the avalanche journal

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SAFETY

Canadian Pacific has a long history of operating in the mountains and we have learned some important lessons about avalanche safety along the way. Safe operations through the mountains requires constant observation, collaboration and communications between our employees and the Canadian Avalanche Centre. Together we are making the backcountry a safer place to work and play.

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Avalanche experts Gord Ohm, Jennifer Coulter and Martina Halik spend the winter gathering snowpack data and speaking to sledders and skiers about avalanche conditions in the backcountry around the Crowsnest Pass, Elk Valley and Flathead.

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South Rockies Local Observer team member Jennifer Coulter tests the snowpack for persistent weak layers that could increase avalanche danger.

Photo by Raven Eye Photography

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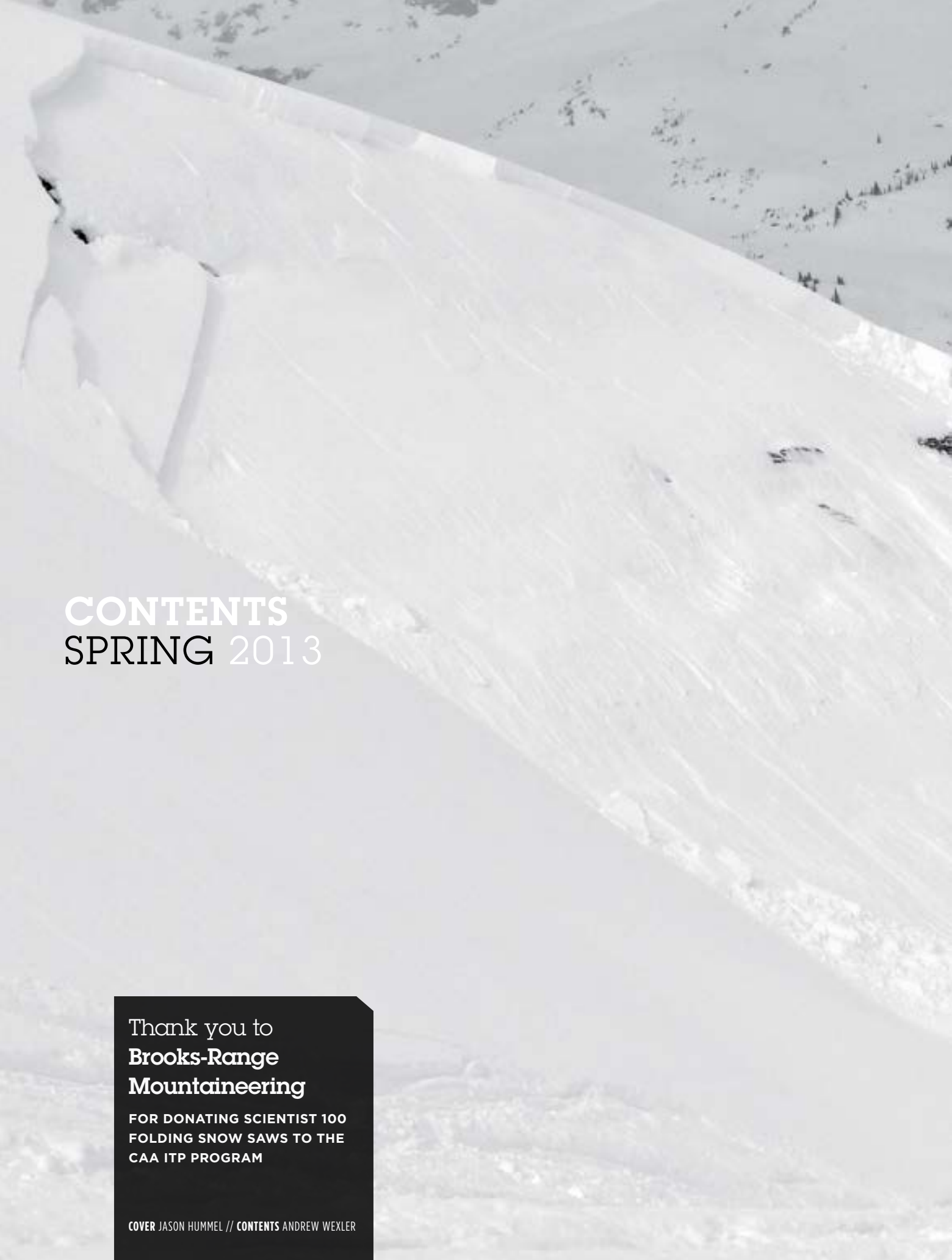

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Thank you to
Brooks-Range Mountaineering

FOR DONATING SCIENTIST 100 FOLDING SNOW SAWS TO THE CAA ITP PROGRAM

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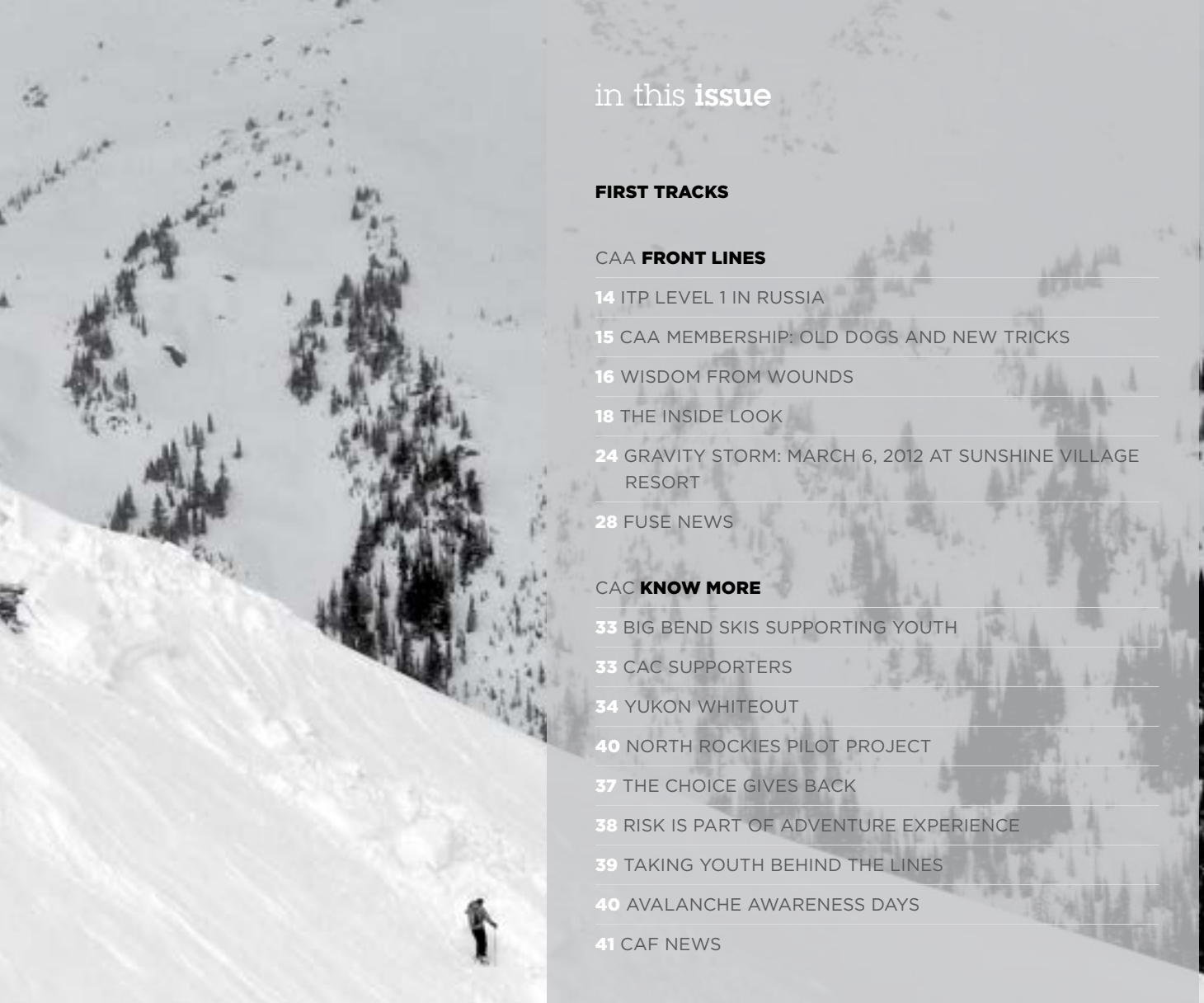

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the avalanche journal


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Karilyn Kempton
Managing Editor

I RECENTLY COMPLETED my CAA Level 1 Avalanche Operations course under the terrific tutelage of Wren McElroy, Sue Gould and Tim Ricci. Eleven of the twenty-four course participants were women—add Wren and Sue to the mix and we were nearly a 50/50 mix. It was an empowering, educational and engaging week, despite a bombproof snowpack, making for some less-than-exciting snowpack tests. One of the first things I did after completing the course was apply for my CAA Affiliate membership. It means a lot to me to be not just a CAA employee but also a member, and I look forward to more professional development opportunities within the avalanche industry. The deep sense of cooperation and camaraderie between CAA members has certainly stood out in the year and a half I have been at the helm of The Avalanche Journal. It is an honour to be a member of the CAA.

As always, we hope you enjoy reading the issue as much as we enjoy putting it together. The case study from a hectic day at Sunshine Village Resort last March is sure to make the desk-bound yearn for excitement, though the chilly report from the CAC's Yukon field team may make you shiver. Manuel Genswein's research articles on transceiver interference will undoubtedly stir up some discussion; what technology do you carry with you in the field? There are also a few pieces on risk: Jon Heshka argues that recreationists have the right to take risks, and indeed that risks are part of adventure. Krister Kristensen, Manuel Genswein and Werner Munter have written an interesting piece on perception of risk in avalanche terrain..

I hope everyone plans to attend the annual spring meetings in Penticton, May 6 - 10. It's your chance to socialize with your peers and have a say in the future of the CAA and the CAC. Find out what's been happening in the field, listen to current research, ask questions, and check out new products.

I hope that you have had a safe, fun winter season. Enjoy the off-season! Look for the next issue of The *Avalanche Journal* in September.

LEVEL 1 LADIES // TIM RICCI

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Failure Plane

In Volume 102 of *The Avalanche Journal*, we missed the BCA Tracker 2 results in "Transceiver Performance When Searching for Multiple Burials." The revised table is included below.

TABLE 2: RESULTS OF FIELD TEST AT DAVOS

	ARVA Axis	Element Barryvox	Ortovox 3+	Pieps DSP Tour	Tracker 2
NUMBER OF TEST RESULTS FOR FIRST, SECOND AND THIRD TARGET	40 / 40 / 40	40 / 40 / 36	40 / 40 / 40	40 / 40 / 40	40 / 40 / 36
TIME* FOR LOCALIZING THE FIRST TARGET (MIN:SEC)	2:00	1:45	2:00	2:00	1:30
TIME* FOR LOCALIZING THE SECOND TARGET (MIN:SEC)	5:45	3:45	4:30	6:00	4:00
TIME* FOR LOCALIZING THE THIRD TARGET (MIN:SEC)	10:00	6:00	6:15	10:00	7:00
NUMBER OF CASES WHERE THE FIRST, SECOND OR THIRD TARGET WAS NOT FOUND WITHIN THE TIME LIMIT.	0 / 5 / 18	0 / 0 / 1	0 / 1 / 12	0 / 5 / 23	2 / 2 / 11

* MEDIAN VALUES, ROUNDED TO QUARTER MINUTES.

Contributors

JEFF BOYD
Born in Australia, Jeff Boyd spent his first four years in Canada on Whistler Professional Patrol. Inspired by Hans Gmoser, Jeff became a certified mountain guide and worked at CMH for 35 years. Jeff has been the Canadian delegate to ICAR MEDCOM for ten years, heading and publishing research in avalanche and other mountain medicine in major medical journals. He is currently the navigator/strategist for offshore sailboat racing in the Pacific, and kicking sand in central Australia.
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KRISTER KRISTENSEN
Krister Kristensen is a mountain guide and senior engineer at the Natural Hazards division of the Norwegian Geotechnical Institute. He has been involved in avalanche work for the institute and in avalanche rescue since the 1970s. He lives and works in Stryn, Western Norway.
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PHOEBE MCNEALLY
Phoebe McNeally, Ph.D. is a Research Associate Professor of Geography at the University of Utah and the Director of the DIGIT Lab. Her research interests include supporting avalanche forecasting and snow science using geographic information science, geographic visualization, database design, and spatial decision support systems.
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BRUCE KIRKBY
A veteran of 18 seasons on Canada's northern rivers, Bruce Kirkby's primary interest remains human-powered journeys through remote wilderness regions—often with his young family in tow. As a *Globe and Mail* columnist, photographer and MEC Envoy, Bruce is widely recognized for connecting wild places with contemporary issues. Bruce lives in Kimberley, BC.
50 AVALANCHE ACCOUNTS: THE FINGER OF GOD

JON HESHKA
Jon Heshka is an Associate Professor in the Adventure Studies Department and Faculty of Law at Thompson Rivers University in Kamloops, BC. He formerly trained and coordinated search and rescue for the Justice Institute of BC/Ministry of Attorney General.
38 RISK IS PART OF ADVENTURE EXPERIENCE

STEVE CROWE
Steve Crowe has been a patroller at Kicking Horse ever since he figured out he likes seriously tilted mountains. He doesn't like that those tilts can cause avalanches, but appreciates the equal draw gravity has on all things. He is also a teacher, bike park builder, writer and videographer for Briefly 7 Productions, and he creates the skiinggolden.com snow condition updates.
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front lines

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// WREN MCELROY

CAA President's Message

ONE OF THE DUTIES OF THE CAA BOARD OF DIRECTORS IS TO ENSURE APPLICATION PROCESSES, OBLIGATIONS, AND BENEFITS OF ALL MEMBERSHIP CATEGORIES ARE CLEAR. THE FOLLOWING FOCUSES ON THE QUALIFIED AVALANCHE PLANNER, BUT IS OF INTEREST TO ALL PRACTICING MEMBERS.

Robb Andersen
CAA President

OVER THE PAST SEVERAL MONTHS, the Board, Professional Practices Committee (ProCom) and Executive Director Joe Obad have investigated and evaluated the position WSBC has taken on Occupational Health and Safety Regulation 4.1.1, and the challenges that has created for administering the Qualified Avalanche Planner application process. Essentially, 4.1.1 states the need fro an Avalanche Safety Plan to be reviewed or approved by a QAP.

The CAA and others have in good faith used the term suspension to describe the current status of OHSR 4.1.1. The flaw in this interpretation is not in the use of the word but the connotation that suspension is temporary. In a departure from the official guideline to 4.1.1, WSBC senior officials have indicated to the CAA that they don't plan to enforce 4.1.1 in its current form, so its disuse is, by all indications, not temporary.

The CAA has pushed WSBC to further define the guidance document to OHSR 4.1.1, given that WSBC's timelines for reviewing the regulation continue to be delayed. We have argued that the guidance document and the WSBC's decision not to enforce 4.1.1 have degrees of ambiguity that would best be clarified given the delay in the public review of 4.1.1, which will not be completed until 2015.

In light of these findings, the CAA has a duty to give its members its best assessment of the context in which members of all categories are operating. In the winter issue of the journal, ProCom chair Doug Wilson reminded members of burdens on employers with 4.1.1 suspended. OHSR 4.1 still applies: *A workplace must be planned, constructed, used and maintained to protect from danger any person working at the workplace.* Such a plan for avalanche hazard is, in our view, much the same as an avalanche safety plan under 4.1.1. We support the concept of the avalanche safety plan, and encourage the use of this term going forward with or without 4.1.1.

Regarding who can review or approve such plans, WSBC's guideline to 4.1.1's non-enforcement points again to 4.1: *Employers should rely on qualified persons—those knowledgeable of the work, the hazards involved and the means to control the hazards, by reason of education, training, experience or a combination thereof – in the identification and control of avalanche risks.* This definition does not limit employers to choosing a Qualified Avalanche Planner.

WSBC enforcement is one matter. However, the CAA was concerned there were implications for civil liabilities with 4.1.1 still legally active, but not enforced. That is, could plaintiffs in a civil court case seek damages from a CAA member who had reviewed or approved an avalanche safety plan relative to the member not being a QAP, as called for by 4.1.1?

Legal advice provided to the CAA focused on three key aspects: OHSR's focus on employers; the limits of OHSR enforcement; and the burden of diligence. First, note that OHSR legislation places burdens directly on employers, not CAA members. None of the provisions of OHSR Regulation 4.1.1 impose a legal duty on workers, CAA members, or others who are not employers. As to who can enforce this burden, the provisions of OHSR set out under the Act in Division 11 "Inspections, Investigations and Inquiries" makes it clear only WSBC officers can enforce the act.

Lastly, there is the core matter of diligence. Our legal advice makes it clear that an employer's duty is to have a competent safety plan for avalanche hazard. The opinion concludes that if a CAA member had acted incompetently when reviewing, preparing or approving an ASP, the Court would likely want to know what sorts of standards of practice were typical or commonly employed by others who provide the same sort of service. *In the opinion of our legal advisor, whether or not the member was in fact a QAP would not be the determining factor in*

assessing the diligence or negligence of an individual facing such a claim.

So where does this leave CAA members? Our Code of Ethics remains relevant to WSBC's current position relying on OHSR 4.1. Section 3a of the Code of Ethics states "A Member of the Canadian Avalanche Association will undertake only those assignments for which he is qualified by experience." The ongoing work of the ProCom to define our scope of practice and standards will eventually provide significant guidance to help members determine what they are qualified for. However, until this work is completed each CAA member must engage in rigorous self-assessment to determine if his or her skills, training and experience qualifies him or her for the work in question. This applies across all membership categories.

The investment of the CAA and our members has been significant in attempting to effectively respond to WSBC's requirements. These recent developments are no doubt very frustrating, but at every turn the CAA has acted in good faith with its membership and will continue to do so.

The ProCom will work with the membership to define professional standards and scope of practice for members to apply to their individual scope of work. This process will support individual members' needs and empower members to diligently chart the course of their careers. Members who have put in the work to become QAPs should not be despondent. The process to become a QAP (including the Level 3 course) provides an excellent foundation for members to demonstrate their competencies as the qualified persons relative to regulators in all jurisdictions.

The board and the ProCom look forward to engaging members as the CAA moves toward professional standards and scope of practice that secure the confidence of Canadians and give members increased confidence in working with employers, regulators and the public.

Robb Andersen, CAA President

CAA Executive Director's Report

PROFESSIONAL ORGANIZATIONS IN CANADA—THERE ARE NO SHORTCUTS.

Joe Obad
CAA Executive Director

PRESIDENT ROBB ANDERSEN'S piece in this issue outlines many of the challenges the CAA has faced as a self-regulating professional organization in working with WorkSafeBC. As the CAA and its members forge ahead developing a scope of practice and professional standards, it is worth looking at the landscape of Canadian professional organizations.

What follows is not a critique of the work that has been done. CAA boards, committee members and staff have risen to the challenges presented by each era of the organization's history. As the burden of 4.1.1 recedes, new challenges lie ahead. Various committees, the Board of Directors and engaged members are already stepping up to lay the foundations for defining the CAA's commitment to society, and the means by which we'll keep it. I look forward to supporting members in the dialogue required to move ahead. In this spirit, I offer a few considerations.

Governments tend to regulate occupations where there is significant risk to the public interest. The aviation industry, for instance, is subject to heavy, direct regulation from Transport Canada at both the corporate and worker level. In other cases, governments support self-regulation where the societal benefits of off-loading regulation to professional self-regulating organizations outweigh the risks associated with reducing government control.

The realm of professional avalanche work is an obvious candidate for regulation, but how much, and of what nature? The CAA is at a juncture where governments allow latitude to CAA members based on their expertise but, with exception of 4.1.1, have taken few steps to endorse the CAA's self-regulation. This is not unexpected given the CAA is at still in early stages its journey of professionalism compared to other established professions.

In the typical model, the government allows a professional organization to self-regulate where clear commitments are in place for the organization to meet specific public interest needs. This exchange should be well thought out, where members of the organization and the government fully understand the nature of the shared commitment.

How much self-control should this entail? What does each party expect from the other in this contract? How does society benefit? These are serious questions that are typically sorted out over years. In some ways, WSBC's 4.1.1 offered limited aspects of what many professional organizations seek—right to title and right to practice. However, these benefits came out in ways that have serious flaws.

For instance, the title Qualified Avalanche Planner and legal right to review and approve Avalanche Safety Plans applied to some members, but what of our other hundreds of Professional members? And the hundreds of Active and Affiliate members? The feedback from many members is that the benefits of the CAA's professional journey should apply broadly to the membership. Indeed, the QAP journey to a certain degree drew the attention of the board, several committees, and the Executive Director away from a balanced approach that serves all members.

The CAA also needs to engage in dialogue with the society we serve. While 4.1.1 put CAA QAPs on par with professionals from forestry and engineering, it did not provide room for dialogue between the CAA and Canadians. In the past several months, as I have supported the board's work on our next strategic plan, close attention has been paid to how our mission statement could function as a promise to Canada relative to the commitments CAA members make as avalanche workers, and the expectations Canadians should have of CAA members.

The framework of the strategic plan supports the development of elements that self-regulating organizations require to make such a commitment. For instance, ensuring our conduct review process is appropriately robust, and ensuring our by-laws clearly define member rights and responsibilities.

As ever, success has many parents. The board and committees tasked with this work need your perspective to set the CAA up for future success. In addition to the formal opportunities to come on these matters, your input is welcome directly to the board or me. There are no shortcuts on the journey ahead, and we'll only get there by working together.

Joe Obad, CAA Executive Director

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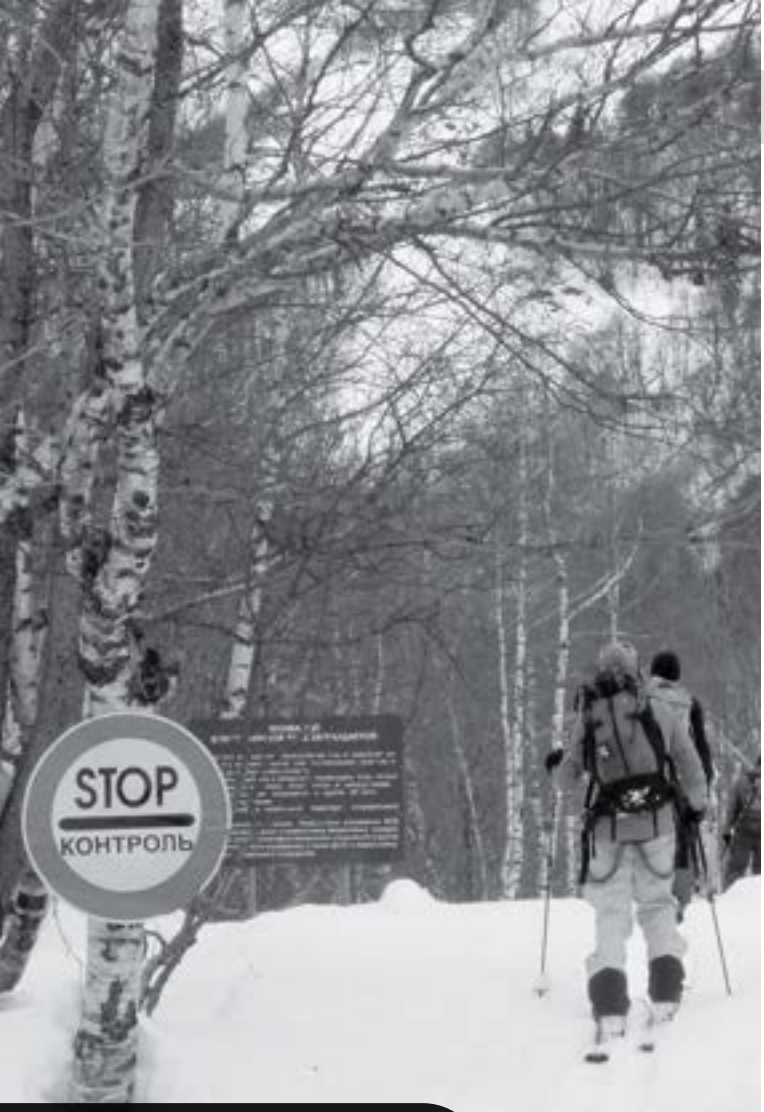


GEORGIA BORDER CONTROL CROSSING // BRAD WHITE

Russian ITP Level 1

Brad White

IT WAS DARK when we piled out of our four-wheel-drive "ambulances" at the camp near Dombay, Russia where we were to spend the next 12 days teaching a CAA Avalanche Operations Level 1 course and an ACMG Introduction to Ski Touring course for the fledgling Russian Mountain Guides Association (RMGA). Fellow instructor Marc Piché looked up: "hmm, it looks a little bit steep."

The Dombay Camp is situated in a side valley of the main Caucasus, about 100km west of Mt. Elbrus. An older student who had done a ski traverse of the Caucasus Mountains in spring conditions years earlier suggested the training venue, recalling good ski touring potential in the area.

Daylight proved Marc right; the steep, glacier-covered mountain faces of the Western Caucasus towered 2,000m above the v-shaped valley floor to the rugged, 4000m summits. Vegetation on the lower valley walls consisted mainly of impenetrable birch thickets with a few patches of large mature conifers or very steep grass-covered openings.

The lower snowpack was weak with a couple of buried rain crusts surrounded by facets. A recent storm had nearly doubled the total snowpack, but it was still only about one metre. There were glide cracks and glide avalanches on most of the steep, grassy, lower elevation slopes and evidence of a widespread avalanche cycle in the alpine, likely failing on the facet/crust layers. The good news was that at least we had some avalanche activity and some interesting layers and crystal types to look at; the bad news was there was literally almost no place where it was possible to travel.

The camp itself was an old mountaineering centre from the communist era, renovated to a strange mix of hostel-type accommodations and ski area. There were a few handle tow lifts on the lower angle slopes near the buildings, and visitors came up the five kilometre 4x4 track from the town of Dombay and rented skis to learn. Meals were prepared in the communal dining area/classroom by the chain-smoking cook; they consisted mainly of boiled eggs, stale bread and plastic-covered hot dogs that sometimes had ketchup already inside. On a positive note, next to the main building there was a bar with a 14' pool table (15 white balls and one black), wireless Internet, alternative meals and reasonably priced beer.

The students were a diverse group with varying levels of experience. Some were heli-ski guides from Kamchatka with lots of winter travel miles, while others were mountaineers just learning to ski, or freeriders with lots of downhill skills but very little uphill experience. Most could speak some English, but we also had a full-time interpreter, Fedor, who translated all the lectures and had done the yeoman's task of translating all of the Level 1 materials into Russian. The students were dedicated and keen to learn, and took whatever twists the terrain and travel logistics threw at them with equanimity. The RMGA has enlisted the help of the ACMG and the CAA in their bid to become a certified UIAGM guiding association, and this course is one of several that are being held to achieve this goal.

Between alternating groups to the same location, and organizing a day trip to the ski resort above Dombay, we were just able to fulfill the requirements for the courses and one day even managed to link a few turns together. The relationship between the Russians and Canadians is strongthening, so the future will likely hold more of these courses with opportunities for Canadian instructors. However, they will not be held at the Dombay Camp so you may miss out on the ketchup-filled hot dogs!

CAA Membership: **Old** Dogs and **New** Tricks

TWO YEARS AGO I MADE THE SWITCH FROM CAA AFFILIATE TO ACTIVE MEMBER. I ACQUIRED MY AFFILIATE MEMBERSHIP AFTER BEING A MEMBER IN GOOD STANDING OF THE ASSOCIATION OF BC FOREST PROFESSIONALS, CARDA, THE SKEENA VALLEY SNOWMOBILE ASSOCIATION AND THE BC WILDLIFE FEDERATION FOR MANY YEARS.

HOW WAS MY FIRST CAA Affiliate membership initiated? Years ago, CARDA executive members Anton Horvath and Kyle Hale requested that all CARDA members consider supporting the CAA through Affiliate membership. The light bulb lit up and I started my relationship with the CAA.

It has been more than 15 years since I entered the CARDA world. Since that time, the continuous efforts to standardize and grow CARDA have led to significant recognition of the professionalism of this volunteer winter mountain rescue organization. Benefits of membership include the comprehensive developmental training environment. I have seen firsthand the organization earn recognition as a gold standard for avalanche dog teams in North America. The CAA has similarly striven for standardization, training and professionalization in the avalanche industry.

For many years, I have been committed to search and rescue in BC. I subsequently got involved with avalanche safety education with a focus on sledders—teaching requires that I stay current and up-to-date on the subject matter, and to seek self-improvement. This led to the completion of my CAA Avalanche Operations Level 2, a wonderful experience.

With my Level 2 came a sense of responsibility to acquire recognized accreditation as a CAA Active member, and subsequently my AST Provider status to connect to a larger student market. As a cross-discipline opportunity years ago, I completed the Advanced Avalanche Mapping course provided by the CAA, and to this day I get great satisfaction in applying the skills learned—and spending time in the outdoors.

Through my more than 20-year career with the BC Forest Service, I have continuously been involved with matters of land use decisions and have interacted with many passionate and dedicated local area user groups. The concerns or interests expressed from an organization or society representing a diverse membership with common interests, such as the CAA, should never, ever be under-valued.

Unified voices can and do make a difference. Member organizations continuously seek to improve what they offer their members—be it membership benefits, developmental opportunities or recognition/value for the great big world out there to consider before hiring you. It matters. I never thought I'd put this in writing, but Anton and Kyle were right.

Are you passionate about the avalanche safety industry? Are you a CAA member? Have you considered applying for a new membership category?

Scott Hicks is the Director for Active Members

Wisdom from Wounds

Steve Crowe

ERIC BROGNO TRANSPORTED OVER MOUNT TUPPER // BRAD LORRIMAN

"ON THE MORNING OF DECEMBER 1, 2011, A GROUP OF SKIERS AND SNOWBOARDERS ARRIVED AT ROGERS PASS IN BC'S GLACIER NATIONAL PARK. FOUR OF THEM WERE SNOW PROFESSIONALS. THEIR OBJECTIVE WAS THE GRIZZLY COULOIR, A LARGE DESCENT FROM A PROMINENT PEAK ABOVE THE HIGHWAY. THE TRIP DID NOT GO WELL."

SO BEGINS THE FILM *Wisdom From Wounds*. Mere days after surviving a punishing avalanche, our three patroller colleagues debriefed us on what had happened and I knew there were two powerful things going on. The third presented itself later.

As Eric Brogno, Mark Herbison and Brad Lorriman gave a sobering presentation, I was first struck by their courage in dressing themselves down for the mistakes they made. They shared hard-earned knowledge at the expense of their pride. The room was rapt.

Secondly, I found myself listening to and seeing absorbing human drama. These guys had just tumbled down a bloody great mountain. Because Brad had the instinct to capture images, the story was that much more compelling.

On a personal level, I had been scratching around for a story to film. Most of my experience has been creating action sport and tourism promo porn, so I was curious about whether I could pull off a longer story with substance. As I watched the presentation, I thought a much larger audience could benefit from their message, and I wanted to organize its telling.

Now would they be interested in telling their story to a camera? I approached the guys, including Andrew Jones, their close friend who participated in the rescue. Despite for the most part being publicly reserved people, they agreed to participate, perhaps due to understanding more than anyone the significance of the event, or perhaps because I said I would buy beer if the film made it into the Banff Mountain Film Festival.

The third powerful component formed when I sought supporters for the film. After conversations with Mary Clayton of the CAA and CAC, I recognized the excellent opportunity for professional development for avalanche workers. Certainly the general backcountry-skiing public can benefit from lessons learned, but I believe the greater advantage is letting fellow professionals see that it is okay to talk about catastrophes, accidents and near misses. These guys have drawn aside the veil of silence that has hidden the mistakes of professionals, hopefully for good as more pros freely discuss their own experiences for the greater benefit of everyone in the industry.

This generation's newfound willingness to discuss errors must be at least partially attributed to the influence of CAA Avalanche Operations Level 2 Module 1, where the importance of effective communication is emphasized. It is ironic that the film's greatest strength is the event's greatest weakness—their mistakes can be summarized as lack of communication, yet by communicating lessons learned, they demonstrate active learning. They redeem themselves and advance us all.

Luckily, the film wasn't accepted into Banff, so I didn't have to buy any beer. Regardless, it has been shown at CAC workshops in Revelstoke and Calgary, is playing at the Rogers Pass Discovery Centre, and has had over 9,000 views on YouTube. A number of people have commented about being affected by the story and impressed by the character and courage shown. It was an honour to be allowed to share their experience with the world, and a pleasure to animate the narrative. It is certainly the most interesting and engrossing film endeavour I have undertaken.

So why were the guys laughing near the film's end when they toured back up to the incident site in the spring? I asked them to skin past the camera from directly behind and continue up slope, normally done single file. They thought it would be more fun to mess with me, and each chose his own path. Survivor humour—they thought they were hilarious.

To view the film online, search "Wisdom from Wounds" in YouTube.

THE INSIDE LOOK

Northwest Avalanche Program

BY THE NUMBERS

NUMBER OF PEOPLE ON THE AVALANCHE CONTROL TEAM: 3

AVALANCHE CONTROL METHODS: Hand charging, heli bombing

MOST USED CONTROL METHOD: Hand charges

APPROXIMATE NUMBER OF AVALANCHE PATHS IN CONTROL AREA: 103

NUMBER OF FORECAST AREAS: 14 avalanche areas / 7 highways

AVERAGE HIGHWAY CLOSURES: 25 hours

AVERAGE LENGTH OF CONTROL SEASON: Mid November to mid May

AVERAGE SNOWFALL PER SEASON: 1300cm

HOW BIG ARE THE AVALANCHES: Up to size 4.5

MOST SIGNIFICANT AVALANCHE: North Route Cafe, January 22, 1974, size 4.0

TOTAL HIGHWAY MILEAGE: 1350km

NORTH WEST AVALANCHE CREW R TO L: SCOTT GARVIN, JASON VERHAGE, STEVE BRUSHEY AND BREE KOROBANIK // MOTI

BETWEEN TERRACE AND PRINCE RUPERT in northwestern BC, Highway 16W winds through the Coast Mountains toward the Pacific Ocean, following the north side of the Skeena River. Prone to significant precipitation events and avalanche activity, numerous avalanche paths shape the landscape. The highway was built through to Prince Rupert in the 1940s and in 1943, three people were killed and several injured by avalanches at a camp built at Mclean Point. On January 22, 1974, a snowstorm stranded people at North Route Café, 45km west of Terrace. In the early morning hours, an avalanche hit the café, resulting in seven fatalities. A government sanctioned Avalanche Task Force was created and provided 16 recommendations to manage the risk associated with avalanches. The Northwest Avalanche Program was formed and in place for the following winter. Ningunsaw Pass was also added to the program at this time.

The forecast area has grown steadily. Telegraph Creek and Highway 51 were included in January 1989, after an avalanche struck several houses in the town of Telegraph Creek, resulting in one fatality. During the same time period, several large avalanches in Ningunsaw Pass—both natural and controlled—resulted in a ten-day Highway 37N closure while nine cats worked to open the road. Man-made cut slopes north of Dease Lake on Highway 37N were added a few years later after a grader triggered an avalanche that nearly pushed it into the Dease River. The Doris Lake avalanche path 50km north of Smithers was added because of a similar problem. With the 1998 Nisga' Treaty signing, a new highway from Greenville to Kincolith affected by 17 avalanche paths was constructed.

One avalanche technician was initially responsible for the NW Program, but an increase in traffic volume and expansion of the area led to more hires. Mike Zylich, Nic Seaton, Al Evenchick, Allan Dennis and Tony Moore provided leadership from inception. Various auxiliary personnel including Kevin Christakos, Al Munro, Johann Slam and Steve Brushey supported most technicians. Today the NW Program benefits from a rich, well-documented historical database complimented by successful mentorship opportunities over its 39-year history. Two full time technicians are employed year round and one auxiliary full time technician works from mid-October to May. Steve Brushey, Scott Garvin, and Bree Korobanik are responsible for seven highways making up 14 avalanche areas from Highway 16 Kitwanga to Prince Rupert; Highway 113 Greenville to Kincolith; Highway 37N which includes Ningunsaw Pass, Dease Lake, Good Hope Lake and Cassiar Access; Highway 51 to Telegraph Creek; and Babine Lake Road north of Smithers.

Over the years various CARDA dog handlers filled various full time and auxiliary positions: Johann Slam and Bene, Shelly Hicks and Kelsey, and this winter Bree Korobanik joined with her dog Aurora. Typically, CARDA handlers have been provided support in some capacity for CARDA training. Each dog is recognized as part of the MoTI team. At times, site safety is provided for Emergency Management of British Columbia personnel who also benefit from having a qualified handler and dog as part of the NW Program.

Through the winter months, we provide 24/7 coverage. Active forecasting generally starts up in early November until early May. During the non-avalanche season, two full time employees work on projects that may include assisting with weather station installation, trail brushing, mitigation work or updating various plans or procedures. All personnel are at the helm by mid-October to spend a month on pre-winter preparedness. In general, all pre-winter meetings are covered off first with the maintenance contractors and various stakeholders. Annual avalanche training begins shortly thereafter for all contractor personnel.

A typical day starts at 07:00 and ends at 16:30. The first hour and a half is usually spent analyzing weather forecasts, weather data, satellite imagery, InfoEx, contacting various road foremen, and the generating avalanche hazard forecasts. During busy periods, weather data is analyzed around the clock and up to 14 forecast areas may need to be monitored. Once hazard forecasts have been completed a plan for the day is established. Given the size of the forecast area, plans are flexible, allowing for modification as conditions change. No one day is like the other, which is a direct result of the weather which affects various forecast areas. It is not uncommon to be doing avalanche control on Highway 16 in the morning then be on your way to Ningunsaw Pass 350km away in the afternoon.

There is now permanent accommodation at Bob Quinn, 425km north of Terrace on Highway 37N. During busy periods in both Skeena and Stikine areas, personnel are strategically stationed in Bob Quinn to manage the Stikine forecast area. In the event of a road closure in Ningunsaw Pass, the crew still has the flexibility and mobility to deal with any concerns in the Stikine area. As required, a considerable amount of time can be spent in Dease Lake, which decreases travel distance to both Telegraph and Cassiar areas.

Since 1974, traffic volumes have slowly increased through all areas. The biggest increase is on Highway 37N, where several large industrial projects in the Bob Quinn/Iskut area are taking place and any highway delays can have a significant impact on stakeholders. Proactive avalanche control, regular weather station maintenance, updated snowpack data, and trained maintenance personnel all contribute to meeting the Ministry mandate of reduced closure time.

There are no permanent avalanche structures or remote avalanche control devices in place in any of the forecast areas. All avalanche control done is either by helicopter or roadside case charging. Up to 28,000 kg of explosives can be used on a busy year and as low as 4,000kg on a quiet year. Explosive magazines are strategically placed through the forecast areas in order to reduce the transportation of explosives.

The most problematic forecast area is 35 Mile, located 56.4km

STEVE BRUSHEY OUT IN THE OFFICE AT CASSIAR // MOTI

west of Terrace on Highway 16. It is a 460m sloping rock face that contains several small start zones feeding three separate tracks: East Bluff, Mid-Chutes and West Gully. This area is responsible for 75% of closure time on Highway 16. At the East Bluff, the highway turns a corner and is constricted between the railway on one side and the rock face on the other creating poor sight lines. Almost all avalanches affect the highway here. Depending on several variables, a 20cm snowfall can begin to elevate the avalanche hazard. Several plans have been discussed to help mitigate the problem, but there has been no firm solution yet. At this time helicopter bombing is the only active control method. To further compound the challenge, icefall is problematic as well.

The geographic area has coastal, transitional and continental snowpacks. Fieldwork is important to monitor changes, as site visits may be infrequent through the forecast areas. Prior to starting fieldwork, a comprehensive pre-trip plan analyzes work objectives, weather, snowpack, terrain, human factors and travel methods. Once completed, check-in procedures are started with the Provincial Highways Conditions Centre, which provides a primary contact in the event of a missed check-in. An up-to-date backcountry atlas is kept at PHCC that documents each fieldwork site that may be visited throughout the winter period. Key study plots have been maintained in each forecast area, providing a historical perspective that is valuable when looking for possible trends and avalanche events. Snowpack observations are done in non-standard locations in order to better determine spatial variability.

Environmental Electronic Technicians Paul Hadfield and Jason Verhage manage 30 automated weather stations and support an extensive frost probe network. The various automated weather stations provide the ability to maintain a watchful eye over a large geographic area. When nightfall or stormy conditions prevail, the importance of a well-maintained system of weather stations is readily apparent. Weather stations offer IFR (Instrument Forecasting Reference) when VFR (Visual Forecasting Reference) is not available due to nightfall or no personnel in the area. These same stations are used in combination to confirm weather forecasts, forecast models and satellite imagery for real time reference. Highway level webcams also contribute to the information base and are proving to be an extremely valuable tool.

The maintenance contractor acts as the eyes and ears when avalanche technicians are not in the area. Various equipment operators provide occurrence and weather observations, play an important role when closing highways for preventative or avalanche control closures, and provide avalanche rescue capability. All maintenance contractor personnel who operate in avalanche areas are required to take annual avalanche training and participate in yearly mock rescues. Eight avalanche rescue caches are located throughout the area at various maintenance hubs, and are inspected twice per year.

Challenges arise when several forecast areas experience rising hazard levels that may lead to a road closures. These areas receive the highest priorities and crews are dispatched accordingly. Dedicated A-Star B2 or Bell 407 helicopter charters are located in Terrace, Smithers and Dease Lake. Recently, qualified pilots undergo a half-day avalanche training program to better familiarize themselves with the NW Avalanche Program.

Success is contingent upon staying ahead of the many variables that come with a large geographic region. Experience pays off when it comes to understanding the nuances that can lead to a rising avalanche hazard for a given area. Whether it is a high elevation wind event in Cassiar, a rapid temperature rise in Telegraph Creek, a sudden increase in snowfall rates at 35 Mile, or outflow winds at McLean Point, each area has important criteria that technicians monitor. Adding to the list is maintenance contractor shift rotations, staffing numbers and traffic patterns, all of which contribute to the challenge. Technicians are better prepared to risk manage a large forecast area through proactive avalanche control. It isn't always possible to follow this strategy, but whenever a PWL is buried avalanche control is a primary consideration.

Highways are open 24 hours a day, which means working around the clock as required. At such time, avalanche personnel keep in close contact with road crews, patrol key avalanche areas and advise the Provincial Highways Condition Centre in Burnaby, BC of changes in avalanche forecast levels. On a stormy night, it can be reassuring to speak to one of the several operators at PHCC as they issue an avalanche forecast on your behalf. Unlike some industrial operations, MoTI Snow Avalanche Programs have no control of the whereabouts of the general public on the highway nor is there a means to communicate with them. Posting a High Avalanche Hazard and closing the highway is a tool to risk manage those situations when numerous small or a large avalanche are expected to reach the highway and avalanche control is not possible.

Working in public safety for a risk-adverse employer who demands a high level of accountability and transparency has its challenges, however the rewards and job satisfaction remain high. Whether it is keeping the road open to the town of Telegraph Creek, minimizing road closures to a non-profit ski hill, keeping the ore trucks on schedule from the Yukon, allowing transport trucks to carry their goods to the Port of Prince Rupert or keeping the general public safe on the highway, the NW Avalanche Program enjoys the challenge each winter brings.

35 MILE // MOTI

HIGHWAY 16W 1979 // MOTI

SIZE 3.5 NINGUNSAW PASS 2009 // MOTI

BOURGEAU 7 AVALANCHE DEBRIS WITH MATURE TIMBER IN THE MIX. SNOWCATS AND A LOADER WORKING ON THE CLEANUP. // SUNSHINE SKI PATROL

Gravity Storm: March 6, 2012 at Sunshine Village Resort

Brendan Martland

DISCLAIMER: THE FOLLOWING IS A TRUE—AND ENTERTAINING—STORY. THE TIMELINE IS ACCURATE TO WITHIN FIVE MINUTES.

UNSAFE WORK PRACTICES involving explosives occurred, but all necessary training was performed and documented before the event, and an in-house safety investigation occurred afterward, including meeting with the explosives supplier. I chose to include this part of the story as it acts as a reminder to us all to not ever assume too much, and, perhaps more importantly, provides the punchline.

Last winter in the Rockies was rather eventful Sunshine Village Resort broke its known March snowfall record (298cm), and the total season snowfall record on March 26 (passing 908cm set during 1989-90 to finish at 1047cm by closing day). The dense storm snow that arrived in early March fell on a relatively average continental snowpack: a weak base of facets and depth hoar; a midpack hovering around the 1F- resistance range; and a huge amount of spatial variability due to numerous wind events from all quadrants. The Valentine's Day surface hoar layer stood tall and strong at 10-20mm in all sheltered areas.

The storm began the night of March 2, delivering 27cm (14mm water equivalency) overnight. This low density snow (53kg/m^3) is what usually falls for us in midwinter, and we have to keep a close eye on the trickle-loading. The March 4 HN24 was 34cm and much more dense (90kg/m^3), with increasing westerly winds at perfect loading values. March 5 read 30cm at 77kg/m^3 with strong SW winds, and March 6 saw another 27cm at 95.2kg/m^3. By the day in question we had received close to our monthly average of snowfall in four days—118cm at 93.4mm. As you can imagine, things started getting interesting at this point.

Operationally, we were in lock-down mode for much of this storm. With visibility close to zero in the alpine and the reload of previously-controlled terrain difficult to keep up with, we chose to close harder-to-manage areas and concentrate on the "meat and potatoes" and lower elevation terrain. On March 5, the lifts accessing the alpine were closed due to high winds. Uncertainty grew daily, especially because we were receiving twice as much precipitation as the models and tables were forecasting, and nearly twice as much as our neighbours were reporting. As soon as the storm ended, we planned to rent a helicopter and get back on top of everything.

The storm ended on a Tuesday, which would usually make for a relatively quiet day at the hill, but the highway was closed to the west and the backcountry danger rating was High—we got a lot of hard-charging skiers hungry for deep powder. We knew it would be a wild day, so we talked about sticking to the rules and only opening terrain when we were

happy with the avalanche danger within.

Our morning snow safety meeting was busy. What are we expecting? How do we approach this problem safely? All the helicopters in the Bow Valley fit for heli-bombing were accounted for, but I had arranged to jump into the Parks Canada Visitor Safety team's machine after they heli-bombed our access road paths in the early afternoon; we could at least drop a handful of shots on key targets. The avalanche control team headed out to different areas first thing to start stabilization efforts.

I went to the Shoulder with a keen rookie ski patroller, packing four one-kilogram emulsion explosives charges, all primed with the standard one metre safety fuse assembly. One charge was essentially a spare, in case we didn't get the results we wanted on the route down the ridgeline. The Shoulder has two Mastex systems: metal booms that are swung out over a cornice-line with several steep gullies that threaten the run below. Our third shot was tied to the lower mast and everything was going well with the run and the results. I verbalized all actions: "pull-wire on; safety off; three, two one, pull …" I watched the smoke puff out the end of the fuse and waited until the pull-wire drooped on the end before confirming, "we have a burn."

We swung the boom out to get the airblast we wanted, and then…nothing. We informed dispatch of the misfire and kept the guard in place at the entrance, staying put ourselves with the spare shot to take care of the dud after the requisite one-hour wait. Luckily the Mastex system allowed us to swing the charge back to just above the surface without disturbing it. The misfire had a completely limp, burned fuse with no kinks or pinching evident.

We lowered our spare shot down with a rope so it was right beside the misfire, separated by only a few millimetres. It was a textbook misfire removal, and I thought "what a great learning opportunity for my young partner here!" The final charge was successful; though it didn't detonate out over the cornice like we wanted, it still triggered all the remaining new cornice growth and storm slabs on the slopes below.

Before continuing on, I explained to my partner that we had to do our due diligence and have a good look around for any non-detonated explosives (in case it was the emulsion that wouldn't initiate) and in particular any evidence of the high strength cap from the misfire charge, in the rare event that it had somehow survived the blast. We had a good look around both up on the ridge and down on the slopes below and found nothing. Running an hour late now with a busy day ahead, I thanked the patroller and reminded him that any time we find a misfire, even if it is just pieces of a charge, we never touch it: the area is closed and secured and we then destroy any remnants with another shot.

The rest of the crew was busy on Goat's Eye Mountain where the Wild West freeride area was close to opening. I met up with some technicians to have a look around in the Wild West, and was rewarded with a bit of a "joy lap"—the control work was mostly done in there, and we double-checked a few small, lingering pockets before turning the skis downhill and getting faceshots for most of the fifty or so turns as the area was opened behind us.

While riding the chair, dispatch called out a potentially serious accident: "Snowboarder injured in Peyto's gully in the Wild West; fell off a 20-metre cliff; not moving; injuries unknown." Uh-oh. Response was quick as several patrollers were at the entrance gate to the area. I thought about what might be involved for us operationally: *We can close the ski-out and use it as a landing zone for the medivac flight; or if the injuries are life-threatening we may need to request a sling rescue from Parks Canada for quicker extrication …* When the call came through, I was pleasantly relieved and utterly bewildered: "I'm on scene and there are no injuries. Patient will snowboard down after catching his breath." The snowboarder had managed to fall into one of the few steep untouched pillows of snow in the tight couloir below the cliff. I started thinking it may be a crazy day.

BOURGEAU 7 AVALANCHE POWDER CLOUD VIEW FROM THE TRUCK // SUNSHINE SKI PATROL

We tackled the South Side chutes next, a very complex area with multiple cross-loaded, cornice-capped gullies feeding into several large avalanche paths. We were stretched thin trying to work this big terrain safely in partners, and uphill travel was agonizingly slow and tedious. We were increasingly fearful of poachers getting into the runout zones of the paths we were working in above, so we posted two guards for the area at the main entry points. I spelled off the upper guard for a half hour of educating the hungry public—maybe it would help if they heard the message from the horse's mouth, so to speak.

Lunchtime came and I headed up to the office to draw up shot placement sheets for the quick heli-bombing run scheduled for 13:00 or so. The crew in the South Side chutes were getting close to opening the area, and they were hungry and exhausted. They had worked every piece of terrain to satisfaction with one major path to go: Saddledome. This outer path is often wind-scoured on its flanks and receives far less skier compaction than any of the other start zones in the area. The final explosives charge was placed in the centre of the start zone, but it did not trigger a storm slab as expected. The technician then started traversing across the slope to ski cut it. . .

Parks Canada Visitor Safety buzzed around above our access road, getting good results with their control run. Two paths are a regular threat to the road during big annual cycles, and another eight paths only pose a threat in the 1:10 to 1:100-year events. They worked their way up the road, past the two targets controlled regularly with Gaz-Ex exploders, to the Bourgeau 7 path. This path does not have a remote-fire system like the other two producers above the road (Bourgeau 4 and 5), and as such tends to grow a little fatter between heli-bombing runs. It was the final path to drop shots in that affected the "No Stopping, Avalanche Zone" section of the road. A large swivel sign marked the end of the zoned hazard area. High above, the first shot was deployed. . .

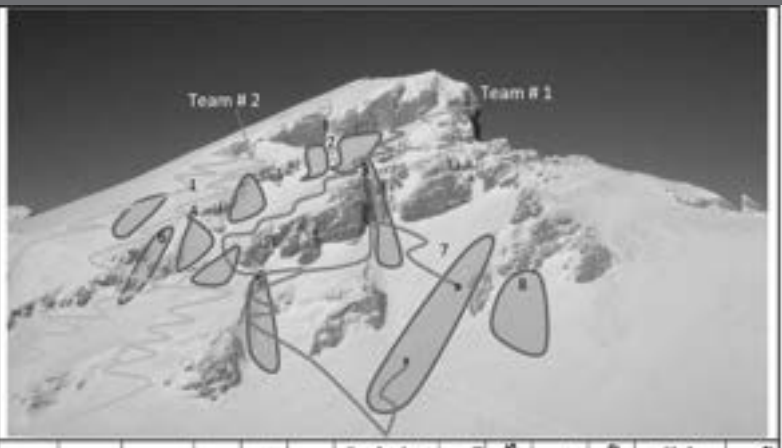
Up in the office, I was trying to finish up the control sheets from the morning's work, knowing that otherwise it might take days. Parks contacted me on the radio: "two more shots to go and then we'll land at your LZ; you can hot-load into the front to oversee the placements you guys want." While on the phone with a patroller, arranging to have the LZ secured and someone standing by to land the helicopter, a call came over the radio from our Assistant Forecaster Tim Ricci: "We're watching Martin go for a ride in an avalanche in Saddledome. He's pulled his balloon pack. Looks like a good size 2. He's riding on the surface ..."

Shit.

Is he OK? What happened? Where does that leave us? And then another radio call: "Brendan from Brad White, Parks Canada. Yeah, so Bourgeau 7 went pretty big, I'd say size 4. There's about 200 metres of timber on the road. We're going to need some heavy machinery to clear this up, and do you guys have any chainsaws?"

Shit.

CONTROL SHEET FOR GOAT'S EYE SOUTH-SIDE CHUTES



Date	Time	Path	Size	Trigger	Failure Type	Explosive		Start Location	Terminus	Sliding Surface	Moisture	Slab		Toe Distance
						No.	Size					W.	Th.	
6-Mar	1100	R2-D2	1.5	Xt	S	2	6.5	T	TK	S	D	15	30	40
6-Mar	1145	Sad Cor	1	Xe	CS	1	1	T	TK	S	D	8	50	70
6-Mar	1115	F gully	1.5	Xe	CS	1	1	T	TK	S	D	12	35	25
6-Mar	1130	Me2	1.5	Xe	S	1	1	T	TK	S	D	20	40	35
6-Mar	1130	G gully	1	Xe	S	1	1	T	TK	S	D	18	30	30
6-Mar	1230	Saddle	2	Sa	S	1	1	M	TR	O/G	D	30	60	100
6-Mar	1430	Saddle	1.5	Xh	S	1	3	T	TR	S	D	20	45	50

Date	Comments	Initials
6-Mar	Sc and Xe up to Sz 2.0, easy propagation in immediate lees, some reverse-loading in deeper gullies.	ML
6-Mar	Technician caught in Sz 2.0 while Sc after Xe placement, successful airbag deployment, 70m ride, no injuries, lost ski poles. Airbag prevented full burial.	ML

Phones are ringing, the radio is buzzing. I call Brad to confirm that our staff are clear to enter the deposit. The trail crew supervisor is rounding up his team and heading down with chainsaws. Dispatch is asking how long the road will be impassable; Brad thinks possibly five hours. How will we get patients out if they need an ambulance? Is Martin okay? Then the rookie patroller from the morning control run in the Shoulder appears in the doorway, pulling something out of his pack…

Oh, shit.

In his hand is a twisted, bent, mangled high strength cap at the end of a well-burned, half-exploded fuse.

"I found it!" He's stoked. He went back twice and combed the area, and when he found the undetonated safety fuse assembly with the twisted blasting cap, he decided to put it in the top of his pack and ski it down to me. Truly amazing!

I hang up the office phone and my cell phone and tell him how happy I am that he's brought it down here, that he's been so diligent, that he's so … "WHAT THE #$%& HAVE YOU DONE." I put the cap in a large, crush-proof pelican case, not quite knowing the protocol at this point. We destroyed it in a meadow as soon as we could, and I make a mental note, to never trust anyone, ever.

Martin figured the SnowPulse pack kept him from being completely buried in the terrain trap gully feature he ended up in. He tweaked a knee and lost his favorite poles. The shot was a little high and the slab he ski cut stepped down to ground, leaving him nowhere to go. "There's still more work to be done out there; we underestimated how much snow fell on the scree at the edges, suddenly bringing them above threshold, and that the winds blew from the east at the end of the storm for just long enough to reverse-load isolated features like skier's left of Saddledome." 10-4. Down at Bourgeau 7, the two snow cats we parked at the base area after the night shift (let's just say we had a feeling) fired up and headed down to the debris, along with a Parks front-end loader.

I jumped into the 407 where Steve Holeczi from Parks was bombardier. He was just buzzing: "This is the best day of heli-bombing I'll probably ever have!" Yes, it probably is Steve. Sorry if I'm a little preoccupied, we're having a crazy day up here. We headed over to Delirium Dive and hit the difficult-to-access pockets. One feature called Milky Way failed to ground, bringing down tonnes of snow that had been open and skied sporadically for a few months. The weight of the bag of ANFO in Eagle Basin triggered the whole thing, size 2.5, if not bigger. Many areas were scrubbed to ground.

Then we hovered above Fat Boy, a big alpine shoulder feature in the lower region of Delirium Dive, that has surprised many technicians and forecasters (including me) with its tendency to "wake up" without warning. Because of this history (and after taking the CAA Avalanche Operations Level 3 course), I had been exercising what many would consider overkill—big shots every storm system (even the minor ones), and as much compaction as we can manage in between. The bag of ANFO ended up a little high but gave the whole slope a good shake. No result. Hmm. Then we dropped a 3kg charge up high, further along the slope, in a pocket that straddles the boundary. Everything beyond the skier's right of the main run failed in one go, a big old size 3. It ran into the trees at the end of the flats at the bottom: storm snow only, no step-downs.

The main run remained intact—maybe the extra effort early season had paid off. Just as we were about to fly away I noticed movement in the main pocket just below the original ANFO placement. A three-metre crown was suddenly visible, a straight wall down to the ground. The first avalanche remote-triggered this semi-compacted ski run from 400 metres away, but not on the surface hoar layer; we had flushed that out and skied it extensively. This was the Rotten Rockies Special: depth hoar crystals growing at the base, planning their comeback. After two months of being open and skied almost daily, half of the snow on the run was now shaking the trees at the end of the runout zone. Confidence: low. Uncertainty: high.

Arriving back in the Village, I learned that one of our avalanche technicians had sustained a serious injury trying to get to Martin as he was riding the avalanche in Saddledome. This injury would eventually require surgery. I also learned that the Bourgeau 7 avalanche had failed on the ground and put three separate lobes of debris on the road, over three metres in depth. Mature timber was ripped out and the biggest lobe came down beyond the swivel sign marking the end of the "No Stopping" area. An extensive deposit in the track deflected the avalanche, and the surface hoar at treeline helped to feed a lot of snow into an already massive slide. The 100-year return period event was the result—the last time these lobes hit the road was during the historical cycle of 1972.

The next day we got our chance to do the full heli-bombing run and got the remaining part of Fat Boy to fail to ground, along with widespread full path results throughout Delirium Dive. We also had a lot of paperwork to do: near-miss reporting, injured worker forms, control sheets with results to record in almost every path, explosives ordering. We also had to discuss how vulnerable we had made ourselves, and what we could change or improve to avoid any similar close calls from occurring. But the down-time was short-lived, as March saw significant snowfall with moderate wind almost every day of the month. The fracture lines filled in, the skiing only got better, and we rode out the most memorable year I may ever see at Sunshine.

Brendan Martland is the Avalanche Safety Director at Sunshine Village Ski & Snowboard Resort.

Fuse News

THE CAA EXPLOSIVE COMMITTEE ENGAGES AS A GROUP ON A REGULAR BASIS TO KEEP ABREAST OF EXPLOSIVES RELATED ISSUES.

Scott Aitken
Chair of the CAA Explosive Committee

AFTER THE MOST BENIGN February in the Coast Mountains in recent memory, explosive use and number of avalanches occurrences in the Duffey Lake area, like many other operations, are well below average. Reports of explosive misfires and mis-lights are fewer this year; the two may be connected. Explosive products used in the avalanche industry today are reliable when used in accordance to manufacturer's recommendations.

Avalauncher Products Recall

All AVR-2 Avalauncher rounds have been recalled by Orica Canada and all users have been notified. Visit the Explosives Resources page on the CAA Members Only site to see that recall. The AVR-1 round is still being supplied from existing stock.

Avalauncher crews are still required to fire from behind approved blast shields or from a remote location as a precaution.

Pull Wire Igniters Best Practices

The Martin and Shaft pull wire fuse lighter is used universally for lighting safety fuses on avalanche control primers. In season 2012, some igniters had excess glue on the fiber tube which interfered with inserting the fuse in this tube. No recent cases of this defect have been reported.

Here are some directions from Dave Sly of Maple Leaf Powder, in addition to those included with your box of Martin and Shaft pull wires.

- Inspect the pull wire igniter to ensure that the two different diameter fiber tubes are well bonded.
- Hold on to and pull the string as well as the white cap when lighting the fuse.
- Firmly hold the pull wire igniter with your non-dominant hand and brace that hand on your leg or other dead rest while pulling the string sharply to ignite the fuse.
- Once the string with the white cap has been pulled, confirm the fuse is lit. Do not attempt to re-light a fuse which appears mis-lit.

If in doubt, check with your supplier for manufacturer's recommendations regarding the use of their explosive products. Keep your powder dry!

Safety Bulletin

C-I-L HAS ALWAYS taken the position that we insist users of our snowlauncher products fire these from either a remote and protected area or that a ballistic guard be in place to protect the practitioner in the event of a mishap. Also C-I-L has engaged their technical staff and consultants to develop action as shown necessary.

Recent discussion and supposition on the safety of firing avalauncher units has led us to strongly reiterate our position on this point.

All users of our snowlauncher products must do so using a remote protected position or a ballistic guard.

If a user finds they cannot accommodate or will not accommodate such a practise, we would ask them to immediately stop using the C-I-L product and call C-I-L for immediate retrieval of any product in stock. This will be done of course at no cost to the customer.

Also if anyone needs help or advice to immediately address this situation, please call our technical consultant David Sly at 250-744-8765.

MANDATORY PROCEDURES POLICY for both SUB-CALIBER and FULL CALIBER pressure plates.

ALWAYS:

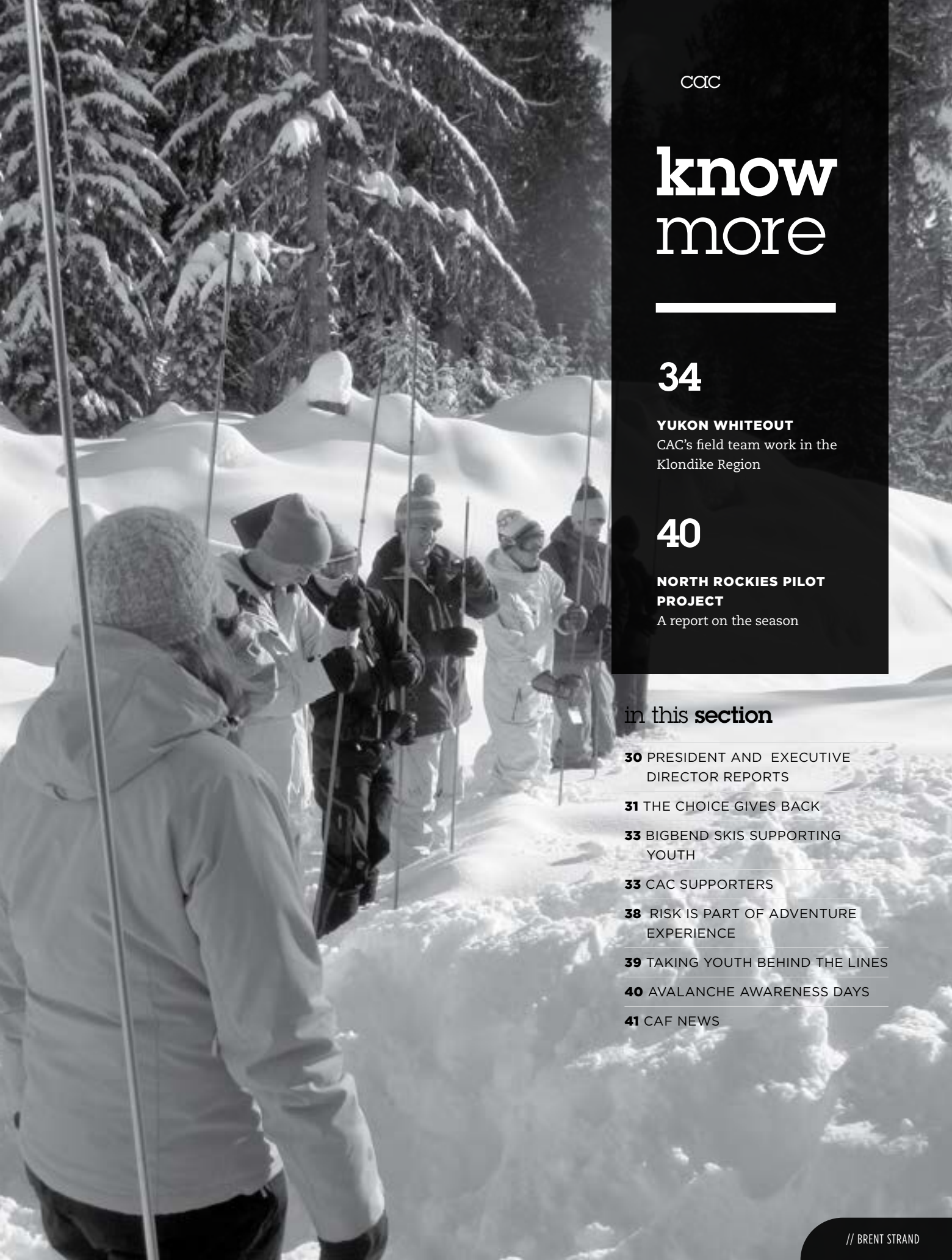
- Initiate your gun from a remote firing area at least 100 feet away from the gun in a straight line.

OR

- From behind a protective ballistic shield, ground barrier, structure or snow mound
- Always ensure your crew is properly trained prior to the use of any C-I-L explosives products

NEVER:

- Stand beside your gun to fire
- Never combine any C-I-L snowlauncher system part with other manufacturer's system part
- Force any parts together



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// BRENT STRAND

CAC Secretary Treasurer and CAF President's Message

A NEW VISION AND DIRECTION FOR CAC AND CAF FUNDRAISING

Kevin Seel
CAC Secretary Treasurer

Gordon Ritchie
CAF President

OVER THE PAST SEVERAL MONTHS, one of the tough questions facing the CAC board has been how we stabilize, strengthen, and diversify our revenues and funding base.

Currently, the CAC relies heavily on government sources, including gaming grants, to make up almost half of our $1.86M FY2013 budget. The CAC also generates its own revenues through retail sales, sponsorships, journal subscriptions, special projects and seminars, and collecting small donations and membership dues.

Given the pressures faced by all governments these days to control or reduce expenditures, and the uncertainty of winning gaming grants from year-to-year, the CAC would clearly like to be more self-reliant in generating its own funding. In addition, the CAC depends on a yearly grant from the Canadian Avalanche Foundation (CAF) to meet operational requirements and make up for any anticipated shortfalls.

The CAF has a solid, 13-year track record of fundraising, providing $1.5 million to avalanche safety since inception. However, the CAF board is facing its own tough question of how to grow fundraising revenues over time. A new structure and additional resources are needed.

The boards of the CAC and CAF believe we have opportunity to take a more aggressive, systematic, and coordinated approach to fundraising development. What do we mean by that? Historically both the CAF and the CAC have successfully engaged in a variety of fundraising activities with a shared focus on supporting public avalanche safety, but these activities have not always been done in coordination with one another, or under a single over-arching strategy.

For the CAC, the focus of fundraising has traditionally been on winning sponsorships, selling memberships and accepting donations. For its part, the CAF runs a number of annual fundraising events soliciting contributions from corporate sponsors and private supporters. As a charitable foundation, the CAF is able to issue tax receipts for the donations it receives.

Occasionally, but with best intentions, our efforts overlap and sometimes collide, which leads to a little embarrassment for us, and confusion for our stakeholders and the public at large. With that in mind, the boards of the CAF and CAC met last June to begin discussions on how we could better work together towards a common fundraising purpose. Since then we have struck a joint fundraising committee, and in January the CAF retained the services of an expert fundraising development consultant to help the CAF and CAC create a comprehensive strategy and action plan.

Ultimately, to undertake and enable this work, we may need to fundamentally reorganize and restructure the way the CAF and CAC operate. We are considering the model that many hospitals and other public health institutions use to structure their fundraising. Many hospitals have created their own hospital foundation to help raise money for specific programs and initiatives beyond what is covered by their regular government funding.

Under this type of structure, the board of the hospital sets the overall three- to five-year goals and priorities for fundraising. The foundation board delivers on these outcomes through specifically designed campaigns and other fundraising development activities. The resulting funds are, in turn, disbursed back to the hospital for the purposes they were intended, e.g., new equipment, a new building wing, or a research chair.

Based on our current understanding, this model seems to show promise as it resonates very closely with where we think the CAC and CAF need to evolve. To get there may require some fine tuning of our respective governance structures (by-laws, articles of incorporation, etc.) but these changes should be relatively straight forward to make, and we plan to do this in consultation with membership and other stakeholders.

Assuming all goes smoothly, the recommendations of the consultant review will be tabled and accepted at the next joint meeting of the CAF and CAC boards in June 2013. In the meantime, if you have any questions, concerns or ideas, please don't hesitate to contact the authors and they would be happy to respond.

The Choice Gives Back

Mike Peabody

THE CHOICE SNOWBOARD SHOP raised $2636.64 for the Canadian Avalanche Centre at the video premiere of Jeremy Jones' Further on November 3 at the Key City Theater in Cranbrook. The event was a huge success—The Choice has been hosting snowboard video premiers at the Key City Theater for six years now, and this year's turnout was by far the best.

The Choice's sales have reflected the rising popularity of backcountry snowboarding, with last year's splitboard sales almost surpassing regular snowboard sales. As more and more clientele venture into avalanche terrain, we want to help keep our customers safe. Money raised at the event goes directly to the Canadian Avalanche Centre. The Choice would like to thank everyone that came out and contributed to this good cause.

DAVE QUINN ACCEPTS A CHEQUE FROM MIKE PEABODY // DAVE QUINN COLLECTION

CAC Acting Executive Director's Report

MY FIRST REAL JOB AFTER HIGH SCHOOL WAS LOADING BOXCARS AT A FERTILIZER PLANT. EVERY FEW SECONDS, A 50LB BAG WOULD HURTLE AT ME OFF THE CONVEYOR BELT, FAST ENOUGH TO KNOCK ME DOWN IF CAUGHT OFF GUARD.

Karl Klassen
CAC Acting
Executive Director

AFTER THE FIRST WEEK, I had been pummelled and pounded, was bruised and sore, and I was responsible for many dropped and broken bags. The early days of my tenure as acting CAC Executive Director felt a lot like that: issues and challenges coming so fast that I felt beaten up every day. At the fertilizer plant, over 35 years ago, it didn't take long to figure out I shouldn't be trying to catch the bags and then lift them into position—the trick was to allow momentum to do the work and simply guide the bag to its proper place in the pile. Over the last few weeks at the CAC, I've learned that I can't handle every individual issue all the time—I've spent a lot of time focussing the energy of and redirecting issues, tasks, and challenges so they end up in the right hands. I can't take much responsibility for the great work that's been accomplished here this winter. A few notable highlights are listed below and full credit goes to the people who make the CAC run:

- A very successful pilot project in the North Rockies that will help define the future of public avalanche programs in that region.
- A great new Facebook site for youth called Behind the Lines.
- An expanded youth education program.
- Well-attended and well-received Backcountry Avalanche Workshops.
- Improved integration of the South Rockies and Yukon field teams with the forecasting program.
- A snowpack modelling research project with the University of Calgary that's garnering international interest.
- A strong partnership with Mountain Equipment Co-op that's allowing us to build new smartphone bulletin apps.

I always knew CAC staff was hard working and willing to put in the extra effort to be not only successful but a global leader. Looking at it from the corner office though, I've found a truly awesome level of dedication and passion. People are willing to take on extra work, help me figure out things about which I have little or no experience or knowledge, and just simply dig in and support others and the organization. I've been amazed by the diverse skillset the team possesses. Hidden talent, broad experience and a wide range of knowledge on any number of subjects seems to be the norm. Every time I find myself at wit's end about an issue, someone on the team comes up with the missing piece I need (often thinking well outside the box) to complete the picture and make a good, informed decision. Without everyone pitching in, there's no way I could have managed both the Public Avalanche Warning Service and the organization as a whole this winter, and certainly the CAC would not be in the good operational shape it's in.

I've also relied heavily on our partners this season—sponsors, funders, and agencies and organizations we regularly work with. Of these, my most sincere thanks goes to the CAA, whose staff has been very supportive, taking on tasks and managing issues that, while of joint interest, should have been more CAC responsibilities than CAA. Regardless of any talk about CAC/CAA separation, I think we can and should maintain strong ties wherever we have mutual interests. Finally, I want everyone to know what a great Board of Directors we have. They have been proactive and willing to assist me in all facets of running the CAC.

If this sounds like a farewell speech—well, yes and no. Yes, I have not applied for the Executive Director's position. While the challenge of running the CAC is attractive and leading the team here would be an honour, I'm not ready for a full-time desk job. I have a few good years left in my guiding legs and I want time to spend with my family before our son becomes too old to want to spend too much time with his old man.

I have seen the resumes of people applying for the ED job and there's an impressive lineup. I look forward to handing off to someone with the training, experience, and knowledge that's required to take the CAC into the future.

And no, I'm not leaving the organization. Once the new ED is in place and brought up to speed, I'll go back to running PAWS—the place in the CAC I feel I belong and am best suited for.

I wish everyone a great spring and summer. And I encourage all, when you have the opportunity, to personally thank the hard-working staff at the CAC who make the magic happen here.

Karl Klassen, CAC Acting Executive Director

// BIGBEND SKIS LTD

Bigbend Skis
Supporting Youth

Karilyn Kempton

IF YOU'RE LOOKING for a new pair of skis this season, look no further than a pair of CAC-branded sticks from Bigbend Skis—a portion of the proceeds from each pair go to CAC youth avalanche education programming.

The CAC is happy to announce a partnership this winter with Bigbend skis through their 'Graphics that Give' program. The CAC, Bigbend Skis and Revelstoke-based artist Isaac Becker designed a ski topsheet with the CAC in mind that is available as a stock graphic through Bigbend Skis.

"Bigbend Skis has demonstrated a commitment to youth avalanche education, and we appreciate their ongoing support," says CAC Acting Executive Director Karl Klassen.

"It is exciting to find creative ways like this to show our support for the CAC's important work," says Bigbend Skis owner Daryl Ross. "Manufacturing custom skis and knowing that Bigbend's efforts will help fund some of the CAC's youth programs is very rewarding."

Bigbend Skis also donated a pair of custom skis to the CAC web auction. All proceeds from the sale of these skis will also go to the CAC youth avalanche education programs. The CAC's web auction runs throughout the season and features gear donated by our sponsors. Visit avalanche.ca/cac/auctions to see what's available during the winter season.

Based in Revelstoke, BC, Bigbend Skis offers full custom ski manufacturing. For more information and to order, visit bigbendskis.com/gtg-cac-youth.

CAC supporters

1664 BMX Ltd.
Andrea Geller
Azimuth Solutions Inc.
Black Bull Enterprises Ltd.
Blue River Powder Packers
Bulkley Backcountry Ski Society
Calgary Scrambling & Mountaineering Club
Coquihalla Summit Snowmobile Club
Crowfoot Mountain Snowmobile Club
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Eagle Valley Snowmobile Club
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Iron Horse Racing
Kamloops Snowmobile Association
Lawrence White
Merritt Snowmobile Club
Mike Gigliotti
Roy Maxwell
Slocan Valley Snowmobile Association
Snowwater Heli-Skiing Inc
Tom Kusumoto
Valemount Area Recreation Development Association
West Kootenay SnoGoers

Hot Coffee for a Cool Cause

THE CAC THANKS INNATE for generously donating CAC-logoed Doppio tumblers and vacuum-insulated Kaze travel mugs, now for sale at the CAC store. Order your mug or tumbler by calling 250-837-2435. All proceeds directly support CAC public avalanche safety programming.

"The work these avalanche teams do to keep people safe, educated, aware, even alive, is incredible and we are deeply indebted to avalanche safety centres worldwide," says Greg Foweraker, Managing Director of Innate.

// SCOTT STEWART

Yukon Whiteout

Up North with the CAC's Yukon Field Team

Justin Abbiss

"OK, TAKE A BREAK; LET ME GIVE IT A TRY NOW," I BARELY HEAR CAC ASSISTANT AVALANCHE FIELD TECHNICIAN SCOTT STEWART YELL OVER THE SOUND OF GORE-TEX FLAPPING IN THE WIND.

I'M LOSING DEXTERITY ANYWAYS

and needed to shelter my frozen appendages, forcing them back into a glove. It is windy, really windy—it is -15°C with a steady 50-60km/h wind from the north, which puts us around -35°C with the wind chill. We are situated on Summit knoll, installing a wind anemometer on our ridge-top weather station.

Skinning up the same route to de-cloak the weather station of its 'coastal plaster' has become a bit of a weekly chore. We are becoming quite proficient at navigating this landscape that I think must resemble Mars. It never fails: each Summit mission seems to be associated with strong winds and limited to nil visibility. Jedi-like forces come in handy as there are no defining features and each boulder and crevasse resembles the last—even Helen Keller would be impressed.

Welcome to the White Pass and the CAC's Klondike Forecast Region. At roughly 4100km^2, it is about one-tenth the size of Switzerland. It stretches from the Watson River (just south of Whitehorse) in the north to the Alaskan border in the south, roughly 20km from the Alaskan port town of Skagway. Mind you, a large portion of this area is remote and glaciated terrain that sees little human traffic. The high usage areas are concentrated along the South Klondike highway corridor, connecting the two user communities of Whitehorse, YT and Skagway, AK.

The Yukon Avalanche Association is a not-for-profit organization founded in 2010. Their mission is to promote avalanche safety and awareness in the north by facilitating the development of risk management tools for backcountry users. The YAA is a highly successful organization whose heart beats because of its dedicated, passionate army of volunteers—the same type of hearty, good-willed people that make living and playing in the north so enjoyable. In 2011, the YAA contracted the CAC to conduct fieldwork and produce a regional conditions report. The two-year pilot project was born, and still feels like a dream job to the field team.

THE FIELD TEAM

Norwegian-born Eirik Sharp is a long-time patroller from Kicking Horse Mountain in Golden, BC. His international and Canadian experience creates an eclectic mix of Euro style and wisdom with a Kootenay powder-slaying flair. As the lead Avalanche Field Technician, Eirik has truly adopted the field program as

his brain child. When not shredding powder on skis or sled, he's likely to be found behind a desk or computer, masterminding his next conceptual model of how to better gather and communicate data for public backcountry avalanche forecasting.

Scott Stewart hails from small town Saskatchewan and now lives the dream in Haines Junction, YT. As down-to-earth and fun loving as they come, he truly exudes Canadianism. With over a decade of experience navigating the high altitude mountains around Kluane as a Parks Canada Public Safety Specialist, Scott brings a healthy dose of depth and knowledge.

And then there is me, Justin Abbiss, born in a small town in Ontario. I am thankful to be so passionate about my work in the avalanche industry—it has provided opportunities to travel around the world from New Zealand to India, and work with amazing people like Eirik and Scott.

Unfortunately, White Pass lives up to its name, but perhaps not in the way you're thinking. For a lot of the winter, the 'white' does not necessarily refer to epic powder skiing or accumulated snowfall, but rather a mixture of coastal-influenced high relative humidity, strong winds and the limited visibility mentioned earlier—think inside a ping pong ball.

We refer to our snowpack in the south as quasi-coastal with average tree line depths of around two meters. Moving north, the snowpack tapers out considerably and becomes continental, with average snow depths of about 50cm. At roughly 60 degrees latitude we feel the northern effects. In the months of December and January, it is not uncommon for the region to be under the spell of a high-pressure that spills cold Arctic air into the area, locking temperatures in the -40 °C range for prolonged periods.

However, it is not all wind slab and sastrugi skiing. In fact, at the time of writing in mid-February, the days are lengthening and the energy is building. People are coming out of hibernation in anticipation of spring just around the corner. By mid-March, the winds will lose their strength, the sun will be higher in the sky and enthusiasts will be out skiing until 19:00 or 20:00. There will be kites in the sky, the smell of two stroke in the air, guitars around fires and even deep-fried backcountry turkeys as make-shift communes dot the highway corridors.

So as I thaw my hands inside my gloves and write this, the coastal winds continue to blow, laying on yet another fresh coat of rime on the summit weather station. When we are not digging out a sled or feeling the effects of the coastal winds in the form of nostril riming, we are usually enjoying the latest alpenglow light that the Klondike region has to offer, and grateful for a job that allows us to explore this vast and stunning region.

// JUSTIN ABBISS

North Rockies **Pilot Project**

Mary Clayton

IN EARLY DECEMBER OF 2012, THE CAC LAUNCHED ITS NORTH ROCKIES PILOT PROJECT IN A SMALL EVENT HELD AT THE NORTHERN LIGHTS COLLEGE IN DAWSON CREEK, BC.

THIS PROJECT IS MADE POSSIBLE by generous funding from the BC's Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) and Apache Corporation, and has been aided immensely by a number of smaller donations from many sources.

This pilot project aims to lay the foundation for establishing a regular avalanche forecasting program for the region. Currently, the CAC provides backcountry users in the North Rockies with a weekly conditions report. Issued on Thursdays throughout the winter, this report includes information on past snowpack and weather conditions, an analysis of current conditions as best as can be determined, and some very general advice on what might occur in the near future.

"Establishing an avalanche forecast for the North Rockies has been a dream of ours for many years," said Karl Klassen, acting Executive Director of the CAC. "This region encompasses many popular winter recreational areas, and better avalanche forecasts would definitely improve public safety. But we need reliable sources of good data before we can provide the services seen in our other forecast regions, such as danger ratings and snowpack analysis. This pilot project is putting us on the road to developing those data sources."

In the fall of 2012, the BC Government donated $50,000 and Apache Corporation donated $25,000 and two remote weather stations, complete with telemetry. With these resources, the CAC is able to send forecasting staff on several field trips to the North Rockies throughout the current winter season. Their focus is to determine what kind of avalanche information products and services would be most effective for this region.

As well as scouting locations for establishing the two remote weather stations, the field teams are gaining an understanding of the recreational-use patterns, identifying existing and potential sources of professional data, and exploring recreational data sources. Most importantly, the work in the North Rockies this winter will include extensive networking with local recreational users, provincial agencies, resource industry and other stakeholders. Establishing contacts at the local level is a key component to improving public avalanche safety in this region.

At time of writing, CAC staff have made three trips to the North Rockies, with two more planned for late March and early April. The field teams have covered a lot of miles on their snowmobiles with local stakeholders in the Kakwa area, Pine Pass, the Renshaw area near McBride, and the Babcock region near Tumbler Ridge. They have also met with stakeholders in Mackenzie, Prince George, Grande Prairie, Chetwynd and Tumbler Ridge, making connections and gathering ideas on what the locals want for improved avalanche safety programs.

"There's a tremendous amount of backcountry use going on in the North Rockies and it's been good to get a handle on where people are riding and how much they are using the area," said Carole Savage, the CAC's Snowmobile Program Coordinator. "We're building good relationships with the snowmobile clubs and SAR groups, and we'll be continuing that work right into spring."

The North Rockies Pilot Project will conclude later this spring, with a report and recommendations for the future. The CAC is grateful to both the BC Government and Apache Corporation for funding this pilot project. In order to move forward on developing avalanche safety programs for this area, sustainable funding will have to be established.

STANDING IN TRUCK (L – R): TUMBLER RIDGE MAYOR DARWIN WREN, COUNCILLOR ROB MACKAY. IN FRONT OF TRUCK (L – R): CAC NORTH ROCKIES FIELD TEAM GRANT HELGESON AND CAROLE SAVAGE, COUNCILLOR ALEEN TORRAVILLE, COUNCILLOR SHERRI-LYNN HEWITT, COUNCILLOR MIKE CAISLEY AND COUNCILLOR TIM SNYDER. ON THE TRAILER IS JEFF COOL FROM JACEY WELDING // CAROLE SAVAGE COLLECTION

Stakeholder Support

STAKEHOLDER RELATIONS HAVE ALREADY PROVEN INVALUABLE TO THE NORTH ROCKIES PROJECT. THE DISTRICT OF TUMBLER RIDGE HAS DONATED A DECOMMISSIONED TRUCK FROM THEIR FIRE DEPARTMENT.

THE 2001 CHEVROLET SILVERADO is more than road-worthy and the CAC's North Rockies field team has already put it to good use. Tumbler Ridge Mayor Darwin Wren has also committed to working with the other mayors of MacKenzie and Chetwynd to set aside money in their budgets to help with maintenance of the donated equipment.

In addition to the truck, Tumbler Ridge resident Jeff Cool of Jacey Welding donated a custom-built snowmobile trailer. Jeff received donated materials from Fountain Tire, TRU Hardware and Northern Metallic Sales, all in Tumbler Ridge, and Gaudin's Honda in Beaver Lodge. Jeff is donating the trailer in memory of his close friend John Couture who died in an avalanche in 2010..

Over in Grande Prairie, a group calling themselves the North Rockies Fundraising Team have been working over the past two years to raise money for improved avalanche safety services in their backyard. Team leaders Ryan Shelly and Paul Wheeler are members of the local Swan City Snowmobile Club, and through their efforts close to $9,000 has been raised for this cause. Up until the current winter, the CAC has put these funds towards terrain rating projects in the North Rockies.

Risk is Part of Adventure Experience

Jon Heshka

THE COST OF SEARCH AND RESCUE FOR SKIERS IS INFINITESIMAL COMPARED WITH OTHER GOVERNMENT EXPENDITURES

WHILE I APPRECIATE the sincerity of the *Vancouver Sun*'s Dec. 28 editorial, "Have fun in the snow, but don't forget safety" to save skiers, snowboarders and snowmobilers from themselves, the approach tilts the scale a little too close to comfort to that of a nanny state.

The editorial properly suggests that such recreationists take responsibility for their safety, warns would-be adventurers of the potential price tag of irresponsible behaviour and ends with the suggestion that dying in the mountains would prove that they have not taken such responsibility.

The conversation about out-of-bounds skiers and boarders would benefit from a little balance and perspective. Seven people die daily in car accidents in Canada. There are approximately 400 drowning deaths a year in the country. Let's not forget that smoking contributes to more than 37,000 deaths a year in Canada. On average, 14 people die per year in Canada due to avalanches. In this light, the public's shrill opposition and moral outrage seems disproportionate to the offence of skiing out-of-bounds.

Those who go out-of-bounds or recreate in dangerous backcountry conditions are often called stupid or labelled as misfits. Even further, there is a cruel undercurrent out there saying that those who die while skiing out-of-bounds "had it coming" and "got what they deserved." It behooves us to re-examine the risk-reward calculus.

There is value in adventure and exploration. There is worth in climbing a mountain "because it's there." This same attitude drives those who backcountry ski or duck under the ropes. If we as a society value adventure — and I think we do (witness the reverence attached to Sir Edmund Hillary, Amelia Earhart and Sarah Burke) — then we should be prepared to accept that it comes with a cost.

While I am sad when someone is hurt or killed in the mountains, I am not surprised when it happens. Many people are too quick to pound the square peg of adventure into the round hole of socially acceptable behaviour and judge the reasonableness of risk-taking actions against such conventions. Those who participate in adventure — whether it be snowmobilers, climbers or backcountry skiers — are (or should be) willing to accept responsibility for their actions.

Some argue that the answer lies in the regulation, legislation and criminalization of the behaviour (e.g. reckless skiing, boarding or sledding) which gives rise to these deaths. I believe that many people who pursue such activities balance the risks and make informed decisions but I also acknowledge that some go in blind with little real skill and are essentially playing Russian roulette.

The inconvenient truth is that recreationists have the right to take risks and make mistakes, even if it costs them their lives. Sadly misplaced in the debate is, to paraphrase John Stuart Mill, the sovereign right of the individual to take risks.

Equally forgotten is that Canada was founded by a Company of Adventurers and its spirit of exploration is at risk of being eviscerated and replaced by a namby-pamby state. The concern for out-of-bounds skiers and boarders and backcountry recreationists seems motivated by the cost of search and rescue and the safety of searchers. We must be mindful that the costs are infinitesimally small relative to other government expenditures.

According to Emergency Management BC, the operational costs of search and rescue in BC have averaged $1.2 million per year over the last decade. This is in contrast, for example, to the estimated economic burden of obesity in Canada ranging from $4.6 billion to $7.1 billion annually. By comparison, SAR seems a pretty good investment.

Searcher safety is a valid consideration but must also be placed in perspective — no search and rescuer in BC has died looking for a skier or snowboarder who has gone out-of-bounds at a ski hill. The climbing instruction 'bible' is aptly entitled *Freedom of the Hills*. Implicit in its title is that backcountry recreationists have the right to take risks that may unfortunately include decisions that result in their deaths.

It is troubling that there are those who paternalistically believe that government has the right to protect — skiers, boarders and sledders in this instance — those who do not wish their protection by closing areas that might hurt them or fining them if those areas are entered. If this happens, I fear that it will be the thin tip of the wedge representing just the beginning of a process that will gut risk from adventure. Risks are inherent and integral to adventure. Without risk, it wouldn't be adventure. It would be a video game. If people want to be safe, they can stay indoors in a padded room wired for virtual reality.

The *Vancouver Sun*'s editorial has as a noble but unrealistic goal that nobody die in the mountains this winter. We ought to brace ourselves, however, for the sorrow which will follow the next inevitable avalanche fatality. It is sad when people die in the backcountry. Indeed, it is sad when people die — period.

The solution (assuming there is a problem) doesn't lie in the state posting signs in the wilderness telling people how and where they should recreate or fining those who push the envelope. The answer resides in educating recreationists about the risks they take and hoping they make the right decision.

This article was previously published on January 7, 2013 in the *Vancouver Sun*.

CHRISTINA LUSTI'S LINE ON SIR SANFORD // CHRISTINA LUSTENBERGER

Taking Youth **Behind the Lines**

Karilyn Kempton

THROUGH THE GENEROUS SUPPORT of the Canadian Avalanche Foundation and the Hugh and Helen Hincks Memorial Fund, the CAC took over the youth-focused Behind the Lines Facebook page in the fall of 2012. It has since increased by more than three hundred fans and growth is steady.

The CAF launched Behind the Lines several years ago in order to inspire avalanche awareness in young backcountry enthusiasts. The mission has been to help youth realize the hard work and safety measures that go into riding big lines in avalanche terrain.

Part of a 2012-13 CAF youth education grant, the CAF passed the Behind the Lines torch over to the CAC to be managed as part of the CAC's social media efforts this winter. While many of the posts on Behind the Lines also appear on the CAC's Facebook page, it receives a lot of unique content that will appeal to youth. There is a strong focus on videos, with educational context included in each description.

Two main components of the Behind the Lines 2012-13 strategy have been an avalanche awareness video contest and a professional athlete blog series. The video contest was run entirely on Facebook and has been promoted through social media and via CAC avalanche awareness classroom presentations. Canadian youth were invited to submit videos up to three minutes in length with an avalanche safety message. The top three videos win an avalanche transceiver, shovel and probe package. Winners will be announced in spring 2013, so check the Facebook page for details. The contest has not received as many entries as expected, but we are still pleased with the outcome and hope to run a similar contest next year. We plan to use some videos created by youth to use for education purposes.

The pro athlete blog series has introduced several professional athletes and followed them throughout the season as they prepare to ride a line. Pro skier Christina Lustenberger introduced a line on Sir Stanford North via the Hourglass. Pro snowmobiler Jeremy Hanke is another involved athlete. We hope to have more athletes involved with the blog next winter, because they do a great job revealing the planning, preparation, safety precautions, decision making and teamwork that go into successfully and safely riding big lines.

If you're a Facebook user, please like Behind the Lines (facebook.com/CAC.BehindtheLines) and share it with youth and young adults who play in the backcountry. Contributions from the avalanche community really help magnify the message, whether you're posting photos, tips, trips or videos.

Avalanche Awareness Days **2013**

Lake Louise Ski Area & Mountain Resort
Lake Louise, AB

Kananaskis Country
Alberta

Revelstoke Mountain Resort
Revelstoke, BC

Shames Mountain
Terrace, BC

Sunshine Village Resort
Banff, AB

White Pass
Yukon

GUEST SPEAKER AARON BEARDMORE OF PARKS CANADA, CAF DIRECTOR SAMANTHA STUART, BANFF MAYOR KAREN SORENSEN AND CAF PRESIDENT GORD RITCHIE // DEBBIE RITCHIE

CAF Banff **Mountain Adventure Night**

Debbie Ritchie

THE SECOND ANNUAL MOUNTAIN ADVENTURE NIGHT WAS HELD ON JANUARY 12, 2013 AT WILD BILL'S LEGENDARY SALOON IN BANFF.

THE EVENT MARKED the official opening night of SnowDays in Banff National Park. SnowDays is a month-long celebration jam packed with mid-week events and weekend festivals that celebrate Banff's historic love for winter.

Over 100 people enjoyed watching four winter mountain films from the 2012 Banff Mountain Film and Book Festival. In addition to the films and silent auction, patrons heard Parks Canada Visitor Safety Specialist, Aaron Beardmore present an historical overview of Parks Canada's avalanche safety program. It was remarkable to see the similarities in avalanche control results in large snow years 40 years apart.

The Foundation would like to thank John Bowden of Banff Heritage Tourism, Karin Ogilvie of Wild Bill's, Shelley Wallman of Banff Lodging Company, John Wigmore of Big Rock Brewery, Deb Smythe and Jamie Carpenter from The Banff Centre and Banff Mountain Film Festival, Aaron Beardmore and Parks Canada, Diana Gould of Banff/Lake Louise Tourism and Karen Sorensen, Mayor of Banff for their support of the event.

A total of $1,955 was raised in support of avalanche safety in Canada. The Foundation extends its sincere thanks to the Banff Lodging Company, Big Rock Brewery, Banff Mt. Norquay, Alpine Helicopters, The Banff Centre and Banff Mountain Film & Book Festival, The North Face Banff, Patagonia Banff, Ultimate Ski & Ride, Parks Canada Hot Springs, Paul Zizka and Meghan Ward (Mountains in Motion), Dan Markham and the Association for Mountain Parks, Protection and Enjoyment (AMPPE) for their generous donations to the silent auction and door prizes.

The evening would not have been possible without the help of volunteers Judy Breese, Al MacKeigan, Laurel Martell, Val Pitkethly, and CAF Administrator Pattie Roozendaal.

// CORA SHEA COLLECTION

Cora Shea
Memorial Fund

THE CORA SHEA MEMORIAL FUND IS ACCEPTING APPLICATIONS UNTIL MAY 31. Cora Shea completed her Ph.D in Geoscience from the Applied Snow and Avalanche Research group at the University of Calgary in September 2011. She is remembered for her contributions to snow and avalanche science, insatiable curiosity about snow physics, and her skill at explaining physical processes.

In her memory, the Cora Shea Memorial Fund has been established to provide modest financial assistance to women seeking to do snow or avalanche research and/or study towards professional practice in avalanche safety, education or forecasting. Selection is based on a proposal on avalanche-related career intentions and how the grant would assist her career.

The Cora Shea Memorial Fund selection committee consists of Samantha Stuart, CAF Board of Directors (Chair); Amber Wood, CAA professional member; and Bruce Jamieson, University of Calgary. This committee will review applications and award grants.

Those interested may send in an application to the Canadian Avalanche Foundation at info@avalanchefoundation.ca by May 31.

To donate to the fund and for more information, please visit avalanche.ca/caf/programs/cora-shea-memorial-fund.

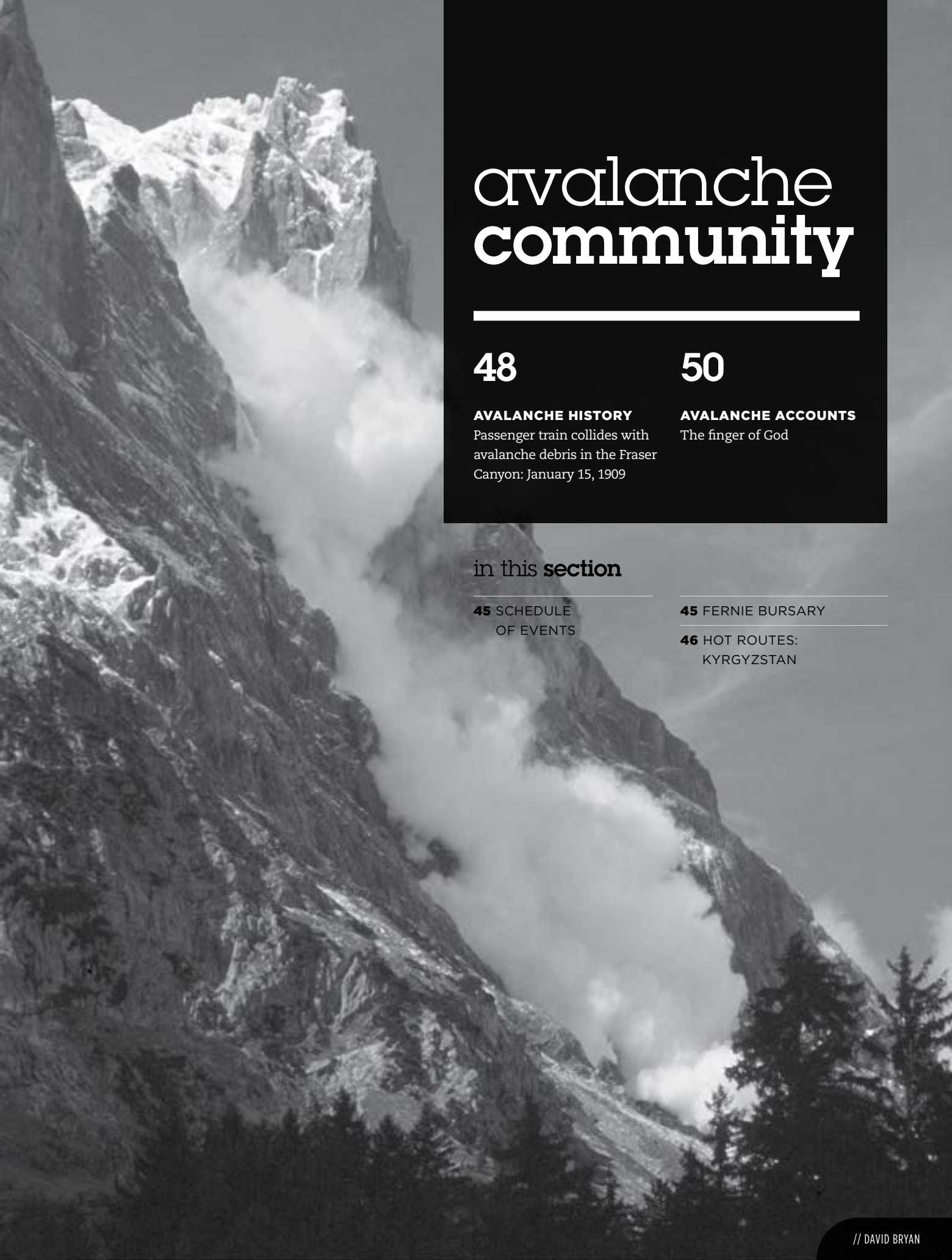
DIRECTOR SAMANTHA STUART ACCEPTS A CHEQUE ON BEHALF OF THE CAF // BRETTON DYTE

Women in Winter
Supports the Canadian Avalanche Foundation

THE THIRD ANNUAL WOMEN IN WINTER EVENT WAS HELD ON OCTOBER 14, 2012 AT CALGARY'S MOUNT ROYAL UNIVERSITY.

WOMEN IN WINTER AIMS TO INSPIRE women to stay fit and active and have fun throughout the winter, and to connect women with other women looking to get out into the mountains and play. Sponsored by Ski Cellar Snowboard, Canadian Mountain Holidays and Resorts of the Canadian Rockies, the event was hosted by Calgary media personality Nirmala Naidoo.

Organizers donated the nominal admission fee to the Canadian Avalanche Foundation. CAF Board member Samantha Stuart accepted a cheque for $1000 from Jean Hunt of Ski Cellar Snowboard. The Canadian Avalanche Foundation extends its thanks to Ski Cellar Snowboard, Canadian Mountain Holidays, Resorts of the Canadian Rockies and the over 200 women in attendance for their generous support.



avalanche **community**

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AVALANCHE HISTORY
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AVALANCHE ACCOUNTS
The finger of God

in this **section**

// DAVID BRYAN

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Schedule of Upcoming **Events**

WESTERN SNOW CONFERENCE

April 15 – 18, 2013
Jackson Hole, WY

The theme for the 81st annual conference is: "Wild Weather in the Wild West"
For more information:
westernsnowconference.org/2013.html

CANADA WEST SKI AREAS ASSOCIATION 2013 SPRING CONFERENCE

May 6 – 9, 2013
Delta Grand Okanagan Hotel, Kelowna, BC

For more information:
cwsaa.org/calendar3.html

CAA & CAC SPRING CONFERENCE AND ANNUAL GENERAL MEETINGS

May 6 – 10, 2013
Ramada Inn & Suites, Penticton, BC

May 6: ITP
May 7: Annual General Meeting
May 8: Continuing Professional Development Seminar
May 9-10: Case Studies and Reseach
For more information: avalanche.ca

HELICAT CANADA ANNUAL GENERAL MEETING

May 10, 2013
Ramada Inn & Suites, Penticton, BC

For more information:
helicatcanada.com

INTERNATIONAL SNOW SCIENCE WORKSHOP 2013

October 7 – 11, 2013
Grenoble, France

The ISSW promotes exchanges between practitioners, mountain professionals and researchers in the field of snow and avalanches.
For more information: issw2013.com

WILDERNESS RISK MANAGEMENT CONFERENCE

September 30 – October 2, 2013
Grand Teton National Park, Wyoming

An outstanding educational experience to help you mitigate the risks inherent in exploring, working, teaching and recreating in wild places.
For more information: nols.edu/wrmc

Fernie Bursary

MILD, MEDIUM AND AGED CHEDDAR CONGRATULATE TWO FRESH CURDS.

Fernie ski patrollers Melissa Makepeace and Megan Kelly with CAC Field Technician Gord Ohm congratulate Dylan Siggers and Caleb Brown who achieved their CAA Avalanche Operations Level 1 this season at Boulder Hut.

The Fernie Avalanche Safety Bursary awarded $500 to each. Fernie born and raised, Caleb and Dylan are free ski competitors with numerous other talents and achievements. Congratulations guys! Well done.

MELISSA MAKEPEACE, MEGAN KELLY, DYLAN SIGGERS, GORD OHM AND CALEB BROWN // R. SIGGERS

Kyrgyzstan

Article and photos by Leah Evans

When I got a call in early December 2011 from filmmaker Anthony Bonello asking me if I would like to go on a ski trip to Kyrgyzstan, I sheepishly asked if I could call him back because I had no idea where this 'Stan' was located in the world.

AFTER 17 DAYS in Kyrgyzstan I can proudly say that this place is like no other location I've visited. The social landscape is comprised of people who look Mongolian, Chinese, Turkish and Russian all sharply dressed in fur and leather and adorned with gold teeth. The language is a mix of Kyrgyz and Russian, which creates a problem when ordering food. You usually default to charades and a bowl of borscht appears minutes later.

Unlike other ski trips, I valued our time in the cities as much as in the mountains. Because Kyrgyzstan only gained independence just over 20 years ago from the Soviet Union, the people are still trying to reconfigure national identity. There is no sign of "Americanization" with popular restaurant chains or clothing brands; however, there is a presence of "Russianization".

Our time in the Tien Shan Mountains with 40 Tribes Backcountry Adventure (40tribesbackcountry.com) was equally as educational as we dealt with a continental snowpack (much like the Rocky Mountains in Canada). With rocks underneath and powder sprinkled on top, you had to be light on your feet and ensure you planned your escape zones on absolutely all terrain on any degree of slope. The challenge of the snowpack was meet by North Face athletes Izzy Lynch, Mike Hopkins and legendary guide Ptor Spricenieks.

Director Ryan Kopal, aligned himself with amazing local Krygyz people to bring his vision of a yurt-based ski touring operation to life. From our driver Schumacher to the yurt boys Kaste and Onnibeck, he has created sustainable eco tourism in the region.

AVALANCHE CONDITIONS:

The avalanche conditions in the Tien Shan range were marginal to say the least. Having not grown up in a continental snowpack, this trip was a huge learning curve for me, and really taught me how to stay safe in avalanche terrain. It was really interesting to gain knowledge of a new snowpack. The first day spooked me out the most as I climbed on top of a very benign flat slope and was met with cracking and whumpfing, two red flags for me when in the backcountry. As we checked out the terrain further, we realized it was an upside-down snowpack. With every turn, you were not sure if you would sink to the bottom or float effortlessly on top. As the days progressed and the sun appeared, we ventured further up into the alpine only to find slopes that had been splattered with avalanches.

We had many group discussions about route selection and if was even safe to take the risk to film/shoot certain lines. Our guide Ptor Speckniks was a great voice of reason; having skied so many infamous lines in his life, he was able to tell us the real repercussions of skiing certain lines. Ptor really helped me learn to ski fast, avoid rocks where facets may hibernate, and to not have one escape route but rather two or more.

HIGHLIGHTS

Filmer Nicholas Techirob broke his ski on the very first day of the trip but was able to mend the problem with a door handle and some screws—field improvisation at its best.

We stayed in a yurt, and sharing that space with new and old friends created a sense of community. We played yahtzee (later renamed yurtzee) every night while snacking on dried fruit and sipping on tea. Another incredible highlight was teaching the daughters of the host family with whom we stayed the first evening to ski outside in the parking lot.

Avalanche History: Passenger Train Collides with Avalanche Debris in the Fraser Canyon: January 15, 1909

John G. Woods, Wildvoices Consulting, Revelstoke on behalf of *The Land of Thundering Snow Virtual Exhibit Project*

SHORTLY PAST MID-DAY ON JANUARY 15, 1909, A CANADIAN PACIFIC RAILWAY PASSENGER TRAIN SNAKED SOUTH ALONG THE PRECIPITOUS WESTERN BANK OF THE FRASER RIVER NORTH OF YALE, BRITISH COLUMBIA. WORKING IN TANDEM, STEAM LOCOMOTIVES NOS. 496 AND 841 PULLED MAIL, EXPRESS, AND PASSENGER CARS THROUGH HEAVY SNOWDRIFTS AND INTO THE INTO THE TEETH OF A BLINDING SNOWSTORM.

WITH LITTLE or no warning, the train ran into a snowslide already down on the tracks. Derailed, the head-end locomotives plunged towards the river, wrenching part of the train from the rails and dragging several cars downslope. In what must have been a cacophony of tearing metal and scraping rocks, engines and cars were sprawled across the steep river banks, some in, and some out of the water. Anchored by a heavy dining car mid-train, the following cars stayed upright on the track.

Quick thinking and action saved the lives of the three onboard mail clerks. Tossed in a jumble of mail-bags, they could hear water flooding their overturned car. Clad only in undershirts and overalls, they forced open the car door and escaped the rising waters. Miraculously, the firemen on the lead locomotives escaped serious injury; sadly, the engineers who worked beside them were killed.

News of the tragedy spread slowly because snowslides had torn up the track-side telegraph wires. But when word did get out, the grim tally included the two engineers, Hugh Carscadden and James Foster, along with more than 30 injured passengers and crew. As a sobering post-script, in the aftermath of the first accident, two passengers decided to inspect the disaster scene on foot and were buried by a second avalanche. They survived but needed to be dug out.

While less well-known for avalanches than the CPR's mountain subdivision between Field and Revelstoke, or the Clanwilliam to Craigellachie area west of Revelstoke, the Fraser River route from North Bend to Hope has a long and continuing history of snowslide problems.

In modern terms, the passenger train disaster of 1909 happened at about Mile 19.3 in the Cascade subdivision of the Pacific Region—within slide path #8 between mile 19.0 and 21.0 (Latitude 49.6392 Longitude -121.4069). If you are travelling this area on the Trans-Canada Highway, as you pass through Sailor Bar Tunnel, the avalanche path is above you and the railway still runs in the open air beside the river.

Today, all maintenance railway crews working in avalanche hazard areas wear transceivers and are equipped and trained for avalanche rescue. Under the constant surveillance of an avalanche professional during the slide season, train and work-

CLEAN-UP OPERATION OF A CPR PASSENGER TRAIN AFTER A COLLISION WITH SLIDE DEBRIS ALONG THE FRASER RIVER, JANUARY 15,1909 // COURTESY OF THE KAMLOOPS MUSEUM & ARCHIVES PHOTO #1193A

crew activities in this slidepath are governed by work practices applicable to the daily hazard rating and whether the personnel are within or outside of a "track unit" (e.g., a train or plough). If the hazard rating is Low, then there are no work restrictions; if the rating is High or Extreme, no travel or work is allowed. When the hazard is either Moderate or Considerable, then only carefully defined activities are permissible. Given the conditions on January 15, 1909, it is unlikely that any trains would have been permitted across Slide #8 under today's standards.

While we tend to think of avalanche accidents as situations where moving snow causes the damage, this incident illustrates that collisions with slide debris, given the right circumstances, also can be both destructive and deadly. In fact, railroaders have many stories to tell of times their trains struck snowslides and embedded objects such as rocks and trees down on the track. Sometimes the train would break through the debris, but other times the engine might get stuck or derail. Archives contain a number of photographs of locomotives literally plastered by snow after they bullied their way through a downed avalanche.

Recognizing the real and potential hazard of driving onto avalanche deposits, the Canadian Avalanche Centre has recently added a "collision with avalanche debris" category to the online incident file (Pascal Haegeli, personal communications 2013 January; see avalanche.ca/cac/library/incident-report-database/view).

As more and more avalanche histories are added to the CAC database, new perspectives on both the character of snowslides and wide-scale storm events emerge. For example, recent database additions show that there were actually two fatal collisions with snowslide debris along the railway that day in 1909. The second incident took place about 256 track-miles (412 km) to the east when a CPR work train ran into a downed snowslide in Eagle Pass along the shores of Three Valley Lake (Longitude 50.934 Latitude 118.455). Engineer W. Coughlin and fireman G A. Hawkins died when their engine deflected into the lake.

ACKNOWLEDGEMENTS

The Kamloops Museum and Archives kindly supplied photograph 1193A as well as indexed notes on the Fraser River collision. Dylan Casola, Dan Sewell, and Mark Rickerby of Canadian Pacific were instrumental in locating the exact location of this incident and explaining the current Canadian Pacific safety protocols for the area.

SOURCES

Anonymous, 1909. Engine locomotive of C.P.R. freight train derailed by snow slide and sent over embankment. *Daily Colonist* (Vancouver) CI No. 31 Saturday, January 16, 1909 Page 1.

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Anonymous, 1909. Many on train near to death: wonderful escapes of people who rode on wrecked C.P.R. Express. *Daily Colonist* (Vancouver) CI No. 32 Sunday, January 17, 1909. Page 1.

Avalanche Accounts
The Finger of God

Bruce Kirkby

IF YOU SPEND TIME IN THE BACKCOUNTRY, YOU HAVE LIKELY SEEN THE RECENT NEW YORK TIMES FEATURE "*SNOW FALL*" WITH ITS DETAILED ANALYSIS OF THE FEBRUARY 2012 TUNNEL CREEK AVALANCHE. THAT STORY, WHICH WENT VIRAL IN PART DUE TO ITS GROUNDBREAKING INTEGRATION OF MULTIMEDIA, AND AN EARLIER OUTSIDE PIECE ON THE SAME EVENT (*TUNNEL VISION*) ARE BOTH WELL WORTH READING FOR THEIR REVEALING LOOK AT DECISION MAKING AND GROUP DYNAMICS IN HIGH RISK SITUATIONS.

'Which way?' shouted my friend, in the lead. 'Go right' came the answer from behind. "Better turns." I knew it was the wrong call, but said nothing.

I STUMBLED ACROSS the article on Christmas Eve, quickly drawn into the compelling events. But as the story unfolded, I found myself more and more shaken by the eerie similarities between the Tunnel Creek incident and my own 'near-miss' in avalanche terrain west of Kimberley just a few years earlier.

The lead up to both was identical: heavy snowfall, experienced skiers, and most critically, concerns that went unvoiced. Although our group was smaller (just four of us), the physical terrain and skier placement across the slope bore an uncanny resemblance. Two members of our party remained high on the ridge. One skier had descended partway, and was waiting in a clump of trees. I skied next. If you have read "Snow Fall", I was Jim Jack. I was the skier who triggered a slide that ripped across the entire slope, funneling into a steep, rocky gully and running all the way to valley bottom.

And that is where the similarities end. Jim Jack died, probably within seconds. The friends that dug him from the debris pile discovered a pummeled body, folded in half backwards with feet above the head. Cause of death was officially listed as brain trauma, but the medical examiner also noted partially torn aorta, broken neck, broken vertebrae, broken sternum, broken ribs, and internal blunt force injury. Two of Jim Jack's companions also perished that day.

We all skied away. And to to be fair, our survival was nothing more than fluke. Tunnel Creek highlighted the conclusion of the story that we, and our loved ones, narrowly avoided: the sense of utter helplessness amid powerful moving snow, the disbelief and then despair in the silence afterwards, the frantic 911 calls, the rescue, the survivors, and the lives changed forever.

Perhaps because I felt embarrassed, or perhaps because in no way did I want to appear to be assigning blame, I let our incident slip by quietly and unnoticed at the time. After reading "Snow Fall", I now feel compelled to share it, in the hope that its lessons might help other backcountry enthusiasts.

It started, as all adventures do, with the simple, wholesome desire to have some fun. My good buddy and expedition partner of fifteen years suggested we go ski touring. Despite the fact we live in the same small town, busy schedules had prevented us from getting outside together for over a year. To remedy the situation, we picked a day, and marked it in our calendars weeks in advance.

Then, the night before our planned departure, a heavy winter storm blew in. By dinnertime, snow was piling up at over an inch an hour, and for the first time, I began wondering about our plans. Had the commitment been with anyone else, I would have suggested spending the next day at our local ski hill instead of traveling in the backcountry. But there was human history to consider. For years, I'd been the conservative one in our partnership; the one

TELL US YOUR STORY
If you have been involved in an avalanche and want to share your story, email us at: stories@avalanche.ca

"SOMEWHERE, IN THE CLIFFS FAR ABOVE, SNOW WAS COMING DOWN ON ITS OWN. FIRST ONE. THEN TWO. THEN THREE. SURELY WE WEREN'T GOING TO SKI NOW? 'NOT A PROBLEM,' SOMEONE EXPLAINED. 'WE CAN STICK TO SAFE TREES.'" // WREN MCELROY

who suggesting bailing when things didn't look or feel right. It had become such a bone of contention that my friend and I began doing less together. This outing was supposed to be a step towards healing that rift. And I knew he'd still be gung-ho. I set my alarm for 05:30.

By dawn, a foot of new snow lay on the ground outside my house. There would be more in the high peaks. But neither my friend, nor the two experienced skiers he'd invited to join us, seemed concerned. Lacking the heart for confrontation, I decided, I'd bite my tongue, and bite it all day long if necessary. For once, I'd go with the flow. That mistake nearly killed me.

The road into the mountains—one we knew well—was obliterated beneath a blanket of featureless snow. Just minutes outside town, my friend missed a curve and drove full speed down a farmer's lane, soft powder billowing over the hood as we drifted to a stop. Even as it happened, I knew it was another warning. We should have turned back. But we didn't.

After parking the cars, an hour-long snowmobile ride along abandoned logging roads brought us to the foot of the basin where we planned to ski. Heavy clouds and mist meant we could see nothing. I'd visited the valley before in the summer, but never winter. Now I would have to rely on others for their understanding and judgement of the terrain both above and below us.

Even as we attached skins to our skis and tested beacons, the ominous sound of natural avalanches filtered through the forest. Somewhere, in the cliffs far above, snow was coming down on its own. First one. Then two. Then three. Surely we weren't going to ski now? "Not a problem," someone explained. "We can stick to safe trees."

Skinning upwards, the trail we cut felt protected, weaving thought stands of old growth draped in old man's beard. An hour later, as we reached a high ridge, the trees were thinning. In the mist to our left appeared silhouettes of thicker forest. To our right, blowing snow and cloud obliterated what looked like an open slope. "Which way?" shouted my friend, in the lead. 'Go right' came the answer from behind. "Better turns." I knew it was the wrong call, but said nothing.

We had a quick snack, shared a few sips from a thermos of tea, took off skins, made a plan, and then dropped in. Skiing one at a time, we regrouped after just ten turns in a small clump of wind-blown alpine larch. Then the first skier set out again. Soon his faint call wafted up through the mist "Safe!" I went next.

Six turns in I dragged a hip in the powder to slough speed, and I suspect that is what broke the hillside free. Suddenly, everything in front of me was moving. As far as I could see, the slope was breaking into blocks the size of washers and drivers, tumbling away as puffs of snow rose like smoke. Without even thinking, completely instinctively, I turned away from the chaos. But ahead of me, in this new direction, everything was moving too. Not knowing what to do, I put on the brakes.

Far above, I heard my friend scream, "AVALANCHE!" There was an urgency in his voice I'd never heard before in fifteen years of friendship. My skis ground to a stop. I wasn't moving? The hillside was silent. From below, a muffled cry: "I'm OK."

It took a moment to piece together what had happened. A massive fracture had ripped across the slope above: 160cm deep and roughly 100m wide. Miraculously, a single vertical finger of snow—smack in the middle of the avalanche path—had not slid.

And that finger extended all the way down from the crown to the point where I now stood. I'll never know whether it was the hand of God, or micro variations in the terrain, but I was perched atop the only safe island in a swath of total destruction. Had I been skiing just a few metres to either side, I'd have been swept away.

But what of the skier below? Leaping off the 'snow finger', my skis landed on a rock hard snow surface (which the avalanche slid upon). Side-slipping as fast as I could, I followed the yells until I spotted him, jammed between two pine trees, buried up to his neck.

"I always stop on the uphill side of trees," he smiled, still unshaken. It was a decision that probably saved him. By the time I'd dug him out, the other two had joined us.

The slide I triggered ran over 800m to the valley bottom. We followed its path though the old growth stands where we'd skinned earlier. Far overhead, beyond the reach of our extended poles, was a "high-tide" mark of refuse (branches, twigs, ice) showing the depth of snow that ran through these stands. Below, the slide funneled into a rocky gully, tumbling downwards and eventually spewing across flats below.

The burning question is how could I have been such a fool? Why did I remain silent in the face of so many alarms and obvious warnings? I am an extremely conservative decision maker, with many avalanche courses under my belt and twenty plus years experience traveling in the backcountry. The fault for silence is all mine; my companions bear no blame.

In hindsight, of course, the events appear ridiculous, almost unfathomable. But human dynamics, personal histories, the perception of pecking-orders, the unspoken hierarchy of experience, the desire not to disappoint others, even those we barely know—these are powerful forces. Anyone who spends time in the backcountry will recognize these influences, and I suspect will have wrestled with them at some point.

In the days and weeks following the "near miss," as I tried to make sense of the events, and understand how to avoid similar situations in the future, three themes emerged. They by no means encapsulate all the human factors that can influence backcountry decision-making, but I think they are a good starting place. I made an oath to myself to follow these as best I possibly could. They are unquestionably what I'll impress on my boys if they decide to explore the backcountry in the future. And I share them now in the hope they might benefit you, or the ones you love:

Always speak up. If you have reservations about snow conditions or route decisions, speak without reservation. Speak even if you don't know why you are worried. Speak if it is just a feeling in your gut. Ignore any concerns you might harbour about the judgments of others. Speak up because it is the only way you will learn. Speak up because you care about the lives of the people you are with. This sounds easy, but anyone who has spent time out there knows it can be challenging at times. At least ten of the extremely experienced skiers standing atop Tunnel Creek harboured concerns. Not one said a word, thinking someone else would chime in if it were necessary. Don't wait for others. Speak up.

Do not defer to experience and local knowledge, especially when it is pushing you towards a decision that feels uncomfortable. Your opinion and judgment matter as well. Experience and local knowledge can be powerful forces in groups; but they are not always right. Other factors may be at play—including overconfidence, overfamiliarity, and even the false sense of security that comes from surviving previous bad decisions. Trust your inner voice. Conversely, if you ever find experience and local knowledge suggesting you be more conservative with your decision-making, listen up.

Finally, and perhaps most importantly gravitate towards partners who are more cautious than you. Not because someone is "right", and someone else is "wrong"—risk assessment and acceptance is highly personal. But, in my opinion, it is far better to find yourself mildly disappointed at the end of the day (when your group did not accomplish everything you'd hoped) than to find yourself dragged into situations you don't like. The best thing I ever did was align myself with a handful of skiers who are just as happy to spend a day poking through valley bottom forests as they are to summit a big peak. Any turns we happen to get are an added bonus to the main joy of simply exploring the outdoors.

Staying safe in avalanche terrain has always been an odd mix of science and Zen, of collecting facts while simultaneously listening to instinct. It is a game of constant observation in the search for ultimately unattainable answers. No one can tell you, with absolute certainty, whether a given slope on a given day is safe or not. You might ski a run where nothing releases, but still have made a mistake. If you walk away from a slope, you'll never know if you were being wise, or unduly conservative. So instead, the best we can do is stack the odds heavily in our favour.

A solid understanding of snow science, weather patterns, pack history and avalanche dynamics is the starting point. Carrying all the requisite safety gear, and knowing how to use it, tips the balance further in your favour. After all that, don't make the mistake I did and allow the unspoken, universal human issues we all wrestle with to pull even one chip from your stack.

Originally printed at
http://blog.mec.ca/2013/01/23/the-finger-of-god/
on January 23, 2013.
This avalanche occurred on a ridge east of White Boar Lake about halfway up Meachen Creek in the St. Mary's River drainage, west of Kimberley.

research &education

in this **section**

// WREN MCELROY COLLECTION

AIRWAY PATENCY. IN BURIALS LONGER THAN 35 MINUTES, THE PATENCY OF A VICTIM'S AIRWAY BECOMES A CRITICAL OBSERVATION. IF THE AIRWAY IS PATENT THE VICTIM MAY SURVIVE, EVEN IF THEY ARE IN CARDIAC ARREST DUE TO HYPOTHERMIA. // HERMANN BRUGGER ARCHIVES

Medical Management of the Avalanche Victim

AN EVIDENCE-BASED GUIDELINE FROM THE INTERNATIONAL COMMISSION FOR MOUNTAIN EMERGENCY MEDICINE (ICAR MEDCOM)

Jeff Boyd[a,b], Hermann Brugger[b,c], Fidel Elsensohn[b], Peter Paal[b,d]
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For further explanation or information, contact Dr. Jeff Boyd at jbcaa@telus.net

BACKGROUND

Medical management recommendations (Brugger et al., 2004; Brugger and ICAR[1], 2006) have been previously based on concepts extrapolated from the avalanche survival curve derived from biostatistical analysis (Falk et al., 1994). A recent study comparing Canadian to Swiss survival produced similar sigmoidal-shaped curves (Fig. 1)(Haegeli et al. 2011).

The initial "survival phase" was shorter in western Canada due to greater mortality from trauma. Thereafter, survival plummeted in both series during the asphyxia phase, ending at 35 minutes burial, with mortality greater in Canada due to denser snow.

Deducing that victims unable to breathe had succumbed to asphyxia at the end of this 35 minutes, while those with a patent airway and an air space could survive longer until death from hypothermia at 90 minutes, the International Commission for Mountain Emergency Medicine (ICAR MEDCOM) published resuscitation recommendations and a management algorithm (Brugger et al., 2001).

However, this analysis did not consider actual clinical experience. The first systematic review of clinical evidence for these recommendations confirmed that duration of burial, airway patency, core temperature and serum potassium levels were reliable predictors of survival (Boyd et al., 2010) and, after expert review by the International Liaison Committee for Resuscitation (ILCOR), were included in the 2010 BLS and ALS[2] Resuscitation Guidelines for North America and Europe (Soar et al., 2010; Vanden Hoek et al., 2010).

Although current adoption of these recommendations approximates 75%, there are substantial failures, notably in initiation or withholding of CPR and triage to extracorporeal

[1]International Commission for Alpine Rescue
[2]BLS = Basic Life Support; ALS = Advanced Life Support.

circulation rewarming (heart-lung bypass) (ECR) (Brugger, 2011). Additionally, recent research in avalanche trauma (Hohlrieder et al., 2007; Boyd et al., 2009), survival analysis (Haegeli et al., 2011) and hypothermia management (Brown et al., 2012) has shifted emphasis.

METHODS

A structured clinical-literature review of the components of the 2001 algorithm was performed using an ILCOR worksheet format after establishing subject matter, objectives and inclusion/exclusion criteria a priori at a TOPIC meeting of the ICAR MEDCOM. This format examined each of 27 components using individual PICO (population, intervention, comparator, outcome) questions as well as 10 general questions. Findings were presented by the working group to a SCIENCE meeting of the ICAR MEDCOM for expert debate, and consensus recommendations were developed at a MANUSCRIPT meeting in October 2011.

RESULTS

Keyword- and hand-searching found 3,530 publication citations in the peer-reviewed clinical literature of which 96 articles were scrutinized in detail for content, study design and methodological quality. Thirty-seven recommendations were developed, classified for benefit and a simplified algorithm was developed. These recommendations and an algorithm (Fig. 2) for ALS personnel have been published (Brugger et al., 2012). Below is an abridged text oriented to both BLS and ALS rescuers.

GENERAL RECOMMENDATIONS

Safety and welfare

The safety and welfare of rescuers and all others remain paramount.

Companion and organized rescue

Prompt extrication with initiation of BLS resuscitation remains the priority for companions. Organized rescue is best mobilized early, ideally by helicopter, with rescue-trained emergency physicians or paramedics equipped with critical medical and safety kit, plus dogs with handlers.

Airway patency and air pocket

Rescuers are to dig from the side and, in burials longer than 35 minutes, note whether the airway is patent +/- an air pocket present.

General measures

To mitigate against the common rescue collapse from cardiac arrhythmias, hypothermic victims are best managed gently, with minimal truncal and limb movements, without rough motion or inappropriate chest compressions, and kept in a horizontal position.

Dry insulation includes insulation from the snow surface as well as from continued conductive, convective and radiant heat loss. Assemblies include blankets, padded rescue bags and outer windproof and waterproof reflective foils. Wet clothing may be replaced with dry layers if efficient although adding thick insulation over wet clothing is equally effective and usually more practical (Henriksson et al., 2012).

Field rewarming is principally prevention of further heat loss plus chemical heat packs, although more sophisticated rewarming with specific equipment may be indicated if evacuation is prolonged. Heated humidified inspiratory air or oxygen requires field-usable equipment and does not greatly reduce heat loss but may be indicated in prolonged transports.

Oxygen is indicated for any degree of asphyxia and will reduce the risk of arrhythmias in hypothermia (Danzl, 2012). Pulse oximetry may be unreliable with cold extremities and device malfunction from the cold, bright light and high altitude (Luks and Swenson, 2011).

Monitoring

Victims of significant involvement are best monitored throughout evacuation and ideally from the moment they are exposed. This includes electrocardiographic (ECG) monitoring with an AED or monitor-defibrillator. Core temperature is most reliably measured in the lower oesophagus in victims that have an endotracheal tube (tube in the trachea) in place. A medical thermistor probe is preferable although inexpensive probes from indoor/outdoor thermometers can be sufficiently accurate (Pasquier et al., 2012). Epitympanic (ear drum temperature) probes are accurate if used appropriately (Walpoth et al., 1994). Rectal temperatures provide a reasonable initial temperature (Danzl, 2012) although require undressing the victim and lag during rewarming. Other temperatures are likely unreliable. Clinical staging is unreliable if asphyxia or trauma impairs mentation.

Airway management and ventilation

An unresponsive victim without an advanced airway is best transported in the recovery position with the cervical spine stabilized as well as possible. Airway interventions have low risk of inducing arrhythmias and include oropharyngeal airways as well as advanced airways such as endotracheal intubation or supraglottic airways (such as the laryngeal tube). Advanced airways protect against aspiration of vomitus and allow better victim access and spinal stabilization with the victim supine.

Ventilation is indicated when breathing is inadequate and always with chest compressions in CPR.

VICTIMS WITH NO VITAL SIGNS THAT ARE BURIED LONGER THAN 35 MINUTES BUT THAT HAVE A PATENT AIRWAY ARE LIKELY TO HAVE SUFFERED A CARDIAC ARREST FROM SEVERE HYPOTHERMIA AND ARE BEST TRANSPORTED TO EXTRACORPOREAL REWARMING WITH HEART-LUNG BYPASS. // INNSBRUCK MEDICAL UNIVERSITY ARCHIVES

Trauma management

Pneumothorax is managed with needle thoracostomy (large-bore needle through the chest wall) or open thoracostomy (hole through the chest wall), ideally in a victim that is ventilated with an advanced airway.

Severe limb bleeding is managed with tourniquets.

Other trauma modalities additionally include splinting, wound care, analgesia and antibiotics for open fractures.

Trauma victims are best transported to the medical centre that is most appropriate for their injuries, directly to a dedicated trauma centre[3] if severe.

MANAGEMENT SCENARIOS

Alert victim

These are normothermic or mildly hypothermic. After assessment add insulation with or without changing wet clothing and allow active movement that will likely be sufficient to rewarm them. They may ingest warm clear sugar-containing fluids that are not alcoholic or strongly caffeinated so long as they are not likely to require sedation or anaesthesia in less than two hours and not significantly injured. Oral fluids will maintain hydration, especially if evacuation is delayed or prolonged.

If the involvement was clearly not life-threatening, then a decision may be made for them to remain in the field. However, if the involvement was potentially life-threatening they are best evacuated to the nearest emergency department for advanced assessment and observation as delayed complications may occur.

Poorly responsive victim with vital signs

These are asphyxiated +/- moderately or severely hypothermic. They are to be closely monitored, ideally with ECG monitoring as early as possible due to the risk of rescue collapse and arrhythmia. Core temperature will be very useful especially for disposition decisions. All general measures and other management modalities become critical.

Transport to the nearest hospital for advanced assessment, intervention and observation is indicated. If significantly asphyxiated, this would best be a hospital with an ICU. Seriously injured victims are best transported directly to a trauma centre. Hypothermic victims need rewarming with modalities such as the forced-air rewarmers most commonly used in surgical programs. However, if there is evidence of cardiac instability, such as ventricular arrhythmias on the ECG, or if the core temperature is <28°C (less than 28°C) direct transport to a centre[4] with advanced extracorporeal rewarming (ECR), such as cardiopulmonary bypass, is preferable due to the risk of cardiac arrest during rewarming.

Victim with no vital signs with burial duration less than 35 minutes

These are asphyxiated and only mildly hypothermic. If lethal trauma is found, such as unsurvivable decapitation or truncal transection, resuscitation is withheld. Otherwise, prompt exposure and extrication with BLS including ventilations, with AED/ECG monitoring and defibrillation if indicated/prompted, +/- ALS are started expediently.

If clinical improvement results from resuscitation or any cardiac rhythm is seen on ECG or an AED prompts defibrillation, then resuscitation should continue to the nearest hospital, ideally with an ICU. If no improvement is found after 20 minutes of resuscitation and only asystole (flat line) has been seen on ECG or an AED does not prompt defibrillation then resuscitation may be terminated in the field (Soar et al., 2010; Vanden Hoek et al., 2010; Paal et al., 2012).

Victim with no vital signs with burial duration more than 35 minutes

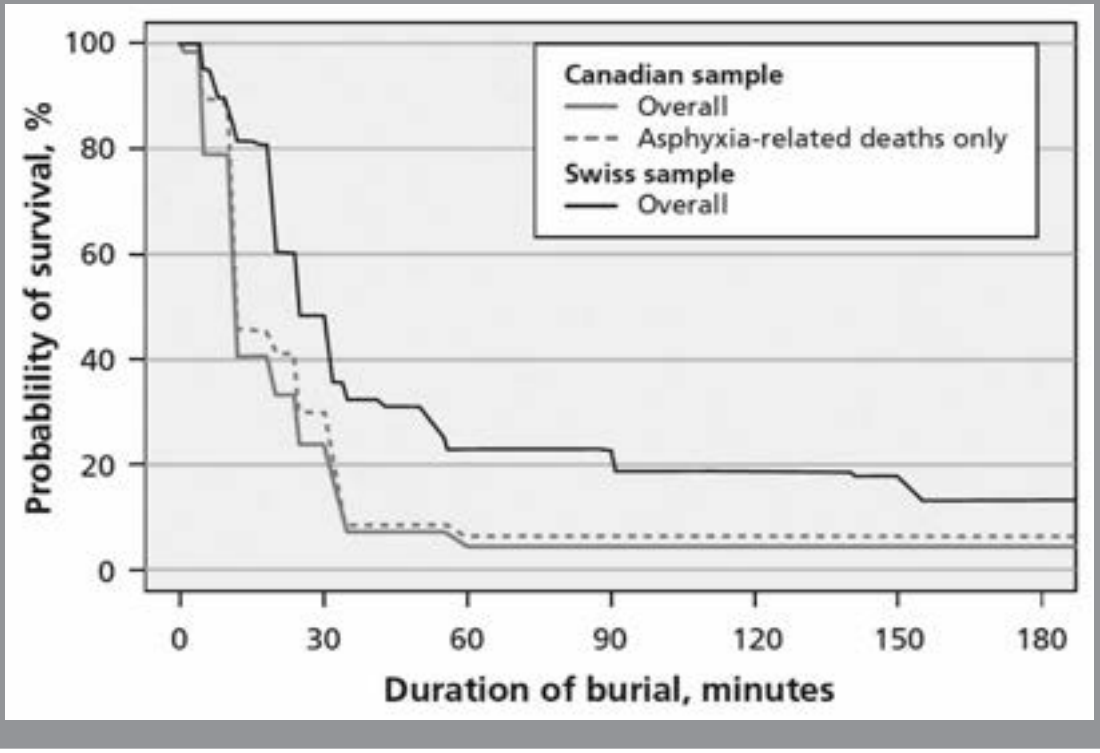
These have suffered cardiopulmonary arrest from prolonged asphyxia or hypothermia. If lethal trauma is found or the whole body is frozen, resuscitation is withheld.

If they have an obstructed airway they have arrested from prolonged asphyxia, which after 35 minutes has a very poor prognosis, and resuscitation may be withheld (Soar et al., 2010; Vanden Hoek et al., 2010).

If the airway is patent they may have arrested from prolonged asphyxia with the resultant poor prognosis; but alternatively they may have been able to breathe and the arrest may have been from significant hypothermia and the victim may therefore be salvageable. Therefore, if the core temperature is found >32°C they are principally asphyxiated and a resuscitation attempt may be initiated but terminated if no improvement is noted after 20 minutes and only asystole is seen on the ECG or an AED does not prompt defibrillation. But, if the core temperature is <32°C then arrest may be from hypothermia and resuscitation is continued and the victim is transported preferably to a centre with ECR[5]. If the duration is not known and understanding that a core temperature of <32°C can only occur after at least 35 minutes of cooling, a core temperature of <32°C may therefore be a surrogate for burial longer than 35 minutes (Boyd et al., 2010; Vanden Hoek et al., 2010).

[3]For example - Vancouver General Hospital, Royal Inland Hospital in Kamloops, Kelowna General Hospital or Foothills Medical Centre in Calgary.
[4,5]For example - Vancouver General Hospital, Foothills Medical Centre in Calgary or University Hospital in Edmonton. Near future - Kelowna General Hospital

FIG. 1: OVERALL SURVIVAL CURVES FOR PEOPLE COMPLETELY BURIED IN AVALANCHES IN CANADA (N = 301) AND SWITZERLAND (N = 946) FROM OCT. 1, 1980, TO SEPT. 30, 2005, BY DURATION OF BURIAL (DUMBGEN COMPARISON: P = 0.001). THE DOTTED LINE REPRESENTS THE CANADIAN SURVIVAL CURVE INCLUDING ONLY ASPHYXIA-RELATED DEATHS (N = 255). EXTRACTED FROM HAEGELI ET AL., 2011.



CPR is not modified for hypothermic arrest victims although a longer check of 60 seconds for vital signs is indicated as pulses may be indistinct. Persistent breathing or movement should prompt "watchful waiting" but if no signs of life are found then CPR is best started and continued. Defibrillation is performed if prompted by AED or indicated by ECG although repetitive defibrillation (over three attempts) may not be successful due to the cold heart being very irritable. ALS medications have only been shown effective in animal studies so judicial use is appropriate (Brown et al., 2012). No intervention is to delay transport of hypothermic arrest victims. Note is made that successful rewarming has resulted in good survivals after prolonged CPR of up to six and a half hours (Brown et al., 2012).

If the duration of burial or the status of the airway is unknown or a prolonged transport to ECR is being considered, then a serum potassium level (K+) at an emergency department, best in the direction of the ECR centre, may assist. If the K+ is <8mmol/L then survival is possible vs. >12mmol/L which is not survivable (Boyd et al., 2010; Soar et al., 2010; Vanden Hoek et al., 2010; Brown et al., 2012). A K+ between 8 and 12mmol/L may assist in a decision made with consideration of all factors.

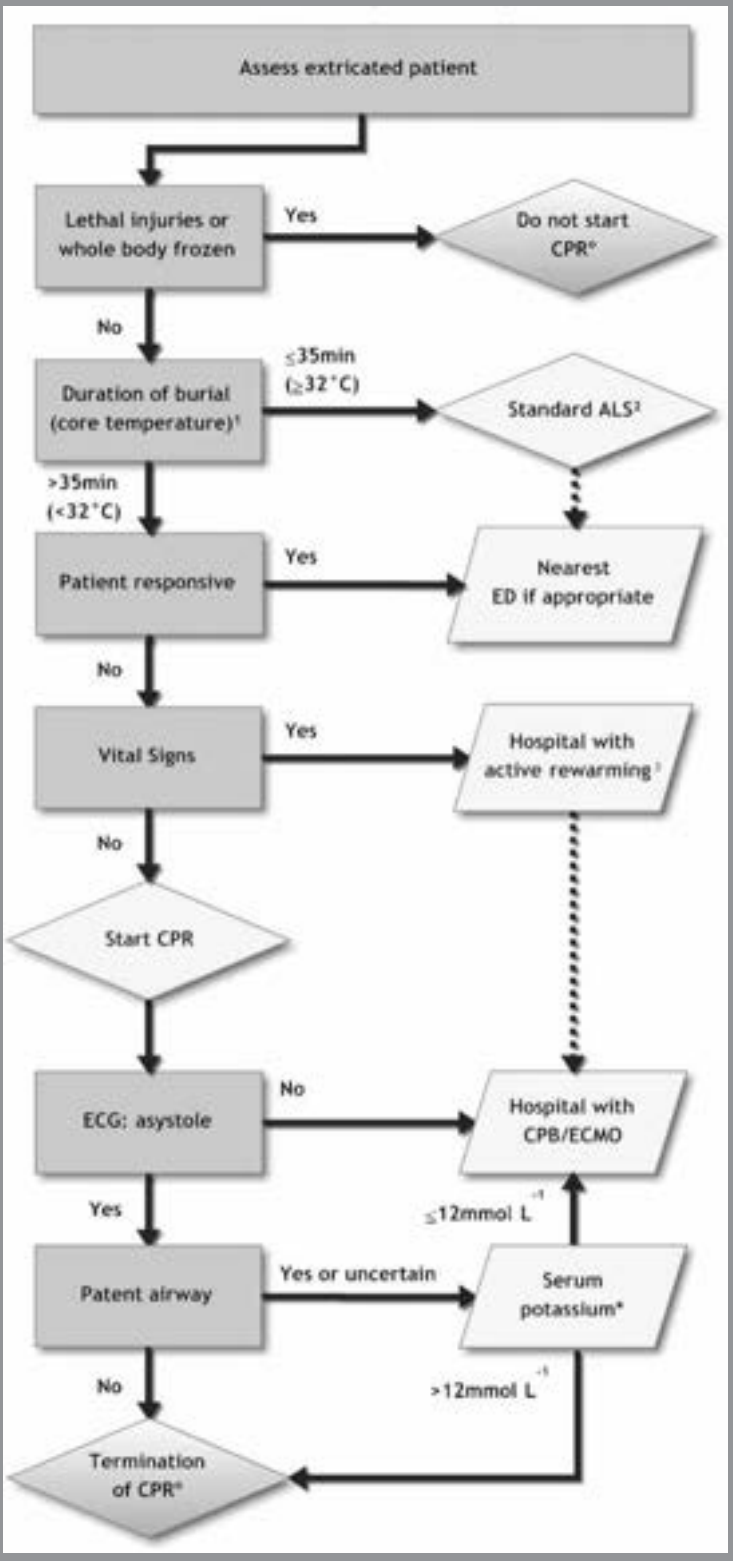
TRIAGE

Where multiple victims exceed available resources then triaging becomes necessary, especially when other victims remain buried. Victims without vital signs, especially if in asystole, are far less likely to survive and place high demands on resources. Victims exhibiting major trauma that appears likely lethal are not likely to survive. Extremely hypothermic victims, especially if their core temperature is the same as ambient temperature and is less than 10°C, are unlikely to survive. A triage algorithm for avalanche incidents that incorporates avalanche and triage concepts has been published (Bogle et al., 2010).

CONCLUSION

Important field recommendations range from simple evidence-based victim-handling measures to integrating critical factors in crucial decisions that include prehospital termination of resuscitation. Advanced airway use as well as AED and core temperature monitoring are more relevant with improved training of avalanche professionals. Trauma management includes the use of tourniquets as well as decompression of pneumothorax. Triage of multiple victims

FIG. 2: AVALANCHE MANAGEMENT ALGORITHM



Algorithm for prehospital and hospital management. In all cases: gentle extrication and spinal precautions. Where appropriate: core temperature + ECG monitoring, oxygen, insulation, heat packs on trunk; 0.9% NaCl and/or 5% glucose only if an intravenous or intraosseous line can be established within a few minutes; prehospital trauma care as indicated.

° Clinicians may consider withholding resuscitation at the scene if it is associated with increased risk to the rescue team and for obviously lethal injuries or where the body is completely frozen.

[1] If duration of burial is unknown core temperature may be a substitute.

[2] Initiate standard BLS and ALS including CPR with ventilations and chest compressions as indicated. Resuscitation may be terminated if resuscitation is not successful after 20 minutes. Transport victims with signs of, or concern of, respiratory (e.g. pulmonary edema) or other-system injury to the medical center most appropriate for their condition.

[3] Hospital capable of advanced external or core rewarming. Patients who present with cardiac instability (malignant ventricular arrhythmias, systolic blood pressure less than 90 mmHg) or a core temperature <28°C should be transported towards or to a centre with ECR rewarming . When VF is present, perform at least one defibrillation attempt.

* If direct transport to ECR rewarming is prolonged, a stop for a K+ level at the nearest ED enroute may assist decisions. If K+ exceeds 12 mmol/L, consider stopping resuscitation (after excluding crush injuries and consideration of the use of depolarizing paralytics); in an adult, levels between 8 and 12 mmol/L may, in combination with other factors consistent with non-survival, assist in the decision to terminate resuscitation.; ECG = electrocardiography; NaCl = normal saline; BLS = Basic Life Support; ALS = Advanced Life Support; VF = ventricular fibrillation; ECR = extracorporeal rewarming; K+ = serum potassium; ED = Emergency Department.

on-site, and those severely hypothermic to appropriate centres, is enabled using the integrated avalanche resuscitation algorithm.

CONFLICT OF INTEREST

None of the authors have any financial conflict of interest. All authors have published on mountain medicine.

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Perception of Risk in Avalanche Terrain

ALTHOUGH AVALANCHE TRAINING AND THE RISK MINIMIZATION STRATEGIES HAVE GREATLY EVOLVED AND ARE BEING WIDELY TAUGHT TO RECREATIONAL AND PROFESSIONAL USERS, TOO MANY SERIOUS ACCIDENTS CONTINUE TO HAPPEN WITHIN THE EDUCATED USER GROUPS. WHEREAS MISINTERPRETATION OF THE HAZARDS AS WELL AS THE COMPLEXITY AND UNCERTAINTY OF HAZARD ASSESSMENT ARE POTENTIAL CAUSES FOR SUCH ACCIDENTS, A FAULTY PERCEPTION OF THE PROBABILITIES OF ACCIDENTS AND THEIR IMPLICATIONS MIGHT BE A MORE IMPORTANT FACTOR, IN PARTICULAR WITH TRAINED USER GROUPS.

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ALTHOUGH ABSOLUTE numbers of terrain users and accidents can only be estimated, it is reasonable to assume that the case fatality rate of recreational activities in avalanche terrain has decreased considerably over the last 30 years. Despite all these efforts and the higher level of awareness, the pattern in the remaining accidents in many countries remains the same. The key to the reduction of future accidents might not be in increased investments within the traditional fields, which are already part of avalanche awareness and training in most countries, but rather a higher level of awareness on how to interpret the probabilities and potential consequences. This calls for a higher level of understanding on how low-probability/high consequence events can to be transformed to real life decision-making. Comparisons with activities including similar case fatality rates are not easy, as there are only few activities with so few regulations left as in mountain sport activities. Furthermore, different utility functions within user groups influence the risk behavior. Finally we suggest ways of dealing with risk perception in curricula for avalanche courses.

INTRODUCTION

Avalanche accident prevention work has improved markedly the last few decades; many of the methods we have available today are quite sophisticated. These include both regional avalanche forecasts, as well as decision support systems for the local level like the "reduction method" (Munter, 2003), its many derivates and similar approaches. In addition, methods for consequence reduction like efficient rescue systems and personal protection equipment such as floatation devices have also developed significantly the last decades and they are in common use. Regarding preventive measures, it seems as if most of the low hanging fruit have been picked by now. Further significant developments in forecasting, snow stability test methods, consequence reduction measures, and so on will probably neither be easy nor come cheap.

Still, quite a few winter trips with experienced winter mountain users end in fatal avalanche accidents (e.g. Atkins, 2000). One can ask why this is the case, especially when most of the accidents occur under conditions where the avalanche hazard is rather obvious according to the methods used and taught today (McCammon, 2004).

Today most mountain users can assess the probability of avalanche release reasonably well and the potential consequences are often possible to guess by considering the terrain features and so on. The chances of being "fooled by randomness" regarding snowpack stability is always present of course (see Munter, 2001) and this is important to point out. But the inherent randomness does not explain the high number of accidents in obviously hazardous situations. If we regard the exposure to the potential hazard of avalanches as a conscious

choice, then today's fatality rates among experienced winter mountain users are maybe something that actually reflects the risk levels considered acceptable by these people. Thus they may be just the result of a utility maximization among the winter mountain users—the personal benefit of being in the mountains is worth the cost in terms of a certain probability of dying in an avalanche.

The underlying assumption is of course that people behave in a rational manner and that they weigh relevant information before making a decision. However, numerous psychological studies have shown that this is often not the case (not even in economics where the methods are well established).

In this paper we would like to focus on the winter mountain skiers that may take high risks without being aware of how real the potential of a negative outcome is. That is, people who would, given the right kind of information and framing, choose to be compliant to the recommendations of the available risk calculation methods.

DISCUSSION

Benefit

In life, nothing is achieved without taking risk. A rational agent takes risks when the expected utility value is sufficient. All things being equal, the greater the benefit, the greater the tolerance for a risk. Although individual risk tolerance varies, society will sometimes determine what is acceptable in the form of legislation and regulations, but these commonly lack any quantification and are open to interpretation. It is sometimes argued that the present accident statistics reflect society's risk acceptance, but often this cannot be said to be the case since considerable effort is done to reduce the number of accidents.

Utility functions are of course also subjective and individual. Some really do want lives that are "intense and short." But most probably do not. Research in psychometrics (Slovic, 2000) has shown that risk perception is more dependent on experience and emotions, than a realistic assessment of probabilities. When asked directly, people generally had lower risk tolerance than what was reflected in societal risk.

If there are flaws in the general perception of risks, then this should be addressed if we want to reduce the number of fatalities further. A main problem with the perception of risks seems to be the ability to translate the abstract probabilities into personal life consequences. In particular regarding trained user groups, it seems that a flawed perception of the probabilities of accidents and their implications might be the most important factor.

Probabilistic reasoning

Probabilistic reasoning has been called "The Achilles' heel of Human Cognition" (Stanovich, 1992). Experiments of gambling have shown that people are notoriously bad at evaluating probabilities, especially when the feedback is slow or infrequent. A now well-known finding was that people use more often heuristics to evaluate information. Being useful shortcuts when quick decisions are called for, they often lead to faulty judgments of the probability of something happening and they can become dangerous cognitive biases (Kahnemann, Tversky, 1979).

Another problem is that the chance of releasing an avalanche in a specific slope is a single event probability. But the human mind may have evolved to think of probabilities as relative frequencies in the long run, not as numbers expressing confidence in a single event (Pinker, 1997). It can be claimed that single event probabilities in principle cannot even be handled by probability theory, since the single event will have its very own specific features. Gigerenzer (2000) suggests that people often retort to non-quantified definitions of probabilities like "degree of belief" and terms like "weight of evidence" and "reasonable doubt." A reason for this may of course be that

FIG. 1: THE RELATIONSHIP BETWEEN FATALITY RATE AND THE PERCENTAGE OF "NO GO" SITUATIONS

reliable frequency data are often hard to come by or apply to a specific situation.

Formal probabilistic reasoning is a fairly recent invention. Even more recent is the possibility to input high quality data gathered and checked by teams and institutions to the formulas for probability. This is a big step from the hearsay and rumors that our ancestors had to rely on—and using only one's own experience from accidental avalanche releases as a base for frequency assessments obviously has large disadvantages.

Using numbers to describe the probability of a single event are commonplace nowadays: weather forecasters use them every day in messages to the public about what percent chance of rain there will be tomorrow. The probability of rain at a specific location, or for a single avalanche release, can never be exactly determined as many of the individual input variables cannot be precisely determined. Therefore, in this paper, probability refers to relative frequencies in the long run (mean values).

Risk tolerance

Many attempts have been made to regulate societal risk tolerance. A Tolerable Risk (TR) framework has for example been suggested by the British Health and Safety Executive (HSE) during its work on the safety of nuclear power plants (Scarlett et al., 2011).

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The HSE has based risk thresholds on risks commonly accepted by the public, such as the risk of death from rock climbing, high-risk professions, and traffic accidents (HSE, 1992). The HSE determined that the highest level of risk the general public would bear in order to receive some benefit was roughly one in 10,000 (deaths per year), corresponding to the highest mortality rate in the average population (for 15-25 year old males). Risks with a chance of less than one in 1,000,000 (deaths per year) were generally considered by the public to be inconsequential (HSE, 2001). The region in between is then considered tolerable, although not immediately acceptable.

Lifetime risk

In the book *3x3 Lawinen* (Munter, 2003) and in other forums, the author discusses the case fatality rates of winter mountain skiing. An estimate of the ski tour case fatality rate (avalanche accidents) in Switzerland in the 1980s corresponds to about one death in 36,000 ski touring days. A high number of tours per winter (i.e. exposure) with this case fatality rate could easily enter into the unacceptable region if one would use the HSE Tolerable Risk (TR) framework for annual fatality rates. A use of 1/100,000 as a base rate for winter mountaineering seems nevertheless reasonable (Munter, 2008). Compared to other risks this can still be seen as rather high, but it can be seen as the price that we must pay for the freedom of the mountains (Munter, 2008).

Legal cases concerning risk and negligence are often complicated, and outcomes can be unpredictable. If we want to prevent arbitrary judgments in court, it is important to define reasonable risk thresholds in winter mountaineering.

It is possible to apply these thresholds to the framework of the Reduction Method (RM). The method is based on the assessment of five key variables: general danger level; slope inclination; slope aspect; previous skiing; and load, which are weighted and integrated (Munter, 2003). In short, the weighted general danger rating is divided by the product of at least three weighted observations from different levels: regional, local and slope (on site level).

The risk level is expressed as an RM-value, which in principle can be any number from zero to 32. Analyses of the Swiss accident data from the 1980s imply that an RM of 2.2 corresponds to the accident rate of this particular period, while an RM of one corresponds to the suggested acceptable case fatality rate of 1/100,000.

The term "Limits" was introduced by Munter (2003) to define a maximum reasonable risk level, akin to "The Stupid Line" used by Tremper (2007). This corresponds to an RM level of 2, or a fatality rate of 1 in 50,000 ski tours, i.e. close to the historical fatality rate from the 1980s. RM=4 stands for the average residual risk which had been taken in multiple fatality accidents in Switzerland in the 1980s with five and

TABLE 1. THE PROBABILITY OF A FATAL ACCIDENT AS A FUNCTION OF EXPOSURE. TYPICAL EXPOSURES ARE ASSUMED FOR THE CATEGORIES OF USERS.					
USER GROUP	EXPOSURE	SUM OF ACTIVITY DAYS IN A LIFETIME	CASE FATALITY RATE AT RM 1	CASE FATALITY RATE AT RM 2	CASE FATALITY RATE AT RM 4
			RISK PROFILE		
			Rewarding with minor limitations and a reasonably long life	Close to the "Limit"	Intense, but short life
ACTIVE FREERIDING	50 day per season for 15 years	750	1 in 130	1 in 65	1 in 30
ACTIVE SKI TOURING	20 days per season for 50 years	1000	1 in 100	1 in 50	~1 in 25
VERY ACTIVE SKI TOURING	50 days per season for 20 years, followed by 30 days per season for 30 years	1900	~1 in 50	~1 in 25	~1 in 12
PROFESSIONAL MOUNTAIN GUIDE	100 days per season for 20 years, then 30 days per season for 20 years	2600	~1 in 40	~1 in 20	~1 in 10

more fatalities. This is equal to a case fatality rate of 1:25,000. Munter suggests to keep the activities whenever possible to RM smaller or equal to one and to use the extended range of motion given by RM=2 (Limits) only in special situations under special circumstances. For novice users, the elementary reduction method targets for RM=0.5 to allow for extended error tolerance. However it has to be understood that these residual risk values always represent a mean value due to uncertainty in determining the input variables of the reduction method. For RM=1, the case fatality rate in a single event may have a stray effect between 1:50,000 and 1:200,000 which is equal to a factor two error. Higher error factors are unlikely.

With this approach it is possible to conveniently visualize the accident probabilities for different categories of mountain activities. Table 1 shows the probability of a fatal accident during the period in life in which they are pursuing their activity, when estimates of typical exposures are assumed. It is natural to strive to get the most out of one's chosen activities, without being subject to unacceptable risks and a likely early death.

A long term study over 5,000 guided touring days of the DAV Summit Club (source: Peter Geyer) shows retrospectively that the mean risk of all activities when respecting RM<=1 corresponds to RM=0.8. A reduction to the risk profile to RM 1 for most users therefore seems feasible and an acceptable restriction of freedom, versus the benefit of a longer life as a ski tourer.

This corresponds to light grey area of the curve graph (Fig. 1) suggested by Munter (2008) on the relationship between fatality rate and the percentage of "no go" situations. Further reduction of the case fatality rate is possible, but only at the cost of an increasing number of missed tour opportunities. The percentage of the backcountry users who are willing to comply with the proposed rules of behavior would probably also decrease markedly.

CONCLUSION AND SUGGESTIONS

Today it is more or less common knowledge among experienced skiers, guides or group leader that many cognitive biases influence decision-making. The problem may be an understanding of what the probabilities of fatal accidents actually means for the individual.

A way of countering the tendencies of un-reflected high risk behavior could be to introduce a "Code of Honor," which states that professionalism should be valued more than perceived heroism (that most likely is just a consequence of luck) and includes these invariable rules:

Elementary precautions:

- Always carry a probe, shovel and transceiver.
- Heed alarm signs such as whumpfing, recent avalanching or remote triggering. Each of these should be considered a stop criterion and encourage a search for gentler terrain.
- Keep distances in case of doubt.

Respect the Limit RM < 2 (for more details, see Munter (2003)):

- Avoid terrain of >30° at danger level High.
- Avoid terrain of >40° at danger level Considerable.
- Avoid untracked terrain of >40° within sector North at danger level Moderate.

Other measures that we feel should be discussed are the following:

- Risk Classification of tour routes. Tour route descriptions should preferably include a risk category (and not just the technical difficulty). This will require some sort of universal risk classification scheme. (Promising work has already been done regarding this item by the Canadian Avalanche Centre in their avalanche terrain exposure scale classification scheme((Campbell, 2010). This could be expanded to include a general description of a typical risk exposure.)
- Develop simulation training set up with fast feedback. (The lack of fast feedback prevents internalizing of objective risk perception).
- Reframing the activity in a way that prevents loss aversion and other bias (i.e. the tour is the goal, not necessarily the summit).

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Rapid Surface Cooling Effects on Snow Slopes and Asphalt Pavements Compared

Colin D. Johnston

PENNY GODDARD'S "COOLING OFF: THE RELATIONSHIP BETWEEN COOLING AND AVALANCHES" IN VOLUME 102 OF *THE AVALANCHE JOURNAL* DEALT WITH FIELD EXPERIENCES WITH SO-CALLED COOL-DOWN AVALANCHES (CDAS) THAT OCCURRED UNEXPECTEDLY AFTER RAPID COOLING WITHOUT ANY OBVIOUS EXPLANATION. THE PAPER PROMPTED ME TO WONDER IF RAPID COOLING AT THE SNOW SURFACE AND THE RESULTING THERMAL GRADIENT THROUGH THE DEPTH OF A SNOW SLAB COULD CAUSE CRACKING DUE TO THERMALLY-INDUCED TENSILE STRESS, AS HAS BEEN WELL DOCUMENTED FOR ASPHALT TEST PAVEMENTS.

WHETHER ANY SUCH CRACKING would induce avalanching would depend on whether or not the assumed weakening of the slab would cause the shear stress at the active weak layer to reach its shear strength. This is just as the weakening associated with whumphing and consequent cracking caused by an approaching skier/rider will sometimes produce avalanching and sometimes not. University of Calgary research on rutschblocks indirectly supported the association between slab weakening and cracking (Jamieson and Johnston, 1992). We found that for relatively weak slabs (rutschblock scores of two or three), standard tests with the upslope side precut (pre-cracked, in effect) scored about half a point lower than the corresponding (non-standard) tests with the upslope side not cut—therefore capable of providing upslope tensile support.

Back in the 1970s when I taught a graduate course on asphalt pavements, low-temperature transverse cracking of asphalt pavements in winter was and remains a major cause of pavement deterioration. University of Alberta research (Christison, et al., 1972) on instrumented test pavements in Manitoba and Alberta exposed to winter conditions reveals how rapid surface cooling and the resulting thermal gradient and consequent tensile stress gradient can cause cracking. Like the reported CDA events, it happens in the absence of live loads and under conditions of rapid and severe cooling when the pavement stiffens/hardens and becomes more brittle. At this time, there seems to be no clearly verifiable explanation for the phenomenon. Floyer (2012) has proposed a mechanism based on lateral variations in slab thickness and consequent depth of the active weak layer.

My ideas consider the simplest case of continuous slabs/pavements assumed to be of uniform thickness, microstructure and density. The snow slabs of interest are, of course, bonded to an underlying weak layer on a stronger midpack, which may provide some restraint to any contraction tendency of the slab on cooling. The pavements are on compacted subgrade or granular base, which likewise provides some restraint to pavement contraction due to interfacial friction. Pavements are essentially uniform in thickness, microstructure and density while snow slabs are rarely uniform in these characteristics, but I believe that there are similarities worth considering.

In the case of pavements, asphalt (the binder in the paving mixture) changes its behavior from predominantly viscous to viscoelastic to predominantly elastic as the pavement temperature drops from 40°C on a hot summer day to -30°C or colder in winter. The University of Alberta researchers used temperature measurements at various depths in the test pavement along with stiffness moduli and determinations on cores taken from the pavement to calculate thermally-induced tensile stresses over 24-hour periods. Several analytical approaches were used in stress calculations. They showed that the maximum thermal stress occurs at or near the surface, and a high stress gradient exists through the depth of the pavement. For example, in a 25cm full-depth asphalt pavement, they showed the stress at the shallowest depth evaluated—1.3cm, which they deemed the maximum—could reach or exceed (depending on the method of analysis) the tensile strength. At the other depths

evaluated—6.4, 14.0 and 24.1cm—the stress decreased sharply with depth to less than 10% of the maximum at the 24.1cm depth, confirming a high stress gradient.

They also showed that for 10cm thick pavements on granular base, the more common form of construction, the calculated maximum stress at depth 1.3cm could likewise significantly exceed the tensile strength. Cracking is expected if this maximum reaches the tensile strength. They found reasonable agreement between predicted and observed cracking, or absence thereof, as the test pavements with different asphalts went through 24hr winter climatic temperature cycles with minimums on the order of -25°C to -40°C. Of the five methods of analysis used to calculate the maximum thermally induced tensile stress, the best fit with field observations assumed that strength and stiffness modulus in uniaxial tension can reasonably be estimated from indirect splitting tests on cylindrical cores loaded transversely across a diameter. It also embodied assumed values for coefficient of thermal expansion/contraction and Poisson's ratio.

So is it possible that a uniformly thick snow slab on a constant slope can be subject to a thermally-induced tensile stress gradient on rapid surface cooling with the maximum stress reached near the surface being sometimes sufficient to cause cracking? And could such cracking in a slab on a weak layer where the shear stability index is already close to 1.0 weaken it further to the point of triggering slab release?

To address these questions we need to know more about the properties of snow and asphalt, specifically tensile strength, stiffness modulus, thermal conductivity, and, perhaps most important, the thermal coefficient of expansion/contraction. Compared with a snow slab, an asphalt pavement is relatively simple. The active ingredient, asphalt, is uniform with constant density and microstructure interspersed with inert granular particles that have little effect on the pavement properties. The thermal conductivity and coefficient of expansion/contraction are essentially the same for all paving asphalts, and the important differences between them mainly involve tensile strength and stiffness changes with change in temperature that are reflected in the performance of the corresponding pavements. In contrast, the typical snow slab above the active weak layer can incorporate major differences in microstructure and density with depth and consequent differences in tensile strength, stiffness and thermal conductivity.

The coefficient of thermal expansion/contraction with change in temperature is key to how a temperature gradient produces a strain gradient and, depending on stiffness, a consequent stress gradient as the cooler surface material contracts against the restraint of the warmer material deep down. For asphalt pavement it is of the order 0.000027/°C (Christison et al, 1972). For ice, and presumably the ice grains that form snow, it is significantly greater at 0.000050/°C (Libbrecht website), suggesting a greater dimensional contraction per degree of cooling in snow than in asphalt pavement. The uniaxial tensile strength of the snow samples we tested (Jamieson and Johnston, 1990) ranged from 1kPa to 9kPa and was primarily and strongly dependent on density and secondarily on microstructure (faceted grains weaker than rounds at the same density), while the splitting tensile strength of the pavement samples (Christison et al, 1972) was of the order of 2000-4000kPa at temperatures below -20°C. Differences in stiffness, which are of course time and temperature dependent for both materials, are likely also very large.

Despite the differences between them, the similarities are that both a snow slab and an asphalt pavement on rapid surface cooling are subject to a temperature gradient across their depth. In pavements, this has been shown to cause a strain gradient and, depending on stiffness, a consequent stress gradient as the cooler surface contracts against restraint by the warmer material deep down. When the 24 hour cyclic cooling is severe enough in terms of the minimum temperature reached, usually -30°C or lower, cracking occurs for some asphalts in their first winter and for most asphalts at a later time as they become more brittle with age. So it seems reasonable to expect similar cracking if the cooling is rapid and severe enough (in terms of rate and minimum temperature) for snow slabs with certain critical characteristics that lead to an induced tensile stress exceeding the tensile strength. This could conceivably go unnoticed in many cases and be inconsequential. However, if such "critical" slabs are on a weak layer with the shear stability factor close to 1.0, it seems possible that such cracking could weaken the slab enough to cause an otherwise unexpected slab release. Could the Mistaya Lodge and Lanark events reported in Penny Goddard's paper, where deep recently deposited slabs were cooled overnight from -3°C to -13°C and -17°C respectively prior to releasing, have been triggered in this way? In the absence of a verifiable answer, I admit that this is speculation, but I believe the analogy with known asphalt pavement behavior merits further thought and consideration by avalanche experts who must deal with such "surprise" events.

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An Interactive Web-Based Approach for Avalanche Control Data Management

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AVALANCHE CONTROL OPERATIONS ARE FACED WITH THE DAUNTING TASK OF MAINTAINING AVALANCHE CONTROL ROUTES AND ARTILLERY-CONTROLLED AREAS. IN THIS DIGITAL AGE, THE MAJORITY OF OPERATIONS STILL MAINTAIN AND ARCHIVE THEIR ROUTES, SHOT LOCATIONS AND RESULTS ON PAPER. ALTHOUGH THIS METHOD OF RECORD KEEPING IS SUFFICIENT, IT DOES NOT READILY LEND ITSELF TO THE IMMEDIATE USE OF DATA FOR QUERYING AND IDENTIFYING PATTERNS.

ADVANCEMENTS IN DIGITAL mapping and web-based environments allow for an interactive application that combines the input, storage and analysis of operational data. This provides snow safety personnel the ability to data mine archived data and identify patterns in a visual environment.

From 2009 to 2012, Snowbird Ski Patrol used GPS to collect shot locations, avalanche starting zones, transitions and runout locations, along with aspect, slope and elevation of starting zones for each of its control routes. A web-based Geographic Information System (GIS) application was built using the route data combined with imagery and terrain data to create an interactive atlas of the Snowbird Snow Safety operation.

This application provides a method for control results to be directly entered into a database from any internet location increasing flexibility and usage of the application data. Once entered into the database, the results are immediately available for querying and viewing. Not only is this application an operational management tool and knowledge base, but it captures institutional knowledge that may otherwise be lost. In addition, explosives accountability and tracking are simple by-products of the data and reports that can be generated easily by the application. The application can be customized for any organization performing avalanche control measures.

INTRODUCTION

Effective risk management practices begin with having solid data to base decisions on. For snow safety, the data collection and management process can be a very daunting task, given the extent of the control area and the number of control locations. The primary goal of snow safety is to keep snow enthusiasts within avalanche control areas safe, not to spend their time being data managers. The value and the usefulness of the avalanche control data collected and archived is often overlooked leading to many snow safety newcomers asking what happens to the data they spend hours each season writing down on paper. A web-based application has been developed to assist with the data collection and risk management practices of snow safety and to ease the burden of maintaining good data while allowing easy access to the archived data. This ability to have immediate access to the data can be critical to snow safety operations and making informed decisions.

STUDY AREA AND DATA

The pilot project for the development of this application is Snowbird Ski and Summer Resort located in Little Cottonwood Canyon of the Wasatch Mountains in Utah. Snowbird consists of 10 skiable square kilometers (2,500 acres) with a vertical drop of 988m (3,240ft) and an elevation that ranges from approximately 2,345m (7,700ft) to 3,353m (11,000ft).

Over the course of three seasons from 2009 to 2012, locations were collected using Trimble mapping grade GPS units along 43 control routes, consisting of 676 shot locations, avalanche starting zones, transitions and runout locations. In addition, aspect, slope and elevation of starting zones for each of its control routes were collected. The collected data was then added to a Geographic Information System (GIS) running a Microsoft SQL Server database backend. The collected data was then overlaid on aerial imagery and elevation data that provided basemap reference data.

The historical control results of the mapped shot locations dating to 1973 were added to the database to provide a historic archive of avalanche activity at Snowbird. The historic data consists of the data variables previously collected on the paper control result forms. The variables currently being collected include date, route, shot, path name, personnel, number of shots used, duds, results, type, size, layers, method, fracture line height, fracture line width, vertical run, percentage of path, comments, and photos. Variables are stored in Snow, Weather, and Avalanches: Observational Guidelines for Avalanche Programs in the United States (SWAG) compliant formats. The database schema can be altered to accommodate different variables and standards to meet the needs of an organization.

APPLICATION

The value of collecting avalanche control data is that one can review, analyze, display, and have a historic record of the snow safety control events that

FIG. 1: INTERFACE SHOWING ALL THE ROUTES ON THE IMAGERY BACKGROUND AND THE DROP DOWN OF ROUTES AVAILABLE ON THE LEFT.

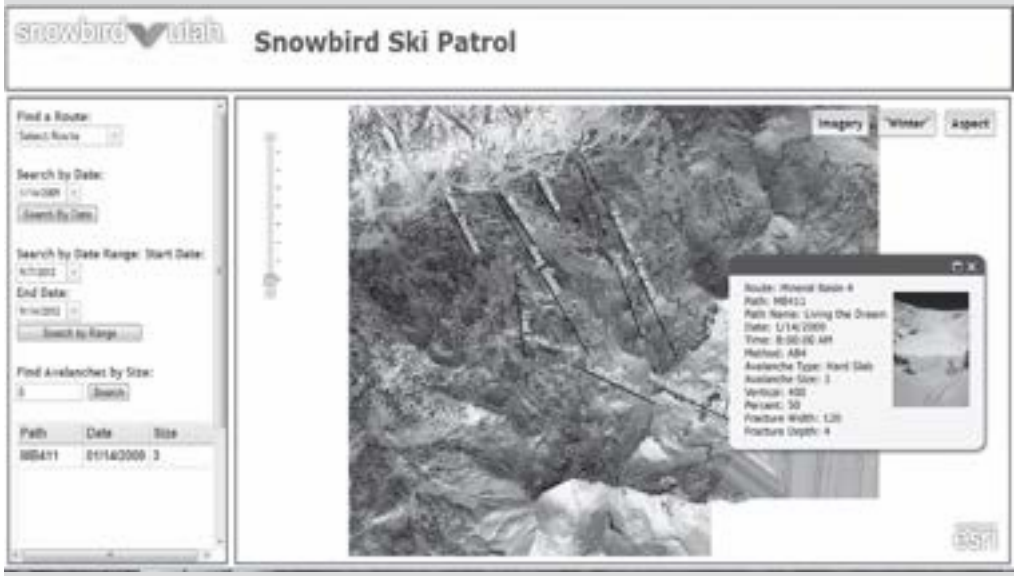

FIG. 2: DATE QUERY RESULT INFORMATION WINDOW DISPLAYED ON THE "WINTER" BACKGROUND.

FIG. 3: NEW DATA ENTRY FORM FOR THE SELECTED CONTROL SHOT LOCATION.

have occurred. Often ski patrollers and snow safety personnel collect data first in a paper format and then when personnel need light duty work or there is a lull in the season, the data is entered in to some digital format. The digital data may or may not be accessible by most personnel and may also be difficult to access. This rather outdated data collection approach diminishes the value of the collected data and its ability to be used by others. The original goal of developing this application was to create a system that would provide ski patrol and snow safety with access to the control results data that was collected in an interactive visual spatial/map environment that could be queried immediately upon request and assist in decision making. In essence, the primary goal is to add value to data that more often than not remains filed in a notebook or stored in an inaccessible digital data format.

The application goal was achieved by developing an interactive web-based GIS system using ESRI's ArcGIS Server 10.0 platform with a SQL Server database backend. The application is accessible via the Internet and consists of a basemap, overlayed with the shot locations of all the routes or a selected route. The user has the choice of a snow off aerial image, a "winter" snow on image created from highly detailed elevation data or an aspect map as the background basemap. The shot locations are color coded according to the route they are part of and displayed on top of the basemap. Routes are selected by using a dropdown menu (see Fig. 1). The user has the ability to zoom in, zoom out, and pan around the image. Each shot location is selectable and when selected the route, path, path name, elevation, aspect, and slope are listed in an information window along with links to photographs of the shot and an add results form.

In addition to being able to see the shot locations, proximity of routes, and associated terrain information, the user can also query the shot results data to display the avalanche results by defined time period, avalanche class, aspect, and elevation. The available queries can be easily customized to the user group and their preferences and the data can be queried according to any of the data fields contained in the database (see Fig. 2).

This application also streamlines the data entry process. Through a web-based data entry interface (see Fig. 3), users are able to add their control results directly in to the database eliminating the need for paper forms and subsequent data entry. Drop down lists and validation rules are used to ensure data consistency and accuracy when possible. By entering data directly into the database, the results are available for display and query in real-time.

Application security concerns are addressed by securing access to the website using password protected logins and restricted user roles. Users are assigned roles based on their responsibilities. Users are categorized into three types of users: 1) read only; 2) contributing; and 3) managing. Read only users are allowed to view and query the database. Contributing users have the same permissions as the read only user plus they are allowed to add new records. Managing users have the same permissions as contributing users and also have the ability to edit and delete records. All changes made to the database are recorded with the user login, date and time. The database is backed up throughout the day to insure against data loss using standard database procedures.

DISCUSSION AND CONCLUSION

The development of this application is intended to provide a platform for users to easily visualize, query, and capture data. The intent is not to answer any questions or make predictions, but instead to visualize and query the data in hopes of invoking questions and hypotheses that help in the snow safety decision making process.

With the current and historical avalanche results being archived in a commercial database with GIS capabilities, there are many potential uses for this application. First and foremost is the improved record keeping and data management. The additional steps needed to convert paper data to a digital format are eliminated and the ability to immediately verify the inputted data is added to the system. Users are able to input data and access the application from any internet connected computer (a mobile version is not currently available). The increased accessibility to the data allows snow safety personnel to review control results from all over the mountain and not just their individual control route and to query the data based on a number of variables. Snow safety personnel will also be able to review the conditions and control results on the mountain during their days off so that they are up to date on the activity occurring around the mountain on their return to work.

With the potential for stiffer explosive regulations always looming, this application provides an easy way to generate reports on the usage and distribution of explosives. Since the user enters the type and quantity of explosive used and its location, it is now a straightforward database query to identify the total volume and location of explosive usage over a season or any given time period or spatial area.

In addition, institutional knowledge about the individual shot locations and their potential transition and runout zones is captured during the initial data collection phase further increasing the value of the data. By input of remarks into a comments field, continuing institutional knowledge is captured and stored for future reference by all. This application can also be used during training to familiarize new mountain operations personnel to the routes and potential avalanche areas and provide a window in to the historical activity of the area.

The types of queries available to the user are determined by the data collected and the preferences of the user group. The current application has several pre-built queries in place. As Snowbird Snow Safety operationally uses the application during

the 2012-2013 season the available queries will be updated based on user feedback to meet the needs of the group. The application is easily customizable and implementing new queries is a straightforward process.

The web-based application and its GIS and database framework is portable and customizable to any potential avalanche control prone area making it easily modified or adaptable for any organization that conducts avalanche control operations.

Future application work consists of allowing users to interactively add new shot locations instead of just being able to add new records to existing mapped locations. The ability to map the extents of an avalanche by "drawing" in the outline of the avalanche and adding comments is currently under development. In addition, the ability to link visual weather data (currently a separate program presented by P.B. McNeally at ISSW 2006 and 2008) with this application to create a one stop environment for reviewing control activity and weather data would be a powerful enhancement.

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Interference Issues Concerning Avalanche Rescue Transceivers

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INTRODUCTION

Metal parts, magnets and any kind of passive or active electronics potentially cause interference for a transceiver. This may lead to the following effects: detuning of the antennas (TX and RX); persistent magnetization of the antennas (TX and RX); increased power consumption (TX); reduction of transmitted field strength (TX); inability for proper signal detection in digital search modes (RX); reduction of receive range due to receive filters opening up to a broader frequency range (RX); and increase of noise in analog sound (RX).

Whereas metal parts may detune the antennas and shield the signal, active electronic devices are likely to cause interference resulting in a higher noise floor and/or arbitrary distance and direction indications. The mass, dimension and characteristics of metals and the amplitude and frequency spectrum of the electronic and electromagnetic interference influence the extent of problems created for the transceiver. It is important to understand that for many sources of interference, the amplitude of the harmful interference increases with proximity by a power of three to distance, i.e. if a certain electronic device causes an interference ring amplitude of level two to the transceiver at a 20cm distance, the interference reaches an amplitude of level eight at a distance of 10cm.

CONCEPT OF INTERFERENCE AND CONSEQUENCES FOR TRANSCEIVER TECHNOLOGY

When speaking about electronic and electromagnetic interference, it is important to understand that an interfering signal may directly influence the electronic circuits of the transceiver and/or be picked up by the antennas of the transceiver. The frequency spectrum of interference often includes frequencies exactly on or close to 457'000Hz, in particular when taking into account that multitudes of harmonics may be in this spectrum. Therefore, the interference is in the avalanche rescue transceiver frequency range and can make exactly the same impression to the receiver as the signal of a buried subject. Electronic and electromagnetic interference with different characteristics influence the transceiver in different ways, however, it is crucial to understand that an incoming interfering signal may look to the receiver exactly the same as a "real" signal transmitted by a buried subject. Therefore, the rescuer may experience that the transceiver shows arbitrary distance and direction indications exclusively caused by interference in an area where there is no buried subject or the distance to the buried subject is much greater than the maximum range of the receiver (signal search phase). The difference in amplitude of interference compared to the amplitude of the real transmit signal of a buried subject is an important factor which influences to what extent the search may be compromised (SNR = signal to noise ratio).

Therefore, we may conclude: 1) the weaker the signal of the buried subject, the lower the tolerance for interference; and 2) a transceiver with high sensitivity has the capability to pick up very weak signals from buried subjects in a far distance (=long range); however, this equally means low tolerance for interference.

- the longer the range of a device, the more it is susceptible to interference.
- the shorter the range, the lower the sensitivity of the device for "real" signals as well as for interference.

MATRIX OF INFLUENCE AND POTENTIAL CONSEQUENCES					
DISTANCE BETWEEN RESCUER AND BURIED SUBJECT	INTERFERENCE AT RESCUER'S POSITION	INTERFERENCE AT BURIED SUBJECT'S POSITION	AMPLITUDE OF INTERFERENCE AT RESCUER'S LOCATION	AMPLITUDE OF SIGNAL OF THE TRANSCEIVER OF THE BURIED SUBJECT AT RESCUER'S LOCATION	OUTCOME
Out of range, signal search	Low interference, all rescuers on scene compliant to rules	Irrelevant for rescuer's position	Very low	Lower than maximum receiver sensitivity	Signal search not compromised, no arbitrary distance and direction indications, white noise on low level in analog sound
Out of range, signal search	Strong interference, from interfering device with normal interference level closer than 50cm or strongly interfering device in greater distance than 50cm or on other rescuer	Irrelevant for rescuer's position	Medium to Strong	Lower than maximum receiver sensitivity	Signal search compromised, arbitrary distance and direction indications, increased noise level in analog sound
Coarse search, 80+m distance, analog sound only	Low interference level, all rescuers on scene compliant to rules	Irrelevant for rescuer's position	Very low	Very weak signal	Coarse search not compromised, weak, but detectable analog sound
Limit of digital range, i.e. 50m distance	Low interference level, all rescuers on scene compliant to rules	Irrelevant for rescuer's position	Very low	Weak signal	Coarse search not compromised, no arbitrary distance and direction indications, multiple burial algorithms work properly, clean analog sound
Limit of recommended signal search strip width, e.g., 25m distance (2x25m = 50m)	Low interference level, all rescuers on scene compliant to rules	Rescuer/receiver: Irrelevant for rescuer's position Buried subject/transmitter: Very strong; e.g., caused by mobile phone turned on, running video camera with wireless functions or larger metal object and *safety distance compromised* due to displacement of equipment on the body during the course of the avalanche	Very low	Very weak signal	Search strip width may be compromised; if search with recommended search strip width does not lead to success, cut search strip width in half
Limit of recommended signal search strip width, e.g., 25m distance (2x25m = 50m)	Strong interference, from interfering device with normal interference level closer than 50cm or strongly interfering device in greater distance than 50cm or on other rescuer	Irrelevant for rescuer's position	Medium to Strong	Weak to medium signal	Search strip width may be compromised, arbitrary distance and direction indications possible, performance of multiple burial algorithms compromised, increased noise level in analog sound
10m distance	Low interference level, all rescuers on scene compliant to rules	Strong, buried subject uses strongly interfering device in minimum allowed safety distance such as mobile phone turned on, running video camera with wireless functions etc.	Low	Strong	Coarse search not compromised, no arbitrary distance and direction indications, multiple burial algorithms work properly, clean analog sound
10m distance	Extremely strong interference due to high voltage power line, antenna mast. Affected radius may be larger than 150m, depending on voltage/ transmit power.	Extremely strong interference due to high voltage power line, antenna mast. Affected radius may be larger than 150m, depending on voltage/transmit power.	Very strong	Strong	Digital signal detections are likely to fail completely, multiple burial algorithms are very likely to fail completely, maybe only analog search with manual volume control possible, apply strongly reduced search strip width.
1m distance	Low interference level, all rescuers on scene compliant to rules	Strong, buried subject using strongly interfering device in minimum allowed safety distance such as mobile phone turned on, running video camera with wireless functions etc.	Strong	Extremely Strong	Fine search not compromised, no arbitrary distance and direction indications, Tracking of multiple burials in medium to longer distance compromised, clean analog sound on low volume/ sensitivity level

- long range and high interference tolerance are antagonists.
- long range leads to shorter burial times and therefore increased survival chances (Genswein et al., 2009).
- users have to know that their degree of compliance to the rules on avoidance of interference directly influences the efficiency of the rescue actions.

In cases where rescuers experience strong interference despite full compliance to the rules of avoiding interference, such as in proximity to high-voltage power lines, antenna masts, cableways, buildings etc., where the source of interference cannot be removed or turned off, switching the device to analog mode with manual volume control may be the only option to allow to search for the buried subject. Often this measure needs to be combined with a reduction of search strip width. Devices targeting the advanced recreational or professional user groups with the aim to provide a solution for 100% of the potential rescue situations such as an Ortovox S1, ARVA Link or Mammut PULSE Barryvox therefore offer such analog search options.

The reason behind the much higher tolerance for interference in an analog search compared to a digital search is the better performance of human hearing to detect to the "real" signal when a lot of interference is present and when the signal to noise ratio (SNR) is bad.

At last, interference degrading the performance and efficiency of the transmit function should be discussed. Transmit mode is less sensitive to interference than receive mode, therefore acceptance of interference is higher and most of the equipment and "gadgets" can be used with only minor restrictions, such as respecting a minimum distance of 20cm between metal parts, electronics (active or passive) and the transceiver in transmit mode. If the recommended safety distance is compromised as the equipment and clothing gets dislocated on the body during the course of the avalanche, the transmitted field strength within the nominal transmit frequency range may be reduced, leading to a shorter range in which the buried subject can be received. However, range reductions of more than 30% are seldom and would require detuning of the antenna and/or shielding of the signal by a massive or large metal object. In particularly negative cases, this may lead to the fact that the weaker signal of the buried subject is not picked up when applying the search strip width recommended by the manufacturer. The appropriate rescue tactical measure in such cases is to cut the search strip width in half, which practically means to search on the middle lines of the signal search pattern (i.e. if in the first phase a 50m search strip width has been applied without success, in the second phase, the signal search strip width pattern is shifted by 25m. This approach is equal to a second coarse search in a probe line with a shifted probing pattern when the first grid did not lead to success).

DETAILED RECOMMENDATIONS CONCERNING POTENTIALLY INTERFERING EQUIPMENT FOR PROFESSIONAL AND INSTITUTIONAL USERS AND SPECIAL APPLICATIONS

GENERAL RULES

Clothing

Avoid wearing clothes with magnetic buttons or larger metallic and/or conductive parts (e.g. nets of heated gloves).

Storage

Do not store the transceiver close to strong magnetic fields as they can magnetize the antennas with a long-term effect.

Magnets and electromagnetic fields

Some transceivers of several brands have a magnetic ON/ OFF or OFF/ SEND/SEARCH switch and therefore magnets in close proximity can turn the unit to OFF, SEARCH or SEND at any given moment.

Some transceivers of several brands contain an electronic compass and are, especially during search, highly sensitive to magnets and electromagnetic fields.

Transmit mode

In transmit mode, a minimum distance of 20cm has to be respected between the avalanche rescue transceivers and any metal object or electronic device. Although the distance where serious interference of transmit mode has to be expected is considerably shorter (<3cm) for many objects and devices, the likely displacement of a carrying system, clothing and potentially interfering objects due to the mechanical impact to the person taken by an avalanche has to be taken into account and therefore the recommended distance has to leave some safety margin.

Search mode

In search mode, a minimum distance of 50cm has to be respected between the transceiver and the listed objects below which can be used with a transceiver.

Definitive list of equipment that can be used with a transceiver

What follows is a list of objects and equipment (conclusive) that can be used with a transceiver, respecting the rules above. This conclusive list includes rescue or operationally critical equipment and equipment which is an integral part of mountain excursions.

For equipment that is critical for rescue or operationally but requires more restrictive rules than the 20cm safety distance in transmit and 50cm in receive mode, the exceptions are specifically mentioned.

General equipment:

- metallic frames of backcountry backpacks
- camping and cooking equipment, metallic vacuum bottles
- non-engine-driven snow sport equipment (skis, snowboards, snowshoes)
- climbing gear (carabiners, ice axes, crampons, etc.)
- electric head lamps excluding headlamps with switching power voltage regulators
- snow study kits including metallic snow saw
- improvised repair equipment and tools like pocket knives and pocket multi-purpose repair tools
- writing tools
- wrist watch without radio functions (may stay on the wrist)
- any kind of food, candy or cigarette box wrapping with metal foil

Search, rescue and survival equipment:

- flotation devices (including remote release device), Avalung, Avalanche Ball
- avalanche rescue transceivers
- devices providing a backup transmit function in case of a secondary avalanche
- RECCO search devices (3m distance and do not point directly to another rescuer)
- RECCO reflectors (reflectors may be placed at any distance without any risk of interference)
- avalanche probes and shovels (metallic and carbon probes may not be placed parallel to the snow surface during fine and pinpoint search)
- high performance lights and generators for night searches in organized rescue (strong interference may occur and affect a larger zone around the equipment. Interference should be checked with an analog receiver on the highest sensitivity setting and appropriate measures taken accordingly)

Vehicles:

- snowmobiles, snow grooming machines, cars, snowploughs, snow blowers (the search from such vehicles can be severely disturbed by interferences from the running engine, metal plates and the vehicle electronics. In transmit mode, reduction of range is possible depending on proximity of the transmitter to metal parts of the vehicle. Search accuracy might be compromised in close proximity of the vehicle)
- helicopters (the search from a helicopter is only efficient with specialized transceivers)

Medical equipment:

- pacemakers (users of pacemakers are advised to carry the device on their right side (adjust the length of the carrying straps. Consult the manufacturer's instructions of the pacemaker with regards to the interference impact).
- portable heart rate monitors (needs to be switched off during search or in 50cm distance to the receiver)
- first aid equipment, including metallic splints
- toboggan, immobilization equipment, stretchers

Communication equipment:

- analog VHF and UHF radios up to 5W transmit power (interference may occur during transmit of the searching rescuer. Loudspeakers of radios produce a strong electromagnetic field and should therefore not directly point towards the transceiver)
- digital VHF and UHF radio up to 5W transmit power (interference may occur during transmit, radio needs to be turned off during search)
- cellular phones, satellite phones, personal locator beacon (inference may occur during communication (including synchronization with the network, communication of text messages and data). Devices need to be turned off during search for all searching rescuers. As long as the search is in progress, use of these devices should be restricted to short-lasting emergency calls in minimum distance of 25m to the closest searching rescuer. Cellular phones in "airplane mode" may stay on during search in 50cm distance).

Orientation equipment:

- electronic and mechanical altimeters
- electronic and mechanical compasses
- handheld GPS receivers (except devices with radio transmit functions)

Equipment of armed forces and law enforcing agencies:

- guns and pistols, ammunition (weapons including optics, but excluding electronic systems; if the weapon is carried diagonally on the front side of the body, the transceiver must be carried sideways)
- body armor systems (carry transceiver sideways)

Non Rescue, Mountain or Operationally Relevant Equipment (all equipment not listed above)

The variety of electronic equipment (entertainment, video, photo, remote controls, etc.) that rescuers have been trying to use in combination with their avalanche rescue transceiver has grown tremendously in the past few years. Whereas some of the equipment might not cause an interference problem in combination with a particular transceiver, it does with others and vice versa. It is therefore impossible to make a recommendation for each individual device and transceiver. Several reports from failed or severely disturbed and delayed rescue action in the last years have shown that electronic equipment can have a very unpredictable and severe influence on avalanche rescue transceivers. Therefore, while a search is in progress on the avalanche, all equipment not listed above must be turned off and remain off on the entire avalanche for the short duration of the search compared to the entire duration of rescue.

High voltage power lines and radio towers may dramatically reduce the performance of an avalanche rescue transceiver as well. Often, the digital search mode completely fails and it is necessary to carry out an analog search by applying signal search strips with a very limited width.

RECOMMENDATIONS CONCERNING POTENTIALLY INTERFERING EQUIPMENT FOR RECREATIONAL USERS (SHORT VERSION)

Avoid wearing clothes with magnetic buttons or larger metallic and/or conductive parts (e.g., heated gloves). Be aware that food, candy or cigarette box wrapping often include thin metal foils that therefore count as a metal object.

In *transmit mode*, a minimum distance of 20cm has to be respected between the avalanche rescue transceivers and any metal object or electronic device.

In *search mode*, a minimum distance of 50cm has to be respected between the transceiver, electronic equipment and metals parts.

All equipment on the searching rescuer has to be turned off, except: radio; cell phone in airplane mode; head lamp without switch power voltage regulator (usually found in high power devices with external battery packs); wrist watch without radio functions on the wrist; devices providing a backup transmit function in case of a secondary avalanche.

All equipment on all non-searching rescuers on the avalanche has to be turned off, except: cellular phones, satellite phones, personal locator beacon (as long as a search is in progress on the avalanche, use is restricted to short-lasting emergency calls/messages in minimum distance of 25m to the closest searching rescuer); devices providing a backup transmit function in case of a secondary avalanche; head lamp.

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Danyelle Magnan is a Visitor Safety Tech working with Parks Canada's Avalanche Control Section in Rogers Pass, and an ACMG Aspirant Ski Guide.

I AM SOMEONE WHO LIKES to keep busy, a multi-tasker, and the Outdoor Research Sensor Gloves™ fit me and my personality well. These lightly insulated, fitted gloves are now my go-to for daily weather plot readings because the tight fit helps keep my writing neat. The TouchTec™ leather allows me to text, call and update my profile picture while walking the dogs or running errands. No more wasted time; but my cell bill might go up and I probably forgot to look at a sunset or two. Due to the close fit, I'm not using these as my "up-gloves" while touring because my hands get cold. I find that the gloves fit a bit small, which is my experience with OR ladies' gloves in general. Maybe I have man hands, but I find the fingers on the gloves are short. I would recommend these gloves, but my next purchase I'll size up.

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- The fit is a bit off for me

Departures

IAN TOMM
CAC EXECUTIVE DIRECTOR

I can still remember the phone call I got from Clair Isrealson in early April 2002: "Colani, Robin and I would like to know if you'd like to come work for the CAA." Without a pause, I replied with a very enthusiastic "YES." This was a chance to work for an organization I deeply respected and valued. I didn't want to disappoint, so there I began an incredible eleven-year journey with the CAA and eventually the CAC. Having worked through a number of positions, eras, critical incidents and eventually spending four years as the Executive Director of the CAA and CAC, I have a unique perspective on avalanche safety in Canada. As a community we have so much to be proud of, so much to celebrate and yet in other ways our work has just begun.

I'd like to take a moment to recognize all the great people that I've had the fortune of working with during my time with the organizations. There are too many to name everyone individually, but I am deeply grateful for the experiences and successes we shared and the challenges we overcame. While the time has come for my departure from the CAA and CAC, my involvement in the greater avalanche community in many ways has just begun. I look forward to what the future holds, and the experiences we will continue to share together.

Three individuals do deserve special attention however. I'd like to express my deep gratitude and sincere thanks to Steve Blake, Grant Statham and Ross Cloutier for their wise counsel, clear vision and unwavering support. It has been a true honor to work with each of you and I look forward to a time when we can work together again. If anyone would like to reach me, please feel free to drop me a line anytime at ian@cobaltsolutions.ca.

KRISTINA WELCH
INFORMATION TECHNOLOGY DIRECTOR

After two years at the helm of the CAA/CAC IT Department, Kristina Welch is leaving Revelstoke to pursue a Ph.D in rural development at Simon Fraser University. In her tenure with the organizations, Kristina launched the new public avalanche bulletin format and coordinated the successful rollout of AvalX, the new avalanche forecasting tool used by the Public Avalanche Warning Service for which the CAC, Parks Canada and Kananaskis Country recently won a government award.

Kristina also oversaw development of the CAC smartphone application to be launched in the fall of 2013. 'Working with a team of talented and passionate people has been the highlight of my time with the CAC," says Kristina. She looks forward to travelling in her time off.

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