire slope propagating ~500m down ridge to east, also sympathetic release N asp into Tangier R (sz 3.5) and SW asp into Helens (sz 3). Jack Macdonald terminated beyond historical runouts with ~25m deep in river and ~5m deep (~100m wide) on CP tracks, breaking mature timber and communication line. ~300m width at terminus with a lot of mature timber from air blast and impact forces."

THE AFTERMATH, PART 1: CLEANUP AND FRACTURE LINE PROFILE

The avalanche overran the west end of the snow shed and put an average of three metres of snow on 80 m of highway, and one metre of snow on the road inside the shed. Deposit removal took almost 2.5 hours, with two large loaders working continuously.

We completed a fracture line profile on Jan. 25 in Helen's (Fig. 4). The Dec. 1 crust was clearly visible and was 10 cm thick. Interestingly, a five-centimetre-thick layer of facets was observed above the crust. The key result on the facet/crust layer was a propagation saw test that ran to the end of the column after 58 cm (PST 58/160 END).

THE AFTERMATH, PART 2: THE WET SLAB CYCLE OF MARCH 29

After the cycle of large avalanches had abated, we wondered if and when a spring wet slab cycle might occur. In a study of 11 winters with notable deep persistent slab avalanche cycles in the Washington Cascades between 1989-

90 and 2020-21, at least four of them had significant deep wet slabs release on the same crust/facet layer around 100-129 days after crust formation (Primomo 2022). Conventional wisdom says watch out for wet slabs after three nights with



FIG. 5: A GOOGLE EARTH IMAGE SHOWING THE WRAPAROUND SIZE THREE AVALANCHE IN HELEN'S TO THE LEFT OF THE MAIN AVALANCHE IN JACK MACDONALD. THE CROWN IN JACK MACDONALD PROPAGATED ACROSS ROUGHLY ONE-THIRD OF THE START ZONE AND INVOLVED THREE MAJOR GULLY SYSTEMS. THE SYMPATHETIC SIZE 3.5 ON THE NORTH ASPECT THAT RAN ALL THE WAY TO THE TANGIER RIVER IS NOT SHOWN.



FIG. 6: THE AFTERMATH IN JACK MACDONALD. THE LEFT IMAGE SHOWS SOME OF THE 3.1 HECTARES OF FOREST DESTROYED BY THE AVALANCHE. THE RED ARROW POINTS TOWARDS ANOTHER 2.3 HECTARES DESTROYED IN THE LOWER TRACK AS THE AVALANCHE SUPERELEVATED. FOR SCALE, THE SNOW SHED IS 141M LONG. THE RIGHT IMAGE SHOWS MACHINERY CLEARING OVER FIVE METRES OF SNOW FROM THE CP RAILWAY LINE ACROSS THE RIVER. DEBRIS IN THE ILLECILLEWAET RIVER WAS ESTIMATED AT 25-30 M DEEP.

no refreeze, so we were surprised when a significant cycle occurred on March 29—119 days after crust formation—as the Fidelity weather station had recorded above zero temperatures for only four hours when the cycle began, and the maximum temperature was only 4 C.

More recent research (Levy et. al 2022) suggests incoming radiation, rather than temperature, is a stronger predictor of wet slab activity. This was particularly relevant in our case as the paths that ran naturally faced due south, where the thickest and smoothest crusts were found. Lower elevation paths (especially below 1,500 m) were particularly active.

THE AFTERMATH, PART 3: DEBRIS REMOVAL

By late August, the remaining avalanche debris above the shed was still 10-20 m deep, and it was abundantly obvious it would not melt before winter. This had the potential to compromise drainage through the three-metre culvert running below the shed and threaten the shed structure itself. The ministry contracted three excavators and three rock trucks to clear the snow, rocks, and trees (including some merchantable timber). They worked for 31 days, removing about 45,000 m³ of debris. Special care had to be taken while excavating as a large snow cave had formed above the creek (Fig. 8).

DISCUSSION AND HISTORICAL PERSPECTIVE:

This was the largest avalanche in 34 years for this path, when helicopter control on Feb. 17, 1988, produced what was recorded as a size 4.5 avalanche that ran a similar distance and left an average depth of six metres snow (max 10.5 m) along 41 m of road beyond the west end of the shed. The average deposit measurements for this avalanche in the ministry's SAWS database were listed as 1,000 m length x 150 m width x 10 m depth, giving a volume of 1.5 x 10⁶ m³, which is an order of magnitude greater than the lower end range for a size five avalanche given in Jamieson et. al (2014). The slab was 2.5m thick and released at ground level, suggesting a rain crust may not have been a factor. Interestingly, 40 minutes later that day, control work in Helen's produced a sympathetic size four in Jack MacDonal that hit the railroad tracks for a second time!

Fitzharris scoured the old CPR avalanche records from 1909 to 1976 and determined the return period of significant avalanches to the railway to be every 7.5 years for Jack MacDonald. Measurements on Google Earth

JACK MACDONALD AVALANCHE STATS

Crown length: approx. 650m

Area of slide: 71 hectares

Area of deposit: 9.4 hectares

Area of existing forest destroyed: approx. 5.4 hectares

Mass of deposit: 2.4 x 10⁸ kg (based on 5 m average deposit depth and 500 kg/m³ deposit density)

Maximum depth of deposit: 25-30 m in the Illecillewaet River and also the catchment above the snow shed.

revealed the distance from the edge of the snowshed to the railway tracks to be 230 m; therefore, any recorded toe mass distance (TMD) greater than 230 m in our SAWS database was taken to be a similarly significant event. There have been six such events since MoTI records began in 1977, giving a return period of 7.5 years!

Fitzharris (1981) also noted that with artillery control, the frequency and magnitude of small and medium avalanches had been altered since 1965, but the effect on very large avalanches was unclear. Our data suggests both the frequency and magnitude of very large avalanches is not different; however, the trigger has changed from 100% natural before 1977 to 17% natural (one of six events) and 83% artificial (five of six events) in the years since. Artillery control began in 1962 with the opening of the Trans-Canada Highway (Schleiss 1990). Previously, avalanche defence of the railway was limited to snow sheds and the Connaught tunnel.

Chris Argue of Dynamic Avalanche Consulting produced a return period graph from MoTI data (Fig. 9) that pegged this as a 1:23-year event. For the large paths in the Selkirks with discontinuous start zones, Fitzharris (1981) used a



FIG. 7: AVALANCHE DEBRIS ABOVE THE JACK MACDONALD SNOW SHED ON AUG. 23, 2022, SEVEN MONTHS AFTER THE AVALANCHE.



FIG. 8: SEPT. 22, 2022: CAREFUL WORK WAS REQUIRED REMOVING AVALANCHE DEBRIS DUE TO SNOW CAVE FORMATION ABOVE THE CREEK. THE EXCAVATOR IS APPROXIMATELY 15 M ABOVE THE ENTRANCE TO THE SHED'S DRAINAGE CULVERT.

best-fit frequency distribution to determine the mass of a 30-year avalanche is 5% of M_0 (the limit avalanche, or the largest avalanche a path can produce in a 30-year winter). Our independently calculated mass (2.4×10^8 kg) compares favourably with this value (1.45×10^8 kg) for Jack MacDonald, adding further strength to this being approximately a 1:30 year event.

Fitzharris (1981) reported the largest avalanche in Jack MacDonald occurred on Feb. 11, 1937, with a mass of 3.06×10^8 kg (which is 11% of M_0). He used National Research Council (NRC) values for deposit density (320–380 kg/m³), which are low for a size five avalanche [see Table 2 in

Jamieson et. al (2014)]. Using a mid-range NRC value (350 kg/m³) for the Jan. 22, 2022, avalanche would yield a mass of 0.91×10^8 kg, roughly one-third the size of the 1937 avalanche. Interestingly, we dated the rings of a mature tree deposited on the snow shed at 84 years old, which means it started growing in 1938, the year after the 1937 avalanche! The tree's original location is unknown, but it likely came from the 2.3 hectares of forest that was cleared when the avalanche super-elevated in the lower track (see red arrow in Fig. 6).

A few words about size: The black rectangles in Fig. 10 show the range of values for the Jan. 22, 2022, avalanche compared to established criteria for avalanche size classification. A continued log

scale is assumed for deposit volume (i.e., size five volume is 1×10^6 m³). MoTI video of the event shows trees being destroyed in the lower start zone, thus, calculating areas where forest was destroyed (or could have been destroyed if trees were present in the track or runout) gives an area of approximately 60 hectares, which places this event squarely in the size five category.

The future impact of climate change on avalanches is a topic of increasing interest. Hendrikx et. al (2022) found the frequency of avalanches to the highway in GNP will likely decrease by the 2090s; however, this key finding may not tell

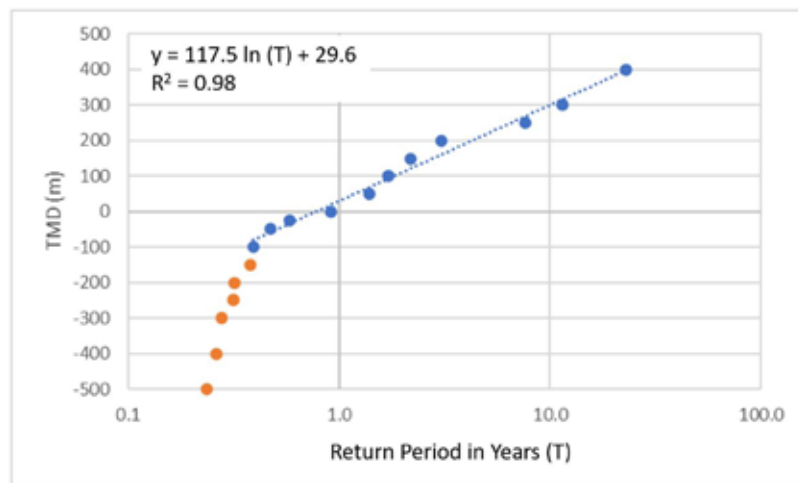


FIG. 9: RETURN PERIOD GRAPH (LEFT) AND RUNOUT PREDICTION DISTANCES (RIGHT) FOR JACK MACDONALD. TMD REFERS TO AVALANCHE TOE MASS DISTANCE (IN METRES) FROM THE HIGHWAY FOG LINE AND RETURN PERIOD (T) IS GIVEN IN YEARS.

Runout Prediction	
T	TMD
1	34
10	299
30	425
50	484
100	564
300	690

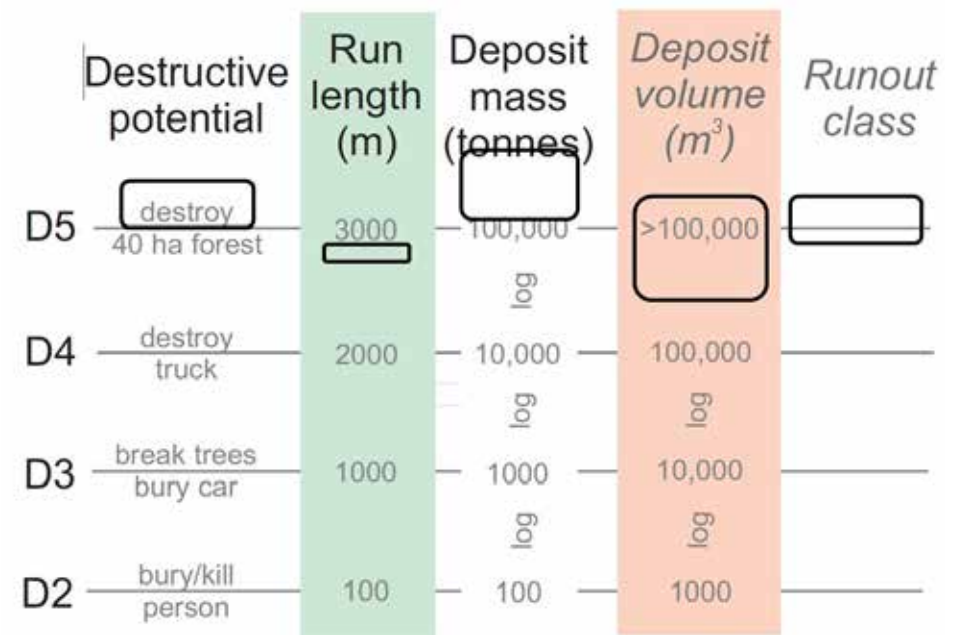


FIG. 10: AVALANCHE SIZE AS DEFINED BY DESCRIPTIVE PARAMETERS. THE BLACK BOXES INDICATE THE ESTIMATED RANGE FOR THE JAN. 22, 2022, AVALANCHE IN JACK MACDONALD. FORMAT DEVELOPED BY BRUCE JAMIESON.

the whole story. Bellaire et. al (2016) found an increase in the frequency of melt-freeze crusts at the Mt. Fidelity study plot in GNP in November or December, especially since 1995. With a higher probability of extreme meteorological events under climate change, Hendrikx et. al (2022) note there is a continued potential for extreme avalanche events. The combination of more sliding layers embedded in the early season snowpack and (warm) rapid loading events potentially explains why extreme avalanche events may not diminish over time.

Thus, the setup for a pattern of large destructive avalanches would take on the form of early season AR events occurring when a significant snowpack has already accumulated, and subsequent (warm) rapid loading events overload crust/facet combinations. Typically, snowpack tests have focused on start zones, looking at initiation and propagation propensity. If thick glaze crusts exist at lower elevations, investigations at the track level might be useful to get a handle on whether the crust could 'turbocharge' any large avalanches. In other words, we might do well to consider initiation, propagation, AND acceleration when forecasting larger avalanches.

ACKNOWLEDGEMENTS

Special thanks to Bruce Jamieson for article review and insightful discussions about large avalanches. Thanks to Catherine Brown at Parks Canada for GNP weather station data and snow profile information. Thanks also to Paul Harwood, Johann Slam, Wren McElroy, and Kate Ryan for article review and comments.

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Temperament Over Time

Alex Baechler

I'VE BEEN RUMMAGING THROUGH MY OLD logbooks and reports recently, digging up examples for the Avalanche Professional membership application process. In the process, I found a Post-it from back in 2008, and this short essay on hazardous attitudes and ski cutting. I remember one of the course evaluators cornering me (at least it felt that way at the time) and asking me to share my experience with my cohorts. At the time, I was inexperienced and fearful of the vulnerability that accompanies being, or being perceived, as impulsive, reckless, or wrong. I declined. At the time I convinced myself I was satisfied with at least achieving some self-awareness from the process. I always regretted giving into my fear of being evaluated or judged. Here are the thoughts expressed in that essay.

AUGMENTING MY STYLE

At times, I have unrealistic expectations of others and myself. A preference for the best practices or an ideal solution can create frustration, contribute to a negative trend in my attitude, and lead to anger and resignation. Being conscious of the symptoms that manifest when I adopt an overly idealistic approach is just the beginning. Matching the appropriate style to the situation instead of relying on ideals will be the real challenge.

Accepting that the ideal solution is not the only appropriate response to a problem will greatly improve the way in which I interact with others. I can at times allow my ego to take over and adopt an "I can do it" perspective to accomplishing tasks, particularly when delegated responsibility by someone I respect, or when the perception that an expedient outcome is desired or required.

HAZARDOUS ATTITUDES: "I CAN DO IT, GET IT DONE, I CAN HANDLE IT"

In my opinion, life is good. I have a four-year-old son who is my world, a partner who loves me and who I have the deepest affection of, good friends and coworkers, and a house on the horizon.

My life is good.

I will qualify my text by stating I am new to the industry. I only have a few basic badges and to date no one has shown me any secret handshakes. I have been conducting avalanche control work in a modified snowpack for four years and leading basic explosive missions this past season. When I was initiated into the crews and began the work, I was overly cautious. Over time, I became careful. Last season, I was overconfident, and that is where my point begins.

Due to several aggregate decisions, we as crews were always under pressure to conduct our control work within slim time margins and the constraints of budgeted resources. Do more with less. We as crews and a department felt the pressure and we responded with style. We felt pride when we had a chance to detonate a 1.5 kg round of coffee while we waited for the lift gods to break out the rime and turn the lift.

Doing more with less can mean taking more chances. Doing more with less means ski cutting is preferable to explosives. It costs less (we'll test that assumption later), it maintains the aesthetic for the public, and, at its best, it's fun: fracture lines propagating from your ski tips, a slab rumbling down the fall line, and a smug smile as you watch the runout obscured by the debris from the comfort of your safe zone. At its worst, you're too low, with no bombs, and it's marginal whether there is enough time to do another clean-up run and still meet the internal and external time pressures. If I cut it, all these pressures will go away. Everyone wins.

This was my poorest avalanche control decision to date. The area we were controlling was new to us. I was too low on the slope, in well anchored trees, with a sweet spot 30 m above me to skier's left. The incline increased across the exposed slope. We need to cut this.

"How far out should I go?" I ask.

Focused on the outcome, "Far enough to make it safe," I think.

There's 35 cm of storm snow on a skied-out crust. The temperature's been rising as we've descended. The turns are heavier and harder.

"Watch me," I communicate to my partner.

I cut into the clearly exposed, clearly loaded slope with a clearly increasing incline. I remember thinking, "Whoa, this is too far!" I crank a turn back; my partner will get the hang fire.

I spot my safe zone. "You're still good."

I muscle another turn.

"Damn!"

Body bomb.

I prepare for a recovery.

"Nope".

Pop! Single-eject. I'm swimming.

The sweet spot crowns above my entry tracks and I'm obscured from my partner's view.

Pop! Double-eject. I'm really swimming now.

I clearly recall thinking, "Uh, I could go under here. Push

for the surface. Keep your head up."

Then it all stops. "I'm OK!"

Couched in debris, the bread-slicer tree line only 20 m away, I confirm with my partner I'm OK. The other crews are waiting at the load station. Three metres of debris below me, I locate one ski near the surface. The other one is buried, gone. I curse my luck. I'm embarrassed and this makes me angry. I sheepishly exchange words with my partner.

"Who hasn't taken a ride?" was his reply. We ski to the load.

I fully expect to experience the consequences of my mistake and get an earful from the blaster of record. I got fists of pow and high fives instead.

I made a bad decision and I made a mistake. I knew that then and I accept it now. While the physical consequences were not very noteworthy, the aggregate decisions leading up to this non-event and my decision in it are. Amplify select factors and this is a reportable incident due to injury or death.

If I can learn from my mistakes, maybe someone else can too. We are unique as an industry, but we should not afford ourselves any special status as workers and practitioners. We all have the right to conduct our work in a safe manner. Our colleagues, supervisors, friends, and family expect and deserve that we observe this due diligence and maintain a high standard. We have the right to, and we are expected to, refuse unsafe work.

REFRAMING EXPERIENCES

I think it's important to determine if the glass you're looking back through has the effect of a prism or a mirror. After my incident, and after about a decade of temperament, I can look back and see the reflection of my initial reflex reaction. Now, with the benefit of time, I can see the refracted light of the whole experience in my life's arc.

ADVICE TO MY YOUNGER SELF

If I could sit down and have a coffee with my younger self, I'd have the conversation I would have likely dismissed or reluctantly endured. Something like this:

"First of all, great to see you and I want to let you know you're doing great! As someone who appreciates you and with a vested interest in your success, I want to share some insights about things I've observed that will keep you and your team safe and extend opportunities in your career path.

"Slow down. You don't have to be the person that doubles down and gets it done every time. In fact, it's likely better for everyone's awareness and safety if you don't. You're making a great contribution. It's important that you consider your limits and safety when faced with critical decisions. In time, you'll come to recognize the faces will change, but the work remains."



IS THERE ANOTHER WAY OF GETTING IT DONE WITH WHAT WE HAVE? TEAM SKI CUTS AT A RESORT IN THE KOOTENAYS. // WREN MCELROY

My practical advice on ways to slow down, attain some stillness, and smooth out actions would be to consistently drill down with targeted questions around the assumptions you have about tasking, time, resources, intentions, and expectations. Timeframes are artificial; pressure is a factor we manufacture with decisions and pre-existing conditions. Ask questions that seem obvious at first but to which the ultimate answers are somewhat elusive:

- Why are we doing this?
- Why isn't there enough time?
- Is there another way to get it done with what we have?
- Why am I working outside the norm?
- Will taking more time even matter at the end of the shift?

Share the insights you uncover with your team regularly. I would offer reassurance that being assertive and confident when standing on the foundation of your rights as a worker is a route that becomes the beaten path of professionalism.

We all want opportunities to stretch and grow, to celebrate the satisfaction and pride that result from overcoming challenges in a day. There's no need or desire out there for you to stick your neck out to achieve it.

Repeat after me: "I have the right to know, the right to participate, and a right and responsibility to refuse the performance of unsafe work."

Instead of taking one for the team, stand up for the team and your future self. It's a tall order and big boots to fill, but you'll grow into them. 📌



Intersectional Heuristics in Backcountry Decision-Making

Aidan Goldie-Ahumada

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IAN MCCAMMON'S 2003 ARTICLE, *Heuristic traps in recreational avalanche accidents*, published in the 22nd Volume of *The Avalanche Review*, provided a heuristic framework that has informed avalanche education and professional training in the years since. The framework builds on the idea of heuristics in the field of psychology, which describes human tendencies to take shortcuts to decision-making based on a variety of different factors. These shortcuts are often positive, allowing us to expedite the minutiae of everyday life. However, when these shortcuts unconsciously trickle into more consequential decisions, like those made while recreating in the backcountry, they can lead an individual or group towards more serious outcomes. Only upon reflection do backcountry users identify the heuristic traps, or “red flags,” they encountered in the field.

This framework, paired with the acronym FACETS, has proven to be a useful tool for backcountry recreationists and avalanche course instructors alike. There is no doubt it has spared backcountry users from venturing into avalanche

First, let's summarize McCammon's framework:

Familiarity	Relying on our past actions to guide our behavior in familiar settings.
Acceptance	The tendency to engage in activities we think will get us noticed or accepted by people we like or respect, or by people who we want to like or respect us.
Consistency	Maintaining consistency with the first decision. A desire to be consistent overrules critical new information about an impending hazard.
Expert Halo	An overall positive impression of the leader within the party leads them to ascribe avalanche skills to that person that they may not have.
Tracks (Scarcity)	The tendency to value resources or opportunities in proportion to the chance that you may lose them, especially to a competitor (Cialdini, 2001).
Social Facilitation	The presence of other people enhances or attenuates risk-taking by a subject, depending on the subject's confidence in their risk-taking skills.

TABLE 1: MCCAMMON (2003). HEURISTIC TRAPS IN RECREATIONAL AVALANCHE ACCIDENTS. THE AVALANCHE REVIEW (VOL. 22, NOS. 2 & 3). RETRIEVED FROM WWW.AVALANCHE.ORG/-AAA

terrain when conditions were dangerous. This article critically reflects on the use of this framework and asserts there is a missing element of intersectional heuristics—shortcuts to decision-making driven by unbalanced power structures—within backcountry recreation and education settings that will continue having detrimental effects in the industry if not addressed. Ultimately, this article suggests an amendment should be made for a more inclusive framework for decision-making in avalanche terrain.

Using this framework, we can tease apart an avalanche incident and retrospectively apply these categories. A group of four skiers ventured into the Utah backcountry, each with varying degrees of experience, but all carrying the requisite transceiver, probe, and shovel. The avalanche forecast had been slowly trending towards stability after a record-breaking storm the past week. The skiers made a plan at the parking lot to ski an eastern aspect at treeline. Upon gaining the summit ridge, they observed high west winds had eroded the windward side of the ridge and deposited snow on the leeward side. The skiers stopped to assess conditions before skiing the line.

A female in the group brought up her apprehension due to the potential wind loading on the eastern aspect. The group talked. Ultimately, her idea was dismissed due to a variety of other factors: this was a slope commonly skied by members of the group, the trees could provide anchoring against large slab avalanches, and there was no other evidence of instability on this elevation and aspect.

All four skiers agreed to ski the slope; however, only three made it to the bottom. Inspecting the slope above, they saw a small, size-1.5 avalanche had ran close to the top of the slope and towards the trees below. The group quickly skinned back up to the site and performed an avalanche rescue. They found their friend deceased after being caught in a wind slab avalanche and getting dragged through the trees.

Upon reflection, the survivors identified red flags that were observed and ultimately ignored as part of their decision-making process. In their debrief, they identified the expert halo and familiarity heuristic traps that led to their poor decisions that day. The expert halo took form through a single member of the group who the others deferred to due to his higher level of backcountry experience. The familiarity trap—a confirmation bias that translated previous positive experiences to the most recent outing—played a role in

terrain selection. But, would the outcome have been different if a male member of the group first raised concerns with the wind loading?

A NEW CATEGORY OF HEURISTIC TRAP

These heuristic traps are common occurrences, according to Johnson, Mannberg, Hendrikx, Hetland, Stephensen, (2020); and McCammon (2003). They can be everyday occurrences that rarely lead to an avalanche incident or fatality. An analysis of this incident, among many others, finds the dismissal of valid ideas or concerns from members of the touring group. This is a type of heuristic trap that is often attributed to the “expert halo” or a sort of “social facilitation.” However, these categories do not adequately describe the nuance of the social interactions at play in this situation and the larger societal paradigm that drives everyday interactions.

I argue there likely was some sort of identity bias. We see this very commonly with gender identities, where those who identify as female will commonly have their opinions dismissed by their male counterparts. McCammon (2003) touches on this idea with the “acceptance” category, under the guise of a male skier attempting to impress their female counterpart, potentially leading to higher risk-taking.

What is not addressed are the power dynamics at play in these decision-making routines. In a patriarchal society, male backcountry users carry a societally constructed dominance over female backcountry users and will consciously or unconsciously use that power to diminish the voice and opinion of the female team member, despite the findings by Sola, Reese, and Kulbacka (2002) that, “Women may be less likely to die in avalanches when participating in recreational alpine activities because they tend to take less risk.” I extend that idea further by making the link between unconscious

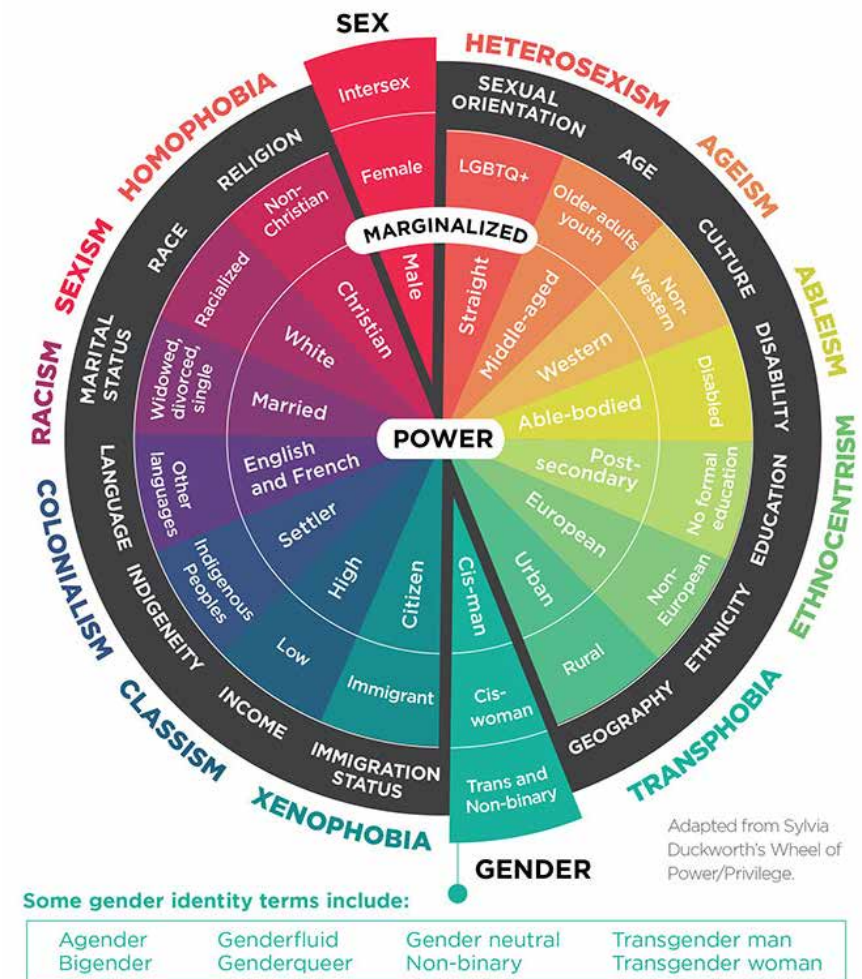


FIG. 1: INDIVIDUALS ARE NOT DEFINED BY A SINGLE IDENTITY, BUT INSTEAD BY A MYRIAD OF SOCIAL AND POLITICAL IDENTITIES. WITHIN SOCIETAL POWER STRUCTURES, CERTAIN IDENTITIES THAT HOLD LESS POWER ARE CONSIDERED MARGINALIZED. ADAPTED FROM SYLVIA DUCKWORTH'S WHEEL OF POWER/PRIVILEGE. (BAUER 2021).



heuristics to unconscious bias. The male-female power dynamic is only one of many negative power structures that impact decision-making, even though it is the one that tends to be talked about most in the industry. I encourage our field to better examine all power structures in our society and how they can influence the everyday decisions made in avalanche terrain.

This is not a new idea, but instead builds on a body of work done by many leading scholars on social theory. Kimberlé Crenshaw first coined the term “intersectional” in her 1989 paper, *Demarginalizing the intersection of race and sex in the Journal of Feminist Legal Theory*. Crenshaw described how intersecting identities of race, gender, and many others, impact the way individuals are treated within certain community structures. The backcountry recreation community and the avalanche industry have a community structure dominated by white, middle-aged, cis-gendered males (Warren, Latosuo, Stimberis, & Morris, 2020, and Reimer, 2019). Despite the good-faith intentions of individuals within this community, the current structure of the community leads to a vulnerability to *intersectional heuristics*.

INTERSECTIONAL HEURISTICS

Intersectional heuristics is the missing heuristic trap that makes backcountry groups vulnerable to unconscious bias towards various identities. Any individual that possesses a marginalized identity (Figure 1) runs the risk of having their input in backcountry decision-making dismissed by the group at large if an imbalanced power structure exists. Like our adoption of heuristics from the field of psychology, I am encouraging the avalanche field to adopt the idea of intersectionality in our everyday practice, including avalanche education.

Intersectionality comes into the conversation when we reflect on the way the idea of diversity and inclusion has been approached in the industry already. This phenomenon of female-male power imbalances was seen as the obstacle that had to be overcome for the industry to be equitable. As a result, we have seen numerous female affinity group avalanche courses, female-specific scholarships, and female-specific mentorship programs. What is largely ignored are other intersections of race, gender identity, class, and ability that impact backcountry recreation and decision-making. Two female ski tourers on paper will be perceived as having overcome the previously mentioned “acceptance” heuristic trap. Under McCammon’s framework, they will need to better concern themselves with the other five possible traps. Under the lens of intersectionality, gender is not the only identity that creates power imbalances. One of these female team members could be of colour. In a community structure that values the experiences of white backcountry skiers, as seen in print and

visual media, this creates a power imbalance that can impact decision-making.

Here is another case study to explore. At an annual winter sports festival in Colorado, a group of three black backcountry recreationists attended as an affinity group. They moved through the events together with hopes they could overcome the discomforts they each had experienced at similar events. When they rode at the resort, the operators pre-emptively slowed down the lifts for them despite their competence. When they hit the skin track, they were met by other backcountry skiers with probing questions that groups that are part of the community majority did not receive, such as: “Are you part of a group or class?” “What brings you here?” and “Have you read the avalanche bulletin?” When walking through the festival, a police officer reflexively placed their hand on their gun. These microaggressions were commonplace and expected by this marginalized group, who was often “othered” in these spaces.

When I sat down and chatted with these backcountry users, the importance of intersectional heuristics became apparent. Even though on paper these three athletes shared a marginalized identity, they also identified and were cognizant of multiple intersecting identities, including sexuality, gender, class, and ability. They were athletes who knew all too well what it felt like to have their opinions in the backcountry dismissed. With the idea of identity heuristics on their mind, they recognized a variety of unbalanced power structures and actively fought against those biases in their decision-making, with frequent check-ins to make sure everyone’s ideas and opinions about avalanche hazard were being heard, and up-front conversations if those imbalances were influencing their decisions.

Here is what is sometimes lost in the discussion around intersectionality and creating inclusive environments: lost diversity in groups is a loss of lived experience. Having diversity in risk tolerance is a good thing. Discussing competing ideas is best practice. The uniformity an exclusive avalanche industry promotes is not ideal and can potentially be dangerous. The literature has shown having a diversity of ideas and lived experiences will improve student education and group decision making (Bogan, Just, Dev, 2013). This applies to backcountry recreation in a fundamental way. Diversity of experiences leads to a diversity of thought, which introduces legitimately competing perspectives towards more conservative risk-taking.

POSSIBLE SOLUTIONS

With the identification of the seventh heuristic trap, intersectional heuristics, one begins to question how to best address it in the avalanche industry. Here are three tangible solutions that can either be implemented on small scales or readily implemented in greater professional contexts.

1. Increased opportunities for meaningful mentorship. Mentorship opportunities in recreational spaces are hard to come by. Mentorship opportunities for those with intersecting marginalized identities are even harder to come by. For the latter to happen, one needs to find a mentor who not only has a wealth of experience in backcountry travel they are willing to share, but also shares a similar lived experiences to the mentee. The Scarpa Athlete-Mentor Initiative provides a good model for what meaningful mentorship could look like. In this initiative, mentees who self-identify as members of marginalized communities are paired with mentors from Scarpa’s athlete team. Scarpa mentors are all given anti-bias training and these relationships are given support by other Scarpa team members and third-party consultants. Initiatives like this can not only lower the barrier to entry into backcountry recreation, but they can also create a more linear path towards gaining experience and allow marginalized athletes to become mentors for others.
2. Intersectional heuristics curriculum in avalanche education. The field of avalanche education has made great changes in recent decades. From informal education in the form of mentorship to formal courses, introductory avalanche education now focuses more on decision-making and terrain selection than snow science. With that in mind, students should be introduced to the idea of intersectional heuristics in introductory avalanche education. If students are asked to confront their unconscious biases and be cognizant of power structures in their decision-making, then there could be an inclusive shift in the way decisions are made in the backcountry.
3. Affinity group avalanche education. The paradigm will not shift if students are learning in spaces that uphold traditional power structures. Guiding organizations and education providers can provide affinity group programming—intentional courses filled by members who share marginalized identities. Programs like these can remove the anxiety that comes with being a marginalized identity in an educational context. When learning with others that share similar lived experiences, students can better build individual and team confidence in backcountry decision-making that can be applied in the future. Avalanche Canada’s MEC Avalanche Safety Grant, which provides free AST courses to BIPOC-led organizations, is an example of this. A bottleneck with this is a shortage of certified guides that can adequately lead affinity courses. One solution to this problem is to train more guides that possess marginalized identities to become course leaders. AIARE’s Kizaki-Wolf Scholarship is one example already working towards this goal. Additionally, existing

instructors can be trained in intersectional heuristics and building inclusive classrooms.

CONCLUSION

The avalanche industry is continually learning and evolving. With that evolution comes a continued examination of the parts of humanity that influence decision-making. This is relevant in professional and recreational contexts as both backcountry operations and individuals are vulnerable to be influenced by community-level power structures. The avalanche industry is noted to have a lack of diversity within its workforce (Warren, Latosuo, Stimberis, & Morris, 2020; and Reimer, 2019). This makes our industry critically vulnerable to intersectional heuristics, a shortcut to decision-making driven by an unbalanced power structure. This article serves as a jumping-off point for the industry to examine how to best address this issue in operational and educational settings.

How can I ensure everyone feels comfortable enough to share their opinions and apprehensions about interacting with avalanche terrain?

This should be a question that is at the forefront of the minds of all industry leadership, course leaders, and recreational touring groups going forward.

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Knowledge, the Curse of the Expert

Jerry Isaak

“Anyone who wants to lift the curse of knowledge must first appreciate what a devilish curse it is. Like a drunk who is too impaired to realize that he is too impaired to drive, we do not notice the curse because the curse prevents us from noticing it.”
—Steven Pinker, Professor of Psychology, Harvard University

IT SEEMS INTUITIVE that the most knowledgeable individuals would be the best possible instructors. Yet, if that is true, why does it sometimes seem like experts have difficulty conveying their hard-earned knowledge to novice learners?

On Jan. 19, 2019, I entered my first Oodarysh (horse wrestling) competition. It took place in the community park of a small, ethnically Uzbek village situated high in the Babash Ata Mountains of southern Kyrgyzstan. I was definitely a novice. The object of Oodarysh is to pull your opponent off their horse without being pulled from your own. To picture the scene, think Genghis Khan meets WWE on horseback, in a snow-covered field surrounded by an audience of hundreds of shouting, cheering locals. Add in the blaring sounds of traditional Uzbek horns and drums, a play-by-play announcer on a feedback-prone Soviet-era microphone, and turn up the volume—those are the primary elements of Oodarysh (as well as every truly great party in Central Asia).

Since this was my first match, I needed significant coaching if I was to have any chance of winning. Before the match, I sought out advice from the most expert people I could find. It seemed to me that I could learn most effectively from the top-rated competitors. My impromptu coaches were experts at the game and eagerly gave me large volumes of information. Unfortunately, I quickly became overwhelmed and could really only remember, “Don’t let him pull you off!” and “When you grab on to him, pull him off his horse!” I also remember receiving oddly detailed instructions on precisely how high to adjust my outside stirrup. It was all well-meaning advice intended to help me survive the match, but I struggled to understand how all that expert advice would fit together in a winning combination. I wasn’t able to process the knowledge of the experts.

In the context of instructing novices, the experts’ knowledge seemed like more of a curse than a gift. Researchers and authors Dan and Chip Heath describe this ‘curse’ in their book *Made to Stick*: “Once we know something, we find it hard to imagine what it’s like not to know it. Our knowledge has ‘cursed us’. And it becomes difficult for us to share our knowledge with others, because we can’t readily re-create our listeners’ state of mind.”

If you are like me, you have experienced this curse both as a novice learner and as an expert instructor. The majority of *The Avalanche Journal* readers are experts in avalanche safety and education, especially when compared with the general population of Canada. In particular, students in recreational avalanche education courses are novices and the instructors are experts. If you are an avalanche expert who is interested in more effectively passing on your knowledge to novices, this article is for you.

THE DIFFERENCE BETWEEN NOVICES AND EXPERTS

Novices and experts are clearly different. The obvious difference between the two is a gap in experience and skills. Experts have more of both. However, the more fundamental and frequently overlooked difference is that experts engage differently with foundational knowledge. According to Rebecca Wallace, an adult learning advisor and coach, “Novices deal in explicit knowledge, facts, and information, which is easy to talk about—know-what. But experts deal more in tacit knowledge. The sum total of what they have learnt from experience, formal, and informal learning, which is hard to articulate—know-how.”

This distinction between novices and experts may sound familiar to readers of Iain Stewart-Patterson’s article *Avoiding the Illusion of Validity* (*The Avalanche Review* 34.4, April 2016). In that article (based partly on his PhD research on the role of intuition in expert decision makers), Stewart-Patterson highlighted that, “Experts typically make rapid, good decisions based on situational awareness and pattern recognition. They use a high-quality mental model as a bridge between the current situation and a previously experienced pattern. Have I been here before? What did I do and did it work? If I am wrong, how will I know?”

The experts’ mental model, based on tacit knowledge, contrasts with the explicit facts and information that are relied upon by novices. This distinction can create difficulty for experts when attempting to communicate their decision-making process with novices, resulting in the seemingly incongruent curse of knowledge.

The rest of this article focuses on how expert instructors can break the curse of knowledge and create more effective learning environments by:

- focusing on what people need to do, not what they know;
- providing context before giving detail; and
- making ideas, theories, and abstract statements accessible with examples.

SYMPTOMS OF THE CURSE

(Based on Wallace’s article *Curse of Knowledge: Why Experts Struggle to Explain Their Know-how*).

SYMPTOM ONE: THE HIT-AND-RUN INFORMATION DUMP

“It’s like drinking from a firehose.” That’s how students of content-rich courses often describe their first few classes. Unsurprisingly, I’ve heard the phrase used to describe introductory avalanche education courses. Expert instructors want to be helpful and can be tempted to focus on sharing as much knowledge as possible with students in their allotted time. This leads to a hit-and-run information dump of the type where students might be introduced to nine classes of snow grains, eight avalanche problems, five snowpack tests, and the entire metric system on the first morning of a recreational avalanche course. These topics are fundamentally important to the subject of study, but the volume of information can become overwhelming for novices, especially outside of a specific context.

THE CURE TO SYMPTOM ONE: FOCUS ON WHAT PEOPLE NEED TO DO, NOT WHAT THEY KNOW

I believe the most important element of every forecast based on the North American Public Avalanche Danger Scale is not the danger level. Public knowledge of an avalanche danger rating of extreme, high, considerable, moderate, or low is just not that important. It is the corresponding travel advice, aimed at what people actually do, that is essential. The same distinction between knowledge and action holds true in avalanche education. What people will do is far more important than what they know. Wallace writes: “Experts often value their knowledge for its own sake. But this isn’t about what they know. It’s about supporting others to do things differently. And what people need to do sets clear parameters for what experts do and don’t share.” When instructing an avalanche class, try organizing your lesson



THE AUTHOR STRUGGLES IN HIS FIRST OODARYSH HORSE WRESTLING COMPETITION. // PHOTO CONTRIBUTED

plans around the following three questions:

1. What does your audience need to do?
2. What information do they need to take this specific action?
3. Can they act without that piece of information? If yes, cut it.

SYMPTOM TWO: DIVING STRAIGHT INTO THE NITTY GRITTY

Avalanche education is a big, complex subject that can quickly be narrowed down to the size of a single snow grain or the number of taps in a compression test. Details matter, which is why experts emphasize them. However, without the frame of a particular context, details can be bafflingly dense to novices. Before my Oodarysh match, I couldn’t understand why my outside stirrup needed to be so high. It was undoubtedly important, but I didn’t know why it mattered.

THE CURE TO SYMPTOM TWO: PROVIDE CONTEXT BEFORE GIVING DETAIL

Wallace recommends, “To steer experts away from a detail tsunami, use a painting metaphor. The big picture matters. Because diving into details like composition and palette is meaningless if you haven’t first seen the whole landscape or portrait.”

For instructors of avalanche education courses this requires that they encounter terrain and avalanche problems together with students and engage reality rather than hypothetical situations. One implication of this practice is that not all topics will receive equal treatment. Although eight avalanche problems could be introduced in a class, they are unlikely to all be encountered in the field during a single weekend, or even a single season. Make it clear to students that the contexts (of terrain + avalanche problems + people) are gradually built up over time to create the pattern recognition and mental models used by experts.



STUDENTS SKIING ALONG AN ALPINE RIDGE ABOVE THE WORLD’S LARGEST WALNUT FOREST. // JERRY ISAAC



SYMPTOM THREE: SPEAKING ANOTHER LANGUAGE—EXPERTISE

Technical language can be a surprising barrier to knowledge. Although precise terms (what Wallace calls “Expertese”) allow experts to communicate more fluently with one another, these terms may actually obscure meaning for novices.

For example, “cornice” is a word describing an overhanging ledge of snow. Students are taught that cornices are formed by wind transporting snow onto the downwind side of an obstacle, typically a ridge. The image of a cornice appears instantly in my mind when I hear or use the word. Though rather than a single specific image, I recall many cornices I have encountered over years of winter travel, akin to the sum total of cornices I have seen. Until recently, I didn’t think of cornice as a technical term, but as a descriptive one like apple or orange.

However, consider the perspective of novices—students of mine who completed their recreational level one course. In January 2019, during a university-based backcountry skiing class, we ascended a low-angle gully to gain a nearly flat ridge on which we would skin about 300 meters to a summit. At the top of the gully, I asked the students if they planned to proceed along the ridge to the summit. They looked at me in horror as though I had suggested going skydiving without a parachute. “There’s a cornice!” one student said, incredulous that I would even suggest something so dangerous.

Technically, the student was correct. Wind drifted snow had extended over the ridge on the downwind side. Calling it a cornice though would be like calling a 13-year-old boy’s peach fuzz a handlebar moustache—it’s the same growth

process, but hardly the same result. This was a peach-fuzz cornice, not Tom Selleck’s Magnum, P.I. moustache; but my students couldn’t tell the difference. They knew the definition of a technical term—in this case a cornice—but didn’t have the experience necessary to create a mental model when they encountered one.

THE CURE TO SYMPTOM THREE: MAKE IDEAS, THEORIES, AND ABSTRACT STATEMENTS ACCESSIBLE WITH EXAMPLES

My students had seen pictures of cornices in class and could describe what they looked like. However, they needed multiple examples, ideally experienced in person, to begin creating effective mental models. In order to help novices gain fluency when introducing ideas, theories, and abstract statements, use multiple examples or, better yet, take students with you to experience these concepts for themselves.

LIFTING THE CURSE

In order to succeed at horse wrestling, or at least not get badly hurt in my first match, I needed to learn what to do in that particular context, and I really could have used an example of how to do it. In the end, I was matched up against one of my college students, who, luckily for me, was even more of a novice. Judging by the cheers (and laughter) of the crowd, our attempts to unhorse each other were highly entertaining. I won a narrow victory in round two and was rewarded with a prize of 700 Kyrgyz Som (about \$11), as well as a memorable lesson about teaching, learning, and the curse of knowledge. ■



STUDENTS SKIING IN FRONT OF BABASH ATA PEAK, SOUTH OF THE VILLAGE OF ARSLANBOB, KYRGYZSTAN. // JERRY ISAAK



in the loupe

42

IS IT A PROBLEM?



Is It a Problem?

Exploring Avalanche Problem Assessments in Public Avalanche Forecasting

Heather Hordowick and Pascal Haegeli

SINCE THE ADOPTION of the Conceptual Model of Avalanche Hazard (CMAH; Statham et al., 2018), avalanche problems have formed a fundamental component of avalanche hazard assessment and communication in Canada and beyond. However, the pathway from observations to avalanche problems is not explicitly defined in the model; therefore, these assessments rely heavily on subjective judgements that are prone to noise and bias. To shed light on these practices, the Simon Fraser University Avalanche Research Program (SARP) has undertaken several studies to better understand the application of the CMAH over the last few years.

In the first project, Moses Towell (2019) used a statistical approach to explore the relationship between the problems posted in the avalanche bulletin in Glacier National Park and simulated weather and snowpack observations at a representative location in the region. The results of this study confirmed trends that we would expect to see, such as a strong relationship between amounts of new snow and storm slab problems being added to the bulletin. However,

the results were not so clear for other forecaster decisions. For example, no statistically relevant explanations were found linking simulated snowpack and weather data to the removal of persistent avalanche problems. This highlighted that there must be other factors at play that determine forecasters' avalanche problem choices.

To dig deeper, we conducted a qualitative research project on avalanche problems in which we interviewed experienced forecasters about their personal practices for adding, transitioning, and removing avalanche problems from the public avalanche bulletin. Over the 2020-21 winter season, we conducted 22 1.5-hour interviews with forecasters from four different Canadian forecasting agencies: Avalanche Canada; Banff, Yoho, and Kootenay National Parks; Glacier National Park; and Kananaskis Provincial Park. In our interviews, we discussed in detail the assessment of either storm slab and wind slab problems, or persistent and deep persistent slab problems. To document our conversations, we used a method called concept mapping that has been applied extensively in the field of

How much time should elapse without observations of deep persistent avalanches before the problem is removed?

Interviewees agreed that avalanche observations are relevant to deciding when to remove a deep persistent problem; however, we saw a wide spread in observation values associated with how much time should elapse before removing the problem. Specific examples included everything from as low as 24-48 hours (following period of instability due to rapid change in temperature) and up to "until a collective decision has been made that the avalanche season is over." *Additional considerations* shed light on why a deep persistent problem might be maintained in a public forecast perpetually by one forecaster and removed after only one day by another

Considerations mentioned for keeping the deep persistent problem in the bulletin	Considerations mentioned for keeping the deep persistent problem in the bulletin
<ul style="list-style-type: none"> Maintaining the problem through periods of dormancy unless there is a compelling reason to remove it. Feelings of personal responsibility or dread of a large destructive avalanche or fatal incident occurring after a deep persistent problem is removed. 	<ul style="list-style-type: none"> Concerns about message fatigue. Emphasizing the problem by removing and re-adding it again. Availability of alternate communication methods to maintain awareness around the deep persistent slab problem (e.g., fireside chats, social media).

In addition, different internal practices between agencies, such as rules around building a consensus about removing this type of problem with a certain number of forecasters over a certain period of time, influences the amount of time it takes to make the decision to remove a deep persistent problem.

cognitive science to capture and describe expertise. The concept-mapping interviews resulted in visualizations that identified considerations and linked them together in a semi-hierarchical structure that represented each forecaster's perspectives on a specific scenario such as 'removing a storm slab problem' (Fig. 1).

THE PHYSICAL PREDICTORS YOU MIGHT EXPECT

The CMAH distinguishes between nine avalanche problem types that are defined by their typical physical characteristics, formation, evolution and persistence, informative observation types, and effective mitigation options (Statham et al., 2018). As one might expect, these physical characteristics and observations were reflected in the concept maps from our interviews.

While the forecasters discussed a wide range of observation types for each scenario, generally all or nearly all the forecasters agreed on the relevance of a few key observation types, which was not surprising. For example, when discussing adding a storm slab problem, all forecasters referenced new snow, wind, and air temperatures as key predictors. However, eight additional observation types were mentioned by a majority of the forecasters, and another 18 observation types related to instability, snowpack, spatial, temporal, and weather factors were mentioned by at least two forecasters.

Comparing scenarios for adding a problem to those for removing the same problem showed that observation types for adding the problem tended to be more numerous

and have a closer alignment with both the CMAH and the data-driven relationships from Towell's (2019) study. This result reflects the challenge and lack of guidance associated with decisions about removing problems. For example, the predictors for adding a deep persistent slab problem mentioned by the forecasters were in line with the CMAH definitions related to the weak layer, slab hardness, persistence time, and avalanche size. The predictors for removing a deep persistent slab problem, on the other hand, only shared avalanche size as an observation type included in the CMAH definitions. However, since avalanche size is unlikely to decrease when considering removing the problem, the CMAH definitions do not provide practicable guidance for the removal of a deep persistent slab problem.

Focusing on the observation values related to each observation type revealed where forecasters agreed and where differences exist. In some cases, we observed divergences that can be related to differing snow climate or terrain between forecast regions. For example, when asked about adding storm slab problems, forecasters from the Canadian Rockies (Banff and Kananaskis) had a lower limit for typical wind speeds than forecasters in transitional snow climates (Glacier National Park). This might be related to the fact that the less dense snow typical of a continental snow climate might be redistributed at lower wind speeds than in a transitional snow climate. However, physical differences between forecast regions did not provide logical explanations for all the differences observed.

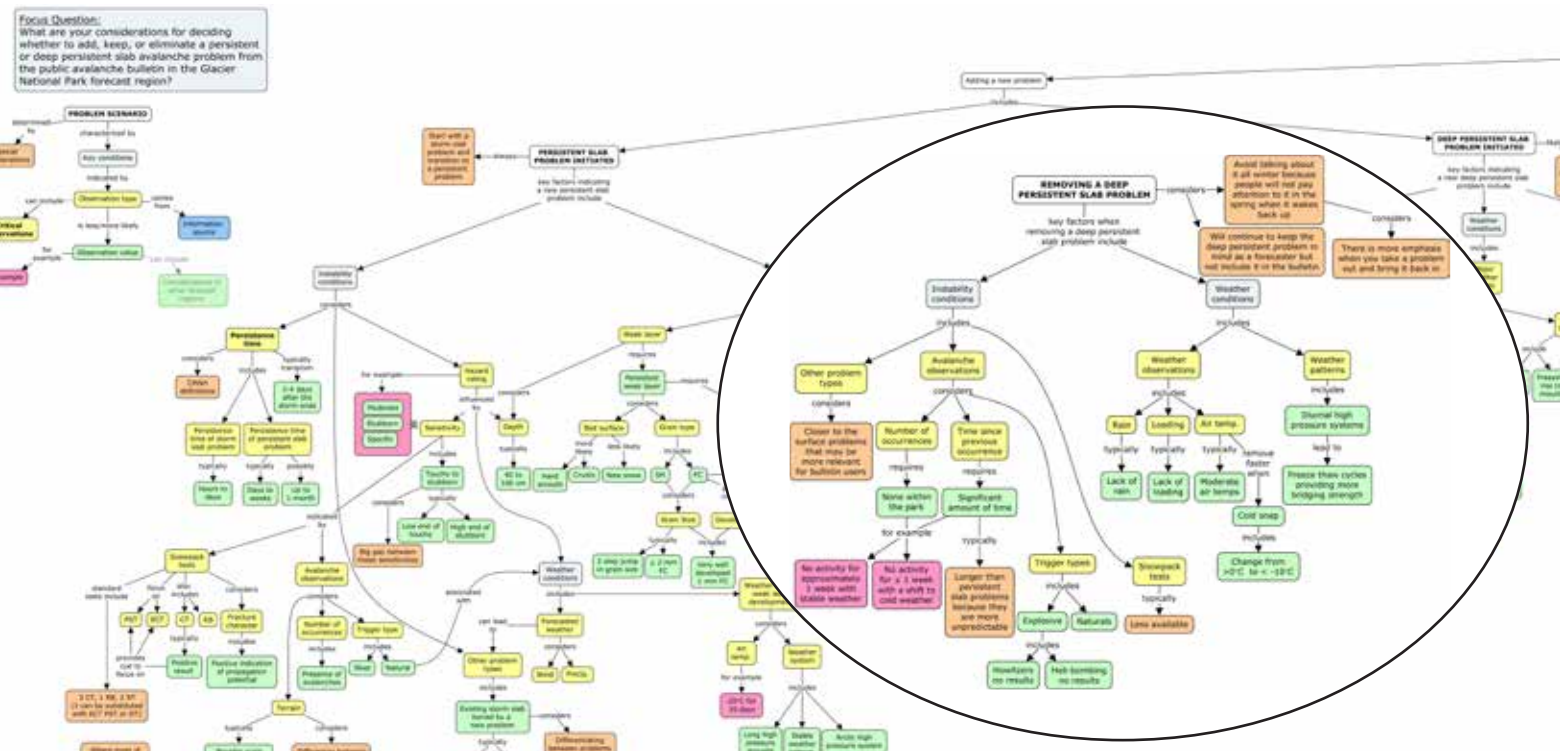


FIG. 1: A SCENARIO FROM ONE FORECASTER'S CONCEPT MAP ILLUSTRATING THEIR CONSIDERATIONS FOR THE REMOVING A DEEP PERSISTENT SLAB PROBLEM.



THE ADDITIONAL CONSIDERATIONS YOU MIGHT NOT EXPECT

Going beyond the physical, snow-science-based aspects discussed above and formally defined in the CMAH, forecasters shared numerous additional considerations that affect their avalanche problem decisions. These considerations revealed many possible explanations for the observed differences between the described problem assessments.

Varying risk communication tactics among forecasters was one of the main themes that emerged, with potential implications for how avalanche problems are assessed:

- One area of misalignment we observed involved practices for grouping certain problem types together. One example was using a storm slab problem to describe simultaneous wind slab and dry loose problems.
- Some forecasters sought to avoid the simultaneous forecasting of specific problems, like storm slabs and wind slabs.
- There were discrepancies in the way problems were communicated as they progressed, such as whether a deep persistent problem should be directly forecast or should transition from a persistent problem.
- We observed practices around the relationship between other bulletin messages, such as using a lower threshold to forecast a wind slab problem when there are no other problems, or when a problem is typical to the baseline conditions for the region. For example, a desire for the bulletin to look substantially different when unusual conditions exist might lead to different thresholds for forecasting deep persistent problems in continental versus transitional snow climates.
- Differing assumptions about bulletin users also emerged as a factor for how avalanche problems were

assessed. Some forecasters were concerned about maintaining credibility with more experienced or local users, while others focused on users with less experience or from a different region.

Our analysis also highlighted that approaches for dealing with uncertainty were a possible source of inconsistencies in avalanche problem assessments. These included tactics like unlisting a problem but continuing to discuss it elsewhere in the bulletin or on an external platform such as social media. Under uncertain conditions, forecasters commonly recounted an increasing value placed on information coming from peers. Forecast agencies in the Rockies, for example, described rules around building consensus with a certain number of forecasters for a minimum time period before removing deep persistent problems from the bulletin. Forecasters based in the Columbia Mountains, who encounter deep persistent problems less frequently, also mentioned a higher value on peers' opinions, but did not describe more formalized consensus rules. Finally, the role of personal experience in dealing with uncertainty was expressed. This can relate to the increased confidence to more readily make changes that can come with more years of forecasting, or variations in risk tolerance in relation to specific personal experiences.

System constraints emerged as another common theme influencing avalanche problem selection. Possible sources of differences included:

- the fundamental differences between the available information sources in office-based and field-based forecasting programs;
- software constraints, such as the limit of three problems that can be forecast, which compelled forecasters to group and prioritize problem types; and
- influences around the time when forecasts were issued.

OPPORTUNITIES TO INCREASE CONSISTENCY

Our results highlight substantial variability in the observation types, observation values, and additional considerations forecasters use when adding, removing, and transitioning avalanche problems; but this variability does not necessarily suggest that forecasters fundamentally disagree about what constitutes these avalanche problem types. Instead, it demonstrates the complexities of assessing and communicating avalanche problems. While some of the observed differences are justified, developing more consistent practices for cases where avalanche problems do not fit neatly into their defined boxes is critical in the public forecasting context. This is because consistency is one of the key characteristics of effective risk communication, and recreationists are unlikely to recognize that information presented in a similar format could have a different meaning between forecasters, forecast agencies, and regions.

With the current absence of industry-wide standardization or training specific to public forecasting, individual forecasters and forecast agencies have developed their own risk communication practices. This is reflected in the discrepancies observed in the largely unacknowledged additional considerations. The development of transparent guidance on more general topics could be an important step towards addressing the disparate perspectives observed related to questions, such as:

- Is the primary objective when selecting avalanche problems to provide the most accurate reflection of the hazard conditions or should risk communication objectives be weighted more heavily if they conflict?
- What constitutes an avalanche problem that should be listed in the public forecast? Is a dormant problem still a problem?
- Should avalanche problems in a region be relative to baseline conditions within the region, or consistent across all regions?
- Should avalanche problem inclusion criteria shift over time within the same region, for example with respect to the existence or lack of other problems?
- What criteria should be used to order avalanche problems in the bulletin?
- Which bulletin users should be targeted when assessing avalanche problems, and which communication tactics are most appropriate to meet their needs?

The creation of more detailed decision aids for scenarios around adding and removing specific problems is another attractive approach for fostering consistency (e.g., CAIC, 2022). Decision aids such as simple checklists, flow charts, or more complex algorithms that leverage additional data sources such as numeric snowpack models could be used. Decision aids could highlight observation types, observation

values, and additional considerations that should be assessed for a specific problem scenario. Transparent decision aids can also be used as training tools for novice forecasters, and support forecasters moving between regions.

A wide variety of assumptions about bulletin users were expressed by forecasters, in some cases leading to conflicting perspectives about how problems should be listed and in what order. Additional research on bulletin users that creates a shared understanding of the target user of avalanche problem information could provide important background information for developing evidence-based guidance on effective avalanche problem use.

CLOSING

Our study revealed considerable variability in the way public forecasters apply avalanche problems in Canada. We hope our results contribute towards developing shared guidance and decision aids for more consistency in avalanche problem assessments; and that they highlight the value of research on how bulletin users apply avalanche problems in their risk management decisions.

While this study focused on public forecasting and considerations related to public risk communication that are not applicable to other forecasting contexts, the important role of largely unrecognized additional considerations in the application of the CMAH stands out. In other contexts, practitioners may consider whether their own operational practices influence their application of avalanche problems; and, if those practices differ between organizations or applications, how that might affect communication of problem information across professional channels and platforms like InfoEx.

If you are interested in having a closer look at Heather's research, you can find her thesis on the SARP website at www.avalancheresearch.ca/pubs/2022_hordowick_mrm.

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Perspectives on risk communication vs. technical accuracy

“We are almost more of a communications shop than we are a forecasting shop... or maybe it is 50/50, and so I think that we look at... every problem and every situation as a communication problem.”

“I really want the forecast to be accurate and... true to the conceptual model as opposed to trying to shape behavior by tweaking these things in a way that looks worse than it is or something.”

“It is sort of like this balance between being always perfectly technically accurate with your bulletins versus trying to accomplish our primary goal, which is efficiently affecting decision-making in avalanche terrain and risk behavior. And so, it could be there are scenarios where my bulletin would be more technically accurate to include that... problem, because it is a problem... but I may choose not to do that for fear of losing the reader's attention because... he or she has one more thing to read and consider, and I really want that person to be focused on those other two problems.”

“I also think there is another thing that goes in here. And this isn't test results or anything, but I think it is how responsible you feel for the bulletin. What you think your job is... Do you feel like you are making decisions for people, or do you think you are just giving information? I think the way that you write the bulletin and feel responsible for other people's decisions will affect whether, and when, or if you actually pull these things, or want to.”

snow globe

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The Last Frontier

Impressions of guiding a winter in the
Altai Mountains, Xinjiang, China.

Willy Trinker

EVERY STORY HAS A BEGINNING AND AN END,

so we've been told. Some are mere chapters within a longer tale, adding more relevance to the book. This is the story of ski guiding one winter in the Altai Mountains of western China—one chapter in my rather long career as an “executive ski-bum,” that being a professional mountain guide and ski instructor. Some chapters are more interesting, alive, telling, and raw, forming the character and really completing the story of said book or career. That could be said about this one.

Where to begin? After some 26 years of working in the heli-skiing industry, guiding, finding new terrain, building and managing lodges, and trying to raise a family in the little remaining time, it was time for a break. This lasted a couple of winters, but sooner or later, the passion for skiing in remote mountains won out and I found myself in the same place I had left, knowing perfectly well it was not the return I envisioned nor had too much interest in taking on again. I'm just not that good at going back and rather think of myself as a more forward-and-onward kind of guy. Needless to say, right about that time, the bucket list was looming large over what was yet to be had in terms of guiding/skiing adventures, or what might just be that next fun gig.

Let's roll back a bit first. Sometime during the 2008–09 season, over a delectable dinner at Silvertip Lodge with some CMH brass, the conversation came up about where was the next biggest market, the next place to explore, and there was room to expand. Revenues, dollars, Wall Street dreams—you get the idea. The consensus was China should not be overlooked. Little did I envision just how correct that foresight was. Not in my wildest dreams would I have thought this China seed would sprout a few years later when Tyson Rettie, Clayton Marr, and me would be offered an

opportunity to experience it first-hand.

In the fall of 2016, Arc'teryx released *China: A Skier's Journey*. Few ski movies inspired me as much as this one. I wanted to see the Altai Mountains. That planted the seed. Now, all it took was a little water, which came when I was exploring the cat-skiing scene, something I hadn't done yet and always wanted to experience. What's a heli-skiing guide with no cat-skiing knowledge to do? Well, phone a cat-skiing guide and see what he recommends!

My call went out to Tyson, who I met the previous season at Silvertip. Pretty quickly, the conversation went to an offer he'd just received from a company called Altai Mountain Heliskiing (AMH, of all things), somewhere in the depths of northwestern China. Silk Road Country, or Xinjiang, to be more precise. After a few phone calls to some connections in Whistler and a follow-up video call to AMH (with a translator), a small little leaf of hope appeared. This China dream was slowly growing into reality and taking us on what would become the skiing journey of a lifetime.

LEAVING TO CHINA

The research began on working in China. After much Googling of the pros and cons of various visa options, it became apparent the Z Visa was the best (and only) option. We requested one through our employer. It is basically a short-term residency in China and not a business or student/teacher visa. It's more difficult to attain and I still believe it was our saving grace to actually get paid for our efforts. Getting paid was a bit of a procedure, from setting up bank accounts, to transferring funds, etc. The one thing that did work flawlessly was the Bank of China debit card and WeChat Pay, which is the monetary aspect of the WeChat app. Think of it as their version of WhatsApp,



just with 100 times more functions, 10 times the user friendliness, and most likely a bit of a tattletale. Yes, your electronics will become yet another brick in the great firewall of China to the extent that even the savviest Telus techs will have a hard time figuring out how they were so corrupted. Speaking from experience, leave your phone at home and get a local burner.

You will need Google Translate regularly for reading menus, ordering your food, shopping, the bus driver, hotel clerk, ticket counter, street vendor, and taxi driver. It was our saving grace to have had Chen and Jennifer, the company provided interpreters, to teach us the daily do's and don'ts and cultural nuances, and to show us the lay of the land. It helped tremendously during staff training, guest issues, injuries, and scheduling.

About living in China! Now it gets a bit trickier, but not really that hard to grasp if you come from overseas. In Canada, we have Albertans, Quebecers, and Yukoners. In China each province has its own hallmarks, quirks, people, and, especially, notable food. Xinjiang is a mix of mainly Han, Uyghar, Kazakh, Kirgis, Russian, and Mongol cultures and languages. The primary language is Mandarin and sitting around the yurt at base camp reminded me of the good ol' days in a Bugaboo guides meeting. We all spoke English (to some extent) but pretty quickly, once the official stuff was over, you heard German, French, English, even some Italian. Then, just to throw off everyone, somebody had to journey into some thick Hasliberger Swiss or Gaspé Quebecois just to garner a bunch of blank stares, followed by some good laughter. Same with our crew in Altai, except we had the blank stares whatever the spoken language might have been. The polite smile and head nod from us was by no means to be interpreted that we actually understood, not even close.

In Altai City, we stayed at the Jingdu Hotel, a pretty fancy hangout with some pretty funny issues. For one, the thermostat did not work. I'm not sure why there even was one, given it was heated from a coal-fired, central hot water plant in town. There were two plants: one heated the even floors and the other the uneven floors, as we found out. This let your room temperature fluctuate from 35 C down to near freezing, depending on if it was your floor getting the heat that day or not. When you hopped into bed, you hoped they didn't switch overnight or you might find yourself either a bit slow-cooked or near-hypothermic come morning.

Also, there was no laundry to be had and no laundromats to be found. The hotel would wash your clothes, like a shirt and jeans, for a somewhat hefty fee, but you would get to do your own undies in the sink or shower. We wound up buying a small countertop washing machine that looked somewhat like a Ninja Foodie that had an "oops date" with a cappuccino machine. But it worked great and did the rounds between us like the Stanley Cup amongst teammates.

SKIING IN THE ALTAI

Let's talk a bit about the snow and skiing, after all, this is most likely why you have read this far, wondering just when I'll come to the point.

The snowpack. Hmm... If I had to find something similar in North America, I'd say look in Manitoba or the Dakotas. It's a dry, very cold, interior climate, and a long way from any ocean and its associated moisture. Did I mention it was very cold? It seemed every system started and finished with some wind. The snowpack was accordingly redistributed, wind effected, slabs-over-slabs, thin-to-thick, depth hoar, varying in all forms possible, and just simply complex enough to make you think twice before entering the bigger and more open terrain.

Probing some of the area showed the variance. For a Rocky Mountain guide, it might not have been that far from a usual snowpack. For us, we were warm, deep snow, maritime interior climate guides, and it gave us the heebie-jeebies at times. In the open areas, it often had that drummy, egg carton feeling of a thick-to-thin, slab-to-facets, and wind-effected snowpack. Tree skiing, on the other hand, was out of this world and will only get better. The alpine fir and tamarack forests, openly spaced and used for foraging during the summer by livestock, were not unlike the Alps in places.

Guiding in new areas always increases the risk of finding yourself exposed to the ever-present danger of avalanches. The high-use core of Altai Snow Park was a rather benign area with groomed roads for sled skiing and wasn't too avalanche-prone. We had some cause for concern due to wind-loading of the upper parts of the area called "Secret Garden," but it could be easily avoided with good route selection off the summit ridge. One of our first snow profiles was done in this area, around treeline, and we were shocked by the amount of faceting and the snow pouring from our shovels. Add some distribution probing across the wind-loaded top slopes, and it certainly brought on a slight case of deep instability stress.

The most stressful and unavoidable part of every ski day was taking the bus from Altai City to base camp. Think of it like going from Revelstoke to Rogers Pass on a 1950s summer road with no forecasting, mitigation, tunnels, snow sheds, vehicle spacing, and proper snow removal equipment other than a large loader. One 14 km stretch had—to the best of my recollection—42 slide paths threatening the road. The most active section became known as the gauntlet among us. Twice, we came close to being swept off. Twice, we were lucky enough to just miss it. We feared that one day we might end up in the river. There was much discussion on mitigation around the road, but the mutual feeling was to distance ourselves from that part of the program for simple uncontrollable liability reasons.

We attempted to sandbag the starting zones from the helicopter after a storm. YES, you read that right: sandbags. There were no explosives in China. This did not have the desired effect; shortly after, a proper helicopter Daisy Bell system was ordered, but it didn't show up until the season was finished and the helicopter had left.

Last winter, several cars were affected by an avalanche hitting the road and the photos and video I received are disturbing to say the least. It was very lucky there were no fatalities. Hopefully with the ongoing growth, a full-fledged forecasting and control system will be implemented, especially after the most recent events and near misses.

During our stay, we worked mainly on the safety aspects of AMH Snow Park: mountain access, road networks, heli-exploration, potential area growth, accident avoidance, staff training, guiding guests, and enjoying the various modes of transport for "wild snow" skiing. That's what we call "powder skiing", but "wild snow" might be the better term.

I think I can speak for the three of us that the sled-skiing was our favourite. It was a bit cold at times, but the simple recipe of fast-paced, no-headache laps was just great. The cat-skiing was slower, more plagued with breakdowns, and just not as rewarding in terms of runs skied compared to the simplistic fun of sled skiing.

Heli-skiing was an expensive option. Talking to some Chinese clients, they felt that for the money spent on flights from Beijing, hotels, and skiing, it was almost the same as visiting western Canada, minus our well-established infrastructure. This has somewhat improved, but then there is still the feather in the hat of having skied "wild snow" in Revelstoke, Whistler, or Blue River.

I certainly felt right at home. Not necessarily with the local snowpack, but certainly with the people. The horsemanship and the buildings reminded me of growing up in the mountains surrounding Schladming, my hometown in Austria, before the big tourism boom hit. Even the skis were familiar, given my grandpa had a similar hand-carved set for his use during my earliest childhood memories. I felt at home amongst the locals, despite the linguistic difficulties. I do believe mountain life and understanding the mountains

transcends language, as sometimes a pointed arm and a facial grimace was all that was needed to be purveyed in the assessment of terrain and stability.

We enjoyed having the opportunity to lay some first tracks as westerners in China. They have beautiful terrain for heli-skiing, but the climatic restraints, like extremely cold temperatures, wind, and greatly varying snowpack, will make it a bit more difficult to get up and running. Add to this a lack of infrastructure such as remote fuel caches, lodges within the skiing areas, and, last but not least, getting a social license (for the select few), and developing heli-skiing may not be as easy in China as it was in western Canada in the sixties, seventies, and onwards.

GOING BACK?

I am often asked, "How is it, really? Would you go back?" I wholeheartedly encourage anyone to put China near the top of their travel list. Nothing had prepared me for the experience, and I do think of myself as an open, worldly person.

Make no mistake, China IS a nation of skiers and snowboarders. The Altai Mountains are the birthplace of skiing. Ski resorts are being built and the masses are heading to the hills. I believe Chinese ski areas will become destinations that rival top notch international resorts, and may even emerge as the leader in resort innovation and design.

Do your research, take your pick, and travel. You won't be disappointed, be it resort, sled-, cat-, or heli-skiing. Did I mention that at the time of our stay day-passes at the General in Altai City were a reasonable 42 CNY, which was about \$8.50?

We would like to express our gratitude to Mr. Lee and his family, who hosted us in Urumqi, Xinjiang's capital, and the beautiful Silk Road Resort. We loved it and it provided a much-appreciated break from daily life in Altai.

In closing out this story and having talked to other guides that have had their own experience in and around Altai, be it on horse, sled, ski touring, and all the means offered and mentioned above, we all tend to agree on one thing—it's one of the last frontiers, so see it soon before it too will see expansion, lodges, hotels, resorts, lift lines, and waiting lists! 🇨🇳



Monashee Ski Traverse 2022

Photos and story by Douglas Noblet

May 5, 2022: Steve Senecal, Isobel Phoebus, and I are walking down the Clemina Creek Forest Service Road. We can hear a bustling construction site nearby. Just as we think about crossing it to reach Highway 5, a truck comes into view. The window rolls down and someone tells us we shouldn't be here without proper hi-vis clothing and personal protective equipment, and we certainly can't cross the pipeline construction or railway. They ask where we came from. "Grand Forks," we reply. It doesn't register. "How long did it take you?" they ask. "37 days, 600 km." Their jaw drops in disbelief. After a short and friendly conversation, they tell us we should just sneak across and get out of the way before anyone else sees us.

STATS

SKIERS	Douglas Noblet, Steve Senecal and Isobel Phoebus
DISTANCE	600 km
VERTICAL METRES	42,000 m
DAYS	37
START	Grand Forks
FINISH	Clemina Creek

LET'S BACKTRACK A BIT. Steve and I started talking about the Monashee traverse as we walked down Quartz Creek road at the end of our 26-day Purcell Traverse in 2019. Prior to that, in 2016, I had joined Steve and his crew on most of the Selkirk Traverse. A big draw for me on these long ski traverses is getting to intimately know a range. And living in Nelson, it just makes sense to explore close to home.

A spring 2021 trip was considered, but with COVID and schedules, it doesn't work out. As October 2021 rolls around, we launch into trip planning, giving us six months to work on logistics, route, food caches, team members, and funding (thanks to the Royal Canadian Geographical Society for the expedition support).

A rule of thumb I've used to plan food caches and length of trip on spring traverses is 10 km and 1,000 m vertical meters per day (factoring in weather and rest days). This gives us 42 days for the Monashees, with eight food caches (two highways, two lodges, and four remote locations).

Another rule of thumb is food and fuel should weigh about one kilogram per person per day. We plan 100 ml of white gas per person per day, and have always ended up with extra.

As we approach our start date of April 1, all food has been purchased, placed into plywood boxes, and delivered. Gear is ready and we are just about to mobilize. Then, suddenly, we get an email with a subject line reading: "I'm out - Monashees 2022". One of our well-respected and experienced team members is pulling out with concerns that the December 1 weak layer is too widespread, with too much consequence and uncertainty.

It catches the remaining three of us by surprise and we ask ourselves if we should be going ahead or if we missed anything important. After some good discussions—the warm-up was a few days ago, conditions have since cooled off, and the forecast is looking decent—we decide to continue, knowing very well we may have to hunker down for a few days or bail if conditions dictate. In the end, it is a long and cool spring—perfect for our traverse.

The trip starts in Grand Forks with 45 km of biking up the Granby Valley. Snow begins as the pavement ends and we put skis on. The route follows higher terrain along the western edge of Granby Provincial Park. A few days of convective weather limits the views, but travel is good. Our last day to reach Monashee Pass leads us through 40 km of less-than-exciting rolling terrain, cutblocks, and logging roads.

Here, our friends Mark and Emily join for about two weeks as we travel from Highway 6 to Highway 1. Another two days of less-than-exciting terrain brings us to the Pinnacles, where a well-positioned trapper cabin offers a great place to hunker down for a couple nights as we wait out some rain. Unsettled weather persists, but we safely make it through the Pinnacles and reach our first major crux, South Fosthall Creek. Steep chutes are the way down, otherwise it's a long way around. The word we got is, "All chutes go." The one we picked does in fact go, if you're willing to do 1,000 vertical meters of sideslipping down a steep and icy bed surface, with a short downclimb around a waterfall at the bottom. Conditions are cool and partly sunny. There's some overhead hazard, but the chute had previously avalanched.

A day after this crux, we get a warm welcome and reach our food cache at Sol Mountain Lodge. Ahead of us lies the beginning of more exciting and committing terrain. With a week of cold and clear weather in the forecast, we cruise through the Gold Range (including a hot sauna and another cache at Blanket Glacier Chalet). Many other people enjoyed this weather window in the range—some runs were nearly tracked out and we didn't have to break trail for almost a week. Near Mount Tilley, we get our first taste of hot and sunny spring weather. Luckily, it is brief. The clouds roll in and we continue without delay.

The next major crux is getting across Highway 1. We'd like to continue straight north, without diverting east to Revelstoke or west to Three Valley Gap. Pre-trip, when asking around for the best way through, the word was, "You don't." Unfazed, we decide to give it a go. A long descent, almost entirely on snow, leads us to an old mill site eight kilometres west of Revelstoke. Here, we press the pause button for a day. Mark and Emily head home, we pick up our food cache in Revelstoke, and we sort out some gear.

After a day of rest and waiting out rain, we head back out. An early-morning drop-off on the highway gets us back on route and lined up with a steep gully. Skinning, bootpacking, and a bit of alder pulling gets us up the gully and on top of Boulder Mountain. Two days later, rain pins us down for two nights in Bews Creek. After that, the weather and travel is generally quite good. We collect food caches in Big Eddy Creek, Sibley Creek, and Soards Creek (thanks to CMH Revelstoke, Gothics, and Monashee, respectively).



May 2 brings our first real taste of spring. Warm weather with no overnight refreeze limits our travel to the Bone Creek valley bottom for a couple days. After picking up our final food cache in Oventop Creek (thanks to Mike Wiegele Helicopter Skiing), we are on to the last leg, which turns out to also be the most challenging.

A whiteout climb brings us just below the summit of Mount Monashee and then across to Dominion Mountain. A large headwall running east-west off Dominion limits northerly travel options. The only note we have on the route is, "Steep?" And steep it is! We attempt to find a way down with belayed cornice cutting and downclimbing, but it is just too committing.

Hoping to find an alternate route, we split the group. We're on a high plateau at 2,800m, it's snowing with strong winds, and our shelter is a Black Diamond Mega Snow. I stay to build camp and a big snow wall while Steve and Isobel bootpack to the top of Dominion Mountain. It takes them a few hours to climb and scout the North ridge, but things are looking promising. After a windy night and a midnight dig to prevent our shelter from collapsing, we head up. It's hard to tell how much snow we received overnight—maybe 10–15 cm. A small wind slab we trigger reminds us to stay vigilant.

After a few hours and 500 m of downclimbing, threading the needle between rocks and wind slab, we safely make it down the north ridge of Dominion, only to get stopped after four kilometres of travel. The sun has come out and within minutes a spring avalanche cycle up to size three is in full effect. We camp by a small tarn, poised for an early morning start.

In the morning, we travel through the previous day's avalanche debris, with lower elevation snow remaining isothermic. Once again, after about five kilometres of travel, we get stopped. Our next move is a steep climb from Dominion to Clemina Creek. The slope next to our climb has a large natural crown, the first one we've seen 36 days into the trip. With the sun poking out, we settle into camp at 9:30 a.m.

The next morning is an early start. Though in the dark and whiteout, we are comfortable with an attempt. Part way up the climb it becomes obvious the refreeze is not great, with snow in some areas completely isothermic. But at this point, finishing the climb seems like a better option than backtracking. By 5 a.m. we make it into Clemina Creek.

Traveling down Clemina, we observe widespread avalanche activity, with many crowns to ground. The snowpack feels more like the Rockies. Our plan was to continue north for another two days, all the way to Canoe Mountain, but with challenging travel the past three days, a changing snowpack, and mediocre weather in the forecast, we opt to ski out the creek to the highway.

After 37 days, approximately 42,000 vertical meters, and 600 km, we call our trip a success on the side of Highway 5, about 30 km south of Valemount.

And, once again, Steve and I find ourselves talking about the next traverse. This time, staring at the Cariboos across the valley. ■

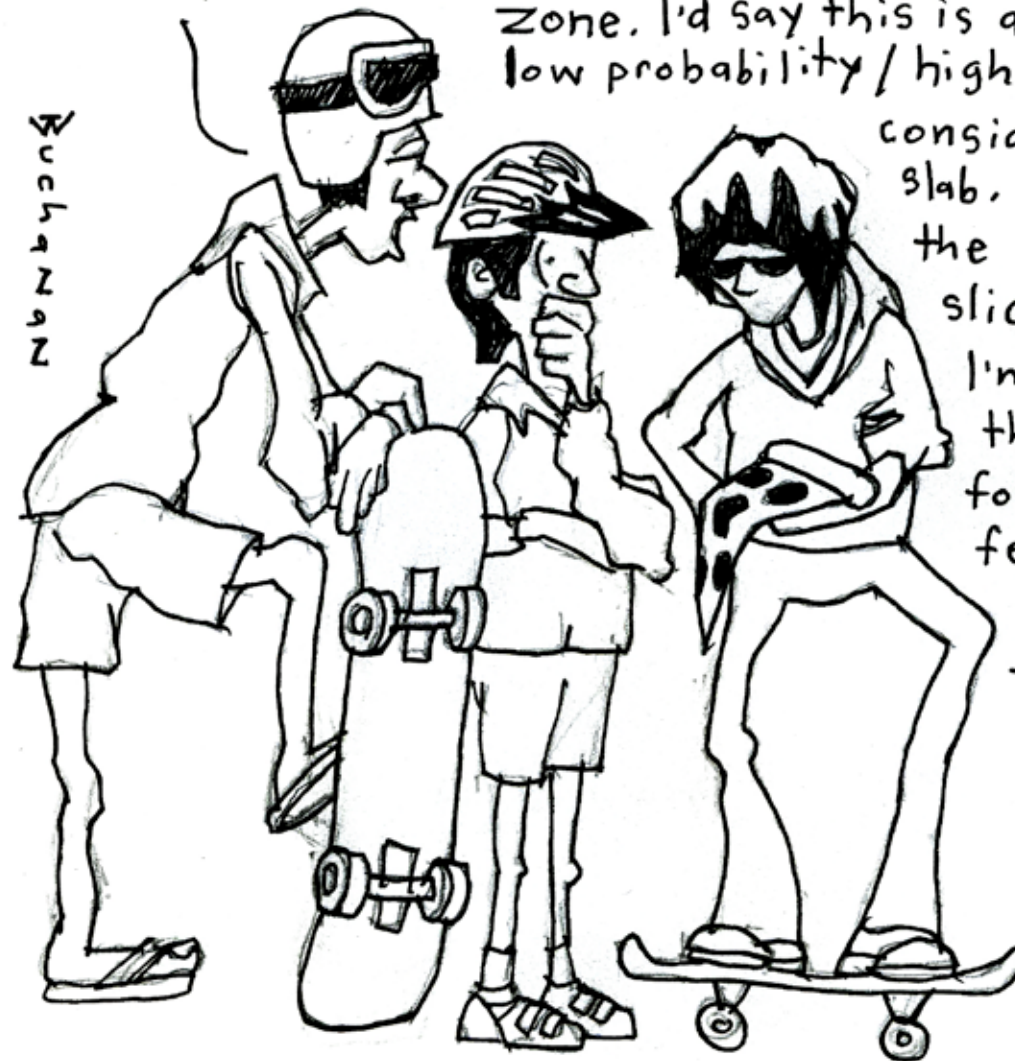


TRAVELLING THROUGH THE PREVIOUS DAY'S DEBRIS.

Flakes

ROB BUCHANAN

Sweet hand shear test dude. There's definitely a Persistent Weak Layer on the Tomato Sauce bed surface with a critical loading pepperoni instability near the crusty start zone. I'd say this is a low probability / high consequence



considerable slab. What was the leeward slice like? I'm thinking this calls for a companion feeding strategy for maximum safety...

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