the avalanche journal

THE VOICE OF **CANADA'S** PROFESSIONAL AVALANCHE COMMUNITY

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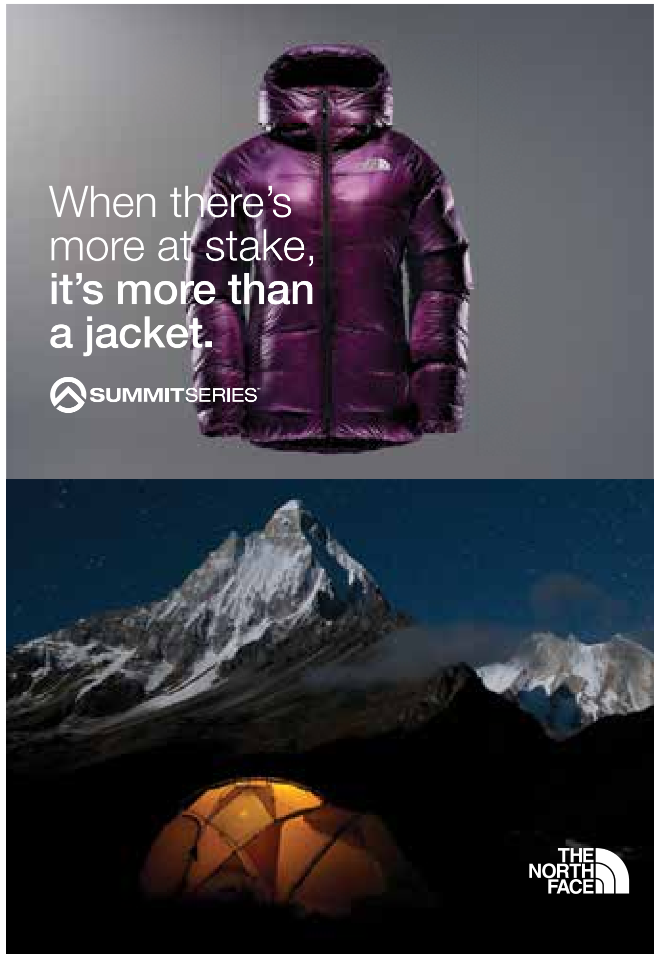

the avalanche journal

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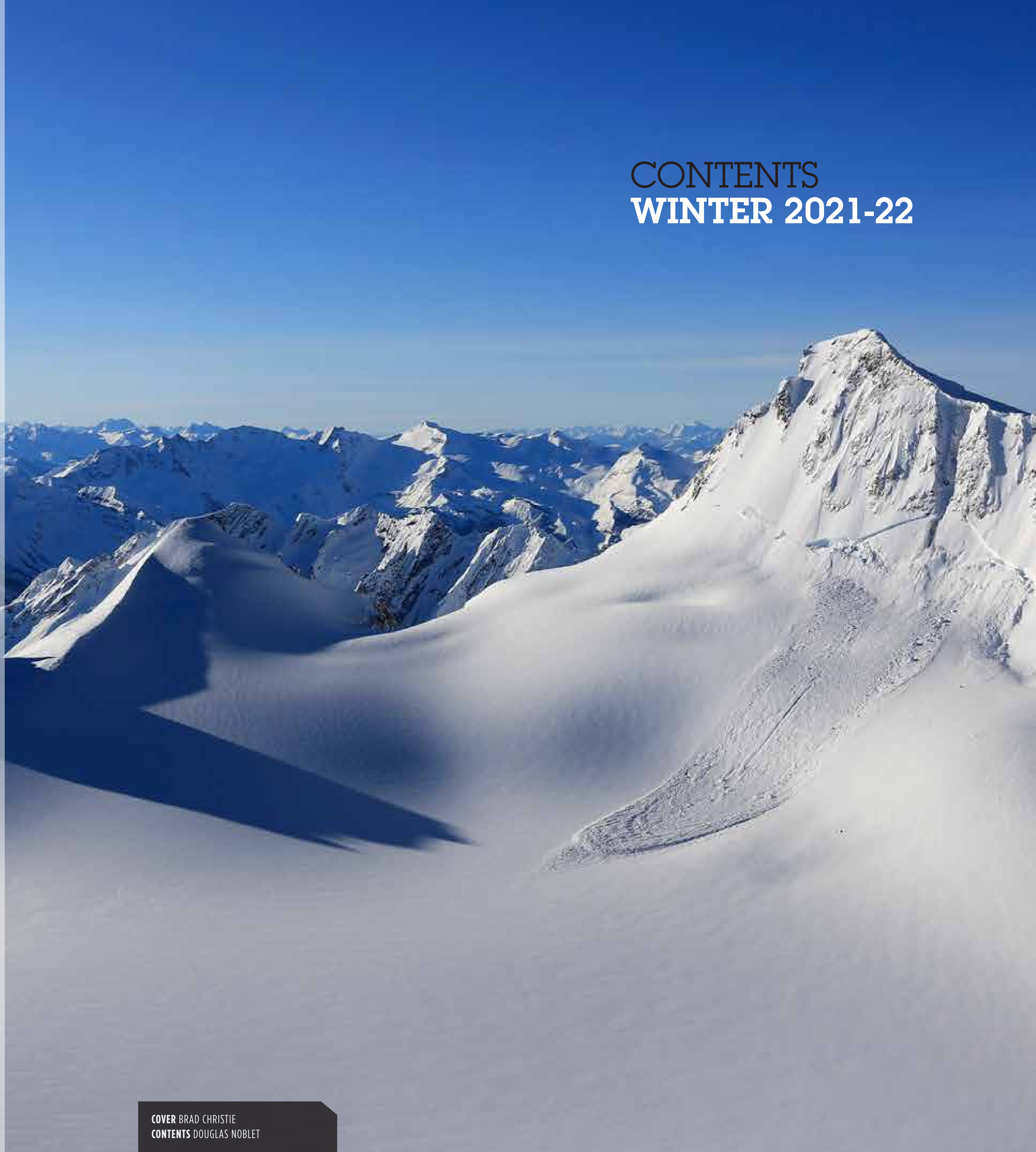
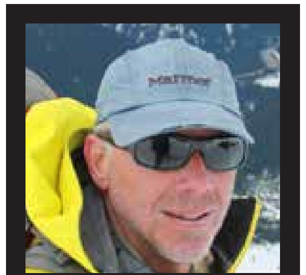


CONTENTS
WINTER 2021-22

COVER BRAD CHRISTIE
CONTENTS DOUGLAS NOBLET

in this **issue**



Walter Bruns
CAA President

CAA President's Message

SHOWING RESULTS

FOR THOSE WHO ACTUALLY read my messages, and Joe's reports that follow, you may recall some recurring themes over these last few years. To put it less politely, we may have sounded like a broken record: good governance, self-regulation, professional path, competencies, sustainable operations—on and on it has gone.

Many ambitious and challenging initiatives have indeed been underway. It is easier to set aspirational goals—it is so much harder to execute them. But some results are now at hand.

Your board met in person in September, with only one member unable to attend. An external facilitator guided us over two days to renew and enhance our strategic plan. It will be circulated for your review and comments in due course.

This summer and fall, Laura Adams led a working group to finalize *Guidelines for Instruction in Avalanche Terrain* (GIAT) based on your feedback. The group had broad sectoral representation from senior members across the avalanche community. The board has accepted their excellent recommendations, including, "Finalizing and implementing GIAT, which if done effectively, will play a fundamental role in lifting the performance and culture across Canada's avalanche education ecosystem." The draft guidelines, full recommendations, and all feedback should be on our website by the time you read this *Journal*.

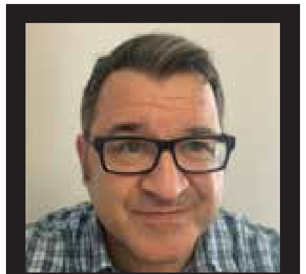
There is also the matter of what to call ourselves. During the development of the competency-based member process, we used "P1" and "P2" as placeholders, assuming we would have the membership vote on replacements for the names of Active and Professional membership classes. Vice-President Eirik Sharp has recently led an effort to determine criteria for new names, and the Ethics and Standards Committee has been tasked with providing recommendations. They will be posted on the members-only page of our website for review. Since a name change requires an amendment to the bylaws, you will have a chance to vote for or against it at the AGM.

Although there is an entire winter between us and the Spring Conference, let's look ahead. We foresee a blend of in-person and online sessions to allow for both peer connections and wide-ranging participation. Our budget for the coming year assumes we can almost return to business-as-usual. Membership Services, Industry Training Programs, and InfoEx are in good shape.

My term as president will end in May. The Governance Committee is seeking expressions of interest from current directors, members, and the public to stand for (re)election to the board and executive. In a most rigorous manner, they will assess candidates and recommend nominations. Please consider stepping up to serve your association by contacting any member of the committee (as listed on page five).

Until then, let me wish you a safe, successful and fulfilling season ahead.

Walter Bruns, CAA President



Joe Obad
CAA Executive Director

Executive Director's Report

BETTER TIMES AHEAD

LATELY, WHEN THINKING OF GETTING BACK to normal, my thoughts drift towards Greek myth. There's good old Sisyphus pushing his stone up the hill only for it to roll back down and repeat the process. After all the COVID setbacks, it's not hard to think of our predicament in the last 18 months as having similar cycles without the fancy Greek grandeur.

Hope springs eternal, however, and there are signs we may just be breaking the cycle. Vaccines and border crossings have many of our members and their operations feeling more optimistic than they've felt since the winter of 2020. Optimism and its twin, caution, walk hand-in-hand when we look at this season. We hope the new tools available to the industries and communities we serve will allow our membership to flourish again. We see the coming season as a transitional one, shifting operations towards services and options closer to pre-pandemic levels. Below, I touch on some changes to support us along the way.

Membership Services is faced with the challenge of knowing the pandemic is not disappearing but recognizing that we may be able to offer more in-person services. This October, we offered a series of virtual continuing professional development sessions with the ACMG and, for the first time, the CSGA. In May, we hope to be together in Penticton for the Spring Conference and to offer a virtual option to members further afield to attend the AGM and other sessions.

Last year, we initiated our competency-based membership application process after countless hours of member effort in development. Over the past six months we have worked with the ACMG to recognize equivalent training for full Alpine and Ski Guides. This helps applicants, but it also helps staff and the Membership Committee focus on areas not addressed in ACMG training. The process was challenging, but hats off to ACMG Technical Director Mike Adolph and Assistant TD Evan Stevens for working with Membership Committee chair Kerry MacDonald and staff in good faith to achieve this objective. The process has shone a light on other areas where equivalency may be recognized.

Over the summer, we also struck a working group to revise the proposed *Guidelines for Instruction in Avalanche Terrain* (GIAT) based on member and stakeholder feedback. We contracted Professional Member Laura Adams to lead a group of volunteer members to process the feedback. Laura and the working group returned to the board a revision to GIAT based on member feedback, an inventory of responses directly to the comments submitted, and set of implementation recommendations for the board of directors. The board has accepted all these documents in principle and will work with the staff on an outreach and education process to help members successfully adapt to GIAT. Look for further communications on this initiative if they have not reached you by the time of publication.

On the Industry Training Program front, Andrea Lustenberger and ITP staff have prepared all summer for the unpredictable snakes and ladders of vaccinations, verification apps, shifting regulations, protocols, and all the other requirements needed to run courses. And that's before students and instructors get together! Last season compelled the team to learn new skills and flexibility. Based on the early season, both students and instructors are benefiting from lessons learned to allow for successful courses. We are pleased to offer a full schedule of courses this season, with options in areas and venues where we stepped back last year (mainly Quebec and several backcountry lodges).

InfoEx development remains busy as well. Manager Stuart Smith and team continue to plug away on the MAInEx project to overhaul and modernize InfoEx. In the meantime, we believe the exchange of data will be much stronger this year based on our discussions with different user groups. As we prepared our budget this year, one fact jumped out that I wanted share: We now receive over one-third of our InfoEx revenue from services we offer outside of Canada. Bravo to Stuart for countless calls and visits to develop this revenue stream that keeps Canadian subscription prices reasonable and data flowing between so many operations.

Whatever your challenges this season, we wish you the best and look forward to serving you however we can along the way. Reflecting on these updates, it's clear that we can move ahead despite the challenges thrown our way. Unlike poor Sisyphus, maybe we can attack the hill at a different angle and choose to push the rock a bit differently. I think this time we'll all get to the other side.

Joe Obad, CAA Executive Director

Alex Cooper
Managing Editor

From the Editor

LEARNING PATIENCE

WELCOME TO THE WINTER 2021-22 issue of *The Avalanche Journal*. As you read this, I suspect many of you have already been out on snow, whether it's been for work, pleasure, or both. Myself, I'm playing the waiting game as I recover from knee surgery that took place in the spring. I'm trying to be as patient and positive as I can as this La Niña winter approaches. How much snow will it take for me to ignore the doctor's orders and risk a set back? Patience, especially when it comes to skiing, isn't one of my greatest virtues.

I'm extremely grateful to all the contributors to this issue of the *Journal*. I love having a job that lets me continuously learn and I hope you get something out of it too. This issue is quite diverse, covering topics from reforestation to GIS, and ADHD to post-pandemic considerations. I'm happy to present the final version of AVSORT II— the Avalanche Survival Optimization Rescue Triage, as well as research into transceiver interference.

This issue also has quite an international flavour that shows the influence of Canada's avalanche industry. Kevin Fogolin and Dave Iles' article about a new ski resort in Japan will probably have you booking a plane ticket ASAP. Craig Sheppard's article about helping to establish a winter backcountry safety program in Australia is equally interesting, though the phrase "slide-for-life ice" makes a trip less enticing.

Finally, Bill Mark and Bruce Jamieson pay tribute to Mike Wiegele, the heli-skiing pioneer who passed away in July. They write about supporting his staff's continuing professional development and his crucial role getting the ASARC program started, respectively.

***

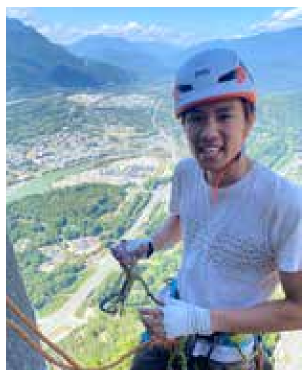
Looking forward, I was recently reminded that this winter is the 50th anniversary of 1971-72— the snowiest winter on record in Canada. I've experienced a few very snowy winters since moving to Revelstoke, but none even come close to the 779cm that fell in town that year. I would love to publish some reflections from that year, when over 24 metres of snow fell on Mount Copeland, outside Revelstoke. It still stands as the highest snowfall recorded in Canada, though I wouldn't be surprised if some remote locations in the Coast Range received more than that. If you were working that year, if it inspired your career in the industry, or if you know any good stories, please email me at acooper@avalancheassociation.ca.

I hope you have a great winter. With any luck and some more hard work I'll be able to join you in the mountains.

Alex Cooper

Welcome **Martin Ho**

Software Developer and IT Support



MARTIN HO RECENTLY JOINED the CAA as a software developer and in IT support. Prior to the CAA, he worked in the outdoor retail industry and in climbing gyms in Vancouver and Toronto before switching career paths and enrolling in an immersive full stack web developer bootcamp. Outside the office, you can find him climbing rock and ice at the crag or in the alpine, and even possibly scheming for his next adventure while bingeing on his favorite podcasts. Martin is very excited and looks forward to working and learning with an organization that is central to the avalanche industry.

2021 CAA Service Award Recipient: **Tony Sittlinger**

Alex Cooper, photo contributed by Tony Sittlinger

TONY SITTLINGER IS THE RECIPIENT of the 2021 Canadian Avalanche Association Service Award. He was honoured for his 33 years of work in the avalanche industry.

Tony is a senior avalanche forecaster with the Blackcomb ski patrol, where he has been a forecaster for 27 years. During his time, he has been a mainstay of the patrol's supervisory group and has led the team by example.

"He has strived to constantly improve the efficiency of the avalanche control operations on Blackcomb while always ensuring both the safety of the avalanche control teams and the public," wrote Nicole Koshure, who nominated Tony for the award. "His innovative methodologies and forward thinking have helped to keep the avalanche forecasting and control programs at Whistler Blackcomb at the forefront of the industry and have fostered a successful forecasting mentorship program, which continues to add depth to the snow safety team/program.

"Tony has been a mainstay of the patrol's supervisory group and is a leader who drives the high performance and professionalism of the patrol group through 'leading by example.'"

Tony is a long-time Professional Member of the CAA and has served on many committees. He currently sits on the Ethics & Standards Committee and has helped with the development of the competency-based membership application process.

Congratulations Tony!

Q&A WITH TONY SITTLINGER

CAA: How do you feel receiving this honour?

Tony: I am very flattered. I feel like an impostor, just trying to keep up with this community most of the time, so it is unexpected.

CAA: How did you get started as a ski patroller?

Tony: My aunt and uncle more or less adopted my lost teenage self, put me into their kid's surplus equipment, and introduced me to skiing. I wanted to continue with it, so I saved up for a BCIT/CAA Level 1 course and got a job at a local ski area. After a couple of seasons, I managed to get hired at Blackcomb.

CAA: What made you continue patrolling all these years?

Tony: Luck and circumstance. There was a lot of change when I got to Blackcomb, and that resulted in a lot of turnover. Somehow, after a few years, I ended up as the new assistant forecaster in the same year that my eldest son was born. I wasn't ready to be a forecaster, or a father, so I kept my head down and did my best to keep up. After a while it became my place.

CAA: What do you enjoy most about the job?

Tony: I still love being outside during a raging storm with my feet in the snow. Forecasting at Blackcomb lets me be right there in the middle of it all when it is as ugly as it gets. Where else will I get to do that?

CAA: What advice do you share with new patrollers considering a career in the industry?

Tony: Don't listen to unsolicited advice. Ask questions, be skeptical, find what works for you, and try to get good at it.

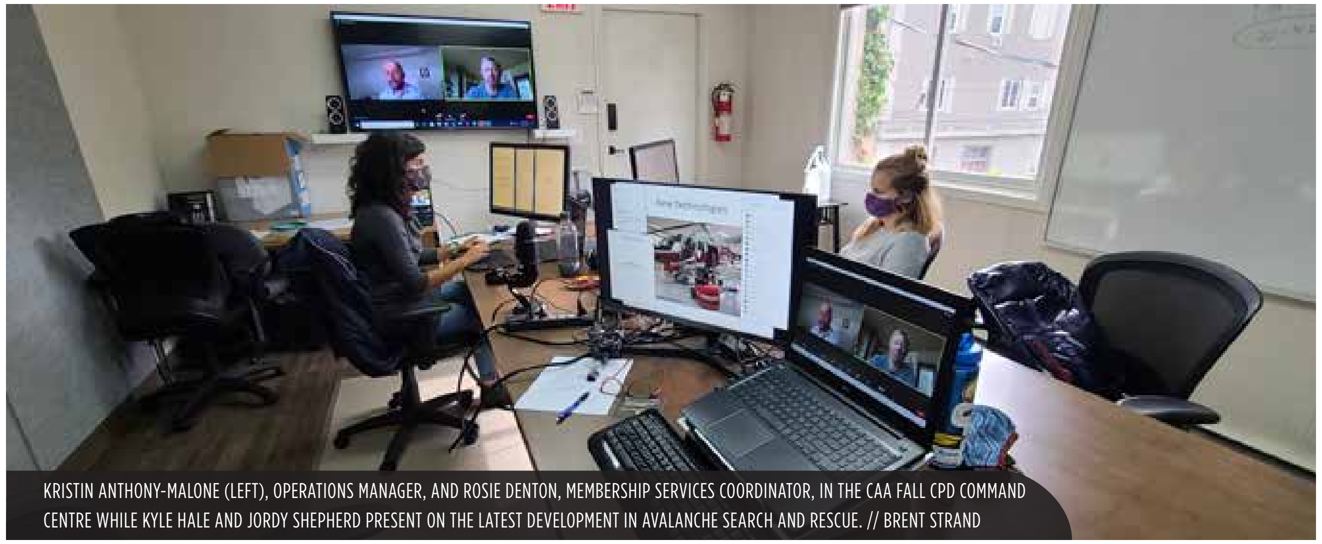
CIL Blasting Scholarship

SOFIA FORSMAN IS THE RECIPIENT of the 2021 CIL Blasting Scholarship. Hailing from Sweden, Sofia is an Active Member of the CAA and an Apprentice Ski Guide with the ACMG. She has worked for several cat-skiing, heli-skiing, and ski touring operations, and taught AST 1 courses during her career in the industry. The scholarship covers the cost of of the Avalanche Blasting Course. Thank you CIL for supporting this opportunity.

CAA, ACMG, CSGA CPD Recap

THAT HEADLINE IS NOT JUST A BUNCH of acronyms—it represents the first joint continuing professional development (CPD) event with all three associations. The Canadian Avalanche Association (CAA) hopes this was the first of many. This was our fifth annual event in partnership with the Association of Canadian Mountain Guides (ACMG) and the first with the Canadian Ski Guides Association (CSGA).

The online event saw over 360 members from the three different associations attend workshops and webinars. There were 11 sessions open to members of the three associations. Topics included critical incident stress management, being an active bystander in the outdoor industry, digital navigation tools, and a session dedicated to best practices for avalanche search and rescue. Most of the sessions were recorded and are available on the CAA's website in the members-only section.



KRISTIN ANTHONY-MALONE (LEFT), OPERATIONS MANAGER, AND ROSIE DENTON, MEMBERSHIP SERVICES COORDINATOR, IN THE CAA FALL CPD COMMAND CENTRE WHILE KYLE HALE AND JORDY SHEPHERD PRESENT ON THE LATEST DEVELOPMENT IN AVALANCHE SEARCH AND RESCUE. // BRENT STRAND

Contributors

FRASER SPRIGINGS is a physiotherapist at Keystone Health in Revelstoke, BC. He has worked with WorkSafe BC, Alberta WCB, and CAA members throughout his 20-year career in various ski towns. To the frustration of his work colleagues, he denies any ability to fold a fitted sheet.
14 PERSISTENTLY PROBLEMATIC PANDEMIC WEAK LAYER

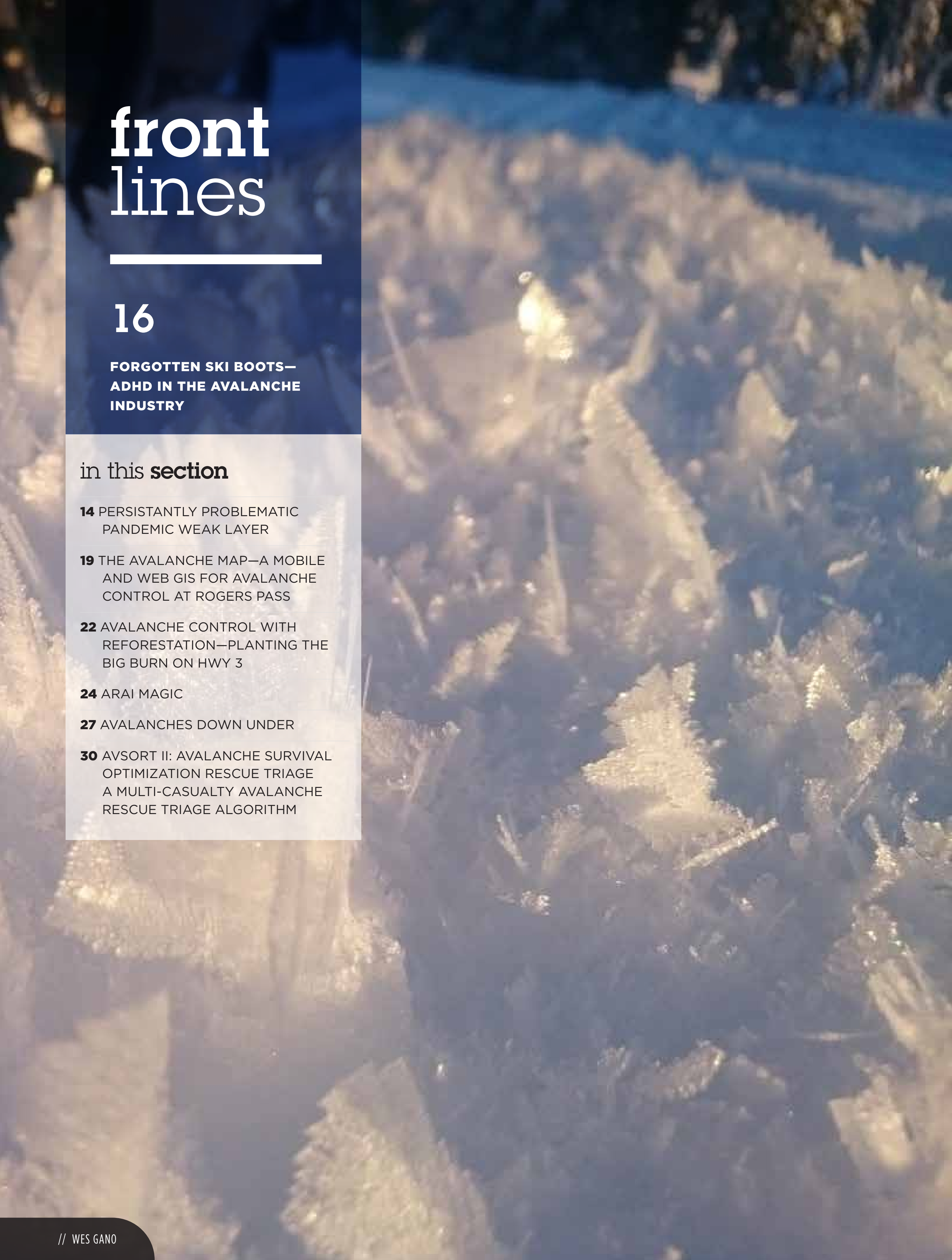
KEVIN FOGOLIN is a principal at Dynamic Avalanche Consulting, where he works as an avalanche specialist. He started in the avalanche consulting field in 2004 when he began working with Chris Stethem & Associates. Since then, Kevin has worked in a number of countries for a variety of industries including government agencies, mining, energy, and ski areas. The development and implementation of the avalanche risk management program at Arai, Japan, has been one of his most rewarding projects.
24 ARAI MAGIC

DAVE ILES is a ski area avalanche risk specialist with over 30 years of experience in the industry. Dave has completed avalanche risk assessments and developed avalanche control programs at several major ski resorts in Canada and Japan. He has been a Professional Member of the Canadian Avalanche Association since 1993 and has been an ITP instructor for 20 years. Dave has been integral to the development and implementation of the program at Arai and has been the lead forecaster since its inception in 2017.
24 ARAI MAGIC

MICHAEL SMALLWOOD is an avalanche technologist for Parks Canada at Rogers Pass, applying GIS and shovel-wielding skills for the avalanche control program, and chasing gremlins out of weather stations. He came to the mountains after graduating from the University of Bristol in 2009 with a master's degree in aeronautical engineering and completed the Southern Alberta Institute of Technology BGIS program in 2019. First arriving in Banff, Mike started ski patrolling at Sunshine Village before moving to Rogers Pass and is now based in Revelstoke.
19 THE AVALANCHE MAP—A MOBILE AND WEB GIS FOR AVALANCHE CONTROL AT ROGERS PASS

CRAIG SHEPPARD is a former avalanche forecaster and long-time patroller at Lake Louise Ski Area. He is a Professional Member of the CAA with varied experience guiding as an ACMG Apprentice Ski Guide and instructing ITP courses. Now living in Sydney, Australia, Craig is looking forward to relocating to Jindabyne, New South Wales, to be closer to the Snowy Mountains and the work that he is doing for the Mountain Safety Collective in Australia.
27 AVALANCHES DOWN UNDER

JEFF JOHNS has spent the better part of the last decade dolling out Entonox and terrorizing the town dogs with explosives. He's dipped his toes into heli-skiing and teaching AST courses, but has finally committed to the move into industrial avalanche work. When he's not skiing or mountain biking, you can usually find him at home in Golden hitting things with hammers, disc golfing, or playing Dungeons and Dragons.
22 FORGOTTEN SKI BOOTS—ADHD IN THE AVALANCHE INDUSTRY



front lines

16

FORGOTTEN SKI BOOTS—ADHD IN THE AVALANCHE INDUSTRY

in this **section**

// WES GANO

Persistently Problematic Pandemic Weak Layer

Fraser Sprigings

I AM NOT A METEOROLOGIST, but I can say this winter will be like no other. This is not in reference to La Niña. As a physiotherapist with 20 years of experience treating workplace injuries, I am forecasting a significant rise in injuries and sub-optimal decision making by avalanche professionals based on a number of acute factors that have come out of the COVID pandemic.

It is anticipated that within the avalanche industry, ski guides are at the greatest risk. Although I am using them as the example for this discussion, other sectors of the industry are also vulnerable to these risk factors.

Last winter, many industries had heavy rounds of layoffs and hiring freezes. Many ski guides faced this reality and will be returning to work this season after an 18 month hiatus. Statistical analysis by the Workers Compensation Board has shown a strong relationship between time away from work and an increased risk of getting hurt upon return.

If someone is injured at work and cannot perform their job, WCB and healthcare practitioners will always ask the worker and employer if there are any modified duties—tasks specific to the worker's typical job demands—the worker can do. If modified duties are not available, they will look at what alternative duties can be performed. These are tasks that are not within an employee's typical job description. Imagine a lead heli-skiing guide, out with an injured knee, folding fitted sheets with the housekeeping staff.

At a glance, for WCB to compensate a lead guide's wage, disrupt the operational flow of the lodge, and teach the guide how to fold a fitted sheet (a level of origami few have ever achieved), it is a waste of everyone's time and the invested parties' money. However, long term analysis has shown this approach drastically reduces future injuries and is the most cost effective in the long term. That's because when someone is off work, the work environment continues to change, as all things do. Staff members, equipment, computer software, policies, and procedures all change. The longer the time off, the more dramatic the changes.

A worker who is not at work may be able to stay relatively fit. However, the specificity of ski guiding is hard to replicate in a home or gym setting. The worker will slowly lose familiarity with operational policies and procedures, and they will return to a less familiar work environment, with increased apprehension and stress. They will have to be more conscientious of tasks that previously were effortless but now are tiring. The net effect, what I call the pandemic condition score (Figure 1), is an employee who is physically deconditioned, mentally fatigued, physically exhausted, and may have anxiety and increased stress.

The pandemic has increased the magnitude of workplace changes. Examples include the number and type of helicopters in use, group size, duration of a guest stay, and increased use of personal protective equipment and protocols. When beginning operations this winter, please consider:

- Are previous staff and guides returning from the past season (familiarity to operation)?
- Are any guides on the team new to this operation?
- Are any guides new to the industry (<2 years)?
- Who is excited to be back at work? Who is TOO excited to be back at work? Will this excitement cloud decision making?
- Who is under financial pressure to make up for last season's slump? Have they taken on too much work for the season? How will they maintain sufficient physical and mental recovery time to mitigate the injuries and hazards their clients, fellow guides, and personal-self will face this winter?

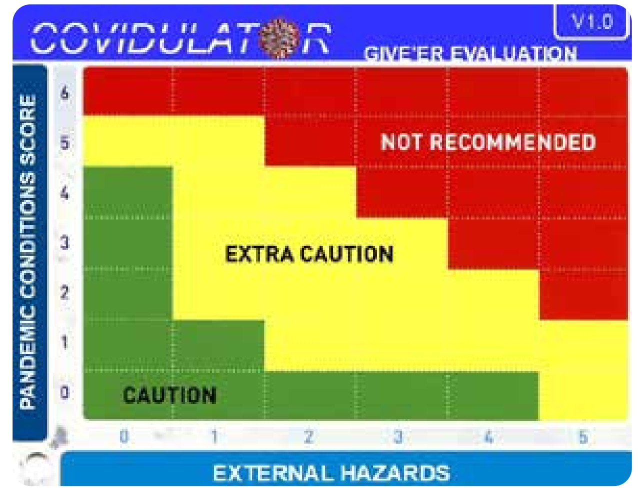


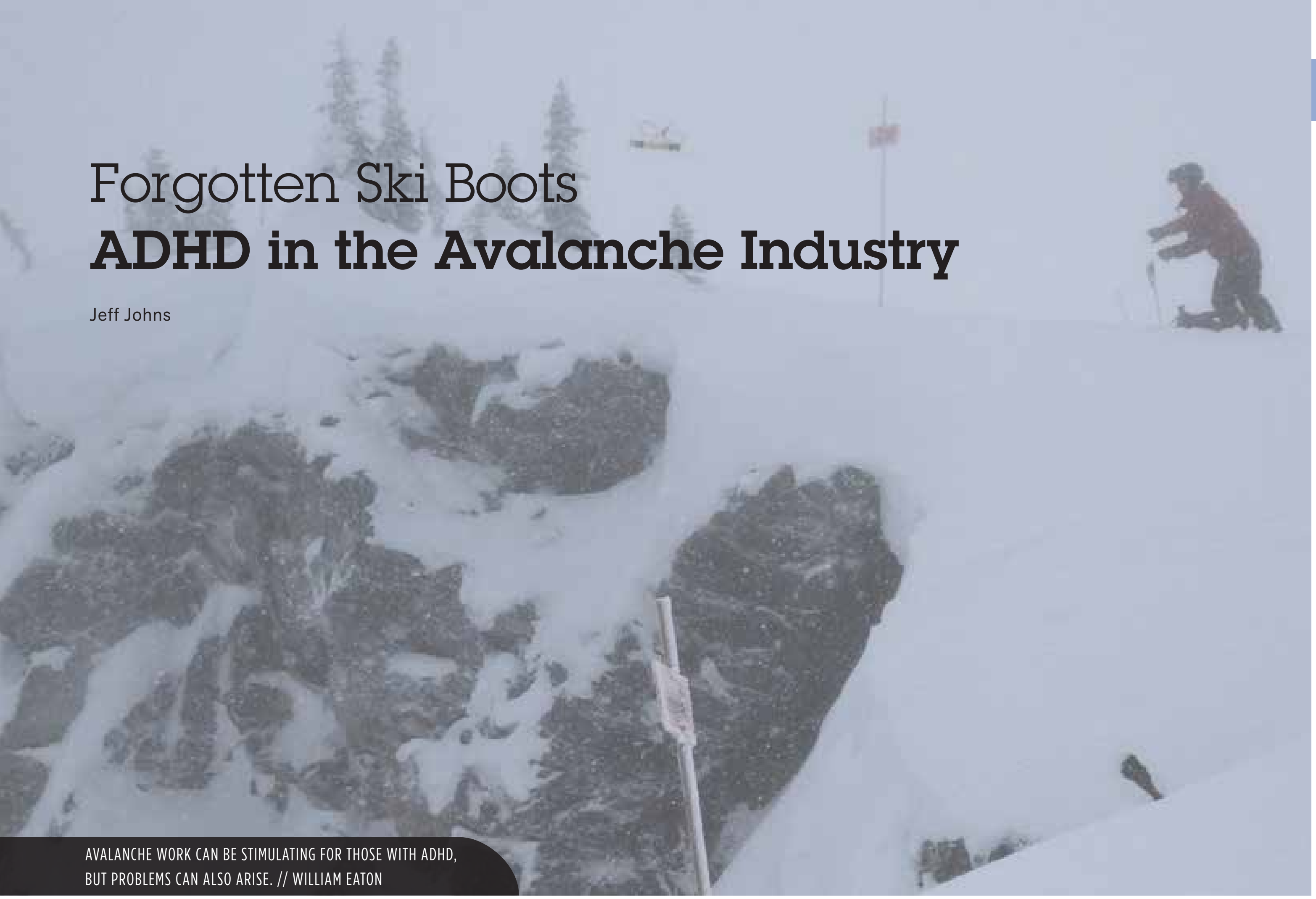
FIG. 1: AS YOUR PANDEMIC CONDITIONS SCORE AND EXTERNAL HAZARDS INCREASE, YOU SHOULD USE EXTRA CAUTION AT WORK, OR JUST STAY HOME.

As this article goes to print, the Canadian healthcare system is under a strain many never thought possible. Intensive care units that traditionally provide 1:1 nurse-to-patient care are stretched out to 4:1 ratios. Healthcare unions are refusing mandatory overtime due to burnout and patients are being airlifted to other provinces for care. Elective surgeries, such as ACL knee surgery, are being cancelled.

As a result, if you are injured and need medical intervention, it will be triaged against a much higher critically sick population than previously seen—ever. Treatment will be delayed and some medical interventions, such as elective surgery, will not be accessible.

Dealing with the pandemic directly or logistically is very stressful, and fatiguing mentally and physically. It is critical to be situationally aware of these factors and openly discuss them with your colleagues, industrial partners, family, and friends.

May you never have to know how to properly fold a fitted sheet.



Forgotten Ski Boots
ADHD in the Avalanche Industry

Jeff Johns

AVALANCHE WORK CAN BE STIMULATING FOR THOSE WITH ADHD, BUT PROBLEMS CAN ALSO ARISE. // WILLIAM EATON

THE STEREOTYPICAL BONE-HEADED ski patroller is possibly the most well-known trope in the avalanche world. We've all worked with (or been) this person. You'll find them stumbling into work late after driving back home to retrieve their forgotten, coffee-soaked ski boots. They will either have a cartoonish number of pull wires bulging in their sleeve pocket or, alternatively, none. Forecasters know who they are because they either won't shut up during the morning meeting or just stare bleary eyed through them while sipping Intuition flavoured coffee.

"Yes, I have a Robbie driver. Yes, I have a replacement clip for the avalanche closure in my vest. No, I did not remember to do it as I walked by."

"Yes, that was my only job this morning."

The true, chronically bone-headed ski patroller knows their trials and tribulations are not limited to mere forgetfulness. Sitting through year after year of first aid training and pre-season presentations and paperwork is a hellish tedium survived only by loudly making jokes or staring at the dead grass outside the window and drooling. Getting to work on time is a dream you wake up remembering but cannot return to.

These also happen to be some of the highly visible, stereotypical symptoms that people think of when they think of ADHD. This executive function disorder, however, is more complex and can be much more serious than simple forgetfulness or hyperactivity.

MY DIAGNOSIS

My ADHD diagnosis came in the summer of 2021. I reached out to a mental health professional after chronic high-risk and impulsive behavior began to have a dramatic and negative impact on my personal life. Within 20 minutes on the phone with this counsellor, they told me that while they were not offering a diagnosis, it was likely that I had ADHD. I went through a self-assessment form and scored higher on it than pretty much any subject I ever took in school.[1] I had never thought about or looked into ADHD at any point despite being told off-handedly that I probably had it by several friends. Until now, the stereotype of ADHD being limited to hyperactivity or forgetfulness made me dismissive of the disorder and I never bothered to look into it.

For me, the diagnosis (which came later) and the subsequent research was life changing. I knew that I was a reasonably intelligent person—if a subject interested me, I could always engage with it and do well. In my adult life that has been avalanche work, and in my childhood it was social studies and language arts. But mostly, I was interested in riding my BMX bike. I excelled in these areas, but my inability to keep track of my finances, important dates, tasks, and organization, among many other things, had led to internal conflict and growing anxiety. If I'm to be honest, I felt like in a way I must be sort of stupid.

I always struggled with an inability to engage with or remember details no matter how important. Even though I'm a very empathetic person, I've always found it nearly impossible to understand how my words or actions appear or how they affect others. Careless mistakes have led to work equipment being damaged and serious near-misses. I once forgot which day of the week it was when I left for a hut trip and my roommate nearly called search and rescue to look for me. I've booked flights on the wrong day and I have forgotten to deliver flu medication to friends until after they had already recovered. The list is endless and it is excruciating. Not knowing that I had ADHD was a heavy psychic burden that I didn't know I was carrying. Having a diagnosis, medication, and a better understanding of the disorder has been a positive and liberating experience.

WHAT IS ADHD?

ADHD is an executive function disorder. Executive function, in a broad sense, covers three areas: working memory, flexible thinking, and inhibitory control. It can be further broken into seven functions:[2]

1. Self-awareness
2. Inhibition
3. Non-verbal working memory
4. Verbal working memory
5. Emotional self-regulation
6. Self-motivation
7. Planning and problem solving

This means a person with ADHD may chronically experience impulsivity, inattention, and mood instability, amongst other things. Many people with ADHD will often struggle with self-awareness and how their actions are perceived by others. They might live in the now—whatever occupies their attention at any given point seems like all that exists. Tardiness, tunnel vision, and poor organizational skills are common. People with ADHD will find varying levels of difficulty engaging in things that do not offer immediate reward, and hyper-focus on the activities that do. Hyperactive and impulsive types will experience hyperactivity but those who have an inattentive type of ADHD may never get that restless feeling.[3] There are those who have a combined type of ADHD, which is a mix of some of the impulsive and inattentive symptoms.

Some broad adult symptoms may include:[4]

- impulsiveness,
- disorganization and problems prioritizing,
- poor time-management skills,
- problems focusing on a task,
- trouble multitasking,
- excessive activity or restlessness,
- poor planning,
- low frustration tolerance,
- frequent mood swings,
- problems following through and completing tasks,
- hot temper,
- troubles coping with stress,
- difficulty winding down and relaxing; and
- issues with getting to sleep at night.

At some point everyone will deal with some of these symptoms. What separates a person with ADHD from those who are neurotypical is that these symptoms will be chronic through their childhood and into adulthood, and will be disruptive to their personal and work lives.

HOW DOES ADHD ACTUALLY WORK?

Our brains use neurotransmitters to relay nervous signals. Two common neurotransmitters are dopamine and noradrenaline or norepinephrine. Dopamine is closely related to reward centres in the brain and interacts with other neurotransmitters to manage mood regulation in particular. Noradrenaline is associated with alertness, sustaining focus, and the formation and retrieval of memory, amongst other functions.[5] A brain with ADHD is deficient in these important neurotransmitters, causing the previously mentioned effects.[6]

Thankfully for those with ADHD, there are medications that significantly improve these symptoms. Several

[1] https://add.org/wp-content/uploads/2015/03/adhd-questionnaire-ASRS111.pdf
[2] https://www.additudemag.com/7-executive-function-deficits-linked-to-adhd/

[3] https://www.additudemag.com/3-types-of-adhd/
[4] https://www.mayoclinic.org/diseases-conditions/adult-adhd/symptoms-causes/syc-20350878
[5] https://en.wikipedia.org/wiki/Norepinephrine
[6] https://www.news-medical.net/health/How-does-ADHD-Affect-the-Brain.aspx
[7] https://www.healthline.com/health/adhd/adult-adhd-medication
[8] https://www.additudemag.com/cognitive-behavioral-therapy-for-adhd/
[9] https://www.additudemag.com/category/adhd-add/related-conditions/
[10] https://www.acmg.ca/05pdf/2019DiversityInclusionandMentalHealthStudyFINALReport.pdf

families of stimulants are shown to provide significant relief from ADHD symptoms while active in the body.[7] These drugs increase dopamine and noradrenaline uptake and give a person's brain chemistry a sort of boost. Cognitive behavioral therapy has also been studied in the treatment of ADHD and has been shown to be a useful tool for addressing some of the symptoms and challenges that accompany ADHD.[8]

ADHD IN THE AVALANCHE INDUSTRY

The avalanche industry treats those with ADHD well. It is highly stimulating and a good day at work feels like a clean getaway after robbing the National Bank of Dopamine. Noisy, dangerous machines, powerful explosives, complex and high-stakes problem solving, dangerous environments, and unfathomable amounts of potential kinetic energy stored in snow keep us coming back year after year to the stimulation factory. These are the elements that keep our brain's pleasure chemicals at such a high voltage. They, however, can also dole out severe punishment for tunnel vision, lapses of concentration, overlooked warning signs, and poor decision making—problems the ADHD mind is prone to.

While forgetfulness, hyperactivity, or being a space cadet are fairly well recognized symptoms of ADHD, there are many others that are not as commonly understood that can have a serious impact on the lives of those affected. Eighty percent of people with ADHD also suffer from a comorbid psychiatric disorder—anxiety, depression, learning disabilities, and sensory processing disorder are among the most common.[9] The avalanche industry already has an elevated rate of psychiatric injury and is a population that suffers from issues like substance abuse, depression, and suicide[10]. A common disorder that causes problems with decision making, inhibition, emotional regulation, self-awareness, and workplace performance can be a dangerous addition to the mental well-being and physical safety of avalanche professionals.

Depending on what study you're looking at, it is estimated that between 2.5–5% of adults in the U.S. have ADHD. Exercise helps to reduce symptoms and people affected by ADHD tend towards activities that offer high dopamine rewards. Because of this, I feel it is reasonable to suspect that mountain towns, and the avalanche industry in particular, have a higher percentage of people with ADHD than would be found in the general population.[12]

CONCLUSION

As our industry continues to develop our dialogue surrounding mental health, group dynamics, and decision making, considerations must be made for neurodivergence. Whether we are patrollers, guides, or forecasters, we work in an industry that has incredibly high stakes. Our consideration of heuristics, decision making, and behavioural patterns needs to include an element of awareness and support for neurodivergence in general—not just ADHD.

A sobering point to drive home the nature of this issue was made in a 2014 Swedish study. It concluded that individuals with ADHD are up to 47% more likely to be involved in serious vehicle collisions. It also showed that the risk of traffic accidents in males receiving ADHD medication was reduced by 58%.[13]

Being aware of ADHD in our profession is not just about improving our work performance, but about keeping ourselves and those within our area of operations safe. As of now, there is no way to permanently fix ADHD. With medication, therapy and, most importantly, figuring out what works for the individual, avalanche practitioners can learn to manage this disorder and be just as valuable to their programs as any neurotypical person.

With all of this, there is unfortunately some bad news. Most ADHD meds take around an hour to kick in, so you're still probably going to be a rolling gong show in the morning. Keep your keys close and your ski boots closer.

[12] https://www.outsideonline.com/outdoor-adventure/exploration-survival/adhd-fuel-adventure/
[13] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3949159/

The Avalanche Map
A Mobile and Web GIS for Avalanche Control at Rogers Pass

Michael Smallwood

Last winter, the Avalanche Control Section (ACS) of Glacier National Park recorded 1,746 avalanches along the Trans-Canada Highway corridor. For the first time, a mobile and web-based geographic information system (GIS) was used to track these events. The mobile app allowed observers to record avalanches using a phone or tablet while in the field and share them within the team. Once synced, everyone could access observations through their own app or using a web browser. These observations were displayed on an interactive map and offered summary statistics and searchable filters to aid in communication.

Improving the communication of avalanche activity was especially important last winter as pandemic restrictions isolated team members. Sometimes individuals were working remotely or separated in smaller teams to ensure continuity in case of an outbreak. Augmenting communication with mobile GIS aided in operations and will continue to be useful as multiple technicians and forecasters work on different shift patterns, often spread across 50km of highway or out in the backcountry.

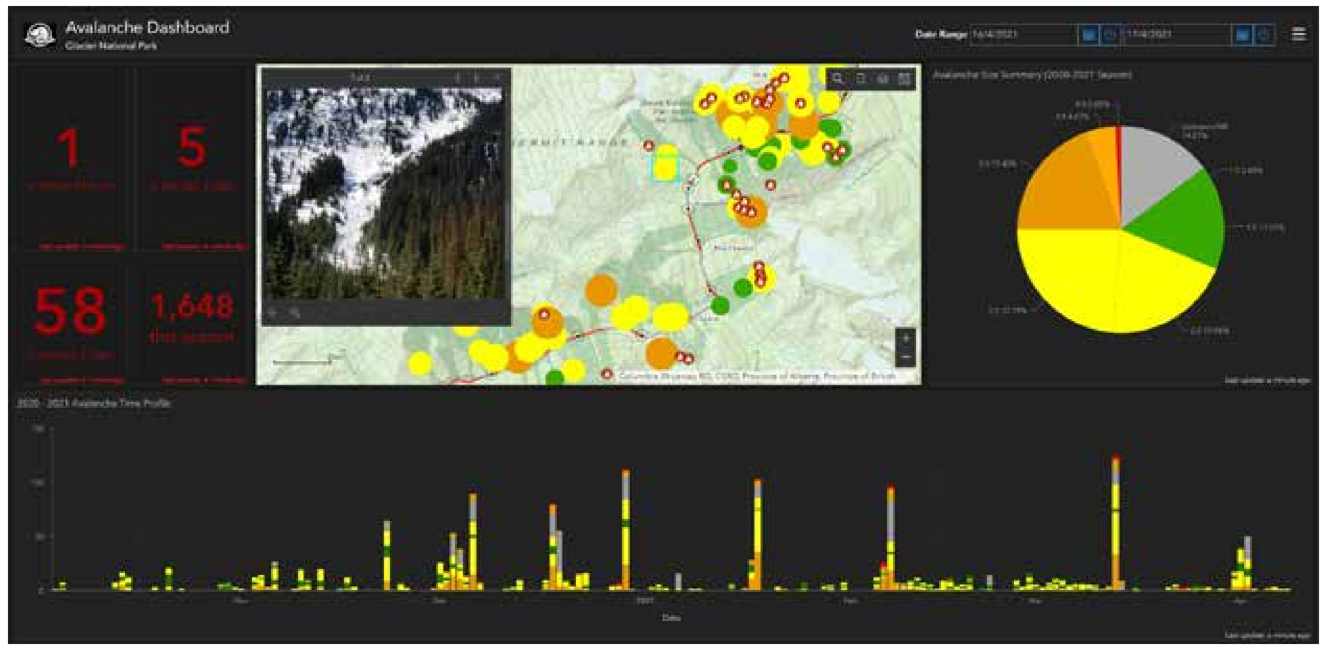
GOING DIGITAL

It is well established that avalanche activity is a key input to decision making at all organizations operating in avalanche terrain. Observing and communicating these events is crucial to the safety of team members and those exposed to avalanche hazard.

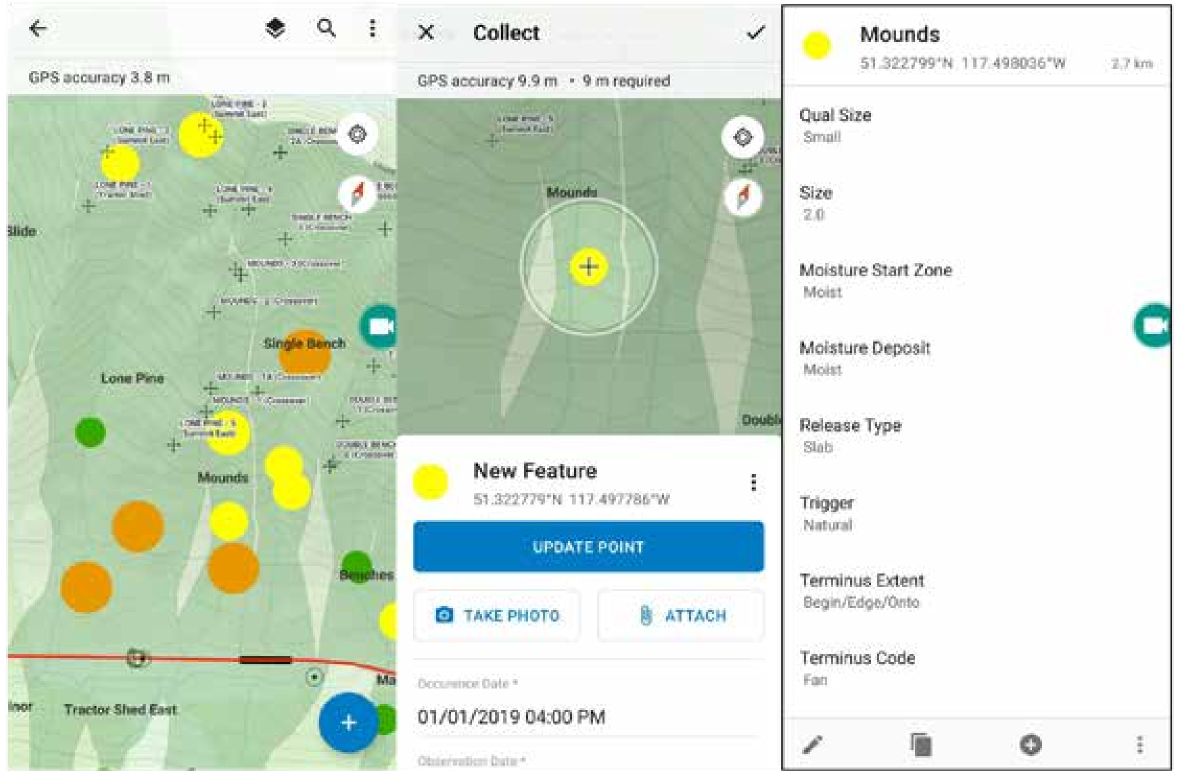
Busy operations can record thousands of events in a season; at Rogers Pass up to 35 unique data points can be recorded for each avalanche. These need to be logged and communicated with the rest of the team, as well as nearby operations. For decades, the ACS has meticulously maintained a series of notebooks recording avalanches. Access is limited to a single, physical record and only one observer can add new information or read information at any one time. Forecasters are extremely experienced at extracting the most important information from observations, but in order to make use of any decision aids or analysis tools in the future, data needs to be digitized in time for that analysis. Time delays and data entry mistakes when copying to a digital format can have a huge impact on analysis and information sharing. Paper records can be lost or incorrectly transcribed, and misinterpretation is possible if entered by someone other than the original observer. It was estimated to have taken 300 hours in 2020 just to check for these errors.

WHY USE MOBILE GIS?

One solution was to use a mobile device to enter observations digitally, directly into a network that could be accessed by the rest of the team. This addressed the



THE AVALANCHE DASHBOARD FROM GLACIER NATIONAL PARKS WEB APPLICATION IN APRIL 2021. // PARKS CANADA



THE ARCGIS MOBILE APPLICATION, FROM APRIL 2021. // PARKS CANADA

timeliness of information sharing and removed the possibility of transcription error introduced during subsequent data entry.

The transition to mobile and web platforms for avalanche work is already in progress. InfoEx now has mobile app functionality and Avalanche Canada's Mountain Information Network has been crowdsourcing public snow and avalanche observations since 2015. Many other generic mobile data platforms exist and these methods are standard in other industries. Several operations, including the Colorado Department of Transportation (ESRI, 2019) and British Columbia Ministry of Transportation (Bishop, 2019), have developed their own systems using ESRI ArcGIS.

A system at Rogers Pass needed to integrate with existing data infrastructure and a historical record that differs in format and terminology from CAA standards. The ACS wanted to be able to record everything and then share relevant observations with the avalanche community and the public. The solution needed to allow the observer to enter, edit, view, and share observations as quickly as possible, but still work with patchy and at times unreliable cellular and WiFi networks. Once data was entered, it needed to be displayed for the entire team to access in a way that was easy to read and that complimented the data presentation format everyone was already used to.

Representing avalanche activity in a map display produced a graphic that was easy to interpret and used a familiar topographic representation of Glacier National Park. ESRI ArcGIS was already in use in geomatics at Parks Canada and having the support of experienced technicians helped ease the transition to a new system. The flexibility in mobile and web GIS for adapting entry forms and web apps to operational use made it preferable over commissioning a dedicated, custom-built app.

THE AVALANCHE MAP

Starting in October 2020, a network of maps and apps has been integrated with existing workflows and data infrastructure at Rogers Pass. In the field, observers can record avalanches and share them as soon as a network is available. If there is coverage, observations are available to the entire team within seconds. In the field, new observations can be added by dropping a point on the map to represent an avalanche. This opens an entry form with both mandatory and optional fields to describe the event, as well as the option to upload a previously marked-up photograph or take a new one.

The basis for this system was developed during the winter of 2018-19 as a BGIS project at the Southern Alberta Institute of Technology (SAIT). Thomas Herbreteau, Artur Wojtas and I, in collaboration with the ACS, developed a series of layers and web maps for use with ESRI's existing mobile app, Collector for ArcGIS (now Fieldmaps). After testing and integrating feedback from the ACS, web apps were developed for the 2020-21 season for analysis and editing once back at the office. The Editor app allows updates to observations and queryable displays of all avalanches recorded. A display replicating the traditional notebook format is available, but it can now be filtered and searched. A printable backup provides an option when an internet connection is unavailable. The Avalanche Dashboard app provides some summary statistics and a season time profile, with a date picker to review periods of activity in detail. These are all updated in near real-time as records are synced to the network.

The central data storage layer is backed up regularly and synced to the Avalanche Forecasting System (AFS) database on its own dedicated network of servers. This ensures continuity of record keeping and compatibility with all the analysis tools contained there. The layer symbolizes recorded avalanches as colour-coded points representing destructive size classifications. Information about a specific avalanche can be accessed in the field or in office by selecting a single record. Observed avalanches can be searched and exported for ease of analysis or for sharing with partner organizations for hazard analysis, detection system performance, and research.

OPERATIONS WITH THE AVALANCHE MAP

The system received positive feedback from the ACS team last winter. Forecasters noted several advantages, including the value of observers digitizing their own observations to avoid misinterpretation, and allowing multiple observers to add and share observations simultaneously. Other advantages included having data available every time a hazard analysis was conducted and the ease of communication throughout the team and with partners. Team members noted the unexpected benefit of using the system as a learning tool by using built-in GPS to locate users in the terrain relative to the displayed avalanche atlas and extensive control target locations.

The system proved reliable with no down time or inability to access information on any day this winter. Offline functionality was effective and a plan was in place for network outages. Visual checking for errors introduced during data entry was not required for observations entered directly into the app. Pre-built queries checked every record entered and flagged those with missing or unusual information to be reviewed, rather than needing to scour the notebook line-by-line to find them. This allowed corrections while the observation was still in recent memory. The dashboard provided an easy way to catch up on events during shift changeovers or after days off. The new ability to query observations and sort them by avalanche characteristic provided a new way of looking at information and gave forecasters the option to ask meaningful questions of the information during hazard analysis.

The biggest challenge was learning how to use it. Adopting touch screens operationally and switching from the familiar paper and pencil was a big change. During very busy storms or while recording rapid artillery work, quick paper notes were still useful, but having a mobile system allowed catch-up on digital recording during lulls while remaining in the field and before detail was lost. Adopting any new technology takes time and now that users have a full season of experience it is anticipated that startup will be even smoother this winter.

HOW CAN WE IMPROVE THE AVALANCHE MAP?

Now that avalanche observations are digitally available for every analysis, adding more advanced decision making aids and analysis tools would be a great way to use that data. The extensive historical database available at Rogers Pass could make this especially powerful. Updating and streamlining the entry forms to pre-fill or skip over fields based on the answers to earlier questions would be a huge improvement and save even more time in the field. Forms could be customized further to limit the entries possible for specific features or conditions to improve consistency. Combining our existing avalanche atlas with this system would allow all of that information to be available digitally in the field and could include detailed, marked-up runout photographs to increase the consistency of observation reporting by having this available to all observers.

Overall, digital mobile recording as a primary data observation and sharing tool was a success last winter. Improvements in efficiency and accuracy freed up time for teams to gather more information or conduct analysis with more ways of looking at that information.

Thanks to Thomas Herbreteau, Artur Wojtas and Allen Fuller at SAIT, Melissa McBride and Ben Dorsey at Parks Canada Geomatics and the Rogers Pass Avalanche Control Section team.

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Avalanche Control with Reforestation
Planting The Big Burn on Hwy 3

Mark Grist

MANY BRITISH COLUMBIANS are familiar with the story of the 1946 'Big Burn' on Hwy 3 and the infamous Manning Park Gallows sign that was erected afterwards. Ben Bradley's excellent book *British Columbia by the Road*[1] tells the story of how 2,300 hectares of forest burnt as a result of a campfire left unattended by prospectors, and how the parks branch seized the opportunity to make the memorable roadside sign. What is less well known is how the former Department of Highways undertook an aggressive tree planting program to reforest the burnt out avalanche start zones in the late 1970s.

The project emerged as a legacy of the January 1974 avalanche that claimed seven lives at the North Route Café on Highway 16 west of Terrace, B.C.[2] The provincial government formed the Avalanche Task Force to look at ways to prevent future accidents. The task force submitted its report to government in October 1974[3]. One specific recommendation it made to safeguard highways was the use of reforestation as a "permanent avalanche control measure."

Requesting assistance from the research division of the Ministry of Forests, the technical aspects of reforestation along Highway 3 were outlined in a 43-page report[4] by legendary BC forester Karel Klinka and RW Mitchell in November of 1976. *Avalanche Control with Reforestation – Experimental Project 781.02* was published two months later, in January 1977. The total project cost (in 1977 dollars) was $135,250 or $181,750 (about $550,000 and $750,000 in today's dollars, respectively) depending on seedling type chosen[5]. This budget included 286 hours of helicopter time.

On the ground reconnaissance "to find severe sites, similar to those of the avalanche starting zones, along roads" took place during the fall of 1977. Preliminary field trials of seedling test stock started at two sites in Manning Park in late September of 1978, with 1,977 seedlings planted.

Over the next three years, more than 40,000 seedlings were planted in the start zones of highway avalanche paths, including 11,799 trees in the Burn North paths in spring 1981. A mix of species was planted, including Engelmann spruce, Douglas fir, lodgepole pine, and subalpine fir (the best

performer on north aspects). Interestingly, receipts from 1979 showed fuel charges at 26 cents per/litre and helicopter time billed at $300 per hour (about $1,060 per hour in 2021 dollars) from Highland Helicopters Ltd. in Vancouver—a similar machine would cost $1,500 per hour today!

In the *Avalanche Task Force–Technical Supplement*[6], Allison Pass (Highway 3 between Hope and Manning Park) was rated as a MODERATE Avalanche Hazard Area (index rating between 10-100) back in 1974, noting "the highest avalanche hazard exists in the Burn." Table 1 below qualifies "the avalanches according to the damage which they can produce to traffic" and predicts their frequency[6]. Thanks to reforestation (including 164,000 seedlings planted on lower slopes between 1953 and 1960[4]), the frequency in all categories has been zero for several years now.

Peter Schaerer authored the technical supplement section for Allison Pass and predicted, "Restoration of the forest would eliminate the avalanches on the south side, and infrequent large avalanches only would be observed on the north side." Indeed, the trees have held and the last notable avalanche was in 2009, while the last avalanche to affect the road was in 1996.

It remains to be seen whether we have entered a new norm of severe summer wildfire seasons, but we can say that the three worst in British Columbia's recorded history have all happened in the past five years. After significant wildfires in Waterton National Park, RAAMS simulations by Campbell et al. showed an increase in runout distance near, and measured post-wildfire runout extents increased on Mt Whymper[7]. While remote avalanche control systems and passive defense structures are excellent solutions to be implemented on a short timescale, one could make the case for reforestation being the forgotten 'semi-permanent' avalanche solution where climate and soils allow, especially considering treelines have been increasing in elevation[8] and will continue to do so if climate trends continue.

TABLE 1: AVALANCHE TASK FORCE (1974) PREDICTED FREQUENCY AND LENGTH OF ROAD AFFECTED BY FOUR DIFFERENT CATEGORIES OF AVALANCHE EVENTS FOR THE BIG BURN AREA[6].

R1 (SNOW DUST OR WIND BLAST ONLY)	**6.5 EVENTS/YEAR AFFECTING 1150' OF ROAD**
R2 (SLUFF: SMALL BANK AVALANCHES)	**0 EVENTS/YEAR**
R3 (LIGHT SNOW: DEPOSITS ON ROAD 1-4' DEEP)	**1.3 EVENTS/YEAR AFFECTING 600' OF ROAD**
R4 (DEEP SNOW: DEPOSITS >4' DEEP ON ROAD)	**1.98 EVENTS/YEAR AFFECTING 1950' OF ROAD**

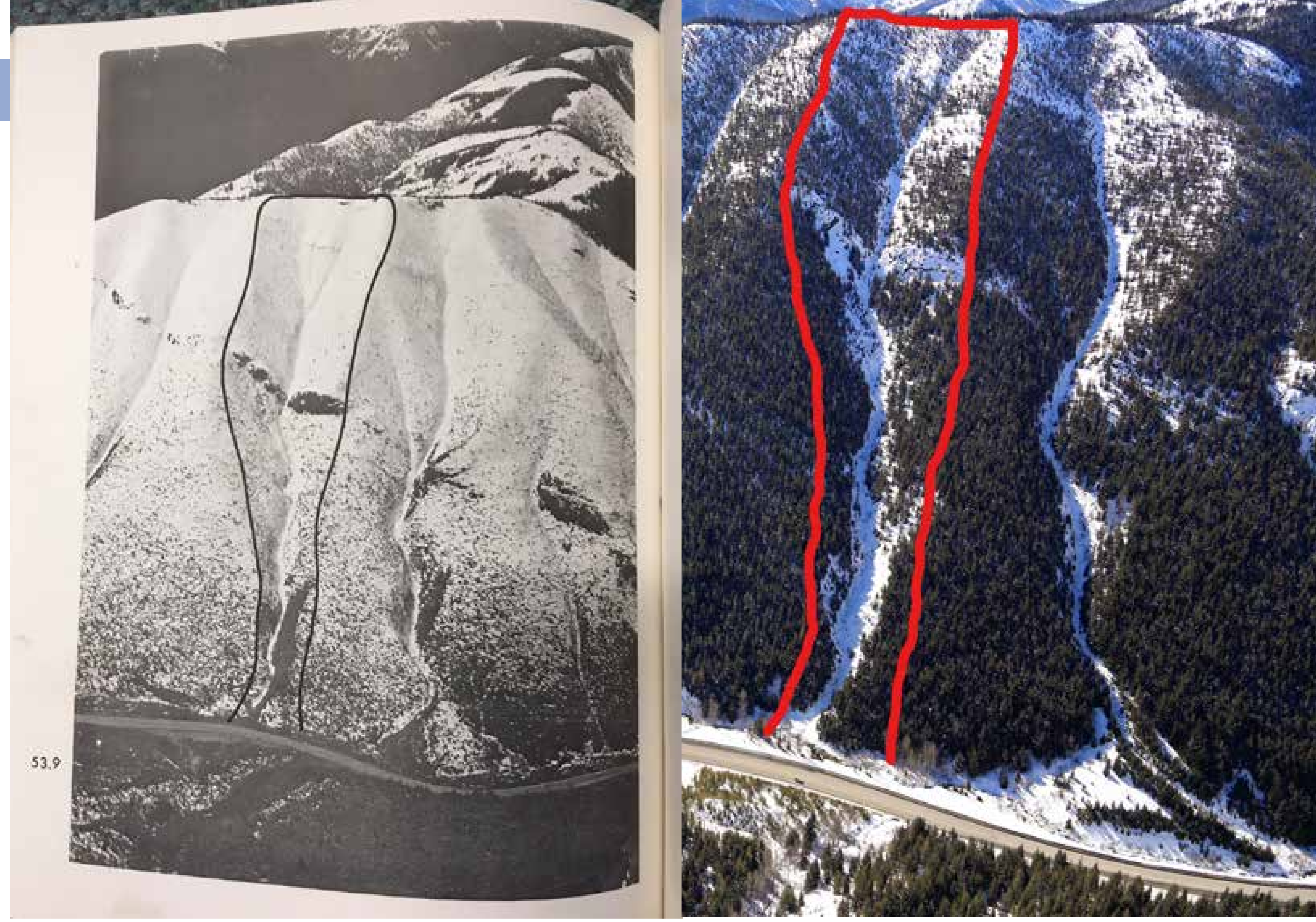

FIG. 1: LEFT – PATH 53.9 FROM THE MOTI AVALANCHE ATLAS IN 1981; RIGHT – AERIAL PHOTOGRAPH TAKEN MARCH 16 , 2020.

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Arai Magic

Kevin Fogolin and Dave Iles

DYNAMIC AVALANCHE JAPAN, Arai Avalanche Hazard Evaluation Worksheet: "HN24: 30 cm. HST: 101 cm. HS: 530 cm. Ta: -8.7°C. Snow today with a further 20 cm and winds light from the North. Temperatures steady around -8°C. Surface conditions: deep powder, excellent skiing."

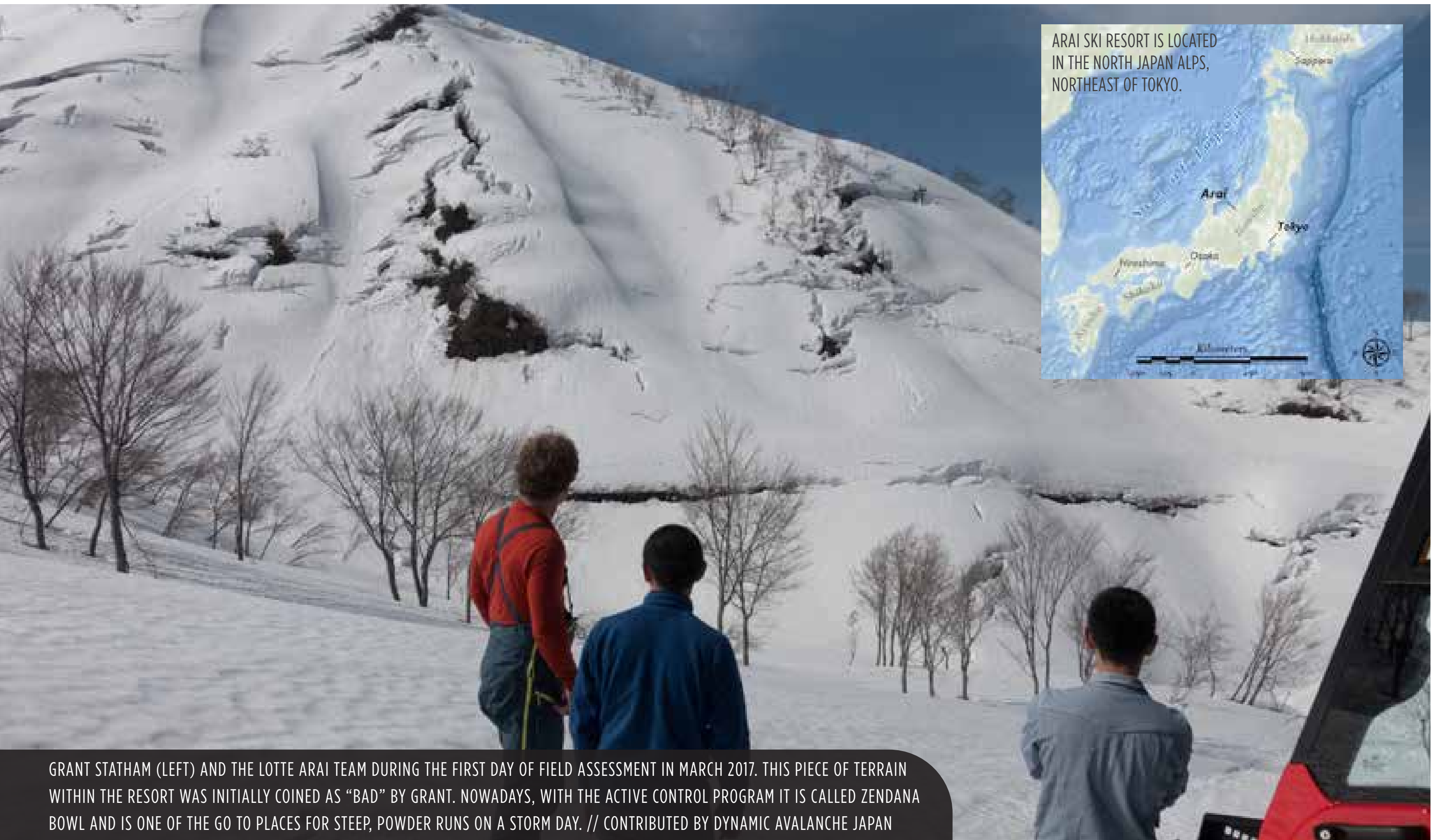
For many ski resorts, this would read as the storm of the decade. During powder season in the Myoko region of Japan, located on the western edge of the Island of Honshu, this is standard fare.

Arai Ski Resort and Spa opened in 1993 as a "luxury ski resort" founded by Hideo Morita, the eldest son of Sony co-founder Akio Morita. Arai opened with state of the art facilities and luxurious accommodation, not to mention never-ending snowfalls. Unfortunately, the resort failed to be an economic success and with the Japanese economic downturn of the mid-2000s, it closed its doors in 2006. For a decade, the resort was left abandoned, boarded up, and buried in winter snowfalls, with only a few locals touring up to enjoy some deep powder turns.

In March 2017, an email request came to the Dynamic Avalanche Consulting office in Revelstoke, B.C., requesting support to develop an avalanche program for a ski resort in Japan. This is not a typical request for Dynamic, and though these types of requests sound interesting, they rarely develop into something fruitful.

This one was different. The email came from the Lotte Arai marketing director, Tomo Yasuada, who had lived in Washington state for several years, was an avid snowboarder, and had seen the implementation of an avalanche program at Niseko, Japan, which was initially developed by Chris Stethem in the late-2000s. Lotte had recently purchased the abandoned resort and was investing considerable funds to transform it back to its luxurious state of the late-90s. The grand opening was planned for December 2017.

A couple weeks later Grant Statham and Kevin Fogolin were on a flight bound for Tokyo, headed to Lotte Arai to conduct an avalanche risk assessment for the resort. The goal was to develop an avalanche risk management plan (ARMP) for winter operations. They spent a week at the resort, using their brand new Pisten Bully snowcats to provide assisted ski touring to assess and map the avalanche terrain. A few things jumped out: there was a lot of avalanche terrain and hundreds of glide cracks! The days were spent analysing the terrain, meeting the management team, and putting a framework together to implement an operational avalanche program for the upcoming ski season.



ARAI SKI RESORT IS LOCATED IN THE NORTH JAPAN ALPS, NORTHEAST OF TOKYO.

GRANT STATHAM (LEFT) AND THE LOTTE ARAI TEAM DURING THE FIRST DAY OF FIELD ASSESSMENT IN MARCH 2017. THIS PIECE OF TERRAIN WITHIN THE RESORT WAS INITIALLY COINED AS "BAD" BY GRANT. NOWADAYS, WITH THE ACTIVE CONTROL PROGRAM IT IS CALLED ZENDANA BOWL AND IS ONE OF THE GO TO PLACES FOR STEEP, POWDER RUNS ON A STORM DAY. // CONTRIBUTED BY DYNAMIC AVALANCHE JAPAN

Upon returning to Canada, our team spent several weeks putting together the ARMP for the upcoming winter. This involved combining our field evaluation of the terrain with avalanche runout modelling and snow supply analysis. With the avalanche terrain mapped, including avalanche magnitude and frequency estimations, control routes were developed that would allow for safe, efficient terrain openings. Further components of the plan included organizational structure and staffing requirements, training requirements, identification of avalanche risk mitigation measures, weather and snowpack observation sites, daily avalanche hazard and risk assessment worksheets, a backcountry response plan, and avalanche rescue plans.

With the ARMP in place by late summer 2017, an avalanche forecasting team was assembled that included senior avalanche forecaster Dave Iles from Whistler, B.C., and assistant forecaster Iwao Yokohama (JAN Level 2), who had patrolled at the resort back in its former days.

Fast forward to 2021, and Dynamic Avalanche Japan (DAJ) continues to operate the snow safety program at the resort. Here is a summary and a few highlights from the last few seasons.

THE SNOW

Lotte Arai is located in the northeastern corner of the North Japanese Alps and is subject to very heavy winter snowfall. During the main winter months (December through February), a northwest winter monsoon originates in continental Asia due to the building Arctic airmass over Siberia. This push of cold, dry air over the relatively warm waters of the Sea of Japan creates winter storm systems that are subject to intense orographic lifting when they reach the west coast of Honshu. This results in very heavy snowfalls. It is not uncommon to receive 50-75cm of snow in a 24-hour period, and high-elevation winter snow depths typically exceed 500cm. Storm systems regularly produce snowfalls in excess of 100cm.

In January of 2021, a five-day storm resulted in a H2D cumulative total of 348 cm. Table 1 below shows snowfall totals for the previous four seasons. The 2019-20 season was described by locals as a historically low season, even though the resort still received over 12m of snowfall. The winter season is short—the tap literally turns on around early to mid-December and, just as quickly as it turns on, it switches off by late-February, with very little snowfall in March and April.

Table 1. Cumulative monthly snowfall (ΣHN12, in cm) at Zendana Lower study plot.

Month	2020-21 Season	2019-20 Season	2018-19 Season	2017-18 Season
November	~	37	~	~
December	680	228	539	458
January	880	370	848	706
February	528	403	391	453
March	39	139	128	70
April	17	39	134	8
May	0	~	0	0
Total	2144	1216	2040	1695

AVALANCHE RISK MANAGEMENT PROGRAM

The DAJ snow safety team at Arai consists of Iles and Yokohama. Lotte Arai also provides two trainee forecaster positions to the program who work under the mentorship and guidance of the DAJ team. This season, DAJ will be adding a third forecaster position to the program. DAJ's scope of work includes assessing avalanche hazard and risk, terrain management decisions, and providing training and mentorship in snow safety to both the ski patrollers and the Lotte Arai snow safety team.

Given the impressive storm season snowfalls, one might expect to see widespread avalanche activity, however this is typically not the case. The snow seems to come in and quickly settle out and stabilize, leaving many mornings when the snow safety team is hard-pressed to get anything more than a few loose dry sluffs out of steep terrain. The thought of calling it LOW hazard after 100cm of new snow always seems to generate a fair bit of discussion.

The most common avalanche problem is surface sluffing, which can be extensive when it is continuously snowing 5–10cm/hr. These sluffs, which can entrain significant amounts of snow, are usually loose or very soft slabs. Control is mainly achieved by ski cutting and then quickly opening terrain to the public. The resort has a very strong contingent of local snowboarders who make sure every single pocket gets chopped up.

During the winter season, if snow stops falling five or more hours before the start of avalanche control, there will seldom

be avalanche activity, even after snowfall amounts of over 50cm of H2D. This incredible feat of bonding is referred to as "Arai Magic." Given the potential instability and lack of historical data, widespread testing occurs before opening.

Slab activity is usually soft and associated with frequently occurring melt-freeze crusts. It is common for these slabs to become unreactive quickly, normally within a day or two. If possible, it is beneficial to ski the steep terrain early in the storm to facilitate bonding. Widespread explosive testing also provides additional confidence.

Avalanche control with explosives is used routinely on the mountain, typically using one kilogram hand charges. This season, two OBell'X towers will be installed in the upper alpine bowl. Back in the early 2000s, this alpine bowl released a Size 4 avalanche that struck the gondola, resulting in minor damage. The thought of this low-frequency, high-consequence event continues to weigh in on the minds of the forecasting team when storm totals start to exceed 200cm and weather conditions prevent avalanche control. The OBell'X will be a welcome addition.

One of the most significant challenges for the snow safety team is the presence of glide cracks. These are primarily a late-season problem but, depending on the winter, they can present a serious inbounds hazard throughout the season. The prevalent bamboo grasses in the area provide the ideal surface for extensive snowpack gliding and result in some of the runs taking on the look of a heavily crevassed, glaciated slope. Management of the glide hazard is continuous through the season, with marking, fencing, pushing snow into them, and, if required, closure of the runs. Glide avalanches are rarely seen as a result of these glide cracks, but there are a couple routine performers which produce Size 2 glide avalanches every spring. The more common hazard is random blocks coming loose and tumbling down the slope.

Each year, the DAJ team gains more knowledge on the glide problem, but with no historical records, a fair amount uncertainty remains. In general, increased glide activity seems to occur during or shortly after a significant rain event. Explosives have not proven effective as a control measure. They require a lot of observation and at times result in substantial terrain closures, only for us to watch as nothing happens.

As amazing as the skiing and the snow can be at Lotte Arai, for the DAJ team the warmth and hospitality of the Japanese people is one of the main highlights of the program. Lifelong friendships have been forged over the last four seasons under the common universal bond of enjoying deep powder days with fellow coworkers… Arai Magic.

TOP: MORNING EXPLOSIVES WORK; MIDDLE: PATROLLER MARKING LARGE GLIDE CRACK; BOTTOM: OVERNIGHT SNOWFALL AT STAFF PARKING. //PHOTOS CONTRIBUTED BY DYNAMIC AVALANCHE JAPAN

Avalanches **Down Under**

Craig Sheppard, President and Program Director, Mountain Safety Collective

A SIZE THREE AVALANCHE ON ETHERIDGE RIDGE IN THE MAIN RANGE OF NEW SOUTH WALES IN AUGUST 2019. // DAVID HERRING

AUSTRALIA IS NOT A COUNTRY THAT is typically associated with mountains and ski culture. With more than 85% of the Australian population within 50 kilometres of the coast (Australia State of the Environment, 2016), surf culture definitely outweighs mountain culture. However, there is a long tradition of skiing Down Under. Australia was the first country in the world to form a ski club, way back in 1861, installed its first ski tow in 1936, and debuted in the Winter Olympics in 1952.

Unfortunately, this long tradition in skiing has not been without incidents. In 1956, an early morning cornice failure and subsequent wind slab from the summit of Mount Clarke in the Main Range of New South Wales (NSW) smashed into the back wall of the Kunama Hutte, killing one person and injuring several others. This was the first avalanche-related fatality in Australia. Sadly, there have been several lives lost to avalanches in the ensuing decades.

In 2014, an avalanche on the slopes of Mt Bogong in the Victorian Alps was the impetus for change. Two young men died from traumatic asphyxia after triggering a one-metre-deep slab that swept them into a gully feature. They were found several days later buried over four metres deep. This event spurred a group of backcountry enthusiasts to form the Mountain Sports Collective (MSC) the following year. (It was renamed the Mountain Safety Collective in 2020).

This article shares my experience working with the MSC as they have sought to build a mountain hazard forecasting and outreach program for the Australian Alps.

THE DEVELOPMENT OF THE MSC

The MSC is run by a small group of volunteers. In the last five years, they've built a website and members have published field observations from the trips they have done. While they lacked qualifications and accreditations, they had local knowledge and enthusiasm in spades. They knew they had a long way to go, especially in terms of applying avalanche reporting and forecasting standards, but they had nonetheless taken a huge step forward in raising awareness of avalanches and general mountain hazards.

In 2018, Alex Sinickas, an engineer and graduate of the University of Calgary's Applied Snow and Avalanche Research Centre, returned to Australia from Canada. She could see what MSC was trying to accomplish and introduced them to Alan Jones and Penny Goddard from Dynamic Avalanche Consulting. Together, they reviewed the MSC's operations and helped map out a path for building a standardised, reliable operation.

Alongside the Dynamic report, the MSC also conducted a domestic review by surveying their members and local professionals such as ski patrollers and guides. This cohort pointed out that while avalanche hazard was the prominent concern abroad, in Australia it was also important to communicate other hazards that caught backcountry travellers off-guard. Specifically, it was noted that adverse surface conditions (slide-for-life ice) and adverse weather (whiteout/exposure/visibility) contributed to at least equal, if not more risk, than the avalanche hazard.

With the Dynamic report and the input from local professionals, the MSC understood the direction they wanted to go, but they needed someone with the right background to get them there—that's where I came in.

Personal circumstances had led my family and I to relocate to Sydney, Australia, in 2019. After many years working as a patroller and forecaster at Lake Louise, an apprentice ski guide, and CAA ITP instructor, I had been floundering around Sydney in a variety of jobs trying to find a new direction. Nothing fit as well or was as rewarding as the work I had become accustomed to in the avalanche patch of western Canada.

Well, call it what you will: serendipity, or just a love of cold beers and catching up with old friends on hot summer days, but I was made aware of the MSC and what they were trying to accomplish through a conversation with another Canadian ex-pat and Lake Louise ski patrol alumnus. It was on Sydney's northern beaches that Andrew Mason brought me up to speed on the MSC and the work of Dynamic. After that chance encounter, I read the Dynamic report, met with the MSC in person, liked what I saw, and jumped on board.

THE AUSSIE DIFFERENCE

The mountainous region of Australia is located in the southeast of the country. For forecast purposes, it is divided into three regions: the Front Range and Dividing Range in Victoria, and the Main Range in New South Wales. At approximately 990 square kilometres, the Dividing Range is the largest of the three zones, while the Main Range is the smallest at 220 square kilometres. The highest peaks in these regions are just over 2,000m, with the snow level tending to waver around 1,500m. The MSC publishes daily backcountry conditions reports for each region. These differ from the avalanche forecasts of Canada and elsewhere in three key ways.

First, the MSC's reports consider other factors alongside the avalanche hazard to determine an overall hazard rating for the day. Since most incidents in the Australian backcountry are caused by exposure to the elements and uncontrolled falls, rather than avalanches, we needed to develop a slightly different framework to help the state governments manage the Australian-specific mountain risk.

Second, the MSC has a three-tiered system to rate the overall hazard level each day. The levels are: travel not recommended, extra caution, and usual caution. The daily rating is derived by assessing four categories of backcountry hazards:

1. **Weather Conditions:** Is the weather outlook favourable, or is the weather changing adversely? Is there an exposure risk? Are there going to be blizzard conditions?
2. **Visibility:** Will there be good visibility, poor visibility, or whiteout conditions?
3. **Surface Conditions:** Is there localized ice or widespread ice? If localized, on which aspects and elevations?
4. **Avalanche danger:** low, moderate, considerable or high.

The third major difference regards the avalanche danger itself. We decided to use a four-level avalanche danger scale rather than the five levels used elsewhere, omitting the extreme rating. This is because the nature of the snowpack and the scale of the terrain in Australia makes it very unlikely that conditions would ever reach extreme avalanche danger. Also, given the reports are targeting recreationists, by having a four-point scale, considerable moves higher up and makes it look like a more serious rating. We believe this to be a good thing. Noting the recent research by Pascal Haegeli that a four-point scale may communicate the hazard more effectively to less trained and experienced recreationalists (Jamieson, 2021), we felt we could test this starting anew here, rather than starting with a five-point scale and changing it later.

While concerns have been raised at using a different danger scale than the global standard, I don't see this as a bad thing. For example, if you compare Australia's fire hazard scale to Canada's, Australia has fire hazard conditions that warrant a rating of "catastrophic." This is off the charts; Canada does not have this rating. When I moved to Australia from Canada, I didn't think any less of Canada's highest forest fire hazard of "extreme." Rather, I thought, "Fire conditions reach a whole new level in this country! Watch out!" It's fair to say when Australians visit other countries and see extreme avalanche danger, it reads the same: "Things are more serious in the mountains in this part of the world. I better be aware!"

That said, the fact that avalanches occur less frequently and at a lesser magnitude in Australia than in other mountainous regions of the world does not justify complacency. Australians and visitors alike need to be aware of the hazards when going into the backcountry. Also, they need to be aware that there are many factors to consider when planning their trips—not just avalanches.

CREATING BACKCOUNTRY REPORTS

The MSC goes through a daily workflow to produce its backcountry conditions reports that is similar to what we see in Canada. We are fortunate that the Bureau of Meteorology has automatic weather stations in relevant locations that give us pretty accurate weather values. There are webcams at all the ski resorts at various elevations and some snow depth cams too. Some data gaps do exist, particularly in Victoria around Mount Bogong. To counter this, the MSC has set up its own basic remote webcam and plot. These simple stations are effective. The intention is to continue to strategically grow these assets in data sparse areas in the coming seasons.

For field observations, the MSC relies on a network of information exchange. This does not have the depth and sophistication of the InfoEx but is more of a "ShareEx", with volunteers, patrollers, commercial operators, and MSC colleagues alike sharing their daily field observations. We use various online platforms to facilitate this exchange and have been very flexible and welcoming of all the data that comes in, regardless of how it comes.

In 2022, the MSC will contract two field teams on an as-and-when basis, with one team in each state. These teams will have at minimum CAA Level 1 qualifications and will work more closely with the forecaster. This will better facilitate targeted information gathering throughout the season and streamline the field observations communication. These teams will complement the information sharing that is already in place.

WHERE TO NEXT?

Winter backcountry use in the Australian alpine is increasing. The MSC has three initiatives to service this user group: safety, advocacy, and access. At the end of the day, the MSC is trying to increase awareness and provide the public with reliable, accurate information to contribute to better informed decisions while traveling in the backcountry. It is great that there is momentum here that recognises that this awareness is a good thing, and that people should no longer be complacent when stepping out.

As we look to 2022, good things are happening. The MSC is receiving more government funding and recognition, corporate sponsorships are coming in, and a budding ambassador program is taking form to help propagate the MSC message. With both Alex and I becoming more involved, we will leverage this support to start providing extra training to local patrollers, guides, and educators as they work towards their CAA Operations Level 1 and 2 qualifications, or equivalents from other countries.

One never knows where life will take them. If you find it takes you to this corner of the world one day, come say "G'day!" It would be great to show you around the snow gums and hear what you think about how we've tried to set things up. Safe travels everyone.

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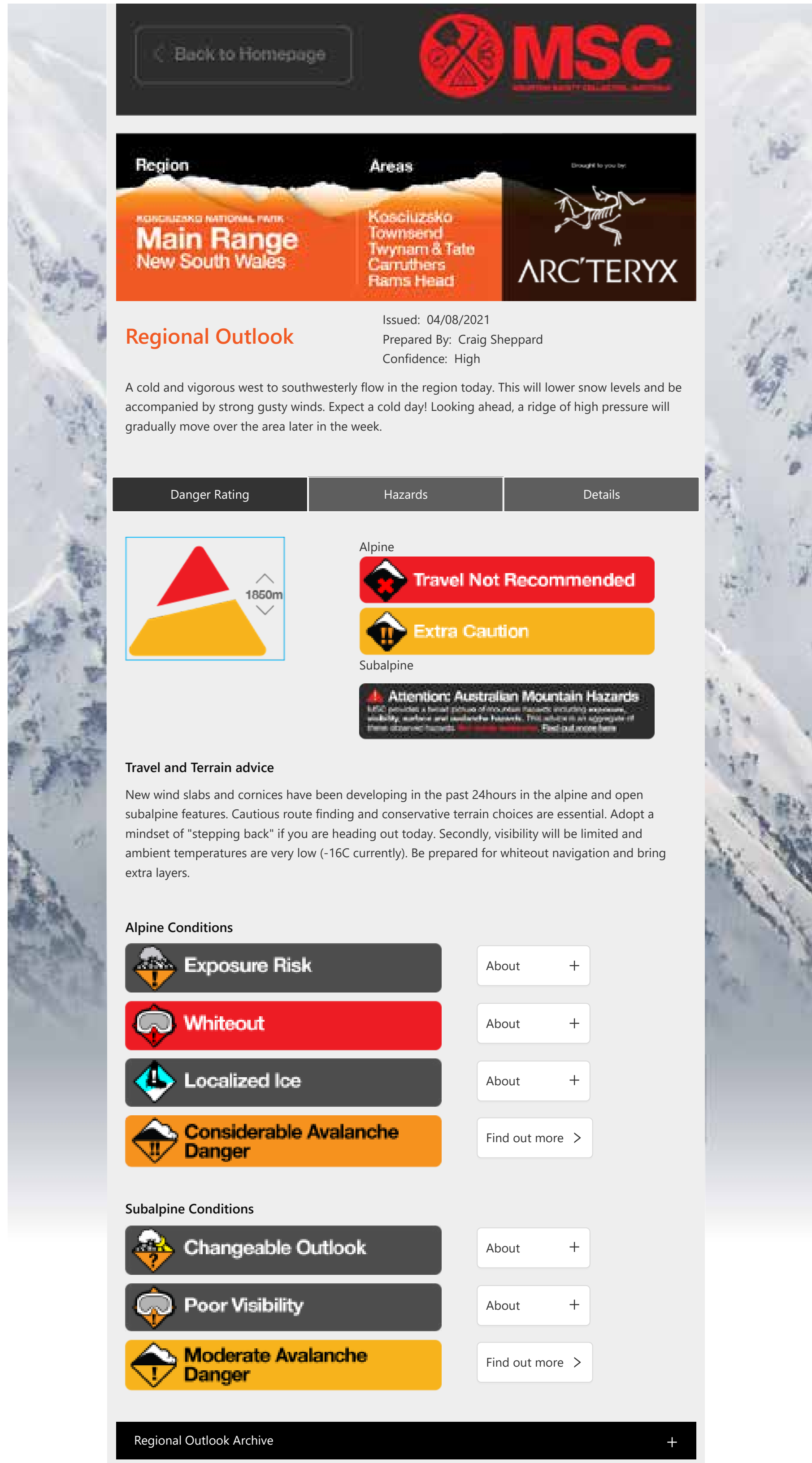


A BACKCOUNTRY CONDITIONS REPORT FOR THE MAIN RANGE OF NEW SOUTH WALES FROM AUG. 4, 2021. THE DANGER RATING FACTORS IN WEATHER CONDITIONS, EXPOSURE RISK, SURFACE CONDITIONS, AND AVALANCHE DANGER.

AvSORT II: Avalanche Survival Optimization Rescue Triage
A Multi-casualty Avalanche Rescue Triage Algorithm

Jeff Boyd MD, IFMGA, Mike Inniss MD, DiMM, and Kyle McLaughlin MD, DiMM

AVALANCHE PROFESSIONALS in the mountains of western Canada are all too aware of how our vast topography and relative isolation often conspires against a brisk and adequate response to avalanche accidents. In 2010, Lee Bogle, Jeff Boyd, and Kyle McLaughlin published the original Avalanche Survival Optimization Rescue Triage (AvSORT) algorithm. AvSORT was designed to assist avalanche rescue teams with the challenging task of triage during multi-casualty avalanche incidents where the needs of the subjects overwhelm available rescue resources.

A project to update AvSORT to modern avalanche rescue standards began with a presentation of an initial proposed revised algorithm at the 2019 CAA Spring Conference and publication in *The Avalanche Journal* (vol. 125/winter 2020). This was followed by alterations that incorporated some valuable industry and peer feedback, and used improved graphics. The project culminated with the presentation of a final version of AvSORT II at the International Society of Mountain Medicine congress in Interlaken, Switzerland, earlier this summer.

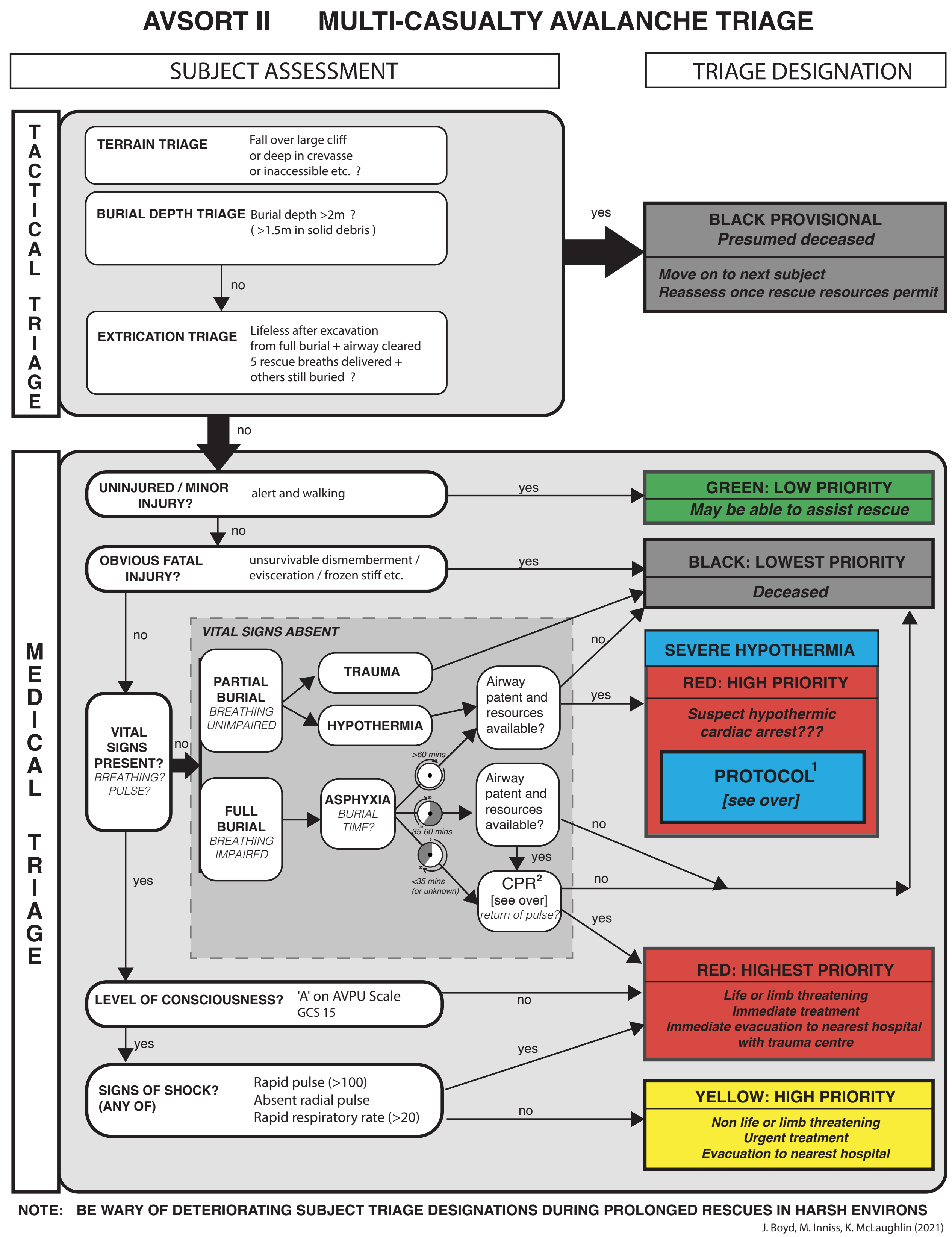
A key update from the original AvSORT algorithm is the addition of three tactical rescue triage concepts at the onset of the rescue response—terrain triage, burial depth triage, and excavation triage. These allow rescuers to designate victims as unlikely to have a favourable outcome, thus allowing the rescuer to move on to other subjects in need of excavation, assessment, and care.

Additional updates include the triage of subjects with absent vital signs by the physiologic mechanism of their arrest (asphyxia, trauma, and hypothermia) and the further triage of fully buried asphyxiated subjects by internationally accepted burial time parameters. As in the original algorithm, medical triage designations use the internationally accepted colour-coded system of green, yellow, red, and black.

New to AvSORT II are the colour-coded triage designations of "provisional black" based on initial tactical triage parameters, and the "red/severe hypothermia" designation for victims meeting specified profound hypothermia criteria. Included and notated within the algorithm is an updated protocol for severe hypothermic cardiac arrest with its corresponding resource-intense pathway of care and a mountainside CPR protocol (non-hypothermic) for the rescuer's reference.

The authors envision AvSORT II as a practical cognitive aid—perhaps printed on weatherproof paper as a field card— that is used on scene by rescue personnel and teams during the cognitively challenging task of multi-casualty avalanche rescue. We also envision it as a living and open-source concept document that we hope to keep up to date with industry feedback as rescue standards and protocols evolve.


PRE-SEASON AVALANCHE INCIDENT MULTIPLE VICTIM PRACTICE. // ALAN MAUDIE



1

HYPOTHERMIC CARDIAC ARREST PROTOCOL

RED: HIGH PRIORITY

ACTIVATE IF RESCUE RESOURCES PERMIT & CHAIN OF SURVIVAL PLAUSIBLE

SUBJECT ASSESSMENT / INCLUSION CRITERIA
- vital signs absent (assess for at least 1 minute)
- prolonged exposure with breathing unimpaired & no signs of lethal trauma

or
- prolonged full burial >60 mins with unobstructed airway & no signs lethal trauma

note: 1) witnessed arrest favourable
2) air pocket present at excavation from full burial favourable

HYPOTHERMIA CARE
- handle subject gently and keep supine
- insulate from snow surface
- insulated wrap with heat source (eg. activated heat panel blanket) to core
- field treatment inside micro climate (eg. bothy/guides tarp sealed to snow surface)

BASIC LIFE SUPPORT
- manage airway (OPA/NPA/Iqel LMA/King Airway) + ventilations (BVM)
- supplemental oxygen (warmed if possible)
- continuous CPR optimal
  -intermittent CPR permissible during transport if necessary
  (5 mins CPR alternating with 5 mins or less no CPR)
- AED - consider withhold defibrillation while severely hypothermic (<30°C)
- mechanized automated chest compression device if available

ADVANCED LIFE SUPPORT
- endotracheal intubation
- nasogastric tube if prolonged CPR
- epinephrine - consider withhold dose while severely hypothermic (<30°C)
- point of care serum K+
  full burial *>8mmol/L terminate resuscitation*
  exposure *>11mmol/L terminate resuscitation*
- continuous cardiac monitor
- point of care portable ultrasound - assess cardiac activity

INFORM EMS - HYPOTHERMIC CARDIAC ARREST TRANSPORT

TRANSPORT TO NEAREST HOSPITAL WITH ADVANCED REWARMING ECLS CAPABILITIES (ECMO/CARDIAC BYPASS)

2

MOUNTAINSIDE AVALANCHE CPR PROTOCOL
NON-HYPOTHERMIC

START CPR if...
1. safe to do so
2. no signs lethal trauma
3. rescue resources permit

STOP CPR if...
1. rescuer(s) exhaustion
2. becomes unsafe to continue
3. no return of pulse after 20 mins
4. after expert consultation based on advanced point of care testing (serum k+/ cardiac ultrasound)

J. Boyd, M. Inniss, K. McLaughlin (2021)

in the loupe

34

AN INITIAL LOOK AT TRANSCEIVER INTERFERENCE WITH SEARCH AND RESCUE CONSIDERATIONS

in this **section**

// DOUGLAS NOBLET

WTF! My Beacon is Broken!

An Initial Look at Transceiver Interference with Search and Rescue Considerations

Ivars Finvers and Doug Latimer

FOR YEARS THE AVALANCHE INDUSTRY has been aware that electronic devices may interfere with an avalanche transceiver search [1-4]. Despite this, many users are still unclear which devices may impact a search, and there are no identified strategies for dealing with interference during a search. We evaluated a number of potential sources of interference in the field and propose some practical search strategies to address them. The purpose of this article is to:

1. Identify and quantify potential threats to a clean signal search.
2. Begin a meaningful discussion on how to mitigate signal interference.
3. Introduce possible search strategies for a buried victim when interference is present.

WARNING

This is not a thoroughly researched peer-reviewed study. These tests were conducted by a working, professional electrical engineer and a seasoned ski guide. Our data is too limited to give any hard numbers or definitive statements. Having said this, we do believe we have done enough testing to begin to identify emerging patterns and apply this to potential search and rescue strategies. We hope this work leads to a better understanding of the problem and initiates more research for search and rescue applications.

SOURCES OF INTERFERENCE

We gathered three transceivers and an arrangement of electronic devices to test. The transmitting transceiver was a BCA Tracker 2. It was placed on the ground 20m away from the receiving transceiver, which was on a wooden platform about one metre off the ground. The poles of the antennae were aligned pole-to-pole for the first test. The interference was measured indirectly by recording the distance reported by the receiver (actually the range of readings, since they always fluctuated) and comparing it to the baseline with no interference. Once interference from all devices was measured, the transmitter's antenna was re-oriented to be perpendicular to the receiving antenna and the test was repeated.

Each potential source of interference was placed at a right angle from the receiving antenna at 30, 20, and 10 centimetres away, and then in contact with the receiver. Two different receivers were tested, the Mammut Barryvox and the Pieps DSP. Figures 2 and 3 provide a graphical summary of the interference recorded by each device. Each sub-plot indicates the distance reading indicated on the receivers when the source of interference was placed at each distance from the receiver. The amount of interference was inferred by comparing the distance readings to the baseline for the test. Any change in distance, direction, or variability was taken to imply interference.

The test was conducted at the Banff airfield; no other potential sources of interference could be found in the area. First, we recorded the baseline distance for each receiving transceiver. At 20m, with the antennae aligned, the baseline for the Mammut Barryvox varied slightly with a signal of 24–25m, while the DSP signal fluctuated between 20–24m. When the transmitting antenna was aligned perpendicular to the receiver, the Mammut Barryvox recorded a distance of 31–33m and the DSP reported distances of 36–39m.

When devices of potential interference were introduced, they either had no immediate effect or the display indicated an altered distance to the transmitter. When interference became more pronounced, the arrow indicating the location of the transmitter began to shift. Additional interference would produce erratic signal locations and variable distances. At this point it was not possible to use the receiver to ascertain the distance or direction from which to search. Further interference resulted in the loss of signal and no distance being reported by the receivers.

THE RESULTS

When the interference sources were at a distance of 30cm or greater, none of the sources—excluding the drill—had any significant impact on the distance readings when the receiver's antenna was aligned with the transmitter's antenna. Rotating the transmitter 90° weakened the received signal, causing the distance readings to increase and show greater variability and, in a couple of cases, resulted in a loss of signal.

As the distance of the interferer was decreased, the variability of the distance readings increased and, in some cases, resulted in loss of signal. Generally, the impact of the

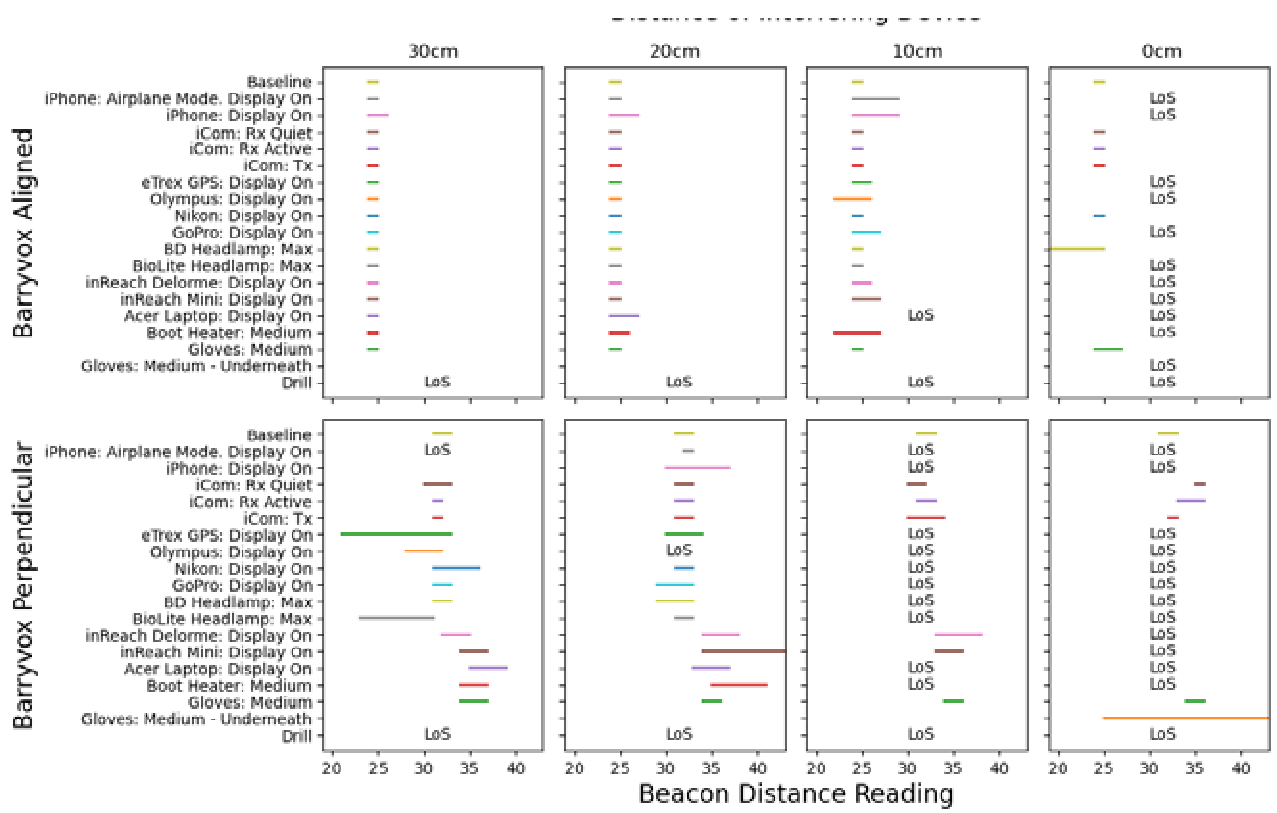


FIG. 1: INTERFERENCE WITH BARRYVOX RECEIVER.

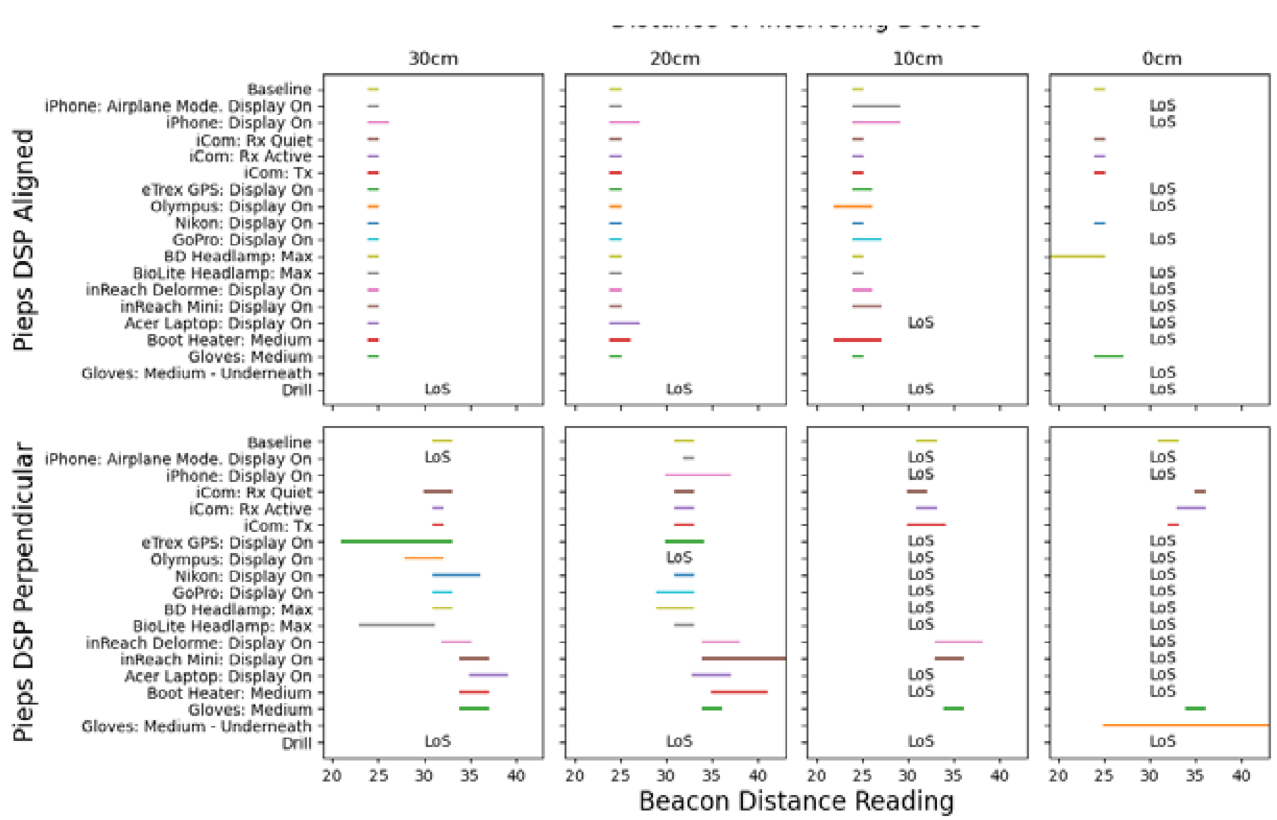


FIG. 1: INTERFERENCE WITH BARRYVOX RECEIVER.

interference source was greater when the transmitter was rotated 90° due to the weaker signal.

The greatest interference was recorded by electric motors. The cordless drill we tested rendered receivers useless when it was 50cm from them. The auto-focus motors on the cameras were also quite disruptive, but because of the short duration to focus, we were unable to accurately determine their effect. Though not part of this test, the magneto on a running snowmobile may also be a major source of interference.

Display screens appeared to be the second greatest source of receiver interference. We suspect this is caused by the display electronics that is present in all smart phones and tablets. The larger the screen, the greater the interference.

LED lights were also a significant source of interference. Just like display screens, LED lights have a refresh (flicker) rate that generates interference. The level of interference was greatest when the antennae were perpendicular to each other. Potential sources of interference needed to be more than 30cm from the receiver to pick up a clean signal 20m away.

Another surprise was how significantly foil impacted the receiver in a search. When a small square of aluminum foil was placed over or under the receivers, the effectiveness of both units was seriously degraded. Foil is an avalanche transceiver's kryptonite. Foil did not have a major impact on transmitters unless the unit was literally wrapped in foil.

An interesting result in Figures 2 and 3 is that the interference produced by an iPhone was similar when airplane mode was enabled and disabled. In both cases, the display was on. This ruled out the cellular, WiFi, or Bluetooth links as the interference source. The likely source was either the display driver or the switching regulator used to power the display. Both of these types of circuits switch currents on and off rapidly and therefore can produce electro-magnetic interference (EMI) across a broad frequency range. Similarly, the LED headlamps use pulse width modulation (PWM), where the current is rapidly switched on and off with a variable duty cycle to control the power delivered to the LEDs; this can produce wideband EMI. Electric gloves and boots also use PWM to control heat level.

Looking across all the interference sources tested, it is unlikely that any of them produce a strong interfering signal directly at the 457kHz transmit frequency used by the beacons. So why does the LED headlamp or an active display cause interference? The likely culprit is saturation, or overloading of the beacon's receiver analog circuitry prior to the digital signal processor (DSP) that is used to isolate the 457kHz tone.

To understand this, one must look at how a digital transceiver processes an analog signal. Before the DSP can process the signal, it must be digitized—the analog voltage coming from the antenna must be converted to numbers the microprocessor can manipulate. The very weak received signal will be amplified, mixed, and filtered by the front-end circuitry, but with lower selectivity than possible with the DSP. If a strong interfering signal is present alongside the weak received signal, it can cause the amplified signal to become saturated. The weak signal is effectively lost. Even before saturation occurs, the strong interferer will reduce the amount of amplification that can be applied to the weak signal. This reduces the resolution with which the weak signal can be digitized and results in increased variability of the reported distance.

IVARS FINVERS TESTS VARIOUS SEARCH STRATEGIES WITH A RECEIVER EXPERIENCING MODERATE INTERFERENCE—AN LED HEADLAMP, GPS UNIT AND VHF RADIO, ALL WITHIN 10CM OF THE UNIT. // DOUG LATIMER

The problem of interference is therefore likely one of broadband EMI overloading the signal processing circuitry of the receiver before the desired 457kHz signal can be extracted. Any circuit that switches rapidly can produce broadband EMI. The higher the voltage or current being switched, the greater the strength of the EMI. The frequency content of the EMI depends on how fast the circuit switches, with faster switching producing higher frequency EMI. A cell phone transmits its signal in the GHz (GHz = billion Hz) range, well above the filter bandwidth of the beacon's receiver, so it is unlikely to cause interference. The switching regulator used to power the display may operate in the 100's of kHz (kHz= thousand Hz) range and can therefore produce EMI that is within the vulnerable frequency region for the avalanche transceiver. One saving grace of many of these EMI sources is that since they are not purposeful transmitters of signals, their effective antennas are poor and the transmitted power is low and therefore weakens rapidly with distance.

It should be noted that this discussion of how interference may impact the receiver is based on general engineering principles applied to similar circuits. We do not have specific knowledge of the circuit design of the transceivers that were tested.

We included a cordless drill in our interference source because the high power PWM circuits used to drive the brushless motor can be a fantastic source of broadband EMI. As seen in the results, the operating drill causes a loss of signal if it is anywhere near the receiver.

With the above discussion in mind, the counter-intuitive result of relatively low interference of the VHF radio, a powerful radio transmitter, makes sense. The VHF frequency band is 30–300MHz (MHz = million Hz) and lies far above the avalanche receiver's bandwidth. Therefore, the radio signal can be filtered out by the receiver's front-end filter. The iCom radio also has a simple LCD display that does not need a high-power switching regulator or display driver, therefore it produces lower levels of EMI and, hence, less interference.

One unexpected result was the impact of aluminum foil on both the transmitter and receiver. Due to the long wavelength (~650m) of the 457kHz beacon signal and the small antenna that is used, the signal is predominantly transmitted in the magnetic domain[5]. Non-ferrous material such as aluminum foil should be largely invisible to it, yet when either the transmitter or receiver were placed on top of a square of foil, it caused the reported distance to vary.

When the transmitting beacon was covered or placed on top of foil, the distance readings reported by the receiver showed little change from the baseline distance readings. When the transmitting beacon was placed between the two layers of foil in a clamshell configuration, the distance readings showed significant impact. Placing the beacon in its holster reduced the impact of the foil clamshell somewhat, possibly due to the increased distance between the beacon antenna/circuitry and the foil.

It is harder to repeat this experiment on the receiver since the foil obscures the display in many of the configurations. A general observation was that if the foil was placed very close to the receiver, the distance readings increased in value and variability.

Based on these results, concerns such as the impact of a foil-wrapped energy bar in a pocket near a transmitting beacon are likely not significant. Most skiers will not wrap their beacons in foil, so the significant degradation with a clamshell configuration is not of practical significance. It is unclear what impact clothing with heat reflective foil layers, such as gloves, may have. This is likely mostly of concern when handling the search beacon (receiver) with such gloves.

MITIGATING INTERFERENCE

When looking at transmitter interference, all but one source of interference made almost no difference when placed within 30 cm of the transmitter. When the strongest source of interference, the operating cordless drill, was placed close to the transmitter, a normal search was not possible. Based on this, low to moderate interference does not appear to threaten the effectiveness of the transmitter. Strong interference severely impacts the effectiveness of the transmitter.

Receivers are a different beast. Searchers need to be aware of potential sources of interference and make reasonable efforts to keep them away from the receiver. Electrically heated and foil-lined gloves can easily be missed and can effectively impair a transceiver search. Electronic displays should be kept more than 30cm from the transceiver or turned off. Headlamps may be necessary for the rescue, but keep them at arm's-length from the receiver. More powerful search lights should stay out of the searcher's immediate vicinity until the transceiver search is complete. VHF Radios can be used by the searcher so long as there is some distance maintained between the radio and the receiver.

It is useful to understand how to continue a rescue with potential interference. What do we do in a rescue where interference is suspected? Our first reaction would be to check the rescuer's gloves. If they are electrically heated or foil-lined, swap them for a different pair or send a different searcher. If this is not the problem, modify the search pattern.

We tested searching with a receiver that was experiencing a moderate level of interference and found a workable solution. Moderate interference was randomly defined as a five watt VHF radio on receive, a GPS unit with an active display screen, and an LED headlamp all within 10cm of the receiver. Finding a signal on a 40m grid search was unreliable. Tightening the initial grid search to 20m did provide a consistent initial contact signal with the transmitter. Once the signal is detected, physically mark the location (with a wand or ski pole). At this point you may attempt a standard search.

Don't be surprised if the signal is lost as the direction arrows may be ineffective due to the interference. Return to the reference point (the marked spot) and estimate the best direction to proceed. Ignore the arrows on the receiver and watch the numbers on the unit. Begin a grid search until the signal becomes significantly stronger. Once you feel you have a strong signal (we found 15m or less), return to a standard search.

We also attempted to locate a transmitter with a high level of interference. We randomly defined a high level as a running cordless drill, large display screen, GPS unit with display on, and a VHF radio, all within 10cm of the transmitter. Neither a standard search pattern nor a reduced search pattern could reliably detect a signal. By applying a 5m micro-strip search to the area, we were able to locate the transmitter using only the distance numbers and a full grid search. The direction indicated by the arrows was useless. The numbers indicated on the transceiver did not reflect even an approximation of the transmitter's distance from the receiver. At one meter, the unit recorded a 4 m distance. Having said this, the smallest numbers displayed on the receiver did represent the best place to begin probing and a grid search provided an effective strategy to locate the victim. A heavily polluted signal can still provide valuable search information.

CONCLUSION

We hope that this is enough information to begin finding a meaningful understanding of avalanche transceiver interference and possible solutions in an emergency. One day at the Banff airfield is insufficient to solve the problem, but maybe it can start to show us the way forward.

For the victim, low to moderate interference near the transmitter does not appear to significantly impact a transceiver search. High levels of interference may crush the effective range of the unit and render the directional arrows on the receiver useless. This is an unlikely scenario, but is certainly possible in industrial settings and may become a growing concern with electrically heated clothing.

For the rescuers, low to moderate interference can affect the receiver, but appears to be manageable. Keep electric motors and generators well away from the searcher. Display screens and LED lights should remain more than 30cm from the receiver and only used by the searcher if it is necessary to conduct the signal search. Electrically heated and/or foil lined gloves may impair or ruin a signal search. VHF radios are not a major source of interference.

If you suspect that interference is impacting the transceiver search:

1. Tighten the initial search grid to 20m until the signal is acquired.
2. Physically mark the location where the signal is first detected.
3. From the marked location, grid search using only the numbers on the transceiver until you have a strong signal (15m or less)
4. Finish by using a normal induction search.
5. If strong interference is suspected, consider having a second searcher begin a 5m micro-strip search in likely burial locations.

Hopefully this information is useful. We look forward to seeing future research develop more effective strategies and a better understanding of transceiver interference.

ACKNOWLEDGMENT

I would like to thank Ivars Finvers for his time and expertise in this project. Guides and forecasters have a responsibility to build on the knowledge and experience given to us by our mentors. People like Ivars have no such duty to the avalanche profession. His act of kindness is greatly appreciated and directly benefits our industry. ~ Doug

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Using Tree-rings to Unravel Avalanche Frequency and Associated Climate Drivers

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Note: For those interested in the technical aspects of our research, we have recently published two scientific papers, "A regional spatiotemporal analysis of large magnitude snow avalanches using tree rings" in Natural Hazards and Earth Systems Science *(https://nhess.copernicus.org/articles/21/533/2021/); and "Climate drivers of large magnitude snow avalanche years in the U.S. northern Rocky Mountains" in* Nature Scientific Reports *(www.nature.com/articles/s41598-021-89547-z).*

UNDERSTANDING AVALANCHE RETURN intervals is critical for local and regional avalanche forecasters, transportation agencies, and land-use planners. Carefully documenting past avalanche frequency and magnitude helps us understand current and future avalanche behavior in the face of climate change. Long-term, reliable, and consistent avalanche observation records are necessary for calculating avalanche return intervals, which can be used in infrastructure planning and avalanche forecasting operations. However, such records are often sparse or non-existent in many mountainous regions. This is especially the case for large infrequent events. To overcome this issue, we can use dendrochronology, or the study of tree rings, to infer the natural (i.e. expected) avalanche frequency at different scales, from the individual path to an entire region (Fig. 1). Even in regions with historical records, tree-ring dating methods can be used to extend or validate uncertain historical avalanche records.

Trees are susceptible to damage from avalanches and they record the effects of this disturbance (Fig. 2). An avalanche may cause wounds on the trunk or branches. It can also locally destroy the growing part of the trunk, or cambium, and disrupt new cell formation. The tree then produces callus tissue, and the cambium cells overgrow the injury, forming a "scar" on the tree-ring. Other types of disturbance within tree rings from avalanches include reaction wood and traumatic resin ducts[7].

Recently, we used tree-rings to:

- reconstruct a long-term avalanche chronology in the U.S. northern Rocky Mountains in Montana;
- examine the frequency of large magnitude avalanches at the regional and individual avalanche path scales;
- identify specific seasonal climate or atmospheric circulation variables that contributed to years with large magnitude avalanche events across the U.S. northern Rockies region; and
- estimate widespread extreme avalanche cycles in Colorado (this is a new project).

We defined large magnitude avalanches as approximately size three or greater[8], which may or may not run the full length of the avalanche path. In this article, we broadly

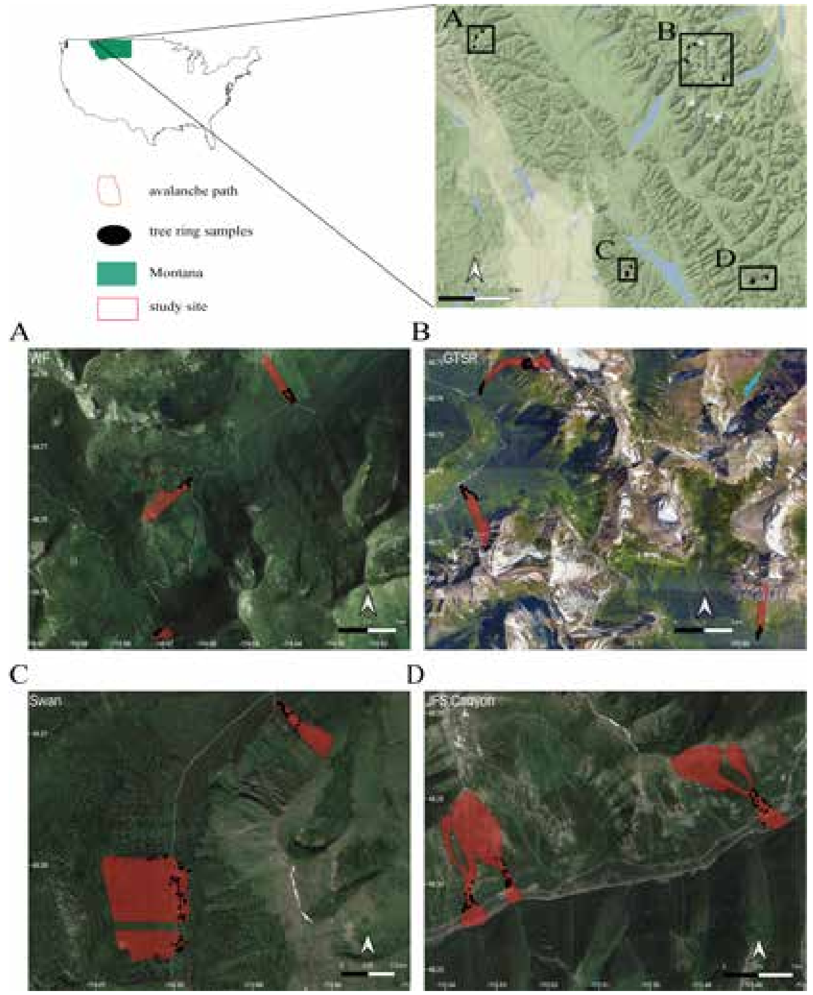

FIG. 1: STUDY SITES. THE RED RECTANGLE IN THE STATE OF MONTANA DESIGNATES THE GENERAL AREA OF THE FOUR SAMPLING SITES. THE SITES ARE: (A) RED MEADOW, WHITEFISH RANGE; (B) GOING-TO-THE-SUN ROAD, CENTRAL GLACIER NATIONAL PARK; (C) LOST JOHNNY CREEK, NORTHERN SWAN RANGE; AND (D) JOHN F. STEVENS CANYON, SOUTHERN GLACIER NATIONAL PARK. BLACK DOTS REPRESENT SAMPLE LOCATIONS AND RED POLYGONS SYMBOLIZE AVALANCHE PATHS. SATELLITE AND MAP IMAGERY: © GOOGLE MAPS[16], PRODUCED USING GGMAP IN R[17].

present our methods, highlight a few key results of our work in Montana, and discuss our objectives for ongoing work in southeast Alaska and Colorado.

CHAINSAWS, MICROSCOPES, AND STATISTICS

In each of our study areas (Montana, Alaska, and Colorado) we strategically sampled avalanche paths in distinct zones to examine how those different zones might compare to each other at a larger regional scale. Our sampling strategy[9] helps us understand the nature of the problem, the scale at which measurements should be made, and how we can estimate the measurements across space. For example, if we are interested in avalanche frequency relationships with regional climate patterns, and tree-ring samples are collected at an avalanche path scale, then a network of sampled paths needs to be spaced and aggregated across the core of the climatically similar region. An example of how this is achieved is shown in Fig. 1 for our data collection in Montana.

We targeted an even number of samples collected from trimlines on both sides of a particular avalanche path at varying elevations, as well as trees located in the lower tracks and runout zones of the selected avalanche paths. We collected samples from trees that were destroyed and transported, as well as those that remained in place. We used chainsaws and increment borers to collect three types of samples: cross-sections from dead trees, cross-sections from the dead leaders of living trees that were damaged by avalanches, and cores from living trees. We predominantly used cross-sections from trees in this study for a more robust analysis as events can potentially be missed or incorrectly identified in cores. We emphasized the selection of trees with obvious external scars and considered location, size, and potential age of tree samples.

After sanding the samples to a smooth surface, we analyzed each one in the laboratory using microscopes for signs of traumatic impact events likely caused by snow avalanches. We used a classification system from previous dendrogeomorphological studies to qualitatively rank the severity of the trauma and tree growth response from avalanche impacts. The ratings ranged from one, meaning an obvious avalanche signal, through five, meaning a weak signal (e.g. Fig. 2). This classification scheme identified more prominent avalanche damage responses with higher quality scores and allowed us to remain consistent with previous work.

We used a multi-step process to reconstruct time series of avalanche activity at three different spatial scales: individual paths, sub-regions, and the entire region (Fig. 1). This process incorporates the sample size, the number of growth disturbances, the number of trees alive in any given year, and the quality of the growth response to avalanches. We calculated the percentage of avalanche years captured in any one avalanche path compared to the avalanche years identified in the entire region. Finally, we used a variety of statistical techniques to look at relationships between long-term climate and atmospheric variables; and to identify trends in regional large magnitude avalanche activity over time.

RETURN PERIODS AND TRENDS IN AVALANCHE FREQUENCY

For our data from Montana, we analyzed 673 samples from 12 avalanche paths. We identified 30 years with large magnitude events across the region and a median return interval of about three years (from 1866-2017). Large magnitude avalanche return intervals and number of avalanche years vary throughout the smaller sub-regions, suggesting the importance of local terrain and weather factors. The probability of avalanche detection of any given path is 40%, suggesting that if we sampled only this path, we would have only captured the regional avalanche activity 40% of the time. This clearly demonstrates that a single path cannot provide a reliable regional avalanche chronology. Specifically, our results emphasize the importance of 1) sampling more paths spread throughout the region of interest; 2) collecting a large number of cross-sections relative to cores; and 3) generating a large dataset that scales to the appropriate spatial extent.

Our statistical analyses suggest specific seasonal climate and atmospheric circulation variables contribute to years with common avalanche events across the region. Maximum winter snow height (HSmax) and maximum winter snow water equivalent (SWEmax) exhibit negative trends throughout our period of record, with large magnitude avalanches occurring, on average, during years with greater HSmax and SWEmax. However, in recent decades, which are characterized by decreasing HSmax and SWEmax, we more frequently observed large magnitude avalanches associated with below average snowpacks. This suggests regional avalanche cycles can and do occur during years with below average snowpack. We know that snow structure is an important factor in avalanche release, and with a prerequisite weak layer in the snowpack, one loading event (i.e., a large storm) can initiate an avalanche. If that weak layer is deep in the snowpack, even a below average snowpack can produce a large magnitude regional avalanche event.

We also found a slight, but significant, decrease (~2% per decade, ~14% over the period of record) in the probability of large magnitude avalanche years from 1950-2017 in the U.S. northern Rockies region. Historically, large magnitude avalanche years in the region were characterized by stormy winters with above average snowpack. Over recent decades, avalanche years were increasingly influenced by warmer temperatures and a shallow snowpack, lowering the chances of a large avalanche. The decrease in HSmax and SWEmax through time corresponds directly to the estimated year-to-year and long-term decreases in avalanche probability.

FIG. 2: A TREE RING SAMPLE FROM GLACIER NATIONAL PARK, MONTANA. THE ANNOTATION SHOWS VARIOUS TYPES OF AVALANCHE SIGNALS AND ASSOCIATED QUALITY RATINGS THROUGH THE LIFESPAN OF THIS SAMPLE. THIS TREE (SAMPLE #18) IS A SUB-ALPINE FIR (ABIES LASIOCARPA) FROM THE 54-3 AVALANCHE PATH IN GLACIER NATIONAL PARK THAT WAS 96 YEARS OLD (1918-2014) WHEN IT WAS UPROOTED AND KILLED BY AN AVALANCHE IN 2014. IMAGE: D. STAHLE, USGS.

As continued climate warming drives further regional snowpack reductions, our results suggest that large avalanches associated with winters with large snowpacks may become less frequent.

Though the probability of large magnitude avalanche years decreases through time as snowpack decreases, our results indicate large magnitude avalanches can occur during years of below average snowpack. This can partially be explained by warmer temperatures, a significant predictor of large magnitude avalanche years in our dataset, causing wet storms, or rain-on-snow events triggering large magnitude avalanches. In other words, though a decreasing probability of large magnitude avalanche years corresponds to snowpack decreases, warming temperatures can contribute to large magnitude avalanche years—at least over the near-term—through different mechanisms that are perhaps compensating for the effect of snowpack losses.

Lower elevation snowpacks are projected to be more susceptible to a warming climate and exhibit greater snowpack loss[10-12], but higher elevations (i.e. above ~2,000 m) are projected to experience stable or increasing snowpack due to increased precipitation across the U.S. northern Rockies region[13]. Future precipitation projections and recent observations also indicate a smaller fraction of precipitation falling as snow, particularly at lower elevations[14,15]. These projections and observations align with our results in that a slight increase in precipitation translates to snow in many of the avalanche path starting zones, but less snow throughout the track and runout zone. The increased surface roughness at lower elevations due to the presence of vegetation is likely to decrease avalanche runout distances. The potential effect this increased roughness has on large magnitude avalanche occurrence is that large avalanches may still initiate at upper elevations but may not be able to reach lower elevations due to lack of snow cover in the lower track and runout zones.

Our analysis shows an increase in March precipitation from about 1980 to 2017. The relationship of March precipitation with avalanche probability from 1980-2017 suggests that increasing spring precipitation in the region is also a partial driver of large magnitude avalanches during low snowpack years. The influence of spring precipitation on the probability of a large magnitude avalanche year during the latter part of our time series combined with warming temperatures provides further evidence for a potentially increasing influence of wet snow avalanches. This potential increase in wet snow avalanches may also partially explain and buffer further decreases in the probability of large magnitude avalanche years through time.

In summary, as continued climate warming drives further regional snowpack reductions in the U.S. northern Rocky Mountains, our results suggest that large avalanches during winters with large snowpacks will be less frequent, and that there exists a potential for more large avalanches when temperatures warm and spring precipitation increases. These results highlight how tree-ring records can provide data on the potential scale and spatial extent of avalanches as well as the influence of climate on large magnitude avalanche frequency.

WHAT'S NEXT?

It is important to note that the impact of a changing climate on avalanche frequency, character, and magnitude is likely to be different within any given region. The rate of change in avalanche behavior is also likely to vary. For example, a potential shift from dry snow avalanches to more frequent wet snow avalanches in the maritime climate of southeast Alaska may differ from any climate induced change in the continental avalanche climate regime in Colorado.

This is precisely the reason we are currently examining long-term relationships between climate and avalanches in multiple avalanche climates. We collected approximately 500 samples around southeast Alaska in avalanche paths that directly affect parts of downtown Juneau, as well as the primary electricity supply to the city. In addition, the dramatic landscape change to many parts of Colorado after the widespread avalanche cycle in March 2019 prompted us to begin a new study there. The Colorado Avalanche Information Center (CAIC) and U.S. Forest Service Rocky Mountain Research Station staff have collected over 1,000 samples in over 15 avalanche paths thus far, with a goal of nearly 2,000 samples. This will allow us to compare long-term avalanche frequency patterns in different avalanche climates that can be used by forecasters and planners to guide decision making on infrastructure planning, resource management, and public safety in the context of climate change.

DISCLAIMER

Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

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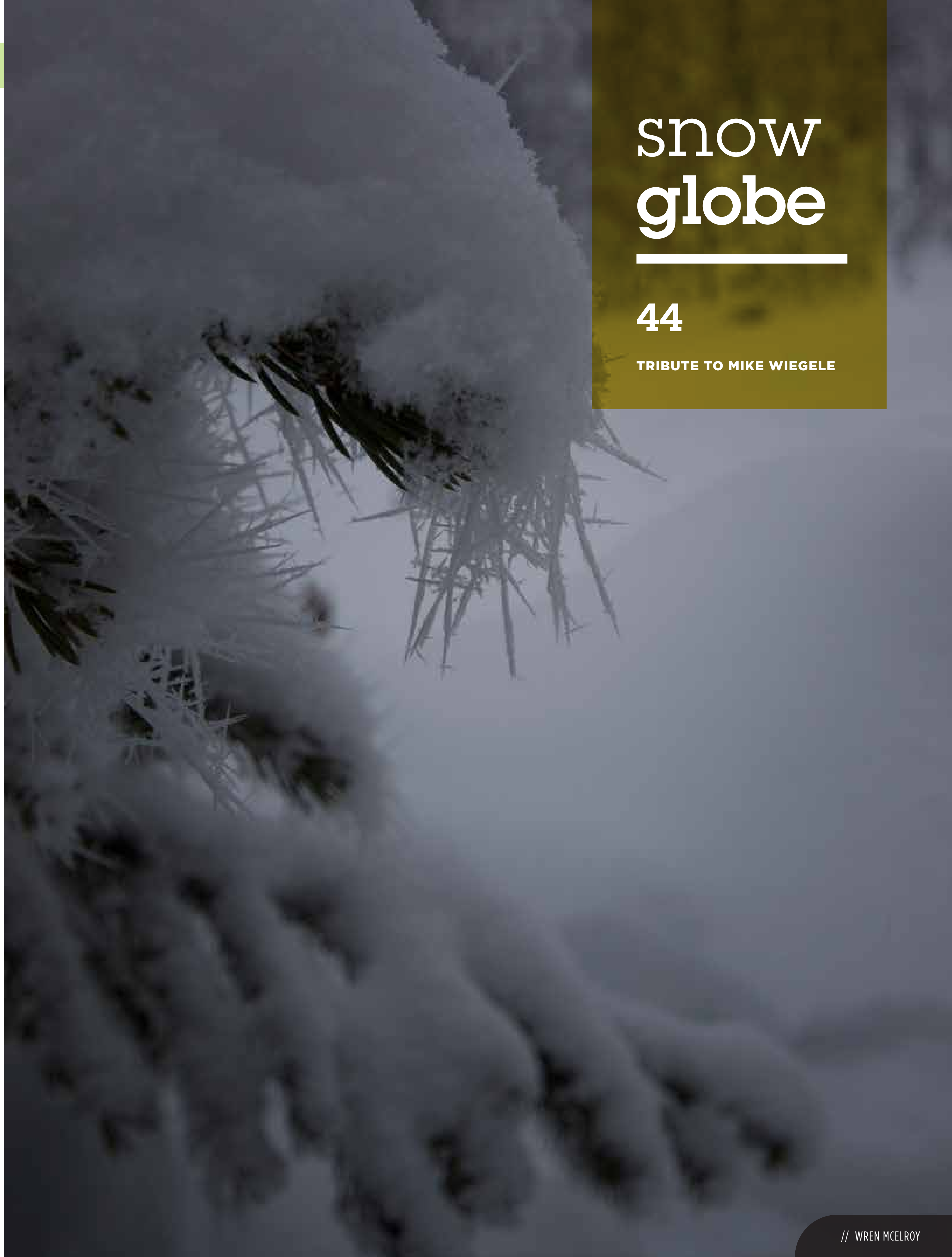

Mike Wiegele: 100% Dedication to Safety

Bob Sayer

// PHOTOS CONTRIBUTED BY MIKE WIEGELE HELICOPTER SKIING

WE ALL HAVE OUR STORIES about Mike Wiegele, some good, some bad, some funny, and some that might surprise you. Let's start with some of the things most people know.

Mike was one of the early founders of heliskiing in British Columbia, but more interesting is that he was only 30 when he started Mike Wiegele Heliskiing. By the time he was 35, he had drawn up plans for his resort and lodge that are still almost unchanged to this day.

People came from around the world to work for Mike, but did you know that in 2010 our president was a woman, our general manager was a woman, and so were our guiding operations manager, human resources manager, and marketing manager?

Mike instituted two guides per group in a Bell 212 helicopter in 1991 because of the increased customer service, increased safety, and the ability to give guides a good apprenticeship in the actual terrain. But did you know the cost of that meant the loss of one paying seat per group (10% of the revenue) and the cost of doubling the guide staff?

When the federal government cut funding to the National Research Council for avalanche research, Mike met with Colin Johnston of the University of Calgary to set up funding for research to continue. This was the start of Bruce Jamieson's long-running and excellent research, and the beginning of many of our current avalanche researchers' training. But did you know that every spring Mike invited the top researchers from around the world to come to Blue River for a week of heliskiing and sharing of ideas and information?

Mike was the first operation in Canada to welcome snowboarders to heliskiing. But did you know he started having guides on snowboards in 1993? And that he was so impressed with how much more fun the snowboarders were having that he pressed Atomic skis into designing the very first fat skis so that skiers could have as much fun as the snowboarders.

What I will remember most about Mike is his 100% dedication to safety and training. From early on, he felt he needed to change the perception of heli-skiing as being a high-risk sport. He truly believed that with enough research, education, training, and discipline you could take the risk out of heli-skiing. He was willing to put his time and money where his mouth was.

Mike worked tirelessly on his forecasting systems. He spent endlessly on avalanche research. Guides training was 10–14 days every fall and weekly training practices all season long. Every CAA Spring Conference and ISSW, Mike would rent a house or a block of hotel rooms so every guide could attend. Guides were sent to attend the International Commission for Alpine Rescue every year. Training courses and CPD for the guides were subsidized and subject matter experts were brought to Blue River constantly. He believed that the money you spent educating guides paid off double—and he was right.

The passing of Mike Wiegele brings to an end the era of the Founding Fathers of the mechanized skiing industry. Mike was truly legendary, but it's the little details of his passion for safety that will live on as his legacy.

As Mike would want us to say, "Let's go skiing!"

Mike Wiegele's **Avalanche Research Legacy**

Bruce Jamieson

AT A 1987 AVALANCHE CONFERENCE in Edmonton, Mike Wiegele approached Colin Johnston and myself. He was a legend to me. Mike was keen on starting avalanche research in his heli-skiing operation. Colin said government funding would be difficult without an industrial partner (and cash). Mike's enthusiasm for avalanche research made the ASARC program happen. Within a couple of years, the other Canadian helicopter and snowcat skiing companies–and later 22 ski areas–started to support ASARC. The program grew to include another field station at CMH Bobby Burns and then with Parks Canada at Rogers Pass.

By the time the program wound down in 2014, 25 graduate students and over 40 research technicians had done over 6,000 person-days of field measurements, shovelled over 8,000 tonnes of snow (not including shovelling to extricate stuck snowmobiles), observed over 5,000 snow profiles, and done more than 20,000 snowpack tests.

In Blue River, Mike insisted the research technicians and graduate students attend the morning guides' meetings and report their findings at the evening meeting. The technicians and graduates really had to understand the questions the guides had about the snowpack. This very practical focus meshed with my interests.

Starting around 2004, Mike would invite several international researchers to ski for a week late in the winter. They were happy to "sing for their supper" by sharing their research results with the guides. The fortunate researchers included Dave McClung, Sam Colbeck, Ian McCammon, Ross Purves, Jürg Schweizer, Colin Johnston, Karl Birkeland, Pascal Haegeli, Charles Fierz, and myself. After ASARC program wound down in 2014, Mike continued to invite researchers to ski and exchange ideas with the guides.

Many of the research technicians and graduate students have gone on to careers in guiding, managing avalanche operations, avalanche consulting, engineering and research in North America and Europe. Mike Wiegele's enthusiasm and drive for applied avalanche research have benefited so many avalanche practitioners and backcountry recreationists around the world.

MIKE IN A SNOW PIT CHECKING CONDITIONS FOR THE DAY. // JOHN SCHWIRTLICH

Flakes


Meanwhile, back at the transceiver interference test site...
RECCO
Hmm... I don't seem to be getting a clean signal in SEARCH mode...
R
L
phone
©Buchanan