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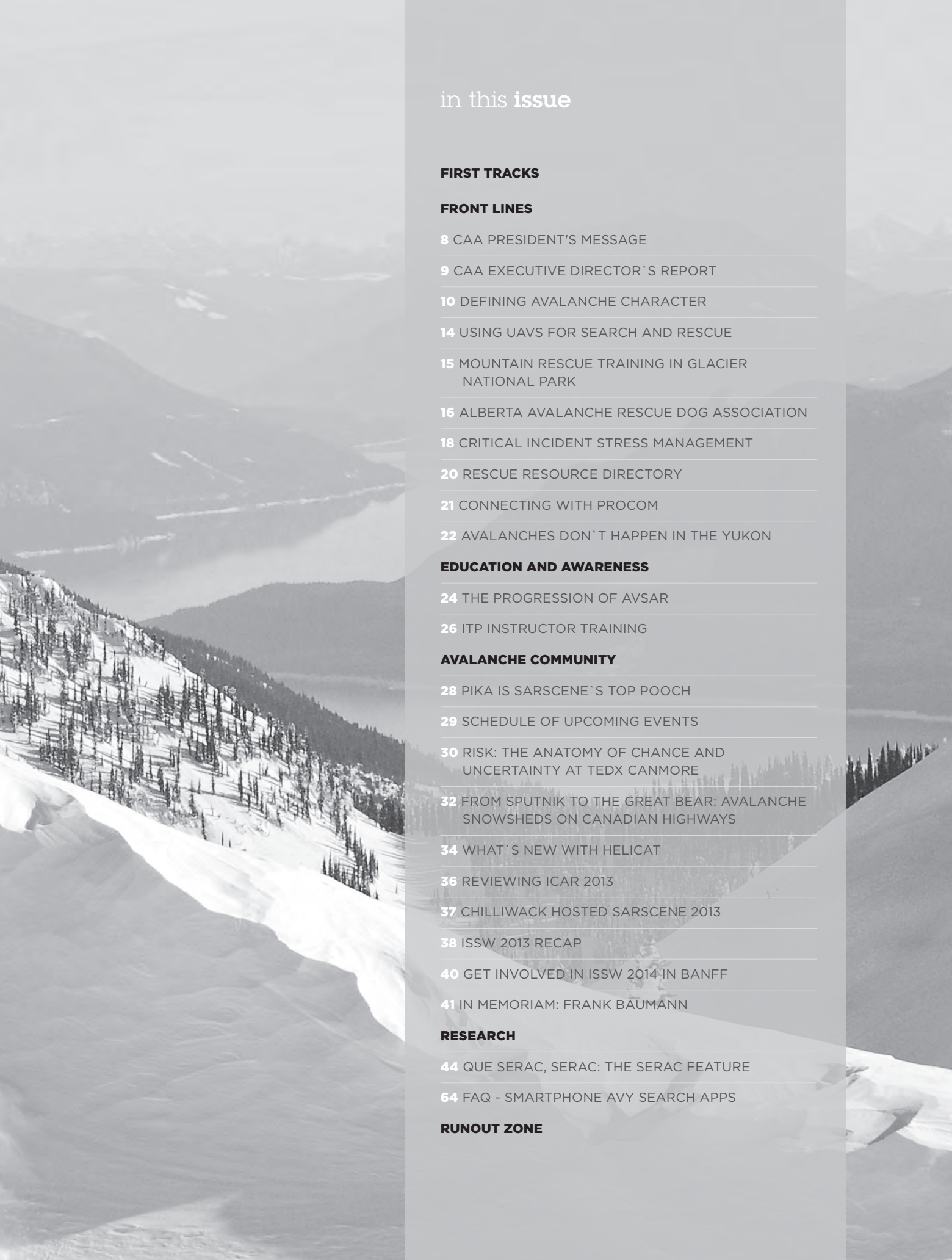

in this **issue**

Working **Together**

Karilyn Kempton
Managing Editor

THE MONTHS BETWEEN Labour Day and Christmas happen in a heartbeat, year after year. It always seems to be upon us before we know it. In the spirit of planning, we have tried to think well into the future about *The Avalanche Journal* and give aspiring authors plenty of time to write.

This was our first attempt at a thematic issue, and we pulled together several articles dedicated to our SAR theme. The theme of Volume 106: Spring 2014 is technology. Can you report on new developments or ideas? What are the benefits and limitations of technological advancements? Where is it heading in your job? How have you incorporated new technology in the field or workplace? We want your thoughts.

The theme of Volume 107: Fall 2014 is "The Canadian Way": we're celebrating what makes us unique, and what's happening in Canada specifically. We've got a lot to be proud of as an industry, so tell us your stories. What are you doing differently? How is the Canadian way shaping avalanche training, rescue, and forecasting around the world?

Also in the cards for *The Avalanche Journal* is a new editorial advisory group that will help ensure relevant, engaging content by making suggestions for articles and topics, and connecting me to those of you best suited to write the articles. I really look forward to the process—the variety of experience and knowledge across the industry and the country is impressive, and you are the ones who best know what's happening on the ground.

Many thanks to everyone who has ever sent in an article, photograph or opinion—*The Avalanche Journal* could not succeed without your participation and your feedback. And thank you to all of our readers. Without you, we wouldn't have a purpose. This magazine is for you.

Happy turns,
Karilyn Kempton

Letters to the **Editor**

Volume 104

IN MEMORIAM: GARRY WALTON 1927-2013
Please allow me to belatedly send a few words in to you following Garry Walton's passing. I first met Garry Walton back in the early '90s when I was employed in Ottawa as the Chief Inspector of Explosives for the Federal Government. Garry was trying to re-engineer the Avalauncher into an explosives delivery system underground at Falconbridge Nickel in Timmins. I can recall visiting the mine to assess what Garry was doing and found a tired, dirty, sweaty, yet incredibly upbeat fellow despite the real challenges of that endeavour. As someone pointed out, success there was not to be—in part because of low demand but also lack of corporate loyalty on the part of some. My respect for and friendship with Garry continued as my involvement with the avalanche industry grew and C-I-L's participation grew. As someone else has noted, he was a wild, witty and always engaged man who lived through a string of trials to continue in his comfortable skin until his passing..
Everett Clausen, President
C-I-L Explosives

JOURNAL KUDOS AND A CAUTION
Let me say congratulations on a fine issue of *The Avalanche Journal* this fall–so many great articles and new developments. Speaking of which, I am particularly impressed with the Professional Practices Committee and like the direction it's heading, especially if the ultimate goal is professional designation granted by an autonomous regulatory body.

I'm continually impressed by both the quantity and quality of work coming out of the CAA and the CAC. The amount of work the ProCom seems to be taking on is breathtaking, so speaking as someone who works for an organization that tries to tackle a lot of work with few staff and resources (and seeing how it can burn staff out), I sincerely hope that the term "stress bulb" doesn't apply to the good folks working on these projects.
Regards, Name Withheld

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Garth Lemke is a CAA professional, ACMG Apprentice Ski Guide, and Visitor Safety Technician for Jasper National Park. He has been a CAA ITP instructor since 2006, with CAA Avalanche Operations Level 1, 2, and AvSAR. He has called Jasper home since 1991, where he enjoys climbing, biking, and skiing.
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LARRY STANIER
Since the early 80s, Larry has worked in the avalanche patch around Blackcomb, CMH, Kananaskis Country Public Safety, Bella Coola, Mustang Powder, K3 cat ski, ACMG and CAA courses, and as a reviewer for HeliCat Canada. Throw in a bunch of work trips on skis to Japan and Europe and he is almost starting to get the hang of spelling the word avalanche. Summers are spent hopefully not forecasting avalanches as an alpine guide at Lake O'Hara Lodge.
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KIRSTIE SIMPSON
Kirstie Simpson has been the Yukon CARDA handler for the last 23 years, and has been involved in search and rescue in BC, Yukon and NWT for over 30 years both professionally and as a volunteer. She has been involved in many SAR operations as a dog handler, team member and search manager. She has been responsible for the investigation on behalf of the Yukon Coroner of all of the avalanche fatalities in the Yukon in the past 20 years.
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JAMES FLOYER
James Floyer is a senior forecaster with the Canadian Avalanche Centre. He comes from a research background, and holds a Ph.D. from the University of Calgary in snow science.
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MICHAEL COYLE
Michael Coyle is a developer and consultant at BlueToque Software, where he writes a consumer GIS package for backcountry professionals. He's also a 13-year veteran SAR volunteer and manager with Coquitlam Search and Rescue, and an avid backcountry recreationist.
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SANDRA RICHES
Sandra Riches has been involved with the AdventureSmart program as the BC Provincial Coordinator and a national subject matter expert since 2005. Her passion for the outdoors coupled with her lengthy career in search and rescue offers a wealth of knowledge and experience. (ca.linkedin.com/in/sriches).
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front lines

in this **section**

education **& awareness**

// SCOTT AITKEN

Robb Andersen
CAA President

CAA President's Message

MEMBERSHIP

WITH OPERATIONS engaged in their avalanche programs, I wish all CAA members a safe season. The board, committees and staff have been working hard towards both short and long term means to empower CAA members to excel in avalanche safety.

One empowering new tool is the new InfoEx. There is a steep learning curve to mastering this system, but the platform gives operations and their CAA members new ways of recording and sharing avalanche, snowpack and weather info. Overtime, this tool will enhance our ability to provide quality avalanche risk assessments to clients and stakeholders.

Pascal Haegeli managed the project, working closely with TECTERRA, the IAG, CAA staff, and CAA professional members, culminating in a world-class, data-sharing platform. CAA staff spent considerable time and energy getting the new InfoEx off the ground and into the hands of users prior to the start of avalanche season, including several well-attended InfoEx training sessions this fall across Alberta and BC. Most feedback I have received has been very positive. Hats off to all involved in the development, design and implementation of this project. I look forward to the journey ahead.

A main focus of the board of directors has been demonstrating value for membership. Part of the process of increasing member value compels us to revisit the question of what it really means to be a member of the CAA. The membership page on our website states, "Becoming a member of the CAA requires knowledge of evolving avalanche related sciences, specialized technical training and extensive operational experience. CAA members serve society by competently evaluating avalanche hazards and managing risks to protect people and property from avalanches. As a member of the CAA, you gain an important credential that assures these vital responsibilities are conducted by a capable and qualified individual." These words capture the essence of what is required for membership.

Our task is to make sure these words hold true as the working context for CAA members evolves. Committees are working at professionalism, ethics and scope of practice in an attempt to ensure CAA membership is the industry's gold standard for avalanche risk management. As expectations of regulators, insurers, and employers increase, I believe that in the future, CAA membership may become the minimum standard for employees across Canada involved in avalanche control and risk management.

Increased standards may result in more opportunities for CAA members as we continue to define excellence in our profession. Our success is dependent on our members. Hiring practices are one way to help the CAA and its members achieve this industry standard. I would suggest that anyone involved in avalanche-related activities—from the first year apprentice to the senior manager—should be a member of the CAA.

If avalanche program supervisors and managers define CAA membership and its obligations as an employment prerequisite, workplace standards will be elevated, fostering professionalism at all levels of employment. Our three membership categories for individuals—affiliate, active, and professional—are appropriate to increasing levels of responsibility.

Accordingly, a key goal for the board is to increase membership. If we as avalanche professionals demand membership in the CAA for all avalanche workers in Canada as a minimum qualification, workplace standards will increase, and our association will be able to advocate better for all the workers we represent.

The board can't increase membership alone. We need all of our members to promote the CAA and membership at every opportunity—particularly those members in the position of instructing or mentoring new avalanche workers. Most of the CAA Avalanche Operations Level 1 students are just getting into the industry and require the Level 1 for their employment. If an employer requires their staff to have completed any of our ITP training courses, the employer should also require those workers to be CAA members to ensure a commitment to excellence through their career.

Although the CAA is a fairly young organization, we have a rich history and a strong, diverse membership. As the culture of risk management continues to evolve, we must continue to ensure that the Canadian public has the highest degree of confidence in CAA members to deliver avalanche safety programs and services. I believe membership is a commitment to professionalism. Let's work together to welcome and empower all Canadian avalanche workers to join this professional journey. As always, if you have comments or suggestions you can reach me at president@avalanche.ca.

Robb Andersen, CAA President

Joe Obad
CAA Executive Director

CAA Executive Director's Report

SEARCH AND RESCUE

***AS THE AVALANCHE JOURNAL* EXPLORES** themes, we're pleased to offer this edition focusing on Search and Rescue. For all its variations, SAR is fundamentally about mutual interdependence. This interdependence plays out on a variety of settings: the trust amateur backcountry skier place in each other's companion rescue skills; the faith workers place in each other after all their early season SAR practice; the communication between backcountry operations to respond to avalanche involvements and other emergencies; the public's reliance on local SAR groups and government agencies to respond quickly; the hundreds of hours CARDA dog handlers put into training their dogs; and so on.

The backdrop of increasing public expectations, limited resources and the need to continually hone professional skills challenges this mutual interdependency. This issue of the journal cannot tackle all these questions, but hats off to the contributors who have shared their insight here.

We hope the perspective offered by Parks Canada's Sylvia Forest helps members and operations consider their own procedures. Michael Coyle's piece on drones may have seemed like science fiction a couple years ago, but the rapid adoption of UAV technology to a number of fields suggests its use in the SAR quiver is not as far away as one might think. Of course technology can be a pandora's box, too. James Floyer's article details the problematic emergence of smartphone apps that threaten to complicate both recreational companion rescue and professional level AvSAR.

For all the influence of technology, AVSAR will always be about people. The profile of risk and loss faced by avalanche incident victims is high in relative terms, but it is worth noting the risks to rescuers are both physical and psychological as well, and poorly understood by the public. This fall in at the International Congress for Alpine Rescue (ICAR), Colonel Blaise Agresti of France's national training centre for its mountain rescue police reminded attendees of this in starkest terms, detailing statistics of 68 mountain *gendarmes* deaths since 1958, with five deaths alone in 2013 related explicitly to training exercises. Col. Agresti went on to outline the revisions France has taken to move from a fault-based culture of examining error to a risk management-based culture that emphasizes pattern analysis and prevention over blame-centric drivers such as culpability and sanctions. France's shift in this direction will be worth noting over time.

Greg Miller's piece on the BC Search and Rescue Association's approach to critical incident stress management points to more subtle obligations related to mental health. BC SARA's proactive approach to addressing psychological trauma faced by rescuers reminds us that managing SAR risk extends well beyond physical incident.

BC SARA is just one of many organizations that support SAR. The breadth of these organizations is reflected in this issue, from reports on the newly-formed Alberta Avalanche Rescue Dog Association to SARScene to ICAR. Of course, the CAA's own role in AvSAR is significant. Garth Lemke addresses ITP's approach to AvSAR in this issue. Additionally, in this issue we remind you about the Rescue Resource Directory.

You've been hearing a lot about the CAA's strategic plan of late, and there is an AvSAR component there, too. Over the past year, the education committee has restructured its work to focus on ensuring that ITP addresses core competencies for professional avalanche workers. Squarely in the sight of the Ed Com and ITP Manager Emily Grady is an analysis of our AvSAR training delivery.

For all the excitement the new InfoEx brings, it too offers AvSAR considerations. As operations familiarize themselves with the system, we are seeing a range of use of how avalanche and snowpack information is recorded. The CAA will work with the InfoEx advisory group to provide guidance to using new features in InfoEx to record avalanche problems and weak layers with enough consistency to ensure reliability of data. Whether rescuers are responding to incidents and checking and using InfoEx as a resource, or reading future research analysis of the data, it is in everyone's interest to ensure consistent entry of critical data.

As *The Avalanche Journal* evolves to focus more deeply on professional issues, we have been encouraged by your feedback, both positive and negative. The staff was keen to figure out how to draw upon your voice even more. To that end we have engaged a group of members from various walks of the avalanche world to act as an advisory group to push us to be even more responsive to your needs. Look for their input in future issues. For now we hope you enjoy this one!

Joe Obad, CAA Executive Director

STORM SLAB, WIND SLAB OR A PERSISTANT SLAB? // DAVE SCOTT

What's The Problem? A Primer on **Defining Avalanche Character**

Karl Klassen

IN THE NEW ERA of a hazard-based InfoEx, avalanche problems and avalanche character are a major component of communicating among peers in the avalanche community. In the CAA Avalanche Operations Level 3 course glossary, avalanche problem is defined as "a set of factors that describes the avalanche hazard." Avalanche problems typically encompass avalanche character, location (usually defined at minimum by elevation and aspect), likelihood of triggering (determined by sensitivity to triggers and spatial distribution), and avalanche size. This article focuses on the avalanche character—defined in the Level 3 glossary as "a classification system describing the type of avalanches release"—specifically, on some challenging situations where the avalanche character is not clear-cut.

We use eight avalanche character designations in Canada: loose wet; loose dry; wet slab; wind slab; storm slab; persistent slab; persistent deep slab; and cornice. These phenomena do not always fit neatly into the boxes we create, and there is often discussion: is it a storm slab, wind slab, persistent slab, or deep persistent slab? In addition, there are questions raised about when small avalanches—especially small loose avalanches—should be listed.

In-depth documentation on the various avalanche characters can be found here: avalanche.ca/cac/pre-trip-planning/decisionmaking. Look for the Avalanche Problem Essentials section.

Critical Avalanche Layers are Not Always Problems

Following the lead of the ASARC crew at the University of Calgary, in this article, I use the terms critical avalanche layer and persistent critical avalanche layer. This terminology is more consistent with the actual layers we deal with (e.g., a crust may be a critical avalanche layer but it is not weak), and replaces the oft-used weak layer or persistent weak layer.

There is often a temptation to describe a critical avalanche layer or persistent critical avalanche layer as a problem, and it is important to note that a critical avalanche layer (even a persistent one) is not an avalanche problem. Even a layer that is buried is not necessarily a problem. If no avalanche activity is expected or occurring on the layer, it is just a layer, not an avalanche problem. Log persistent layers in whatever layer tracking system you use (e.g. the persistent weak layer section of the new InfoEx) and keep an eye on them, but until you think there is a real possibility of avalanches releasing on it, resist the temptation to call it an avalanche problem.

Are Loose Avalanches and Small Avalanches a Problem?

In my experience, even in the best of conditions, small avalanches and loose avalanches are possible. Before I list them as a problem, I first take terrain traps out of the equation. For example, if we are going to list a small sluff in

combination with tree wells as a problem, we will have loose dry avalanches in our forecast and on our list practically every day from early December to late March (at least in the Monashees, where I work). My risk management procedures take this kind of potential into account every day, so I tend not to list this kind of thing.

I put loose dry or small avalanches on my list of problems when they become more than an "everyday" kind of issue, and require an extra effort to manage the risk they present. For example, when loose dry avalanches are running far and fast, and they are large enough to push people around in open terrain in the absence of terrain traps, then I list them.

Logical Transitions and Confidence

Storm slab problems often transition into wind slabs or persistent slabs. The reverse is seldom true. Wind slabs do sometimes transition into persistent slabs. Things tend not to go the other way. Unless your confidence about what is going to happen next is very high, consider starting with a character that is earlier on the transition scale, rather than jumping ahead to something higher up the food chain.

Storm Slab or Wind Slab?

Most storms have a wind component, which may enhance problems on certain elevations and aspects. I resist the urge to post both wind slab and storm slab at the onset of or during a storm. If high precipitation rates and/or significant accumulations are forecast and you expect fairly widespread distribution of avalanches over elevations and aspects, I almost always call it a storm slab to start with. Even though it might be somewhat worse on lee aspects, I can transition to wind slab later if the problem localizes to or persists on lee aspects or features.

If a storm produces little in the way of precipitation but has significant associated winds, I may designated it a wind slab right off the bat. Similarly, a slab that develops well after or between storms due to redistribution of snow by wind is a wind slab with no storm slab early on.

During or shortly after storms, I do not want to assume I have got a wind slab too soon and then find out that it is actually more widespread and have to back up to storm slab. It is much better to start with storm slab, and transition to wind slab after.

When should you transition from storm slab to wind slab? Storm slabs are generally a result of non-persistent critical avalanche layers that are usually short-term instabilities. Certainly there are times when a non-persistent layer does last for three, four, or even five days, but those are the exceptions. In general, if you still have a problem after two or three days—and especially if the problem has localized or is localizing to lee aspects or features—then it is time to change from storm slab to wind slab.

Storm Slab or Persistent Slab?

When storm snow falls on a potential persistent critical avalanche layer, I generally call it a storm slab at first, unless I am highly certain the critical avalanche layer will truly be persistent for the long term. The question for me is less whether it is a storm slab or a persistent slab, and more if and when do I change from storm slab to persistent slab. I would say if you still have a problem three to four days after the storm ends and it is on a CR, FC, DH, or SH layer (or some combo of these), and it looks like the persistent instability is not going away any time soon, then it is time to start thinking persistent slab. If the problem persists on a new snow or fragmented layer that is just hanging on little longer than usual, then I would tend to leave it as a storm slab, even if the timeframe for instability extends past the usual two or three days.

The key point is that I do not want to start with persistent slab only to find out it is not going to persist the way I thought it might, and then need to revert to storm slab or take the persistent slab off the list after only two or three days. I prefer to start with storm slab then transition to persistent slab after the first cycle is over, or after several days have passed and the problem is clearly persisting. If there is a lull between the first and second cycle on a persistent instability, I might even go from storm slab to no problem to persistent slab when the secondary cycle starts.

Wind Slab or Persistent Slab?

When a new wind slab is created on a potentially persistent critical avalanche layer, it can be tempting to call it a persistent slab right away. Again, as with storm slabs, the question is largely about confidence. If you are highly confident that the layer in question will persist for an extended period of time (e.g. more than a week at minimum), then I suppose you could call it a persistent slab from the start. Personally, I would call it a wind slab at the outset until I see what happens in the longer run, particularly if the problem is generally localized to lee aspects and/or terrain features. If the problem persists longer than a week, and if it seems to be broader in distribution than just lee terrain, then transition to persistent slab.

Persistent Slab or Deep Persistent Slab?

I do not use the persistent deep slab designation until the persistent critical avalanche layer in question has undergone at least one dormant period. Another criterion is depth—not so much in terms of being near the ground, but more in terms of relative to the snowpack as a whole. However, perhaps the most important question for me is frequency versus size. Persistent deep slabs are typically infrequent but

very large: what we often refer to as low-probability/high-consequence events. Persistent deep slab avalanches are generally hard to trigger, and they tend to occur in isolation from each other, so it is hard to characterize them as an avalanche cycle in the usual sense. However, these slides are often very large and extremely destructive—in most cases, not survivable if caught.

An Avalanche Character Transition Scenario

Let's look at a theoretical (albeit simplistic) scenario to help illustrate these concepts. In late November, there is 100cm of snow on the ground. A rain event to ridge top followed by a cold snap creates a facet-on-crust layer that looks to me like a potential persistent critical avalanche layer. This layer is widely distributed on all aspects and elevations. On December 1, this surface is covered by 20cm of low-density storm snow with little wind. I log the December 1 FC/CR persistent critical avalanche layer in my layer tracking system. I do not call it an avalanche problem, nor do I assign an avalanche character to it, because it's not doing anything yet.

On December 4, the forecast calls for a significant, warm storm with SW winds, high precipitation rates and 60cm accumulations of moderate-density storm snow. I forecast storm slabs for all aspects, all elevations. A widespread cycle occurs. It could be that some avalanches are on December 1, some are just storm snow accumulation, and some are wind slabs on NE aspects. No matter what the problem is, my risk management approach is similar—I will be careful everywhere until things become clearer, so I keep it simple with storm slabs only. When the storm ends late on December 5, I stick to my guns with storm slab only, figuring I will give things a day or two and then see what happens next. I may drop my hazard ratings or up my stability ratings, but I will not rush ahead with changing the problem just yet.

By December 7, the only avalanches still occurring are on NE aspects in the alpine, where wind slabs created during the storm remain reactive. I transition the storm slab to wind slab and localize it to Alpine, NE. There is nothing notable happening with the December 1 layer, so I keep it in my layer tracking system as dormant but don't associate an avalanche problem or character with it—yet.

On December 9, warm temperatures and clear skies are forecast. Anticipating that the now-old storm snow (where not previously affected by wind) will settle and become more cohesive, potentially reactivating the December 1 layer, I add a persistent slab on solar aspects to the list, in addition to the still-somewhat-reactive wind slab Alpine, NE problem.

By December 14, wind slab action on Alpine NE aspects has essentially stopped, so I pull the wind slab off the table and keep the December 1 persistent slab on the list. A widespread surface hoar layer forms over the next couple of days and is buried on December 17 by a light snowfall. I log the December 17 SH in my layer tracking system but as it is not yet slabbed over, I still have only one problem on my list: the persistent slab on the December 1 layer on solar aspects. From Christmas to New Years, a series of low-density snowfalls with no wind occurs, but the December 17 SH remains unreactive. The December 1 layer has not been seen or heard from since Dec 14. Skiing is awesome and nothing is happening anywhere. I pull all my problems off the list and go with no problems—a little unusual for this time of year, but there it is.

A series of storms starting in mid-January create a number of storm slab and wind slab cycles, which I transition to a persistent slab on the Dec 17 SH once they die out. By late January, the December 17 persistent slab is done so I take it off the list. I still have layers in my layer tracking system so they are not forgotten, but none are reactive so there are no problems or avalanche character associated with them.

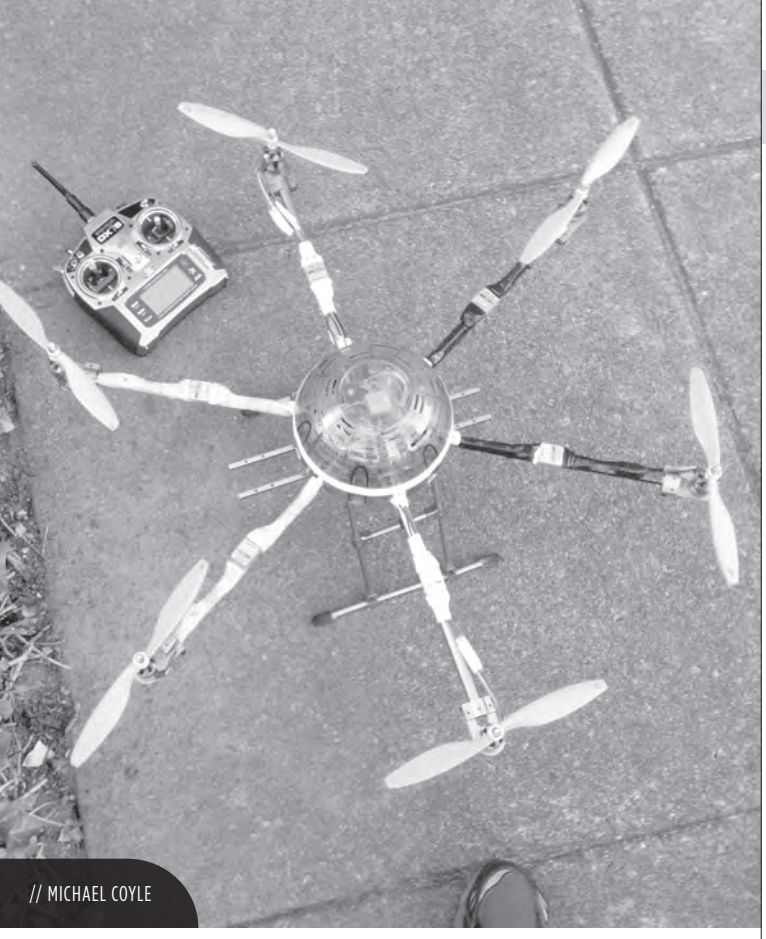
In early February, I start to see the odd massive avalanche running on a layer that is deep in the snowpack, about 80cm above ground level. These are being triggered on warm days from shallow spots on slopes with a variable depth snowpack. They are hard to predict, very scary, and we are clearly in a low-probability/high-consequence scenario. I then put a persistent deep slab problem on my list, thinking the December 1 layer has come back to haunt me.

The challenge with persistent deep slabs is that once they are on the list, they are hard to take off. By their very nature, they tend to last a very long time and are isolated and intermittent in nature. I do not have a great answer for when to take this problem off the list. Maybe you do not—just keep it there in the background. Perhaps you can take it off or put it back on the list as the factors that increase the sensitivity of these layers come and go. Either way, it is a tough one. In the end, I think we all need to do what is necessary to help us improve our risk management. To me, that means keeping things as simple as I can while still providing the information and knowledge needed to make an informed decision.

Hopefully this has been somewhat helpful. I welcome comments and thoughts.

Karl Klassen is the CAC Public Avalanche Warning Service Manager. If you have questions or comments email, kklassen@avalanche.ca.


MEC
FACT FINDER
OUTDOOR RESEARCH
MOUNTAIN GEAR AND SAFETY ESSENTIALS
Andrew Querner
Download and explore the free CAC app on Google Play or iTunes. Available winter 2013.



// MICHAEL COYLE

Using UAVs for Search and Rescue

Michael Coyle

UNMANNED AERIAL VEHICLES (UAVS) bring to mind the image of a predator drone firing missiles or dropping bombs on targets in a war zone, and the media loves to use the term to describe any UAV. However, there are many peaceful uses for these devices, and hundreds of different sizes and configurations. My recent investigations on the uses of UAVs in Search and Rescue easily attracted the attention of national media, but it is not just good news—there are many obstacles to overcome before you will see one searching for lost people in Canada.

The first thing to understand about the UAV industry is that unlike the United States, Transport Canada has regulations in place to permit their use. Any use of a UAV that is not for recreational purposes has to be covered by one of these permits, known as a Special Flight Operations Certificate (SFOC). Consider carefully the implications of "not for recreational purposes." This does not mean "not for profit" as many SAR groups had previously thought. Using a UAV for anything other than pure recreation requires a permit and insurance, and this includes practice and testing.

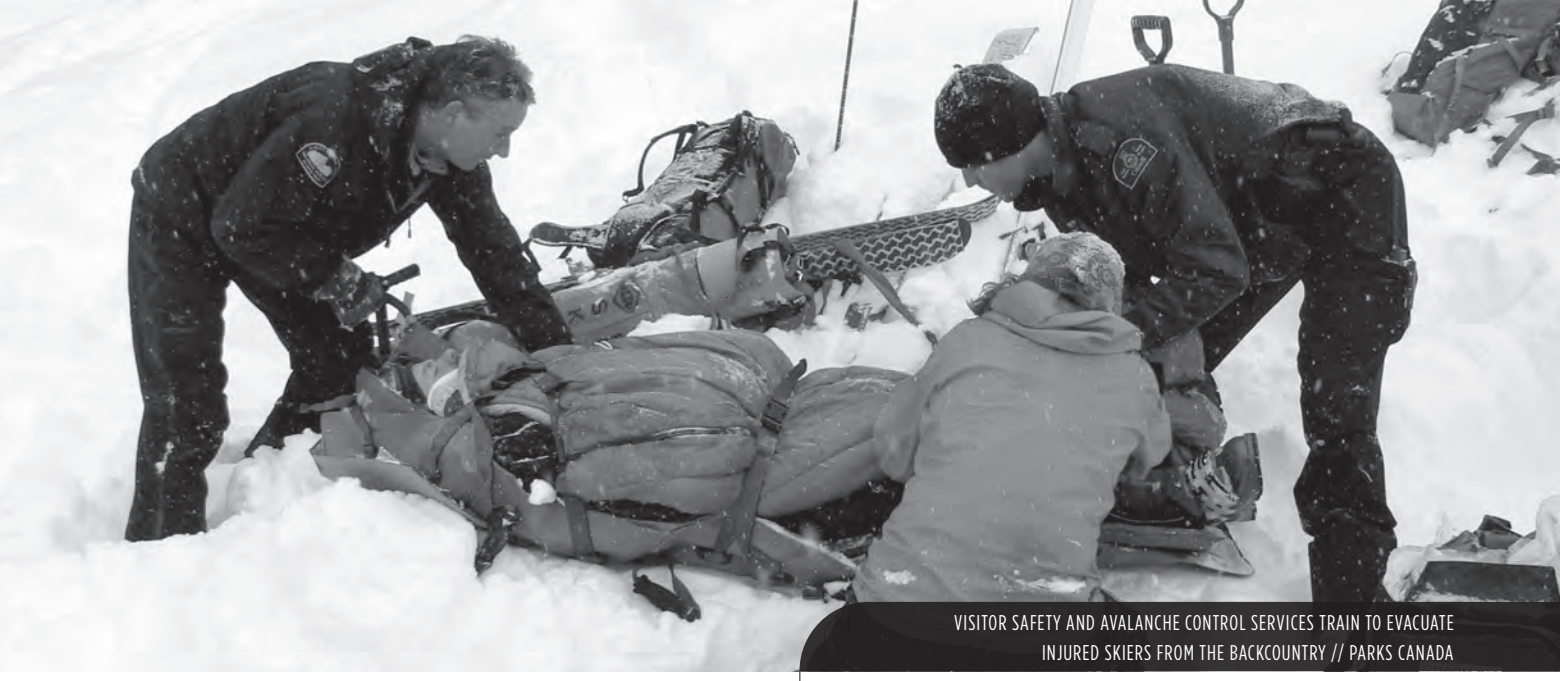
An SFOC can be obtained for free, but requires some effort and paper work on the part of the applicant, including operator training, proof of insurance, an understanding of safety guidelines, and standard operating procedures in place for the flight. The SFOC will be granted for a prescribed area, and will include restrictions such as line-of-sight flying only, two operators (a pilot and a spotter), limits to height and other basic aviation safety rules.

Under these circumstances it might seem like a UAV is not going to be much use. After going to all the trouble to build or purchase one, it is limited to fly only within line of sight? However, earlier this year Canada was the location of the world's first civilian rescue of a live subject who was located by an RCMP UAV near Saskatoon, Saskatchewan. The device, primarily used for traffic accident investigation, was manufactured in Canada by Draganfly Innovations Inc. and had both video, and infra-red sensors mounted. It was the IR camera that located the missing person, who was unconscious and hypothermic when he was found.

UAVs are primarily either fixed-wing aircraft, or rotary-wing copters with anywhere from one to eight blades—more blades give more lift. The smaller, sub-35 kilo range are either built using hobbyist-style kits where the end user orders parts to build their own, or can be ordered as complete units, as in the Draganfly mentioned above. Fixed wing versions can be made of simple styrofoam or custom-formed composites. Prices range from a few thousand to tens of thousands for complete unmanned systems with computer-controlled flight controllers. Flying times are typically 30 minutes for rotary wing, and an hour for fixed wing, both being battery operated. Longer flight times are possible using internal combustion engines, and extremely advanced aircraft in the hundreds of thousands of dollars can fly for 12 hours or more.

With direct applications to avalanche rescue, a research project in Switzerland recently produced a prototype "flying avalanche transceiver" called the "Alcedo", a quad-copter that can be carried in a backpack, launched by hand and can find a buried subject wearing a transceiver in 10 seconds. Once found, the copter releases a smoke signal. Other possible uses for UAVs in the avalanche industry include surveys of avalanche terrain, photography and analysis of avalanche accidents, and even the possibility of delivering explosive charges.

The SAR community in BC in actively investigating the use of UAV for simple SAR operations, and is working on a pilot program to test how they can be applied to standard SAR operations. Hopefully, BC will soon be able to report a "live find" like what happened in Saskatchewan this year, and any developments would have clear implications for the broader avalanche community.



VISITOR SAFETY AND AVALANCHE CONTROL SERVICES TRAIN TO EVACUATE INJURED SKIERS FROM THE BACKCOUNTRY // PARKS CANADA

Mountain Rescue Training in **Glacier National Park**

Sylvia Forest

YOU'VE GOT YOUR LINE PICKED OUT. You've cut a cornice, or done a ski cut, or tested the slope somehow. The avalanche danger rating is in that nebulous "considerable" range; the wind is howling, but the line looks good. Your slope test and your snowpack tests didn't give you much info, and it would be brutal to have to ski down your up track.

Or it's a casual day in the trees—just a few laps before heading to town for dinner.

Maybe it's a bright sunny day and the avalanche danger is rated low. Or it could be a whiteout on the Illecillewaet Neve—you're peering through the fog on the summit of Young's Peak, wondering "is this the descent?"

Whatever the situation in the national parks, Parks Canada rescue teams must be ready to respond. Teams, and their individual members, must train physically and mentally. So how do Parks rescue team members prepare for going out into that gnarly day, just as daylight is fading (as it almost always is when they get the call)?

In a word: training. Visitor safety program managers must be full mountain guides, and rescue leaders must either be ACMG certified or have equivalent training and experience to lead a rescue team into technical and avalanche terrain. Additionally, rescue personnel attend external training courses such as advanced first aid protocols, advanced rope rescue rigging courses, CAA ITP courses and CPD events, and Incident Command training, among others. And finally, rescue technicians regularly participate in in-house training, honing their skills and developing the strong team bonds and trust that are essential in organized rescue.

In Glacier National Park, a typical pre-winter rescue training agenda—repeated throughout the year—includes patient packaging and first aid; toboggan handling in steep terrain; high-angle rope rescue; companion and organized avalanche rescue; terrain management; and heli-sling evacuation training. Carrying out each of these skills in the field under rescue conditions requires a high level of skill and judgment.

Rescue training is rigorous, because it has to be. In recent years, an increasing number of skiers and riders are seeking out more challenging descents, and climbers and mountaineers are attempting increasingly more difficult and committing routes. Better equipment, social media promoting the rewards of limit-pushing adventures, and the overpopulation of easier-to-reach terrain mean that areas that historically have been discarded as "unskiable," "unclimbable," or "unreachable" are being treated like common routes. This shift in terrain use by the public means that rescue leaders must be prepared to safely manage a rescue team in that same terrain.

Parks Canada's Visitor Safety Program focuses on accident prevention, providing information on current conditions to the public and promoting self-reliance and self-rescue through education. But when the call for help comes in, the training and preparation for this eventuality are critical for the safety of the rescue team, and of the public needing help.

Whenever you head into the backcountry, consider your routes carefully and think about the possible risks to those involved in keeping you safe. Check out the Parks Canada website, or parksmountainsafety.com to determine the best method of communication in the area you plan to travel.

Teaching a new dog old tricks: **The Alberta Avalanche Rescue Dog Association**

Jay Pugh

LAST MAY, CANADIAN ROCKIES SEARCH AND RESCUE FIELD GREW WHEN THE ALBERTA AVALANCHE RESCUE DOG ASSOCIATION (AARDA) WAS CREATED AS AN AFFILIATE TO THE BC-BASED CANADIAN AVALANCHE RESCUE DOG ASSOCIATION (CARDA).

AS MOST VOLUNTEER-BASED Search and Rescue groups can attest, financing is a major challenge and the Government of British Columbia will no longer fund out-of-province teams. Despite the name, CARDA has been heavily subsidized and supported by provincial funds from the beginning. There have always been a small but significant number of handlers from outside BC, primarily from Alberta with a few from the Yukon as well. As CARDA has grown, so to has this contingent. At present, there are ten active members of CARDA in various stages of training who are now the initial members of AARDA.

This is not to say that AARDA has totally separated from CARDA. Members will continue to meet CARDA guidelines in terms of certification. The validation standards will be the same and AARDA members will still have to attend the required courses for initial training and recertification. AARDA has its own policies and procedures that are similar—if not identical—to those of CARDA. For example, members will still have to belong to a recognized search and rescue organization and have the required CAA ITP qualifications. This is a separation for financial convenience more than anything else.

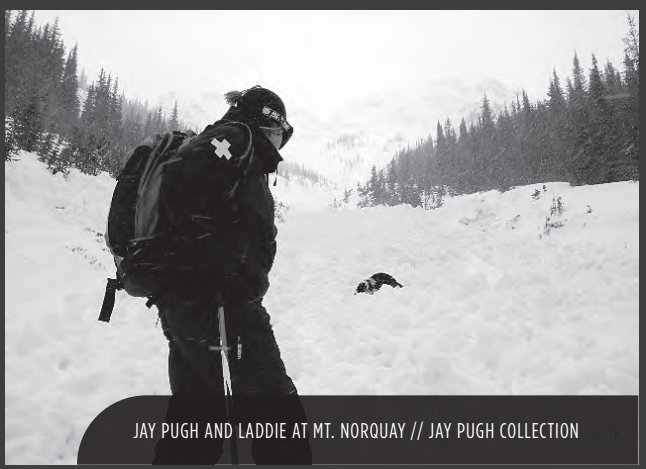
That being said, it is still exciting as well as daunting for the members of this small group. While using a recognized and experienced association as a template offers advantage, problems still exist for a brand new group.

Getting financial backing is the fundamental challenge. For a province made up mostly of boreal forest, prairies and foothills, there is not a lot of awareness about the need for a volunteer resource specializing in avalanche rescue. It is easy for those of us who live near or in the Alberta mountains to forget that we are in the minority, and that there is not nearly the focus on avalanche safety that there is in BC. This is heightened by the fact that most of the well-known recreational mountain areas in Alberta are in the National Parks and are therefore under federal and not provincial jurisdiction. Getting the powers that be to help pay the bill is basically uncharted territory.

The second major challenge is establishing AARDA as credible in Alberta's professional SAR field. Alberta does not have the Provincial Emergency Program that BC does. While this means less hoops for our members to jump through, it also means that there is less recognition and apparent credibility. Three agencies in Alberta have search and rescue in their mandate: the RCMP province-wide, the Park Warden Service in the National Parks (Jasper, Banff and Waterton), and Conservation Officers who fall under the Alberta Ministry of Tourism and Recreation in Kananaskis Country. As is the case in BC, it is essential that AARDA create strong working relationships with these organizations. Simply put, we have to prove that we are a viable and valuable resource through commitment and competence.

Most of the Alberta handlers are members of professional ski patrols and will have an expectation of responding to avalanches in their areas. There will be involvement from one or even all of the professional

ALBERTA CARDA MEMBERS AT LAKE LOUISE IN 2008 // JAY PUGH COLLECTION



JAY PUGH AND LADDIE AT MT. NORQUAY // JAY PUGH COLLECTION

groups, and hopefully AARDA members will be called in for backcountry responses if so desired. Luckily, a precedent has already been set in that the Park Warden dog handlers have been quite involved with CARDA as Course Instructors, roadside validators and appreciated mentors throughout the season in numerous training sessions. It is up to AARDA members to continue to strengthen this bond and expand with a humble, respectful manner.

AARDA must also maintain its relationship with CARDA. The history of volunteer search groups, particularly in Alberta, has sadly included rifts between passionate and unified founding members. It is all too easy to let strong personalities and basic differences of goals and values divide a program into a piecemeal and competitive entity. Despite the defined geographical lines, we must all remember that we serve the same purpose summed up in CARDA's motto: "So that others may live."

Even with these challenges, it is nonetheless exciting to be part of a small group just setting out. Over the past few years, the Alberta CARDA members have gotten into the habit of setting up twice-monthly informal training sessions (including summer and fall dry land training). A culture of mutual support, which can be lost as organizations grow, has kept handlers motivated and committed. Most AARDA members live in the Banff/Canmore area, but there are frequent trips to and from Jasper to enjoy the advantages of shared knowledge and multi-dog training. We hope there will be more time spent with the handlers from Castle Mountain (our true cowboys). As a small, distinct group, we can continue this familial feeling and help each other maintain the high standards of our founding group.

Critical Incident Stress Management For Search and Rescue in BC

Greg Miller, Peer Support Person, CISM Team

THE SEARCH AND RESCUE OF SOMEONE BURIED IN AN AVALANCHE IS HIGHLY STRESSFUL. IF THERE ARE INJURIES OR DEATHS INVOLVED, EVEN THE MOST SEASONED SEARCHER MAY EXPERIENCE STRONG EMOTIONAL OR PHYSICAL REACTIONS AFTER THE EVENT IS OVER.

These reactions are common and, in fact, it is quite normal to experience a range of stress reactions after experiencing a traumatic event. These critical incidents are any unusually challenging events that have the potential to create significant distress and may overwhelm one's usual coping mechanisms.

The volunteer Search and Rescue (SAR) responders of BC have access to the British Columbia Search and Rescue Association's (BC SARA) Critical Incident Stress Management (CISM) Program's team of specially-trained peer SAR personnel following any critical incidents in their line of duty. The purpose is to enable SAR volunteers to return to their daily routine more quickly, with an increased awareness of signs and symptoms the may follow the critical incident.

The BC SARA CISM Program was formed in 2006 as a response to concerns within the SAR community over the number of highly experienced volunteers who suffered negative emotional effects and/or quit SAR following their involvement in traumatic rescue calls. The program began offering CISM interventions in January 2007 with 25 trained peers. All team members are active volunteers in search and rescue teams scattered across the province of BC. They are trained in the International Critical Incident Stress Foundation (ICISF) model of Critical Incident Stress Management.

CISM is designed to help people deal with their trauma one incident at a time, by allowing them to talk about the incident when it happens without judgment or criticism. All interventions are strictly confidential and the emphasis is always on keeping people safe and quickly returning them to more normal levels of functioning. These interventions may be thought of as psychological "first aid" and are not intended as a form of psychotherapy. It is completely normal for anyone to have

CISM TEAM TRAINING 2012 // WHITNEY NUMAN

stress reactions following a traumatic incident and with the appropriate CISM intervention they can be stabilized and restored to normal levels or, if needed, referred to a higher level of care.

In 2012, the CISM team performed 25 interventions with SAR teams across the province. These interventions are conducted by a minimum of two peers, depending on the size of the group, who may be accompanied by a mental health professional in cases of highly traumatic events. There may be follow up with individuals by the peers or through a referral to mental health professionals, if required. Delivering the intervention shortly after the incident, and the possible follow up, is critical to the effectiveness of the program. Follow up may be a personal contact from one of the intervention team or it could be a referral to a mental health professional. For members of search and rescue teams, this can be up to six personal counseling sessions covered by WorkSafeBC.

The team maintains 20 to 25 members recruited from the BC SAR community and are expected to be available on short notice to deliver CISM interventions to SAR teams in the province. All peers are certified through training sessions from certified instructors by the ICISF.

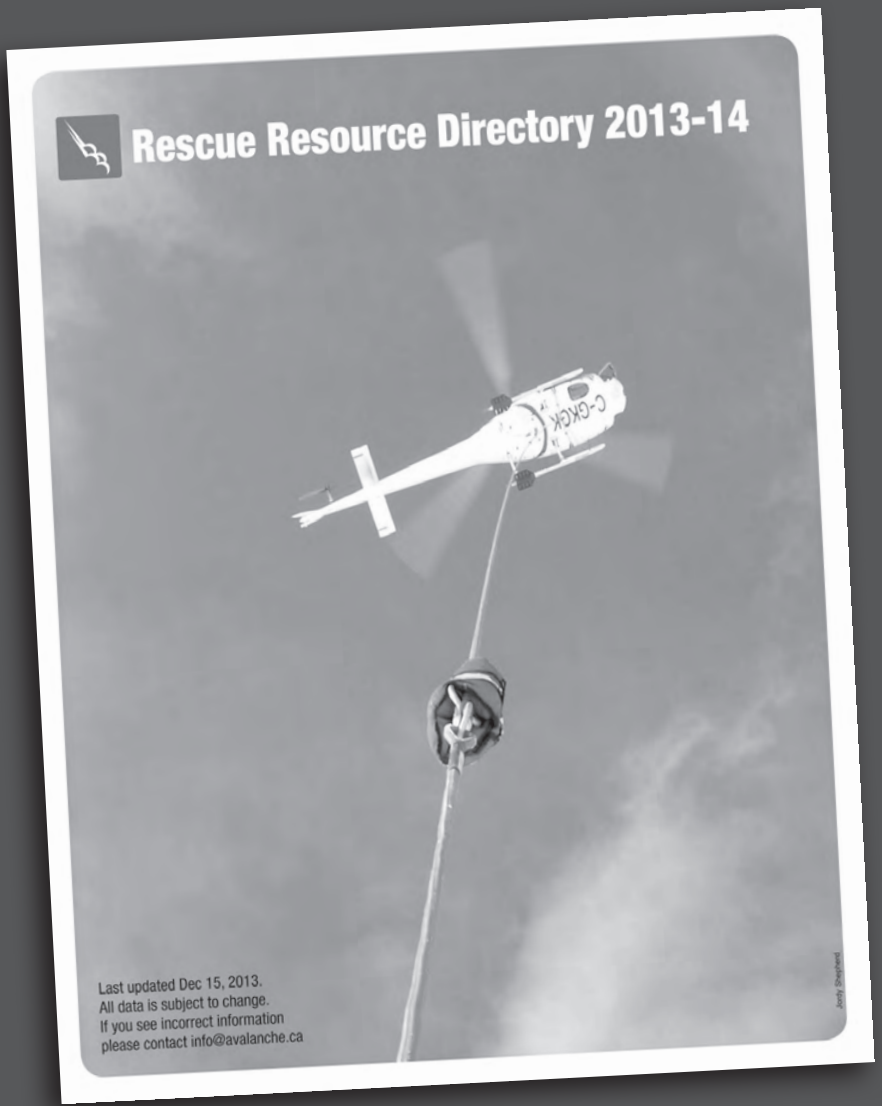
Another service provided by the team is the delivery of education and awareness sessions to SAR teams as a form of pre-crisis preparation so everyone can understand what critical incident stress is and the kinds of effects that one may experience following an exposure to those incidents. Discussing the range of common stressors, their effects and different stress management techniques are a form of psychological immunization that research has found useful in enhancing the resiliency of those who may face traumatic incidents. The use of peers in these types of interventions have been found to be highly effective in ensuring the acceptance and trust of SAR members in hearing from someone they know who has a personal understanding of the roles and expectations of SAR volunteers.

For members of the public or those involved from other agencies, there are similar services that can be made available following critical incidents that have involved other professional first responders.

It is common for SAR members following a CISM intervention to reflect on traumatic calls in the past—before the CISM team existed—and realize how they or others had been negatively affected and be thankful for the suggestions and support.

The BC SAR CISM team is financially supported by the Emergency Management BC division of the provincial government and by the BC Search and Rescue Association. The team will be ready to be deployed the next time there is a SAR call in BC that is associated with a traumatic or critical incident.

Why the **Rescue Resource Directory** Matters to You



Karilyn Kempton

Each year, the CAA updates and publishes the Rescue Resource Directory, a comprehensive list of agencies and resources available for backcountry search and rescue, related services, and operational support. The publication is distributed free of charge to many organizations, including search and rescue groups, RCMP, Coroners Service, Parks Canada, BC Parks, ski areas, backcountry lodges, helicopter skiing operations, cat skiing operations, and to CAA members. The Rescue Resource Directory serves as your one-stop contact list in case of a rescue situation—it essentially acts as a telephone book for your avalanche safety plan or rescue plan. The directory plays a vital role in any backcountry rescue, and everyone who recreates in BC's winter mountain environment benefits from it. The CAA has been publishing the directory for more than 15 years. Find it online at the CAA Members Only site, under Technical Resources. Please check the Directory to ensure that your organization's information is up to date. Please e-mail Brent Strand at bstrand@avalanche.ca to make any changes.

Connecting With **ProCom**

CAA VICE-PRESIDENT AND PROCOM CO-CHAIR AARON BEARDMORE FILLS US IN ON THE NEWEST PROFESSIONAL PRACTICES COMMITTEE DEVELOPMENTS.

What has ProCom been working on since the last issue?
Since the last issue, we have had a strategic planning session at the Board of Directors level. Some of those strategic goals (which will be available to members soon) are closely connected to ProCom, and we have been aligning those goals with the ProCom terms of reference. Support was generated from the Board of Directors to further enable ProCom's work.

Can you tell us about your work on professional ethics?
We are currently rationalizing the code of ethics with the latest draft of the professional standards so that there is no redundancy between documents. We are picking out the best parts of both and trying to generate a single professional ethics document for CAA members that addresses the challenges members face and is consistent with common ethical standards for other professions. We aim to put the revised ethical standards before the membership this spring, because any changes to the Code of Ethics require bylaw changes.

Where is ProCom with scope of practice?
ProCom is continuing to work on scope of practice—we're peeking into it. We are looking at some supporting resources to expedite this process. We have the right people, but as volunteers we may need to enlist outside resources, which will help us speed things along a little bit. We will have more work to show the membership in draft form at the AGM. The membership will have the opportunity to read through the scope of practice, then we will have a feedback period, and then we will revise based on that feedback in order get something everyone is happy with.

How are you working with other committees?
At the strategic planning meeting, we assigned goals to each committee, while noting where the work needs to be integrated with other committees. We are starting to devise a strategy to get all the committees talking to each other more on an ongoing basis. What we find is that when several committees need to piggyback on the work of another committee, there's lag that slows things down. We hope to change this by having members of other committees (Membership or Education) sit in on ProCom calls and then bring back what we're doing to their respective committee so that there is less catch up time. As we move forward in developing the body of knowledge and a continued competency program, we'll need lots of crossover between committees. The mechanism for cross-pollination on an ongoing basis will make the process more efficient.

How is ProCom engaging with members going forward?
I'd encourage the membership to email their president, board or committee chairs, or the executive director if they have questions, ideas, or anything to offer—we're all ears. Send us an email or give us a phone call; we're willing to listen and would love to capitalize on the collective knowledge of the membership. We will be regularly communicating through member emails and *The Avalanche Journal*, but we also encourage members to contact us any time. The real takeaway message is to get ready for a big AGM with lots of positive changes coming up.

OBSERVATION MOUNTAIN FATALITY BURIAL SITE // KIRSTIE SIMPSON COLLECTION

Avalanches **Don't Happen** in the Yukon

Kirstie Simpson

HERE IS THE YUKON PROBLEM: MOST AVALANCHE INCIDENTS IN THE YUKON ARE ACTUALLY IN NORTHERN BC, WHILE THE PEOPLE INVOLVED ARE ACTUALLY FROM THE YUKON AND ALASKA.

THE TWO MOUNTAIN PASSES most commonly used by skiers, boarders and sledders in this part of the world are the Haines Pass and the White Pass. Both of those passes are in BC, but are isolated from the rest of BC by the Yukon on one side and Alaska on the other—hence the Yukoner use. Notwithstanding, serious avalanche incidents have happened in Yukon, including at least four avalanche fatalities as well as a number of recorded full burials and partial burials. However, as a long-time avalanche course conductor, I am continuously surprised by the stories people share of incidents they have been involved in that have never made it on a list.

A grassroots community has worked for several decades in the Yukon to promote avalanche safety and recognition of the risks of travelling in avalanche terrain without adequate knowledge or training. The fairly low number of avalanche involvements can be attributed to a combination of high quality education opportunities (such as the CAC Avalanche Skills Training program) and the fact that the highway often closes when avalanche conditions are particularly poor, rendering the pass inaccessible.

The Yukon's largest community, Whitehorse, is two hours away from one pass and three from the other, so we perhaps don't behave quite like a mountain community. As a small, northern community we are blessed with amenities many larger communities don't have, including world-class Nordic ski trails, a downhill ski area, and many coffee shops. Yukoners are never short on things to do when the conditions in the pass are poor.

In recent years this has changed. We have grown our mountain culture and attracted skiers and sledders from other regions who are accustomed to a certain degree of avalanche services and products. The Government of Yukon actively promotes winter tourism, inviting backcountry skiers to visit our "endless snowy landscapes for alpine touring and carving turns."

The grassroots effort has culminated in the development of public avalanche forecasting and awareness products. Ironically, these efforts have helped drive the interest in the Yukon backcountry. Public outreach around avalanche risk has encouraged the creation of products such as guidebooks and avalanche terrain maps, which in turn encourage those who might not otherwise venture into uncharted areas

on their own. The public expectations around avalanche safety and rescue have also also grown. But here is the problem: according to Yukon emergency services managers, avalanches don't happen in the Yukon.

The overall structure of the SAR community for the provision of ground and inland water SAR services in Yukon is provided through a partnership between RCMP, the Emergency Measures Organization of Yukon Government, and volunteer SAR teams. Response to a SAR incident is coordinated through an established reporting structure by the RCMP, with each incident having unique considerations depending on the circumstances as well as the skill set of responding members and volunteers. In terms of avalanche rescue and response, the efforts to date have been informal and on an as-needed basis, with no formal structure in place.

In the Yukon, training standards for avalanche rescue have not been established. That makes it difficult to meet the duty of care and to minimize the risk of liability associated with use of civilians and other under-trained responders during an operational avalanche response.

So where does this leave us? It should be simple. The avalanche terrain in question is in BC and the BC standards for avalanche rescue and response are very clear, with standard operating procedures based on recognised levels of standardized qualifications and training, such the CAA's ITP program. But in fact, the BC standards are not applied because the response comes from Yukon responders. Without an established standard in Yukon, this means that rescuers may respond outside of their scope of training and qualifications. To me, it would seem a simple solution that for the high-use areas in both BC mountain passes that the BC standards are applied. In terms of the Yukon, well, avalanches don't happen.

CLOSE CALL CORNICE RELEASE // KIRSTIE SIMPSON

// JORDY SHEPHERD

The Progression of AvSAR

Garth Lemke

THE INCEPTION OF THE Avalanche Search and Rescue Response (AvSAR) course was in the spring of 2007 with the CAA's eTraining on-line project, funded through the National Search and Rescue Secretariat New Initiatives Fund. In the fall of 2008, CAA offered Medical Aspects of Avalanche Rescue Seminar (MAARS) with Dr. Renata Lewis. In the fall of 2009, the eTraining project re-focused on producing best practices manuals and course development. Ken Wylie, Mark Bender, Helen Rolfe, and Jordy Shepherd collaborated to yield three technical manuals in March 2010 outlining Canadian best practices for search and rescue in avalanche terrain. The process involved extensive input from various stakeholders and subject matter experts.

The *Wintersafe* manual provides information for employers sending workers without avalanche training into the mountains. The *Avalanche Search and Rescue Response* manual, used within the AvSAR course, is for rescue-equipped organizations providing peer-reviewed industry research and best practices for rescue teams. The *Avalanche Incident Management* manual is for team managers responding or coordinating responses to avalanche incidents, providing commonly accepted and applicable national standards. All three manuals are available for sale on the CAA website at avalanche.ca/caa/store/books. In the spring of 2010, the AvSAR course was developed out of the *Avalanche Search and Rescue Response* manual and incorporated the MAARS curriculum.

The inaugural three-day AvSAR course occurred November 2010 in Revelstoke with instructors Dr. Renata Lewis, Mark Bender, Kyle Hale, Garth Lemke, and Jordy Shepherd. It set the framework for the next couple of seasons. The original course dedicated a day to AvSAR, a day to MAARS, and a field day of skill stations. The AvSAR component, facilitated by Kyle Hale, Jordy Shepherd, and Garth Lemke, teaches particulars of organized avalanche rescue. It integrates the Incident Command System (ICS) within an AvSAR plan to initiate an organized response, manage resources, and apply appropriate techniques. Students apply this information into a classroom-based, multi-agency avalanche rescue scenario.

The second day, taught by Dr. Renata Lewis and Garth Lemke, focused on medical aspects of triage, how people die in avalanches, prevention in treatment, optimizing resources, and familiarization with first aid and evacuation equipment. The afternoon was spent getting familiar with items such as heated oxygen, evacuation equipment (Sked, KED, Akja, Rescue Bubble, improvised, scoop stretcher, Bauman Bag), RECCO® Rescue System, avalanche response packs, vacuum splints/mattress, Pulse-oximeter, Kendrick, King LT Supraglottic Airway, and aerial transceiver. Students were able to get comfortable with the equipment used for the next day's scenarios.

The most compelling part of AvSAR is applying what you have learned. The field day integrated four stations: tactical triage, command and control, AvSAR techniques, and evacuation and treatment. The tactical triage station combines the types of triage, development of tactical strategies, categorization of incident subjects, and application in a mock scenario. At the command and control station, someone assumes the Incident Commander/Operations Chief role and integrate ICS into a large-scale response to practice judging the level of response, prioritizing resource needs, managing resources, and balancing risk versus reward when searching for up to ten burials. The AvSAR techniques station offers students the chance to practice with Recco, locate and excavate deep burials, and choose appropriate techniques. The evacuation and treatment station involved techniques for approaching avalanche-related emergencies, pinpoint search techniques, team shoveling, treatment and transporting of victims. Each station allows for hands-on practice with immediate feedback from instructors and fellow students.

// GARTH LEMKE

The course recently evolved into two days rather than three. The MAARS day has been removed, along with the evacuation and treatment field skills station. A written test requiring 71% to pass has been incorporated, and AvSAR is now a prerequisite to the Module 2 of the Avalanche Operations Level 2. It is strongly recommended that candidates take an introductory-level ICS course prior to attending. Several are offered online either through Justice Institute of British Columbia (jibc.ca/course/cmd110) or Alberta Municipal Affairs (apsts.alberta.ca/online-courses/ics-100/). This facilitates learning, and is the accepted national standard for organizations responding to single or multi-agency emergency responses. ICS will serve you well during any emergency event you find yourself responding to.

> I have never seen a field day go so smoothly. You guys were very well organized and delivered the content in a way that was relevant to the needs of the class!
> *Student feedback*

Candidates continue to represent a wide cross-section of the industry: highways, resorts, guiding, Parks, lodges, and SAR organizations. Students have attended from the United States and Japan. What makes this course unique is that due to the collective experience present, it feels more like an AvSAR operations meeting as everyone shares their experiences. Ultimately, we all learn a great deal from each other. The curriculum continues to be updated and instructors endeavour to stay familiar with the latest research, techniques, and equipment with the focus towards best practices. AvSAR continues to be well received, particularly in regards to the field scenarios.

What is the course not? AvSAR is not a companion rescue skills course or a transceiver "how-to" course. AvSAR will enhance your understanding of these tools and give you more techniques for your organized rescue toolbox. The course was partially developed in response to numerous requests from Canadian SAR organizations. It is a unique course and the only one of its kind in Canada. The two AvSAR courses are full at the time of writing. There will also be a course offered in Quebec's Chic Chocs this January.

Many thanks go to the stakeholders, editors, and subject matter experts who developed the curriculum, the instructor staff who carry the torch, and local ski resorts in their unwavering support for the field day with equipment, CARDA dog handlers, transport, providing scenario areas, and lift passes for students. The course has been held at Whistler Blackcomb Ski Resort, Kicking Horse Mountain Resort, and Revelstoke Mountain Resort. Special thanks goes to Kyle Hale from Golden Search and Rescue, and Garth Lemke from Jasper National Park for loaning rescue, medical, and avalanche scenario equipment.

// KARILYN KEMPTON

Student Engagement Focus of ITP Instructor Training

Karilyn Kempton

NEARLY A THIRD of the ITP instructor pool attended ITP instructor training in Revelstoke this past November to learn about new resources and tools for teaching courses. The focus of this year's ITP training was student engagement techniques, including constructive feedback, PowerPoint dos and don'ts, and informal assessment techniques, taught by Jan Johnson, Peter Tucker, Emily Grady, and Iain Stuart Patterson. Pascal Haegeli also introduced the new InfoEx.

As expected, the diverse course participants offered varied perspectives and made for energetic interactive sessions. There was even a student from Iceland who hopes to teach ITP in his home country (where this year we will hold an Avalanche Operations Level 1, Level 2 Module 1, and possibly a Level 2 Module 2). Both ITP and AST instructors attended the course, and CAA Executive Director Joe Obad sat in. Education Committee Chair Steve Conger summed up popular sentiment: instructors strive to "make the complex simple." All left with plenty of food for thought.

Student engagement was the theme—student engagment involves active participation and psychological investment in learning. The benefits are obvious: motivation, higher achievement, greater learning, better retention, and positive relationships with and among students through dialogue and communication. Instructors and students have often noted a sea of cell phones or blank stares, which is not fun for anyone. Engagement helps bridge between the students and content—students retain what's presented, grasp the content and then build upon it. Student engagement also helps ITP buy-in. The CAA wants students to see good value in their course so that they in turn promote our courses.

Adult learners require unique student engagement techniques. In order for a course to be a success to an adult learner, the learners need to find course content relevant, current and high quality; be internally motivated and self-directed; be able to link subjects to tangible, personal life experience; and recognize the instructor as a credible subject matter expert. Adult learners also desire a friendly environment; respectful, constructive feedback; engagement with a passionate instructor and other students with varied experience; and want the outcomes to clearly match course objectives.

Another important component of student engagement is regular feedback, both from students and from instructors. Students often ask for more feedback, so instructors really need to take time to think about how they give it. This may include formal assessment techniques, or verifying in sessions and field discussions that students are actually "getting it." It may have nothing to do with marks, but whether or not students are processing the information.

Adults need more processing time in order to link new ideas to their life experience. It is important to build in processing time to help students stay motivated and make the necessary links for active learning. Forward links and back links at beginning and ends of lessons help people build those connections.

As instructors, it is important to recognize that students bring life experience and knowledge to the course. Encouraging students to contribute to the class promotes engagement and helps others learn as well. Students learn from more than just the people with instructor hats on—in a friendly environment, learners bounce ideas off each other and are not judged when they are wrong. Constructive feedback may also be more welcomed, since students feel respected and comfortable enough to learn. What motivates instructors? What motivates students? Everyone should explore learning in different ways in order to broaden their ability to teach in different ways.

Instructors who missed this year's ITP instructor training should consider attending next fall to help ensure ITP improves year over year.

avalanche **community**

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RISK THE ANATOMY OF CHANCE AND UNCERTAINTY
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WHAT`S NEW WITH HELICAT CANADA

in this **section**

// SCOTT AITKEN

Pika is SARScene's **Top Pooch**

Ilya Storm

Pika, together with handler Jennifer Coulter, won this year's SARScene Search & Rescue Dog Games. SARScene brings together search and rescue organizations from across the country, so it's a natural arena for some good-natured competition. "The SAR Dog Games showcase a tried and true volunteer resource that is widely available throughout the country," says Coulter, a CAA Professional member. "In a conference full of great flashy new tools and expensive complex technologies, it's a excellent opportunity to remind the organizations about how volunteer dog teams remain an integral part of the rescue community."

When asked what it takes to be a successful SAR K9 team, Coulter makes eye contact with Pika and notes the importance of starting with a great dog. That means selecting both a breed—and the right puppy within that breed—that is well-suited for the rigours of SAR work and fits with the handler's abilities. Finding the right puppy is just the start of a long, challenging road. "It takes no small amount of dedication to shape and develop a puppy into a successful search dog—it's countless hours over many years," admits Coulter. Teamwork is also essential: "We often talk about the team as the handler and the dog, but my team is much bigger than that. Without the training help and support provided by other Fernie SAR dog teams, the Fernie Ski Patrol, and mentors in the CARDA and RCMP dog program, we would not be where we are today."

Pika is certified in Emergency Management BC's wilderness, tracking and avalanche search dog profiles. Jennifer Coulter volunteers with Fernie Search and Rescue, the BC Search Dog Association and Canadian Avalanche Rescue Dog Association (CARDA), where she serves as a director and the Instructor Coordinator. Her professional time is split between the Canadian Avalanche Centre as an avalanche technician in the South Rockies Field Team, Fernie Alpine Resort Ski Patrol, and dog training.

// RAVEN EYE PHOTOGRAPHY

Schedule of Upcoming **Events**

AVALANCHE AWARENESS DAYS

January 18-19, 2014

AAD is a national celebration of Canada's avalanche safety expertise and an invitation to enjoy the winter backcountry with education and training. Mark your calendars and get involved.
For more information:
avalanche.ca/cac/events/avalanche-awareness-days

WILDERNESS MEDICAL SOCIETY'S 22ND WILDERNESS & MOUNTAIN MEDICINE CONFERENCE

February 13-19, 2014
Park City, Utah

Leading-edge information in avalanche rescue, cold injuries, high-altitude illnesses, expedition/travel medicine and more.
For more information:
wms.org/conferences/parkcity14

CAF CALGARY GALA FUNDRAISER

March 6, 2014
CP Rail Pavilion, Calgary, AB

For more information:
avalanche.ca/caf/news-and-events/events

19TH BIENNIAL INTERNATIONAL SKI PATROL ASSOCIATIONS CONGRESS

March 29 - April 5, 2014
Silver Star Ski Resort, Vernon, BC

Fédération Internationale des Patrouilles de Ski (FIPS) is an international corporation made up of ski patrol organisations representing ski patrollers and ski safety bodies in their respective countries
For more information:
fips-skipatrol.org

WESTERN SNOW CONFERENCE

April 14-17, 2014
Durango, Colorado

Now in its 82nd year, the conference aim is to advance snow and hydrological sciences.
For more information:
westernsnowconference.org

EUROPEAN GEOSCIENCES UNION GENERAL ASSEMBLY

April 27-May 2, 2014
Vienna, Austria

One meeting covering all disciplines of the Earth, Planetary and Space Sciences.
For more information: egu2013.eu

CAA & CAC SPRING CONFERENCE AND ANNUAL GENERAL MEETINGS

May 5-8, 2014
Ramada Inn & Suites, Penticton, BC

Mark your calendar. You won't want to miss any of the presentations, meetings or discussions at this year's AGM.
For more information: avalanche.ca

HELICAT CANADA ANNUAL GENERAL MEETING

TBD
Ramada Inn & Suites, Penticton, BC

For more information:
helicatcanada.com

CANADA WEST SKI AREAS ASSOCIATION 2014 SPRING CONFERENCE

May 12-14, 2014
Fairmont Chateau Whistler, Whistler, BC

Spring Conference, Trade Show, Operations & Maintenance Seminar.
For more information:
cwsaa.org/calendar3.html

INTERNATIONAL SNOW SCIENCE WORKSHOP 2014

September 29 – October 3
Banff Centre, Banff, AB

The ISSW promotes exchanges between practitioners, mountain professionals and researchers in the field of snow and avalanches.
For more information: issw2014.com

PRESENTERS AL TIHOLT, FRASER QUELCH AND GRANT STHATHAM // GRANT STATHAM COLLECTION

Risk: The Anatomy of Chance and Uncertainty at **TEDx Canmore**

Grant Statham

IT HAD ALWAYS BEEN A GOAL of mine to do a TED talk, complete with classy stage presence and cult following. This past October, I finally got my chance when my hometown of Canmore held its first-ever TEDx conference. I shared the stage with 16 other creative and courageous people, and I spoke about what I know best—*Risk: the Anatomy of Chance and Uncertainty*.

TED began in 1984 as a conference bringing together people from three worlds: "Technology, Entertainment, and Design", under the simple slogan of "ideas worth spreading." TED speakers are leaders in their field, and in 18 minutes or less, many of them deliver the talk of their lives. Some of the best public speaking you will ever see happens at the TED conference, and TED curates more than 1,500 talks on their website. The most popular ones have over 14 million hits. This is a place where someone largely unknown can send an amazing idea out to the world.

TEDx programs are independently organized community events, delivered under license from TED. Created in the spirit of "ideas worth spreading," their goal is to stimulate dialogue through TED-like experiences in local communities. The requirements are strict: conference organizers must adhere to rules on content, audience numbers, price, licensing and sponsorship.

In May 2013, I found myself staring down the barrel of a 24-hour deadline for submitting a proposal for TEDx. After thinking about it for months, I needed to commit to an idea. I decided to dissect risk into its main pieces, explain them, and then fit them back together and show people how they can apply these concepts to their day-to-day problem solving. After all, everyone faces uncertainty every day of their lives. Why not show people what the mountains have taught me about that? One thing I have learned from talking about risk for the last decade is that everyone is interested, everyone can relate, and everyone has his or her own story. I love watching people relate the concepts I've taught them back to me in ways that help solve their own questions. It's like watching the lights come on inside someone's mind.

I sent in the following proposal: *Every day, every one of us makes choices and decisions in the face of uncertainty. Guided by a blend of intuition and logic, we spend a large part of our lives navigating the murky waters of chance. This is the space between 0 and 1; this is risk, and we confront it daily. But how many of us really understand the underlying constructs of risk? What is risk, and how do we break it down to better understand the decisions we face? How do probability, consequence, exposure and vulnerability play out in the choices we make and the impacts they have? In this captivating presentation, Grant Statham takes us on a journey into the heart of risk by weaving stories, ideas and concepts together with stunning images from a lifetime spent in high places*.

In June, the conference tickets sold out within 48 hours of going on sale. By mid-July, the organizers had received 120 applications for what would become 16 presentation spots. Soon after, I was told mine was accepted and I should begin preparing. So I went climbing and biking for the summer and figured I'd work it out in the weeks leading up to the conference.

Very suddenly, it was early October and I needed to get serious. I'd been given a 12-minute time slot, and told I would be the first speaker of the day. My normal teaching version of this talk is about an hour long, so 12 minutes would be a real challenge. The actual content itself was pretty easy; the trick would be introducing it and providing context within the first few minutes so I could get to the key content. I had no time for frivolous words.

I spent hours poring over my images, searching for the perfect photographs to illustrate my points. I needed images that I could tell a story about, explain a risk concept, and

overlay diagrams on blue sky or white snow. I narrowed it down to 41 images that could work, then again down to 12 for the final cut. I spent hours obsessing over my slides, perfecting diagrams and subtle animations to enhance the story.

I've never really practiced for a talk before; I normally just get organized and then get up on stage and do it—but this time was different. I was gripped about that 12 minute deadline, so I rehearsed in my head using a stopwatch over and over. I did a dry run with some staff at work over lunch, and finally I practiced at home with Ryan and Leigh Ann in the living room (which was totally intimidating).

I was ready; but was TEDx?

The night before at the A/V check, I noticed that my slides were not formatted properly. The aspect ratio on the projector was wrong, and the mountains were stretched horizontally. When I approached the organizers to correct this, the A/V person had gone home and I was assured they'd deal with it in the morning—I was disconcerted, to say the least.

The next morning, I was told that they didn't want to climb a ladder to make changes on the ceiling mounted projectors, and they thought my slides looked just fine. I was stunned. My slides didn't look fine, and this was the last thing I needed while getting psyched to deliver. I couldn't convince them, and the last thing they said as my eyes burned holes through their skulls was, "Don't worry, for the video we'll take the images from your computer."

Two minutes into my talk I looked at the screen for the first time. Only one quarter of my slide was showing, and the diagrams were gone.They botched it completely. I bobbled one word when I realized, took a split second to adjust, and then kept going as if all was fine. People in the audience must have wondered as I pointed out features that they could never see. The organizers went up on the ladder right after I finished.

The rest of the day was amazing. I was honoured to share the stage with speakers who had also poured their hearts into their talks. The subject matter was diverse: from geology to wildlife, fitness, Olympic gold medals, the third world, video games, psychology, addiction, helping, and life in the garden. There was beautiful music, aboriginal drumming, and lots of spare time for walking in the sunshine or socializing with the participants. My mom was even there with me.

Overall, my TEDx experience was awesome. I met some great people, and got to do something I'd always wanted. Check out the video and see what you think. If you like it, please share. It's amazing what the mountains can teach us. Google Grant Statham TEDx Canmore to find the talk.

From Sputnik to the Great Bear: Avalanche snowsheds on Canadian Highways

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

ON OCTOBER 4, 1957, PEOPLE ACROSS CANADA AND AROUND THE WORLD LEARNED THE RUSSIAN WORD "SPUTNIK" WHEN THE SOVIET UNION LAUNCHED THE FIRST MAN-MADE SATELLITE INTO ORBIT. IN RECOGNITION OF THIS MOMENTOUS ACHIEVEMENT, THE NEWLY-ESTABLISHED AVALANCHE SAFETY TEAM WORKING IN ROGERS PASS THAT WINTER NAMED A SLIDEPATH ALONG THE PROPOSED ROUTE OF THE TRANS-CANADA HIGHWAY SPUTNIK 1.

THE TRANS-CANADA Highway was under construction over Rogers Pass at the time and Sputnik 1 appeared on avalanche observation plans of the day (Fig. 1). Since a snowshed was planned for the highway across this slidepath, Sputnik 1 was the name used on the earliest construction documents for Canada's first snowshed on a public highway.

Peter Schaerer was in charge of the avalanche survey crew that winter and describes the naming process in detail: "The crew of the Department of Public Works who observed avalanches and the weather in Glacier National Park in 1956-1960 was assigning names to the avalanche paths in 1957. The three major avalanche paths at Mount Tupper had been designated as Tupper No.1, No.2, and No.3 (actually, the idea popped up—but was abandoned—to rename them with the first names of the wives and girlfriends of the crew members). Because the name Sputnik was in everybody's mind, we called the smaller avalanche path west of Tupper 1 "Sputnik No.1" and the path between Tupper 2 and Tupper 3 "Sputnik No.2." The names were appropriate, because both paths were satellites of larger paths…" (personal communication, Schaerer-Woods, 2013).

The next year, after the United States launched their "Pioneer" rocket towards the Moon, the names of both the slidepath and the snowshed were changed to recognize this North American accomplishment. While the Rogers Pass avalanche atlas still includes the Pioneer slidepath (Schleiss, 1989), more experience during winter operating conditions resulted in connecting Pioneer and Tupper 1 sheds. The combined structure became the shed now called Tupper 1.

Pioneer Shed (a.k.a. Sputnik 1) was chosen as the site for the first snowshed because it was designed to be a relatively short shed—a good project to launch construction on what would become a suite of sheds protecting Rogers Pass's eastern flank. This proved to be an excellent idea affecting the designs of all the subsequent sheds.

The ARMCO construction company won the contract to build this first shed and decided to use metal culverts supplied in multiple steel plates (Fig. 2). Unfortunately, the backfilling required to provide an even pressure distribution across the plates could not be completed by the first winter, and avalanches moved the structure out of position. The federal Department of Public Works lost confidence in metal designs and all subsequent snowsheds in the Pass were made of concrete (personal communication, Schaerer-Woods, 2013).

While the locations and designs of avalanche defences make use of the best

CANADA'S NINE AVALANCHE SHEDS ON PUBLIC HIGHWAYS

Eight avalanche sheds currently protect portions of the Trans-Canada Highway (Hwy 1) between Golden and Revelstoke, BC. Parks Canada manages and maintains five of these (Tupper Timber, Tupper 1, Tupper 2, Lens and Single Bench) in Rogers Pass. Three sheds immediately west of Glacier National Park (Lanark, Twin and Jack McDonald) form part of the BC Ministry of Transportation and Infrastructure's Avalanche and Weather Programs. Canada's ninth and youngest highway shed, the Great Bear, became operational during the winter of 1986-87 with the opening of the provincial Coquihalla Highway (Hwy 5) between Merritt and Hope, BC.

available data on historic slide activity, projected traffic volumes, working challenges, and economic realities, nothing can compare with the learning that takes place once the structures are in place. Take for example Lanark Shed, on the Trans-Canada Highway just west of the western boundary of Glacier National Park. On January 1, 1963, slides overwhelmed both entrances to the shed trapping two cars and several people. While everyone was safely rescued after an eight-hour ordeal, this experience resulted in revisions to the shed design. By the following winter, tall concrete containment wings were added above both entrances (Woods, 2010).

In an incident on January 14, 1974, at Single Bench slidepath in Rogers Pass, an avalanche hit the avalanche control team (at the time called SRAWS—Snow Research and Avalanche Warning Section) in Rogers Pass just west of the existing sheds during a control shoot along the highway. Although no one was seriously hurt, the results were spectacular and ominous. A parked semi-transport truck was sent flying through the air, SRAWS and army vehicles were dislodged and damaged, and the 105-mm Howitzer used to initiate the slide was put out of commission (personal communication, Bay-Woods, 2013). Today, Single Bench Shed protects both highway travellers and avalanche control crews at this location.

Canada's history of studying avalanche terrain and activity along transportation corridors dates from the winter of 1884-85. The Canadian Pacific Railway staffed "snow camps" in and adjacent to Rogers Pass throughout that winter to observe weather and avalanche activity. Their observations were vital to the location and design of the numerous snowsheds that would be needed to allow year-round operation of the railway across the Selkirk and Monashee mountains. In addition to numerous reports to the railway company, one of the survey engineers presented a landmark professional paper on the topic of avalanches and shed design at a meeting of the Canadian Society of Civil Engineers (Cunningham, 1887). Similar studies of avalanche activity for the potential construction of a highway through Rogers Pass started in the early 1950s (Schaerer, 1995; Webb, 2011). In a tenacious and dedicated career spanning more than five decades as an employee of the National Research Council of Canada and as a private consultant, Peter Schaerer played a key role in locating and identifying design requirements for all nine Canadian highway snowsheds—from Sputnik to the Great Bear.

ACKNOWLEDGEMENTS:

I would like to thank Jim Bay, Peter Schaerer and Walter Schleiss for sharing their first-hand experiences related to Canada's highway snowsheds. Jeff Goodrich of Parks Canada kindly provided access to the unpublished plan showing avalanche activity at Sputnik 1 in 1958. Jacolyn Daniluck of Parks Canada and Cathy English of the Revelstoke Museum and Archives offered valued editorial suggestions on early versions of this article.

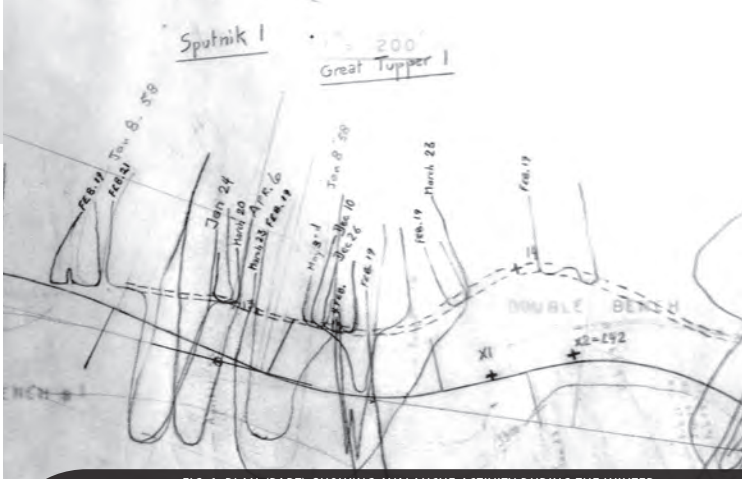


FIG. 1: PLAN (PART) SHOWING AVALANCHE ACTIVITY DURING THE WINTER OF 1957-58 IN ROGERS PASS. NOTE THE ACTIVITY OF "SPUTNIK 1" SLIDEPATH ON JANUARY 8, 1958 // REVELSTOKE MUSEUM AND ARCHIVES

FIG. 2: PIONEER (A.K.A. SPUTNIK 1) SNOWSHED UNDER CONSTRUCTION IN 1961 // REVELSTOKE MUSEUM AND ARCHIVES PSS. 67

SOURCES:

Cunningham, G. C. 1887. Snow slides in the Selkirk Mountains. Transactions of the Canadian Society of Civil Engineers 1 Pt. 2: p. 18-31.

Schaerer, P. 1995. Avalanche studies Rogers Pass 1956 – 1961. Unpublished.*

Schleiss, V.G. 1989. Rogers Pass Snow Avalanche Atlas Glacier National Park, British Columbia, Canada. Revelstoke, BC, Canadian Parks Service, p. 313

Webb, J.R. 2011. Tales of a Highwayman. J. R. Webb, self-published, p. 253*

Woods, J. G. 2010. Snow War: An Illustrated History of Rogers Pass, Glacier National Park, BC.*

** available for viewing at the Revelstoke Museum and Archives*

What's new with **HeliCat**

Ian Tomm

HELICOPTER AND SNOWCAT SKIING WERE INVENTED IN BRITISH COLUMBIA IN THE 1960S AND EARLY 70S, RESPECTIVELY.

MANY OF US KNOW THE STORY well, but as time drifts on much of the industry's rich history is starting to fade. Injecting large numbers of people on skis into the backcountry in the 60s and 70s challenged our knowledge of the mountains, and avalanche safety in particular. Through a lot of hard work and more than a few hard knocks, we have arrived to where we are today. Canada's helicopter and snowcat industry is unique, employing more avalanche workers in Canada than any other sector and bringing people from all over the world to ski BC's legendary snow.

The 60s and 70s were a time of learning and exploration. I remember guiding Leo Grillmair, a founder of CMH, several years ago up at the Campbell Icefields. The stories about the sense of adventure and the unknown were fascinating. A lot was learned in those early years. I'm reminded of similarities between the early years of heli and cat skiing and what happened to the snowmobiling community over the past few years: accidents, media scrutiny, collaboration, partnership, solutions and progress.

Founded in 1978, 2013 marked HeliCat Canada's 35th year of operation. The name wasn't always so catchy: the original articles of incorporation were for the Association of BC Heli Skiing Operators, later renamed the BC Helicopter and Snowcat Skiing Operators Association, or BCHSSOA (try saying that 10 times). After the maturation of the organization's communication and marketing committee, HeliCat Canada undertook a rebranding initiative in 2005 and adopted and registered its new name and logo.

Why was HCC formed back then? The industry was growing quickly and the number of people in the backcountry was rapidly increasing. A few high profile accidents, some ending up in court, tested the community's knowledge and understanding of the mountains and avalanche safety—including its standards, operating protocols and risk management programs. The only way the community could address these issues in a meaningful way was to come together, form an association and start to work on issues of mutual concern and interest.

HeliCat has not had an easy go of things. Being a trade association—a group of competitors trying to collaborate—brings with it certain challenges, and there have been disagreements between members over a number of issues in the past. Some have been resolved, others not, leaving division in its wake. Still, there are many successes and today HeliCat has the majority of helicopter and snowcat operations in BC as members.

What's new with HeliCat Canada? The organization is in the middle of a significant re-profiling, fueled in large part by the keen leadership and vision of the board of directors. In the fall of 2012, the board brought members and non-members together for a facilitated workshop at the CMH Bugaboos Lodge. That workshop developed a new vision

FIRST DIRECTORS OF HELICAT

- Rudi Gertsch (Purcell Heli-skiing)
- Hans Gmoser (CMH)
- Roger Madsen (RK Heliski)
- Peter Schlunegger (Selkirk Tangiers Heli skiing)
- Richard Roy

// LLOYD GALLAGHER

for the organization and defined how it works with its partner organization, the Canada West Ski Areas Association (CWSAA). Numerous options were developed and worked on throughout the winter of 2012-13 and presented to the members at the May 2013 AGM. In a unanimous vote of the members, the option to separate executive and managerial functions entirely from CWSAA and hire a dedicated Executive Director was approved. The vote was significant; it was a clear signal from the members that they sought a renewed HeliCat Canada.

After an extensive executive search and interview process, I was asked to become the first Executive Director and to help lead the organization in partnership with the bard of directors. I am happy to report that a lot of progress has been made in the past few months, including new members, rejuvenated committee work, the evolution of HeliCat's operating standards, and partnership and collaboration with government and stakeholders.

In a landmark development, HeliCat Canada has recently signed formal partnership agreements with the provincial snowmobiling organizations, the Association of BC Snowmobile Clubs and the BC Snowmobile Federation. These two user groups have traditionally not seen eye-to-eye on everything, but we've found common ground and are dedicated to working together in partnership, to ensure stewardship of our lands and the promotion of economic health in our communities across the province.

If you are interested in learning more about HeliCat Canada or its members, mandate, and current activities, visit helicatcanada.com. We are hard at work developing new content for our website, new resources for our members, public, government and the media, and assisting our members in having another highly successful winter season as the world leaders in helicopter and snowcat skiing.

Reviewing ICAR 2013

John Buffery

THIS YEAR'S INTERNATIONAL COMMISSION FOR ALPINE RESCUE conference was held in Croatia. On October 15, 2013, the Network of Prevention and Mountain Safety adjunct group met in Split for a two-day meeting on issues and findings of the working groups' efforts on preventative safety in mountainous areas. Cam Campbell was the honoured guest speaker, outlining the 10-year history of Canada's Avalanche Terrain Exposure Scale (ATES). He opened up the floor to discuss the latest ATES rating zone model, leading to dialogue from different mountain cultures on how they may adopt or modify ATES. So much interest was raised with Campbell's ideas that he was asked to participate at the ICAR Convention.

Two days later, 275 international alpine rescue delegates, representing over 30 national rescue organizations and four separate but linked commissions, met on the southern shores on the island of Brac in the town of Bol for three days of intense listening and discussion. The first day, each commission gathered in their respective groups: avalanche rescue, terrestrial rescue, air rescue and alpine medicine. Every year in the Avalanche Commission, presentations from most countries provide a summary of annual avalanche incidents. Some very interesting issues come to light, like Norway's slush avalanche in a frequently used recreational area. Norway is fearful of a change allowing snowmobiles into their backcountry. France had their first snow shoe victim in a ski touring area. The sheer number of avalanche fatalities in France (36), Austria (26), Switzerland (22) and Italy (28), give perspective to our own number, closer to Scotland (8).

Heated discussion arose around rescuers spending excessive time searching for victims buried without a transceiver. ICAR will develop recommendations regarding people traveling in avalanche terrain during summer alpineering expeditions. The official stance is yet to be defined, but ICAR's mandate is to set the bar in expediting fast, safe recoveries from misadventures. We ended the day with the President of the Avalanche Commission, Dominque Letang's parting words: "If you recreate in the mountains during the summer, equip yourself to be found." I held the floor with a presentation inspired by Bruce Jamieson and Alan Jones' talk from last year's CAA spring conference on using the International Standards Organization 31000 Risk Management strategies, with the practical application of a televised snowboard competition event at Baldface Lodge.

The following day, the Terrestrial Commission joined us for some very interesting topics. A slick presentation from a European company described their smartphone application Alpify. The application allows users to send their position to a local rescue team in the event of an emergency. The service tracks the user's position every two minutes, and also provides information regarding weather, ski lift access and emergency phone numbers. Another presentation on locating people was about Talk Finder, enabling radios to connect with a smart phone dashboard to locate rescuers on a work site. Pieps/Black Diamond gave a very impressive demonstration of their new jet fan avalanche balloon pack. It runs off a 28-volt battery good for four deployments on one charge. Once the trigger is pulled, a jet fan inflates for three minutes at 60,000 rotations per minute. It then mechanically deflates, creating a 200-litre air pocket. Fredrick Jarry from ANENA provided some interesting European statistics about avalanche burial duration. Forty-five percent of backcountry incidents alert professional responders. Eighty-one percent of backcountry riders wear avalanche transceivers, with an average burial time of 30 minutes (or two hours if the victim is not wearing an avalanche transceiver). Off piste riders are recovered in 25 minutes if they are wearing a transceiver, and 1:10 hours without.

The last day was a collective joint session with all four commissions. A. Kottmann from the Swiss air rescue service REGA shared the Avalanche Victim Resuscitation Format, creating an algorithm to help make decisions on advanced life support and to send that information to the secondary help. This timeline continuum is used for further essential treatment.

Dr. John Ellerton from England gave a convincing, pointed talk on analgesia in mountain rescue. He indicated most mountain rescuers need more training to exhibit more confidence and reassurance in providing the best patient care by reducing pain by 30 to 50%. He suggests minimizing the number of solutions and having multiple deliveries for pain relief, and mentioned that using one strong opiate as a core drug is 33% effective. Baise Agresti gave an interesting presentation of risk analysis for rescue missions. His group spends 90% of their time training and 10% on missions (48,000 hours and 6000 hours, respectively). The greatest takeaway I gleaned from his talk is that their group debrief everything, and have a "lessons learned" program.

Chilliwack Hosted **SARscene 2013**

Sandra Riches

SARSCENE IS A YEARLY NATIONAL SEARCH AND RESCUE CONFERENCE HELD BY THE NATIONAL SEARCH AND RESCUE ASSOCIATION (NSS) AND CO-HOSTED BY A PROVINCIAL OR TERRITORIAL SAR ASSOCIATION.

In October, BC Search and Rescue Association (BC SARA) proudly co-hosted the event and the Association organized an interactive, educational and eventful gathering.

Delegates came from across the country and overseas to beautiful Chilliwack, BC to participate in over 30 presentations and workshops, in addition to competing in the SAR Games. The program sessions offered a wealth of information unique to SAR members, including topics such as integrating technology into SAR, social fundraising, operational use of UAVs (unmanned aerial vehicles), assessing the effectiveness of prevention, the AdventureSmart programs, and essentials to successful search and rescue operations.

A pre-conference workshop focused on SAR prevention, specific to the AdventureSmart program. AdventureSmart, national since 2008 and entering its tenth year, offers outdoor recreation safety programs, community outreach and targeted SAR prevention. Thanks to the NSS and a SAR Prevention SAR NIF project, this workshop offered a great opportunity for subject matter experts to share national program delivery outcomes and evaluation standards. Thanks to the Master Trainers and presenters from Nova Scotia, Ontario, Manitoba and British Columbia for all the effort and commitment they put towards SAR prevention, public education and training. They are making a difference across the country in helping to reduce the number and severity of SAR incidents.

The SAR Games took place October 19 on the grounds of the Pacific Region Training Centre with a challenging day of stations that allowed the teams to compete in navigation, tracking, team building, first aid, rope rescue and outdoor skills. The sun shone all day and so did the competitors as they worked towards the coveted SAR Games honor and trophy (and bragging rights for a year). Congratulations to Nelson Search and Rescue, the winners of this year's SAR Games 2013 competition.

The conference tradeshow is always a great hit for SAR members and the visiting public, offering face to face opportunities to meet with industry partners and outfitters. The exhibitors showcased SAR equipment, gear and resources, coupled with BC SAR teams displaying their command vehicles, safety equipment, rescue boats and ATVs for the public to view. Dedicated members were on site to talk with the public at the tradeshow about their volunteer and community work, giving the public an opportunity to learn first hand how SAR operates in BC.

This year's four-day event, including pre- and post-conference meetings and workshops, brought together highly skilled and trained individuals—amongst the most dedicated group of volunteers in the country. Over 1,000 SAR incidents occur each year in BC alone, which keeps our SAR teams extremely busy with response, training, rescue, education and prevention.

BCSARA would like to thank all the volunteers who helped make this conference a success. We look forward to SARscene 2014. For more information about SARscene, BCSARA or AdventureSmart, contact Sandra Riches at sarsupport@bcsara.com.

THE CANADIANS REPRESENT IN GRENOBLE // MARC PICHÉ

International Snow Science Workshop 2013 **Recap**

Grant Statham

ISSW 2013 ran from October 6 to October 11 in Grenoble, France. There were 650 registered delegates representing 32 countries, including approximately 15 CAA members.

The conference schedule included plenary sessions on Monday, Tuesday, Thursday and Friday, with a mid-week Chamonix field trip. The conference was well-organized and went off without a hitch. The organizing committee received over 347 abstracts, which they turned into 102 oral presentations and 245 posters.

Oral talks were shortened from 20 to 15 minutes, which led to many going over time. Overall, the talks were heavy on science and theory, particularly the first two days. The last two days focused more on issues relevant for the practical avalanche forecaster, ski patroller and mountain guide. Following is a summary of what I found most interesting.

Black Diamond/Pieps Airbag

After much secrecy, Black Diamond/Pieps displayed their new avalanche airbag. Overall the bag looked pretty good, though still heavy. The trigger mechanism seemed good, and Black Diamond claims the battery will power four full inflations. It is important to note that this bag is not yet CEN approved, and a number of rigorous tests must be met. I have asked BD for information regarding how this giant battery powering the airbag fan may affect avalanche transceivers. They plan to have this bag on the retail shelves for fall 2014.

Shifting Audience and the Visual Language of Avalanche Risk Communication

Jernej Burkeljca – Slovenia

This presentation focused on public comprehension for four avalanche bulletins: Austria, Utah, Parks Canada, and Spain. The speaker's background is in media communications, and he is currently doing a Ph.D. on avalanche communications. He had solid constructive criticism on all the bulletins, but the Austrians' bulletin was deemed most complicated. Canada came out on top with the clearest, simplest message, but there were still points for us: too much colour makes it difficult to detect danger trend easily, and we need to make the avalanche problem stand out much more.

His main point was for avalanche forecasters to let go of their obsession with detail, and tailor their products for their audience. He promoted the idea of tiered information, where more details can be found by clicking beyond.

Intuition vs. Rule-Based Decision Making—Why Intuition Doesn't Work in Avalanche Terrain

Werner Munter – Switzerland

Munter gave an excellent talk, and although the title seems controversial, his points are hard to argue. He speaks to biases inherent in human decision making, and compares them against using structured decision making systems. I think most people in the room agreed with what he had to say, although a sage Norwegian mountain guide seemed to have a scripted battle with Werner afterwards.

Avalanche Problems/Avalanche Character

Several talks described the use of so-called "avalanche problems" in public warnings. At the moment there is no standard, and every country has a list of problems from as short as five (Switzerland) to 15 (Norway). Some standardization is required, but the system is well entrenched and used in different ways in most countries now. Karl Klassen presented Canada's method.

The Software Behind the Interactive Display of the Swiss Avalanche Bulletin

Marc Ruesch – SLF Davos

This was an interesting talk about software development for public warnings. The Swiss redid their system last year, and predetermined sentences are a main feature, just as we did. However, they have also created blocks where the forecaster can build different sentences from an extensive search menu. They talked about the importance of the search function to make the forecaster's day flow properly. These sentences are automatically translated into French, Italian, English and German.

Avalanche Terrain Exposure Scale (ATES)

Several presentations focused on the use of ATES, which seems to be gaining traction in Europe. The Swedes, Norwegians, Spanish, and Italians described different applications of ATES. Cam Campbell presented a Canadian model he has been using for zoning. It is nice to see our product so far around the world.

ISSW 2014

Perhaps most interesting for me was to observe the conference as organizer of the next one. A few things come to mind. We secured a number of sponsors for Banff, including TAS as a title sponsor and Wyssen as a contributing sponsor. We must ensure that presentations are good for practitioners. We should expect a big turnout in Banff due to high interest, and many commented on what they would like to see. We must also strive to keep it simple.

// DAVID BRYAN

// KIM WILLIAMS

Get Involved in ISSW 2014 in Banff

Mary Clayton

THE PRE-EMINENT CONFERENCE for all things avalanche is coming at us soon. ISSW 2014 will be in Banff next fall, gathering together some of the world's most prominent avalanche specialists.

After ISSW 2012 in Anchorage, Banff organizers surveyed those delegates to get some ideas on how to shape the 2014 conference. Out of the 278 responders, 77% said they wanted more presentations from practitioners. With that in mind, the Banff conference has made some special efforts for front-line workers.

The University of Calgary's ASARC program, under Bruce Jamieson, has offered to provide mentorship for practitioners who have not presented at a scientific conference. There are certain guidelines that need to be met that can be intimidating for those of us without a science background. With help from Bruce and his colleagues, you will learn how to submit an abstract, how to format your paper, and how to deliver a relevant and interesting presentation.

Another innovation from this conference is in the abstract submission process, with an additional level of scrutiny. All abstracts must include a description of how the presentation relates to practical avalanche work. In addition, all research presentations will wrap up by describing how the study applies to people in the field, or pose research questions that might support fieldwork.

There will be daily panel discussions throughout the week designed to stimulate debate about things that matter to front-line workers. Panel discussions are being organized by the ACMG, and topics will be relevant to field workers across the industry.

The conference will be held at the Banff Centre, which is making its entire campus available to ISSW. The Centre is also offering well-priced on-site accommodation, which includes use of all the facilities. Abstract submission and conference registration will open in early 2014. There will be early-bird pricing, so please register early.

On the organizing front, things are going well. Conference organizer Grant Statham reports the sponsor line-up is shaping up nicely, with TAS signed up as one of the title sponsors. Supporting sponsors so far are Arc'teryx, Wyssen Avalanche Control and Black Diamond/Pieps. TECTERRA, CIL Explosives and Osprey have signed as contributing sponsors. There is still room in all those categories for more sponsors, so expect to see more logos soon.

The ski patrol team at Lake Louise is feverishly organizing social events and with CAA Membership Committee Director Rocket Miller in the lead, you can be sure these will be memorable. The ski patrol team at Sunshine Village is organizing the mid-week field trips, and these promise to be notable as well. With about 1,000 delegates expected, the organizing committees have their hands full.

Like most things that are a lot of work, there is a lot of reward as well. The volunteer meetings are full of good energy, creative ideas and great people. The team is proud to host ISSW 2014 and all are looking forward to showing off Banff, the Rockies, and the Canadian way of avalanche safety. More volunteers are always welcome and you can sign up online at issw2014.com. You can count on the Friday night after-party for organizers, staff and volunteers being well worth your efforts.

ISSW 2014

- Sept. 29 – Oct. 3, 2014
- Issw2014.com is updated regularly, or you can sign up for updates
- Sign up on Facebook (facebook.com/ISSW2014)
- Thursday night's banquet will feature Chris Stethem as keynote speaker
- Diva Night at the Aurora on Sept. 30 (men allowed after 9:00 pm)

In Memoriam: Frank Baumann 1947-2013

FRANK BAUMANN PASSED AWAY on Friday, November 1, 2013 at the age of 66 with his family at his side. He was involved in a car accident on October 24 north of Pemberton and spent a week in the ICU at Vancouver General Hospital before succumbing to his injuries. Frank was well known for his boundless energy and many passions, including mountaineering, geotechnical engineering, avalanches, teaching and technical gadgetry, among countless others. A memorial was held to celebrate Frank's life in Vancouver on November 9.

Frank's impact on our organization and the avalanche community as a whole was notable. He was a prominent registered Professional Engineer with the Association of Professional Engineers and Geoscientists of British Columbia (APEGBC), and worked both in the fields of geotechnical engineering and, in more recent years, avalanche risk assessments and management of avalanche safety programs. His avalanche worked included forestry and independent power projects (IPPs) in BC, as well as power and mining developments in South America. Prior to that Frank had been involved with the Whistler Volunteer Ski Patrol, BC Mountaineering Club and was a recreational avalanche instructor.

Although Frank was not a member of the CAA, he worked closely with many CAA members over the years, and was undeniably a catalyst for positive change within our community through his work for the BC Coroner's Service. Frank was outspoken and never one to hold back an opinion, and did so over the years in the interest of public safety, both in the geoscience and avalanche fields.

My colleague Alan Dennis likes to remember Frank as a maverick—as Merriam-Webster puts it, "a person who refuses to follow the customs or rules of a group." That he certainly was, and Frank's passing leaves a gap in our avalanche community, the role of the independent maverick calling for change and helping the CAA move forward in the interest of public safety.

Alan Jones, P.Eng.
CAA Professional Member

I FIRST MEET FRANK on the Whistler Ski Patrol in 1975. He was a weekend volunteer working as a high school teacher in Squamish at that time. He accompanied me on avalanche control routes and we would freeski together, stopping now and then and dig snowpits.

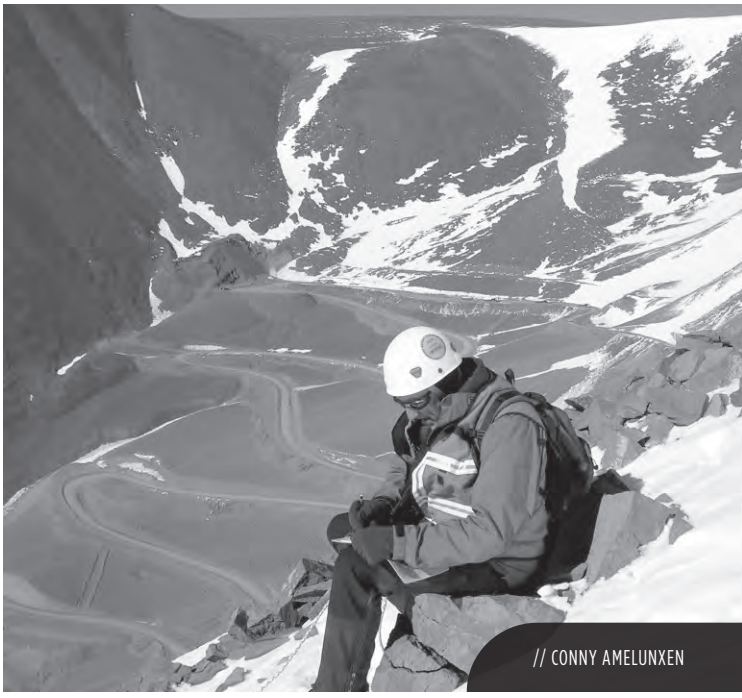
We taught two-day avalanche courses to many outdoor groups together after I got my Level 1 and Level 2 in 1978 and 1980. We started ski touring around that time as well, with trips up the Duffey Lake area and Garibaldi Park.

My background is in Civil Engineering so it worked well with his education and I was his field technician on many jobs. We combined our skills and started doing avalanche work for logging companies in about 1980. We worked together with Alan Dennis at Meager Creek. Our work included laying out roads to avoid all types of hazards and building berms.

We continued to ski together and I worked at TLH for a while. I continued working with him on IPPs, training staff on the use of transceivers and hasty search. I worked with Frank on four different IPPs over the last few years, doing weather observations and terrain evaluation, and met his lead forecaster Conny Amelunxen, who also guides for TLH.

I talked with Frank on the morning of his accident en route to talk at the APEGBC conference. I was at his house getting ready to clean his chimney when the RCMP arrived to break the news at about 12:30. I directed the RCMP to where his wife Nadine was working.

Mike Suggett



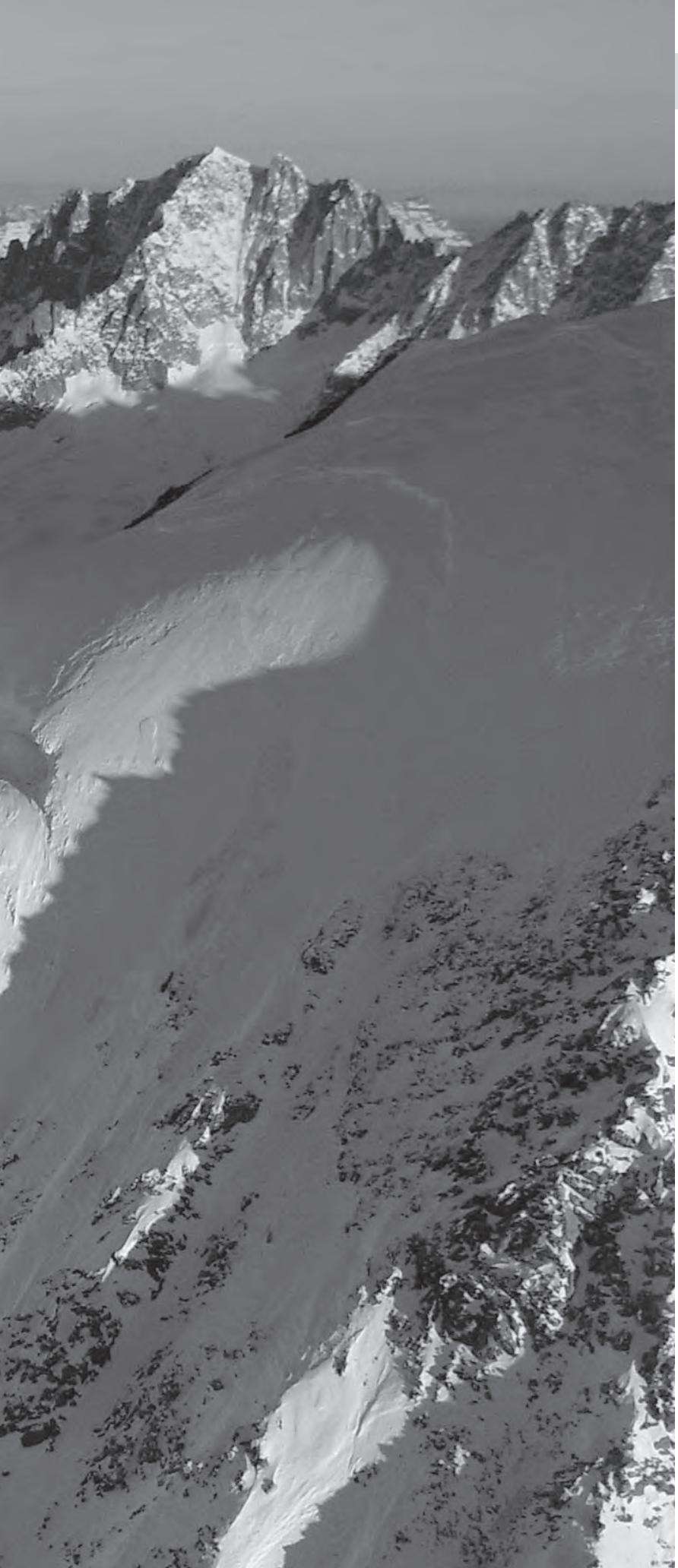
// CONNY AMELUNXEN

research

// SCOTT AITKEN

Que Serac, Serac

WHYMPER GLACIER, JANUARY 2009 // S. MARGRETH, SLF DAVOS



Larry Stanier

SERAC/ICE AVALANCHES ARE A "PART OF THE DEAL" hazard in glaciated terrain. Serac avalanches threaten the Trans-Canada Highway, some backcountry ski runs, a bunch of classic Canadian alpine climbs, and alpinists, skiers, roads and villages in glaciated regions around the globe.

Any of us working as an avalanche forecaster in heavily glaciated terrain, especially with permanent structures, worksites or roads (e.g., BC's northern mining sector) should probably think about whether they have the training and experience to forecast glacial ice avalanche hazards. Extensive experience in observing ice avalanches combined with long-time familiarity and history with a specific ice feature is likely to be the best education available to most of us for the foreseeable, operational future.

My take on it is that when starting from scratch in a new place, none of our classic forecasting tools or triggers are relevant, except perhaps observed recent activity in a particular icefall. It is gravity working against friction, and the structural integrity of the ice. We can identify the hazard and estimate the path, potential size, exposure, and consequences, and be very clear about our uncertainty. It is easy to imagine circumstances where removing the elements at risk from the runout would be the only acceptable answer.

We attempt to minimize our exposure to ice avalanches and to forecast when seracs will fail, but my guess is most of us are attracted to "non-event feedback," good travel conditions, and low probabilities. Do we really know anything about seracs or was Doris Day almost a "state-of-the-art forecaster" in her 1956 recording of "Que Sera, Sera"?

To paraphrase:
"Que Serac, Serac,
Whatever will be, will be.
If we move through here quickly,
Perhaps the serac won't kill me"

Marc Ledwidge, Rob Rohn, Rupert Wedgwood, Herb Bleuer, Stefan Margreth and I are going to try and go a bit beyond Doris Day in the following articles. Hopefully it helps get that song out of your head.

FIG. 1

A Blast from the Past: Reducing Ice Avalanche Hazard at a Mine on the Sitakany Glacier, 1981

Story and photos by Herb Bleuer

A HANGING GLACIER THREATENS a mining operation 500m below in a cirque at the head of the Sitakany Glacier, on the Alaska/BC border east of Juneau, AK (Fig. 1). In the second image, we're filling a crevasse with 600lbs of ANFO and a few cases of powder tied together with detonating cord. We shovelled for two days to bury the explosives in the slot deep enough to have a good effect.
Fig. 3 shows the ice avalanche released by the blast. The staging area for the mining operation was on the glacial shelf just being hit by the debris. Fig. 4 depicts the hanging glacier after the blast. We estimated that the volume of ice blasted was around 200,000 cubic metres.

Debris travelled for around 1.5km on the low-angle Sitakany glacier (Fig. 5). With the ice and snow gouged out of the glacier below the blast, we estimated it probably caused an avalanche of around 300,000 cubic metres. And yes, something registered on Juneau's Richter scale.

FIG. 2

FIG. 3

FIG. 4

FIG. 5

Quitaraju, Peru: When Luck Isn't On Our Side

Rob Rohn

"AS GUIDES WE SPEND A LOT OF TIME IN THE MOUNTAINS AND MOST DAYS LUCK IS ON OUR SIDE, PROBABLY MORE OFTEN THAN WE REALIZE. BUT WE HAVE TO ACCEPT THAT EVENTUALLY THERE WILL BE A DAY WHEN LUCK ISN'T ON OUR SIDE."
Pierre Lemire, ACMG, UIAGM/IFMGA Mountain Guide

IT WAS SPRING 1987. It was going to be a fun mountain adventure rather than an expedition. A large group of climbers—all friends, or friends of friends—were mostly from the Bow Valley or the coast. We'd meet in Huaraz, share lots of laughs, the Peruvian culture and food, and establish communal base camps from which smaller teams could tackle various objectives—a real vacation!

After an acclimatization hike we headed to the Santa Cruz valley. While a guard watched over base camp, we headed off to various objectives: Barry and James to Taulliraju; the rest of us to "the most beautiful mountain in the world," Alpamayo.

After a relentlessly steep, grinding approach up the Quebrada Arhuaycocha, we established camp on the far side of the high col at 5,600m. Our throbbing heads reminded us that we weren't yet fully acclimatized, so we planned to start with a technically easy ascent of nearby Quitaraju. But after a rough first night at that altitude, only three of us were feeling

JIM HABERL AND ALPAMAYO // ROB ROHN

up to it, heading out at first light. It was a perfect day in the mountains—clear, still, cold.

Military strategists call them the unknown unknowns: the proverbial piano crushing the Gary Larson character on the sidewalk below. The wildcards that even the most sophisticated analysis or algorithm misses. Who would have thought that homeowners defaulting on their mortgage in Scottsdale would bring down the largest bank in Scotland? Sometimes, the wisest sense it coming while the rest of us remain blissful and oblivious.

As mountain guides, we are trained to recognize hazards and manage risk, from the subtleties of deep slab instabilities to the ever-present possibility of rock fall. Icefalls and seracs—pretty straightforward, and usually easily avoided, right?

As the sun rose on that crisp Andean morning, I concentrated on navigating through a messy patch of crevasses. Above us, the face of Quitaraju steepened, a fairly non-descript 40-degree snow slope with a few ice patches and rounded bulges exposed: nothing that remotely suggested hazard to me. The snow was frozen hard; conditions were good. Our lungs struggled but we made steady progress.

There's a complex tension in our relationship with the mountain world. We are driven and inspired by our passions, our ambitions, and the fulfillment on so many levels that we crave. Yet survival requires steely and dispassionate objectivity and a highly-tuned situational awareness that can be at odds with our motivations. Euphoria is the most dangerous and vulnerable mind-set. It blinds us to the subtle instincts and barely perceptible clues that don't fit the version of reality we've chosen to see.

Euphoria is the most dangerous and vulnerable mind-set.

We continued our ascent, in awe of the increasingly expansive view, immersed in a joyful and hypnotic breathe-step rhythm. Conditions couldn't have been better. This was what we'd come for.

Suddenly there was a crack of lightning out of the clear blue sky and the rumble of thunder followed. Where the hell did that come from? A mass of ice chunks had exploded from one of those seemingly-inconsequential bulges in the face above. Run! Easier said than done when you're roped together in a maze of crevasses, and don't know which direction, if any, leads to safety. I was sliding now, hit hard.

It was over as quickly as it started. Chunks of ice the size of cars, fridges, and yes, pianos scattered around us. I felt searing pain in my back, and my lower leg twisted at a very unnatural angle. My adrenaline-infused brain alternately screamed "You won't get me that easily!" and tearfully prayed that more wouldn't come down. We were sitting turkeys.

Peter regained consciousness after a couple of minutes. Matt didn't yet fully feel the hairline fracture in his pelvis.

It was a perfect day in the mountains—clear, still and now pleasantly warm in the intense sunlight. The most beautiful mountain in the world gazed down on us—silent, majestic.

The next five days continued to score high on the adventure meter. Luckily an understanding doctor had given Jim a prescription for injectable morphine for his first aid kit. Our friends at high camp heard the calls for help and soon I was being packaged up like a sausage and lowered and dragged to a rescue camp on the flat glacier below. Vicki and Liz brought tents and sleeping bags down from the col. Kevin, Michael and Dave headed out for help. Barry and James, who had decided to rappel off the west face of Taulliraju after they "just got a feeling," showed up the next day with a loud "Did somebody order Chinese food?" Laughter can cure just about anything.

A helicopter was to arrive on day three. Only much later did I grasp the magnitude of the diplomacy and negotiations it had required, and that my employer Canadian Mountain Holidays had posted a $17,000 deposit before the air force agreed to fly. The Bell 214 approached mid-day, circled twice and flew off again, the pilot unwilling to land at our location. Understandable, but more than a little disappointing.

An increasingly large and international cadre of climbers to whom I owe my life now faced the prospect of hauling my carcass over the col (the free-hanging lower over the bergschrund was particularly memorable) to an alternate pick-up that also didn't work out, and finally down the steep moraines to the valley and waiting helicopter below. And then in no time we were flying back to Lima and the hospital in Miraflores. I was heading home.

With time we learn to walk more gently through the mountains. Desire for recognition slowly fades into satisfaction with doing nothing remarkable at all. We find inspiration in the valleys as well as the peaks, the invigoration of a lungful of cold, predawn air and the sparkle of the cresting sun on snow. We appreciate every beautiful moment when luck is on our side, mindful that a day may come when it isn't.

Gone Like A Ghost: A 2012 Ice Avalanche Event

Story and photos by Rupert Wedgwood

"IT WAS DARK AND DIFFICULT to see what was really happening. There appeared to be a river flowing across the road, but it was tough to discern what we were looking at in the headlights. I stopped the car a few metres from the edge of the flow, and we got out of the car to investigate. I was wondering if this was something we could drive the car through, and wanted to have a closer look. Getting out of the car, I remember the roar of water. It sounded like we were standing beside a set of rapids in a big river. We donned the headlamps and walked toward the flow on the asphalt. We took a couple of steps in mud, then water. We trod carefully as we didn't want our boots to be overtopped by the water. The water was flowing hard, and it was soon up to the ankles of my boots. Each step I could feel the force of the water pushing on my foot as I put it down, making walking a little more difficult—but it was nothing that could knock me off my feet. There were fist-sized chunks of ice near the boundary of the flow, some sitting in the mud, others being washed left to right across the road. We quickly realized there was no chance the VW Golf was going to drive through this. After walking maybe 10-15m down the road, with the flow up to our ankles, we returned to the car to regroup."

So wrote an alpine climber recording his early morning encounter with the aftermath of the glacier lake outburst flood that occurred below the north face of Mount Edith Cavell in Jasper National Park. The eruption of water from the small pro-glacial tarn was triggered when the Ghost Glacier, located a vertical kilometer above the tarn on the north face, released overnight on August 9, 2012.

It is estimated that the ice avalanche consisted of 100,000 to 200,000m^3 of glacial ice and neve. Most of this ended up in the tarn, which was brimming with melt water after unusually high winter snowfall and recent rains. The displaced water rose up like a tidal wave and travelled across the half-kilometer distance to the opposite shoreline, where the lower viewing trail was located. Travelling at speeds up to 27km/h, it was outpaced by the accompanying wind blast caused by the downward falling ice. As the wind reached the far shore, it snapped the park information sign off its two by four posts, tossing one 50m upslope, and uprooting one of the few trees in the area that grew over a meter tall.

The east ridge of Mount Edith Cavell is one of the classic climbs in North

America. After a wet July, some good weather was forecast; in the early morning of August 10, two groups of alpinists found the road blocked by a flowing river of rocks and ice chunks. Although unexpected, they parked their vehicles and continued on foot. Another 100m up the road, the lower third of the parking area was underwater. One of four outhouses was knocked over and the pavement, having had the fine material below washed away by the flood waters, was now draped like a deflated pie crust over the large rocks below.

Estimates place the height of the tidal wave leaving the lake at three to five meters. Blocks of glacial ice up to 64m^3 in size were lifted out of the lake and carried downstream. The escaping waters rapidly eroded existing drainage channels to depths of 4.5m and over 30m wide. Up to 50,000m^3 of material washed downstream. As one research team put it, "This equates to twenty Olympic-sized swimming pools of sand, gravel, rocks and material. The largest boulder measured and moved by the water was estimated to weigh over 1,200kg."

In the predawn light, much of the infrastructure damage and landscape alterations went unobserved by the alpinists. A kilometre from the trailhead, the tarn appeared full of ice to the alpinists who were looking down on it from the lateral moraines above.

"Once we got above the moraine lake, we remarked on how much ice was floating on the lake. We were surprised that there was that much ice in August. At this point (and for the rest of the day), we were oblivious to the fact that the Ghost Glacier had fallen off the face of Cavell."

The post-glacial landscape in the Cavell area has been extensively researched over the years, and much is known of the glacial retreat since the end of the Little Ice Age. The terminal and lateral moraines that cross and flank the valley have been dated using tree and lichen growth rings methods. Photographic records starting in the early part of the twentieth century show the retreat of the ice. Until the 1940s, the Angel Glacier, which flows from a hanging valley next to Mount Edith Cavell, touched the valley bottom joining the then-much-larger Cavell Glacier. Little remains of the Cavell Glacier today; in its place sits the pro-glacial tarn. This tarn first appeared in the late 1950s as little more than a puddle during the warmest months of the summer.

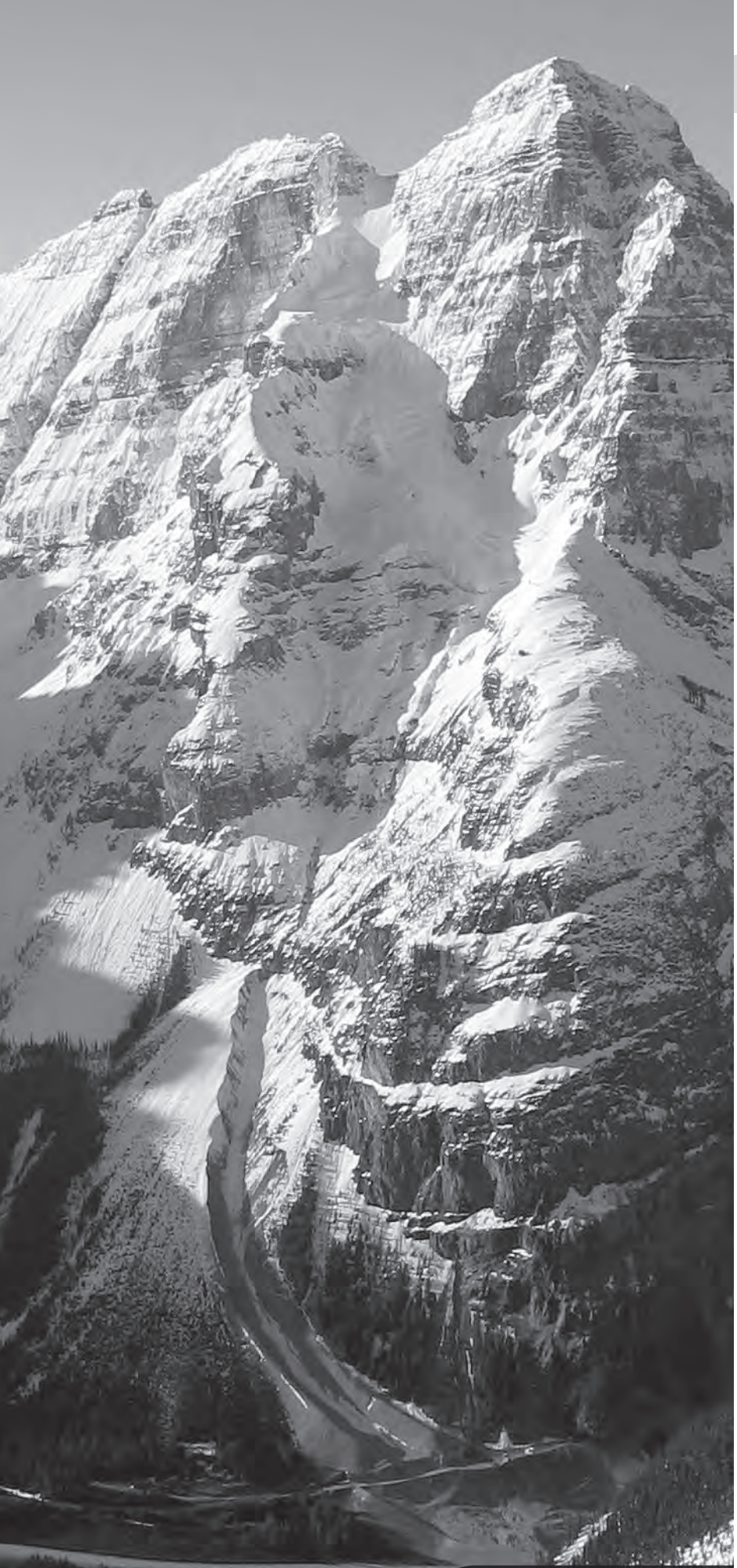
By August 9, 2012, the tarn was over 500m in diameter, with a depth of 30m close to the point where the ice avalanche entered. Two days earlier, an intense rainfall event had produced a landslide from the avalanche paths along Medicine Lake that had washed away a section of road into the flooding lake below. At the Cavell tarn, water levels were high and close to breaching the moraine dam through which the outflow channelled. The rain and snow melt water likely pooled in the Ghost Glacier's bergschrund. Photographs and video postings on social media sites show small avalanches and icefall coming from the Ghost Glacier in the days leading up to the morning of August 10. It is unknown if several icefall releases or a single large event occurred during the night of August 9.

The trail network in the area, maintained by Parks Canada, offers exhilarating hiking and is an international destination to more than 200,000 visitors each year between June and October. A looping valley bottom trail offers easy hiking to families from the parking lot to the tarn. A connecting trail from here joins to an upper trail system that winds upward through the forest into the high alpine meadows. Below lies the tarn across from which the snout of the Angel Glacier extends downward towards its turquoise waters, as if trying to lap at its shoreline. It was

not until 08:21 on August 10 that Parks Canada learned of the ice avalanche from a German tourist. Hoping to see the spectacular alpine meadows wildflowers in the morning light, she, like the alpinist four hours earlier, had encountered a river flowing down the road. Off to her right and hidden by the forest, the surging waters devastated a popular picnic area on the creek flood plain. Many of the steel tables were buried to their tops by so much rock and sand that they appeared, once the waters had subsided, to be at ground level. A large snag close to this site showed watermarks 1.6m up the trunk and splash marks reaching two meters. Such was the damage a kilometer downstream of the tarn.

The surging waters, carrying large blocks of ice avalanche debris, exited the tarn and flowed over the moraine dam and viewing areas. The waters rapidly excavated deep drainage channels where previously a shallow and easily forded outflow had been. Once past the dam apex, the steepest slope gradient of ten degrees abruptly ends at the gravel outwash flood plain. Near here, approximately 200m from the tarn, the excavated channels were at their greatest: 5m deep by 25m wide. Continuing along the shallower gradients of the gravel flats, the water was likely 1.5m deep as indicated by tide marks and debris left by the subsiding waters. In several locations, the waters slowed and pooled behind low-lying terminal moraines left by the receding Cavell Glacier during the late nineteenth and early twentieth century, before their banks crumbled and the waters spiralled downward towards the parking lot. Much of the lower hiking trail, routed along the flood plain, was destroyed, along with the interpretive signs that lined it. Nine hundred meters from the tarn, the last of the moraines was overcome and the waters tore into the parking area before covering the road and picnic tables in sand and rocks.

The reporting person was unaware of the magnitude of the event when she called it in on her cell phone. Park Warden Joe Storms investigated and quickly updated Visitor Safety rescue leader Garth Lemke. What followed was a park-wide response. Access to the area was restricted as an extensive search got underway. As luck would have it, nobody was in the area during the initiation of the flood. The climbers high on the East Ridge of Edith Cavell mused at the activity that unfolded below them. It was only after their descent that they were informed as to the extent of what had taken place that morning. With the area secured and everyone accounted for, members of the Jasper National Park Visitor Safety team surveyed and documented the aftermath. Pictures and measurements were taken along the course of the water. It took several weeks for the scattered blocks of glacial ice to melt in the valley bottom, and longer for the splash marks to fade from the rocks and trees. The area remained closed to most motorised traffic for the rest of 2012. After an initial assessment period, pedestrian and bicycle travel was allowed up to the Cavell hostel on the access road. Parks Canada contracted BGC Engineering Inc. to conduct a risk assessment for the area prior to reopening. The contracted engineers completed a bathymetric survey of the lake in early October followed by a site visit. By mid-winter, an avalanche forecasting field team noted that the tarn was virtually drained as revealed by the large sagging plates of snow covered lake ice. In the spring of 2013, after extensive cleanup work and trail rerouting, the area was reopened to the public.



// MARC LEDWIDGE

Mt. Stephen
Icefall

Marc Ledwidge

MOUNT STEPHEN (3,199 METRES) has a north-facing avalanche path that affects the Trans-Canada Highway in Yoho National Park. The vertical distance from the glaciated start zone to the highway elevation is close to 2,000m. Avalanches that initiate in the upper start zone near the summit that reach the highway are typically large (size 3.5 or bigger), and have significant destructive potential. This path is a difficult problem for avalanche forecasters for a number of reasons. First, the only tool for active avalanche control currently available is helicopter bombing. Given the start zone elevation, there are numerous days where access is not possible. Second, the confined nature of the start zone makes it difficult to fly close unless winds are relatively calm, which is often not the case. The biggest issue is the bar of seracs in the glaciated start zone. When serac failures occur, they can provide a very large trigger and large avalanches can occur.

Passive control measures were put in place approximately 30 years ago. A snow shed was built to protect the CPR tracks and a deflection dyke was built to protect the Trans-Canada Highway. Although this dyke is effective in absorbing some of the energy of large events, it is not completely effective in keeping deposits off the road, especially once one avalanche has filled it. Deposits on the highway occur approximately every two to three years.

Serac failures can result in large natural avalanches down to the highway. In a number of cases, these have occurred shortly after avalanche control measures with limited results. The telltale sign that the trigger was serac failure is ice debris mixed in with the snow deposit. On one memorable December 31, pieces of ice debris were collected for subsequent mixing with Scotch later in the evening.

Mitigating Serac Avalanche Risk in Abbott Pass

Larry Stanier

I SPEND MUCH OF MY SUMMER working as a climbing guide out of Lake O'Hara Lodge on the west side of the Rockies divide. There is always talk of crossing Abbott Pass from O'Hara and going down the "Death Trap" into Lake Louise. As you can see from the two photos from March 1995, there is some residual risk of icefall. There is also rockfall and wet snow avalanche potential from Mount Victoria and Lefroy, and a few big crevasses to cross.

Occasionally the stars align and I have fit guests, a strong early summer snowpack, well-bridged crevasses, and a good overnight freeze—and with an early start will consider descending the Death Trap from the Abbott Pass hut. Usually we will climb the West face of Mt. Lefroy first, as it is usually in great shape if the Death Trap is even worth considering. This also allows me to have a good look down into the Death Trap. From Lefroy, I can see most of the big crevasses and start to evaluate the ease of crossing them. It also gives me direct observations of the state of the snow, temperature, etc., at those altitudes. Finally, I can visually attempt to assess the state of the seracs and get a sense of their likelihood of triggering. Have they melted back or are they fractured and leaning forward over the Death Trap? In my experience observing these seracs over the past 15-plus years, they are fairly dynamic and can present a much different hazard from year to year. It is a somewhat subjective assessment, but if I feel the seracs look unusually fractured, downslope unstable and/or recently very active, I may choose not to descend, irrespective of the travel conditions.

My main risk treatment is to minimize exposure, ensuring I can travel reasonably quickly through the runout of the seracs, with a low probability of being slowed down by poor or complex glacier travel conditions, and with a very low likelihood of wet snow avalanches and rockfall while the sun stays low. The window of time is fairly narrow as the morning sun will eventually shine directly onto the slopes of Mount Victoria, and wet snow avalanches and or rockfall is almost certain to reach the glacier in clear weather.

My visual assessment of the seracs helps with this risk treatment, but I feel I can never have complete confidence in that assessment. Even when I feel comfortable with the decision to descend to Lake Louise, I often get a sore neck from looking up and left at the main seracs.

On average, I may do this trip once a summer, and my risk tolerance seems to have lowered over the years due to some combination of age, wisdom, experience and time spent walking on appalling amounts of serac debris.

THE "DEATH TRAP" // LARRY STANIER

Managing the Risk of Ice Avalanches: Whymper Hanging Glacier in the Mont Blanc Massif

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THE WHYMPER GLACIER IS A HANGING GLACIER LOCATED ON THE SOUTH FACE OF THE GRANDES JORASSES (MONT BLANC MASSIF, ITALY). COMBINED SNOW AND ICE AVALANCHES TRIGGERED BY ICE MASSES BREAKING OFF FROM THE HANGING GLACIER ENDANGER THE VILLAGE OF PLANPINCIEUX AND ITS SURROUNDINGS IN THE VAL FERRET. AT THE END OF JUNE 1998, NEARLY THE ENTIRE WHYMPER GLACIER (AROUND 150,000M³) SHEARED OFF AND THE ICE AVALANCHE STOPPED ONLY 500M ABOVE THE VALLEY ROAD. THE WHYMPER GLACIER HAS GROWN BACK AND NOW HAS A SIMILAR SURFACE TOPOGRAPHY TO 1998. THE SLF AND VAW HAVE CONSIDERED SEVERAL SCENARIOS OF FALLING ICE VOLUMES. THE NECESSARY SAFETY MEASURES ARE DEFINED IN RELATION TO THE LOCAL AVALANCHE DANGER LEVEL AND THE POTENTIAL VOLUME OF AN ICEFALL. THE HANGING GLACIER IS CONTINUOUSLY MONITORED WITH A SYSTEM CONSISTING OF A TOTAL STATION, GPS STATIONS, SEISMIC SENSORS, AND VISUAL OBSERVATIONS.

1. INTRODUCTION

Ice avalanches occur when a chunk of ice breaks off from a glacier, drops downslope driven by gravity, and bursts into smaller pieces of ice. Ice avalanching is the normal ablation process of high-altitude glaciers on steep slopes or terraces. Two main fracture processes depending on the bedrock topography and the type of failure are distinguished (Pralong and Funk, 2006). The wedge fracture occurs if the hanging glacier flows over a discontinuity in the bedrock, usually forming a steep or overhanging cliff. The discontinuity limits the extension of the glacier and leads to a periodic break off of unstable ice lamellas at the frontal ice cliff. The ice temperature at the bed can be either temperate or cold. The volume of the wedge typically amounts to 1,000-100,000m^3. In contrast, much larger ice volumes release if the unstable ice mass is located on a steep bed rock ramp and fails as a slab. If the ice at the bed is temperate, very large volumes of 1.0×10^5 to 1.0×10^6m^3 can be released.

The impact of ice avalanches is comparable to that of snow avalanches, the big difference being that they can occur at any time of year. The most destructive ice avalanches occur when additional snow, ice and/or debris are entrained. The most catastrophic icefall of the 20th century occurred in 1965 in Switzerland, when 2×10^6m^3 of the tongue of the Allalin glacier broke off and killed 88 people at the Mattmark dam construction site.

Following this tragic event, interest in the instability evaluation of avalanching glaciers grew within the alpine glaciological community. In 1973, the first successful icefall prediction was performed at the Weisshorn hanging glacier, which regularly poses a threat to the village of Randa, in Valais, Switzerland (Röthlisberger, 1981). Since then, approximately 16 avalanching hanging glaciers have been investigated, some of them after a catastrophic event, others with the context of consulting work or research programs (Pralong and Funk, 2006). In this paper we present the Whymper hanging glacier case.

2. WHYMPER HANGING GLACIER OVERVIEW

The Whymper hanging glacier is an unbalanced cold ramp glacier located on the south face of the Grandes Jorasses (Mont Blanc Massif, Italy; Fig. 1) at an elevation of 4,000m above sea level (Margreth et al., 2011; Pralong and Funk, 2006). Snow avalanches and combined snow ice avalanches triggered by ice masses breaking off from the hanging glacier can endanger the village of Planpincieux and its surroundings in the Val Ferret. The valley is heavily frequented by tourists both in winter and summer. For the local authorities responsible for safety in the Val Ferret, the key problem is to organise the necessary safety measures by taking into account both the local avalanche danger and the risk of an impending icefall. Overnight between May 31

FIG. 1: WHYMPER GLACIER, JANUARY 2009 (TOTAL VOLUME CA. 150,000-200,000M^3).

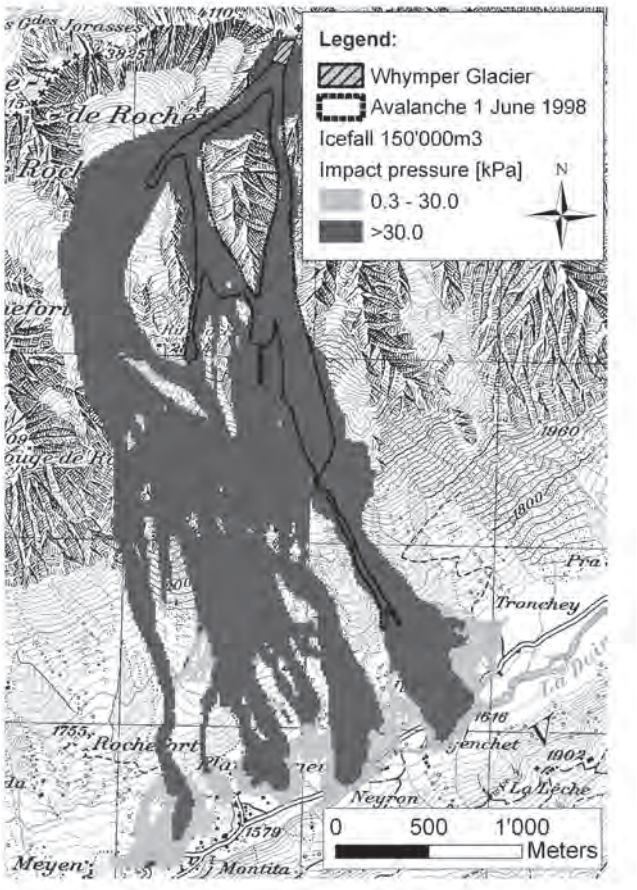
// S. MARGRETH, SLF DAVOS

and June 1, 1998, nearly the entire Whymper glacier (around 150,000m^3) sheared off. The avalanche stopped 500m above the road into the Val Ferret. The horizontal and vertical distances were 3,000m and 2,200m, respectively. After this event, the ice avalanche activity was strongly reduced. However, the hanging glacier progressively reformed, and in 2009 both the volume and the geometry of the Whymper glacier were similar to 1997. In the autumn of 2008, a crevasse opened in the lower part of the hanging glacier and a new instability was suspected by the local autorities. Consequently, SLF and VAW were mandated to revise the 1997 safety concept (Margreth and Funk, 1999).

3. GLACIOLOGICAL, TOPOGRAPHICAL AND AVALANCHE SITUATION

The current ice volume of the Whymper glacier is estimated to be 150,000-200,000m^3. The front of the glacier is about 90m wide and its surface area is about 25,000m^2. The normal ablation zone of the hanging glacier is the glacier front where ice lamellas with typical volumes of less than 30,000m^3 break off periodically. The return period is estimated to be one to two years. According to observations, these smaller icefalls come to a stop above the valley floor if they occur in summer or in winter if the snowpack is stable. A secondary release of snow avalanches has not been documented. As the current geometry of the Whymper glacier is comparable to that in 1997, the whole ice mass could be detached again. We estimate the return period of such an icefall to be at least 15-30 years. The extent of possible starting zones for snow avalanches is very large, with an area of about 180ha. The potential avalanche volume is in excess of 1.0×10^6m^3. For the elaboration of the safety concept, we investigated three different classes of ice volumes breaking off from Whymper glacier: 1) small ice volume < 10,000m^3 (unforeseeable event); 2) medium ice volume of approx. 30,000m^3 (ice lamellas on the glacier front); and 3) maximum ice volume of approx. 150,000m^3 (slab fracture of the whole Whymper glacier).

FIG. 2: RESULTS OF AVALANCHE DYNAMICS CALCULATIONS USING RAMMS FOR MAXIMUM ICE VOLUME (ICEFALL 150,000M³ WITH DANGER LEVEL HIGH).



4. AVALANCHE DYNAMICS CALCULATIONS

The goal of the avalanche dynamics calculations is to quantify the runout distances of different avalanche scenarios in relation to the three volume classes of icefalls and varying snow conditions. The main difficulty is assessing the consequences of the impact of an icefall on the snowpack. The largest known combined snow/ice avalanche events are typically observed in winter. If a small- or medium-sized ice volume impacts a stable snowpack, snow can be entrained.

However, according to our observations, the release of a secondary snow avalanche is unlikely. If the impact is caused by a large ice volume (>100,000m³) or if the snowpack is unstable, the release of a secondary snow avalanche is more likely. In the Whymper glacier case, we assume that an icefall with a maximum volume of 150,000m³ will release or entrain most of the snow pack along the avalanche path. However, we do not expect erosion of the glaciers along the avalanche track. As the potential snow avalanche volume below the Grandes Jorasses is much larger than the largest expected falling ice volume, the runout distances of such combined snow/ice avalanches will be similar to what was observed in the case of snow avalanche events. We expect that the friction of a pure snow avalanche is smaller than that of a mixed snow/ice avalanche. A mixed snow/ice avalanche is expected to behave similarly to wet snow avalanches because of heavy impacts of ice clods and the high flow density.

The ice avalanches were simulated with the two-dimensional avalanche calculation model RAMMS (SLF, 2010). RAMMS was specially designed as a practical tool for the calculation of snow avalanches, debris flows and rockfall. RAMMS has been extensively applied in Switzerland in the past years for the calculation of snow avalanches (Christen et al., 2010). However, the model has so far only been applied a few times for the calculation of velocities and runout distances of ice avalanches and is not yet well calibrated for this purpose. The main input parameters for the calculation of ice avalanches with RAMMS are the following:

Release volume: The three ice volumes described in the section above were considered. The fracture depths of the ice avalanches were varied between 4.9m and 21.0m. It was assumed that the glacier ice disaggregates during the fall and that the density of the ice decreases from an estimated 850 to 900kg/m³ to about 400 to 500kg/m³. The initial ice volume was increased by a factor varying between 1.5 and 2.0 to compensate for the decrease in density, which RAMMS does not consider, and the poorly known mass distribution in the model calculation (Table 1).

Snow entrainment: The largest uncertainty in the avalanche dynamics calculations is associated with the treatment of the impact of a falling ice mass on a snowpack. We approached this problem with the RAMMS entrainment module where an erodible snow cover can be specified (Christen et al., 2010). This requires the definition of the snow cover density, the erodible snow depth, the entrainment parameter K and the area where snow can be entrained. If the snow pack is unstable an ice avalanche will entrain a 1.5m thick snowlayer by frontal plugging and the secondary release of snow avalanches is likely (Table 2). For a stable snow pack we applied a smaller entrainment parameter and a smaller erodible snow depth. Furthermore, the size of the surface areas with potential snow entrainment was varied as a function of the snowpack stability. To quantify the snowpack stability and the release probability of snow avalanches, the five danger levels of the European Avalanche Danger scale (SLF, 2008) were used.

Friction parameters: The Voellmy-fluid friction model divides the frictional resistance into the dry-Coulomb type friction (frictional parameter μ) that scales with the normal stress and the velocity-dependent turbulent friction (frictional parameter ξ). The two parameters were calibrated for snow avalanches as a function of the avalanche volume, terrain features, the elevation and the return period (Table 2). Ice and combined snow ice avalanches were simulated with the same friction values as for snow avalanches (SLF, 2010).

TABLE 1: OVERVIEW OF THE RELEASE AND ENTRAINMENT VOLUMES FOR THE INVESTIGATED ICE FALL SCENARIOS AT THE WHYMPER GLACIER.

Icefall scenario	Ice volume	Release volume considered in RAMMS simulations	Entrainment volume for danger level 1 Low	Entrainment volume for danger level 4/5 High/Very High
Small	10,000m³	20,000m³	10,000m³	830,000m³
Medium	30,000m³	50,000m³	70,000m³	930,000m³
Large	150,000m³	260,000m³	270,000m³	1,020,000m³

First we tested the performance of RAMMS by back-calculation of the June 1998 ice avalanche. The initial release volume was set at 260,000m³, which is 1.7 higher than the estimated ice volume of 150,000m³. The frictional parameters that led to the best simulation of the runout distance were $\mu = 0.35$ and $\xi = 1350 m/s^2$. These friction values differ significantly from the most extreme friction parameters obtained so far because the ice avalanche did not entrain much snow and because the lower part of the avalanche track was free of snow.

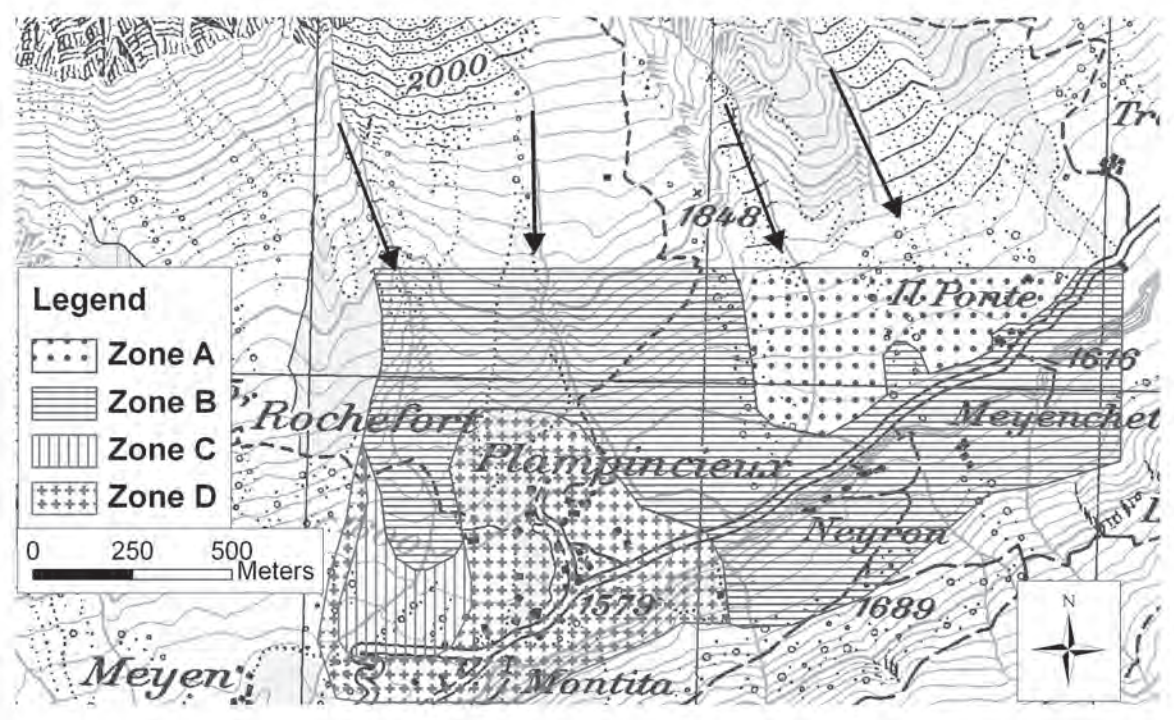
The RAMMS simulation reproduced the extent along the main avalanche axis relatively well. We calculated 14 different scenarios with RAMMS for the hazard assessment (Fig. 2 shows large ice volume). According to these calculations, the danger level Considerable is the threshold at which the valley bottom can be endangered by an icefall with a volume of 10,000m³. The entrainment volumes vary from 10,000m³ for a stable snowpack (danger level Low) to over 900,000m³ for an extreme avalanche situation with an unstable snowpack. If an icefall of 30,000m³ occurs during a time period with a stable snowpack (danger level Low), the dense part of the avalanche does not reach the valley road, but the air pressure of the powder part cannot be neglected. If the snowpack is only moderately to weakly bonded (danger level Moderate/Considerable), around 250,000m³ of snow will be entrained and the avalanche reaches the valley bottom along tracks one and two.

Ice avalanches with an initial ice volume of 150,000m³ always reach the valley bottom regardless of the danger level. If the danger level is High or Very High, the village of Planpincieux can be endangered. The hazard area is similar to the extent of extreme snow avalanches. If an icefall occurs during a period with a danger level High or Very High, the consequences are also very serious for small initial ice volumes. The icefall is only the trigger for the snow avalanche irrespective of the initial ice volume since the released snow masses are much larger than the ice masses.

TABLE 2: ENTRAINMENT PARAMETERS IN RELATION TO THE SNOW PACK STABILITY (K=0: NO SNOW ENTRAINMENT; K=1: THE WHOLE SNOWPACK WILL BE ENTRAINED) AND APPLIED FRICTION VALUES. EXAMPLES OF THE μ/ξ FRICTION PARAMETERS ARE GIVEN IN THE TABLE FOR THE TERRAIN FEATURE CATEGORY "OPEN SLOPE" AND FOR AN ELEVATION "ABOVE 1,500M."

Snowpack stability	Entrainment, snow density 200kg/m³		μ/ξ Friction value category			Danger level
	Snow depth (m)	Parameter K	Ice volume 10,000m³	Ice volume 30,000m³	Ice volume 150,000m³	
High	0.4-0.5	0.2	Small,10 y. $\mu = 0.26$ [-] $\xi = 2000$ [m/s²]	Medium,10 y. $\mu = 0.225$ [-] $\xi = 2500$ [m/s²]	Large 30 y. $\mu = 0.17$ [-] $\xi = 3000$ [m/s²]	1 Low
Moderate	0.4-0.6	0.4-1	Medium,10 y. $\mu = 0.225$ [-] $\xi = 2500$ [m/s²]	Large 10 y. $\mu = 0.18$ [-] $\xi = 3000$ [m/s²]	Large 30 y. $\mu = 0.17$ [-] $\xi = 3000$ [m/s²]	2 Moderate
Moderate-Weak	0.6	1	Medium,10 y. $\mu = 0.225$ [-] $\xi = 2500$ [m/s²]	Large 10 y. $\mu = 0.18$ [-] $\xi = 3000$ [m/s²]	Large 30 y. $\mu = 0.17$ [-] $\xi = 3000$ [m/s²]	3 Considerable
Weak	1.5	1	Large, 30 y. $\mu = 0.17$ [-] $\xi = 3000$ [m/s²]	Large 100 y. $\mu = 0.16$ [-] $\xi = 3000$ [m/s²]	Large 300 y. $\mu = 0.155$ [-] $\xi = 3000$ [m/s²]	4/5 High/Very High

FIG. 3: SAFETY PLAN FOR PLANPINCIEUX, VAL FERRET, REGARDING ICE AND SNOW AVALANCHES FROM THE WHYMPER GLACIER. THE ZONES A, B, C AND D REFER TO TABLE 2 AND DENOTE THE AREA TO BE CLOSED AS A FUNCTION OF THE PREVAILING ICE VOLUME AND THE LOCAL AVALANCHE DANGER LEVEL.



5. SAFETY CONCEPT

The safety concept recommends temporary security measures depending on the local avalanche danger level in combination with the volume of an impending icefall from the Whymper glacier (Table 3). The zones that have to be closed or evacuated for a certain scenario are delineated on a map that forms a part of the safety concept (Fig. 3). If, for example, an icefall with a volume of 20,000m^3 is expected and the local avalanche danger level in the Val Ferret is Considerable, we recommend that the zones A and B be closed.

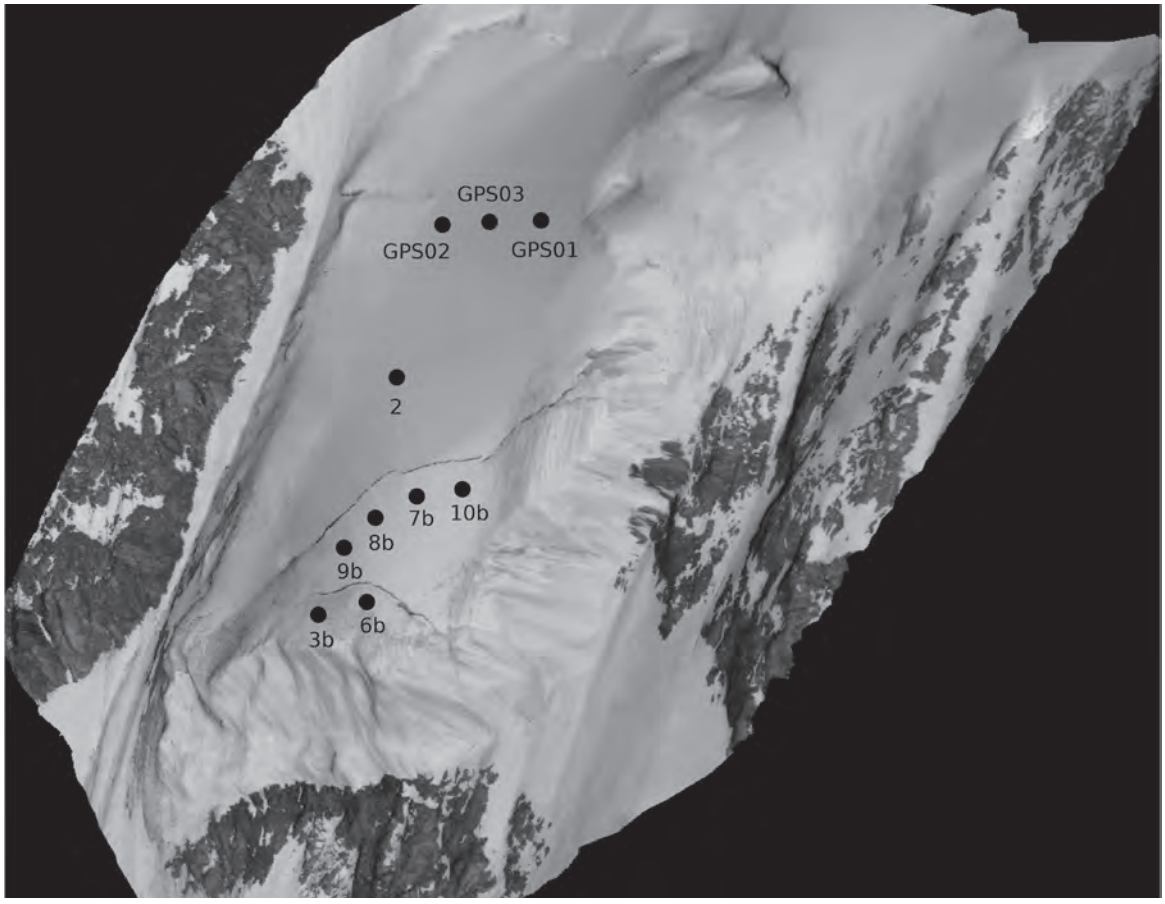
An important input factor is the local avalanche danger level in the Val Ferret. The danger level depends on the snowpack stability, the triggering probability by an ice avalanche, the number and extent of dangerous slopes and the potential avalanche volume. An important point is that the impact of an icefall on the snowpack can generate a very large surcharge, which is much higher than the classical additional load (e.g., a group of skiers or an explosion) considered in the definition of European avalanche danger scale (SLF, 2008). We recommend therefore to stay a few days longer on the danger level 4 (High) or 5 (Very High) than customary, and to evaluate the danger level very carefully if a weak layer is covered by thick snow layers. Three different ice volume categories are defined in the safety concept. The potential volume of an icefall at a specific date has to be assessed with the monitoring system described in the following section.

6. MONITORING SYSTEM

The Whymper glacier has been regularly monitored using visual observations, aerial photographs and topographic measurements. According to the observations in autumn 2008, the opening of a new crevasse could be detected, leading to the described investigations. A new monitoring system was installed in 2009, consisting of stakes with prisms on the glacier surface (Fig. 4) and an automatic total station (theodolite and distometer) located in the valley at a distance of ~4.7km from the glacier. Surface displacements measurements are monitored at hourly intervals. The measurements require good visibility and the stakes need to be reinstalled from time to time. New technologies were therefore applied and are still being tested to improve the reliability of the monitoring system.

Close range photogrammetry techniques were used to quantify volume change of the hanging glacier and the widening of crevasses. A low-cost GPS station was installed to obtain surface displacement data independently of the prevailing weather conditions. In addition, a seismic observation system was installed at an elevation of 4,100m to measure the seismic activity of the glacier. Changes of seismic activity can indicate the imminent rupture of a hanging glacier. Combined motion-seismic monitoring systems are a promising way to improve the prediction of the break-off of a hanging glacier (Faillettaz et al., 2008).

FIG. 4: PHOTOGRAMMETRIC ANALYSIS OF THE WHYMPER GLACIER PERFORMED ON JULY 8, 2010. THE POSITIONS OF THE SEVEN REFLECTORS AND THE THREE GPS STATIONS ARE ALSO SHOWN. THE ICE LAMELLA WITH THE REFLECTORS "PRISMA3B" AND "PRISMA6B" BROKE OFF ON JULY 24, 2010.



Surface displacements were measured continuously during 2010. The average surface velocities were around 4cm to 5cm per day until the beginning of June 2010, and no acceleration was observed. The total displacement was around 8m between mid-January and July 7, 2010 (Fig. 5). During this period, a close-range photogrammetric analysis of the Whymper glacier was performed.

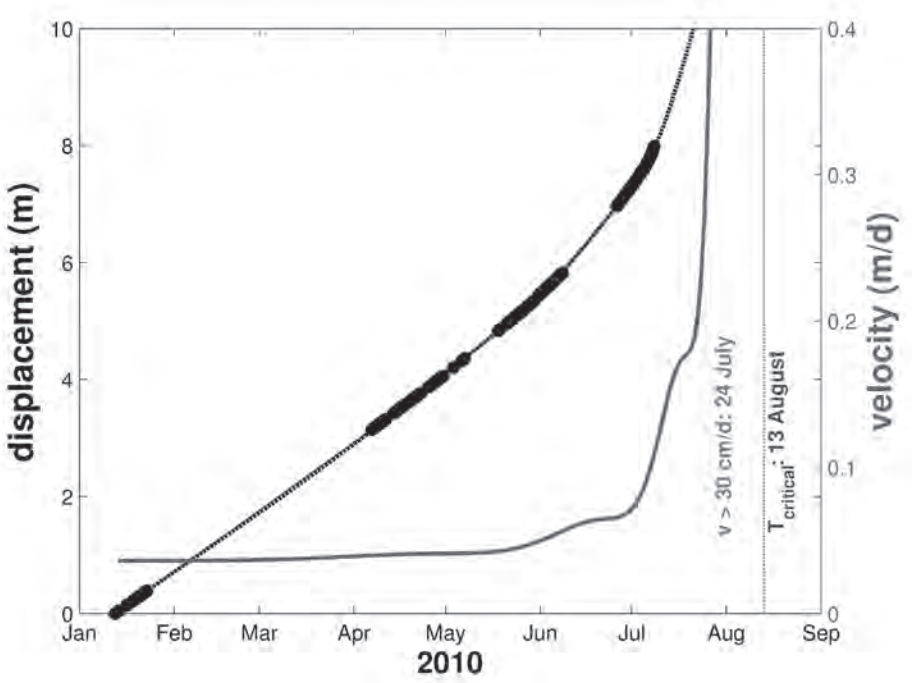
By comparing two Digital Elevation Models acquired one year apart, a slight thickening of the glacier behind the front and a thinning in the upper part could be seen. This observation indicates an ice mass transfer from the top to the front of the glacier that may indicate a progressive development of microcracks in an ice layer located just above the bedrock in the middle part of the glacier. This process could lead to a global destabilization of the glacier in the coming months or years similar to the event in June 1998.

A simultaneous acceleration of two reflectors was detected at the end of June 2010. Following Faillettaz et al. (2008), we fitted the displacement measurements with a log-periodic power law acceleration model. It has been demonstrated that such a function is suitable to predict the failure time of an unstable ice mass. According to the results obtained with the measurements on "prisma6b" (Fig. 5), the surface velocity was expected to increase to 30cm per day by July 24, 2010, which was the day when the icefall occurred. The volume of the icefall was estimated to be 7,000m^3 based on the photogrammetric measurements. This avalanche was not large enough to reach the valley bottom. According to the safety concept (Table 3), no safety measures were proposed for such situations.

7. CONCLUSIONS AND OUTLOOK

The safety concept described here has been in effect since 2009. During the winter of 2009-10, the hanging glacier moved downwards at a rate of approximately 4 to 5cm per day and no acceleration was observed. After an intense snow fall period followed by a rise in temperature, the avalanche danger level was High and the valley was closed to the public for one week. Two small icefalls with an estimated total volume of less than 10,000m^3 occurred in the beginning of April 2010.

FIG. 5: MEASUREMENTS OF SURFACE DISPLACEMENTS AT THE REFLECTOR "PRISMA6B" THE LOG-PERIODIC POWER-LAW FIT OF THE DISPLACEMENTS IS SHOWN WITH THE BLACK DOTTED CURVE AND THE VELOCITY WITH THE SOLID LINE. THE SINGULARITY (I.E., INFINITE VELOCITY) WAS FOUND TO OCCUR ON AUGUST 13, 2010, WHEREAS A CRITICAL VELOCITY OF 30CM/DAY WAS EXPECTED FOR JULY 24, 2010. A VELOCITY OF 30CM PER DAY IS CLASSIFIED AS CRITICAL ON THE BASIS OF PAST EXPERIENCE.



Another icefall with a volume of 7,000m³ took place on July 24, 2010. This icefall could be accurately forecasted thanks to the monitoring system and the authorities were warned in time.

In August 2013, the upper crevasse is wide open on the right side of the Whymper glacier (Fig. 6). The lower part of the hanging glacier has been slowly accelerating since June 2013, passing from about 3.5cm per day to about 6cm per day. The monitoring will be continued to recognize a future dangerous state of the Whymper glacier in time.

The uncertainties in the analysis of snow/ice avalanche processes are rather large. In particular, the interaction of ice avalanches with the snowpack and the dynamics of such combined ice/snow avalanches are still poorly understood. Careful monitoring and analysis of future icefalls in winter at the Whymper glacier and other locations will contribute to an improved understanding of this phenomenon.

The safety concept can only be applied if the volume of the impending icefall can be estimated. Combined motion-seismic monitoring systems seem to be a promising way to improve the forecast of the break-off of a hanging glacier. Further improvements in the assessment of the avalanche hazard and the evolution of the dynamics of hanging glaciers in a changing climate are nevertheless still necessary. For more information, please visit arc.lib.montana.edu/snow-science/objects/ISSW_O-055.pdf.

TABLE 3: SAFETY CONCEPT FOR PLANPINCIEUX, VAL FERRET, REGARDING TEMPORARY MEASURES DURING WINTER. THE NECESSARY SECURITY MEASURES ARE DETERMINED AS A FUNCTION OF THE PREVAILING ICE VOLUME THAT CAN BREAK LOOSE AT THE WHYMPER GLACIER, AND THE ACTUAL LOCAL AVALANCHE DANGER LEVEL IN THE VAL FERRET.

Local avalanche danger level Val Ferret:	**Ice avalanche volume Whymper Glacier:**		
	<10,000m³	**10,000m³-30,000m³**	**30,000m³-150,000m³**
1 Low	No safety measures	Evacuation of zones A and B	Evacuation of zones A, B and C, Curfew zone D
2 Moderate	No safety measures	Evacuation of zones A and B	Evacuation of zones A, B, C and D
3 Considerable	Evacuation of zones A and eventually B	Evacuation of zones A and B	Evacuation of zones A, B, C and D
4 High	Evacuation of zones A, B and C	Evacuation of zones A, B and C, Curfew zone D	Evacuation of zones A, B, C and D
5 Very high	Evacuation of zones A, B, C and D	Evacuation of zones A, B, C, D	Evacuation of zones A, B, C and D

8. REFERENCES

Christen, M., Kowalski, J., Bartelt, P., 2010. RAMMS: Numerical simulation of dense snow avalanches in three-dimensional terrain. *Cold Regions Science and Technology*, 63(1-2), 1-14, DOI: 10.1016/j.coldregions.2010.04.005.

Faillettaz, J., Pralong, A., Funk, M., Deichmann, N., 2008. Evidence of log-periodic oscillations and increasing icequake activity during the breaking-off of large ice masses. *Journal of Glaciology*, 54(187), 725-737.

Margreth,S., Faillettaz, J., Funk, M., Vagliasindi, M., Diotri, F., Broccolato, M., 2011. Safety concept for hazards caused by ice avalanches from the Whymper hanging glacier in the Mont Blanc Massif, *Cold Regions Science and Technology*, Volume 69, Issues 2–3, December 2011, Pages 194-201, ISSN 0165-232X, http://dx.doi.org/10.1016/j.coldregions.2011.03.006.

Margreth, S., Funk, M., 1999. Hazard mapping for ice and combined snow/ice avalanches: two case studies from the Swiss and Italian Alps. *Cold Regions Science and Technology*, 30(1–3), 159–173.

Pralong, A., Funk, M., 2006. On the instability of avalanching glaciers. *Journal of Glaciology*, 52(176), 31–48.

Röthlisberger, H. 1981. Eislawinen und Ausbrüche von Gletscherseen, in P. Kasser (Ed.), *Gletscher und Klima - Glaciers et Climat, Jahrbuch der Schweizerischen Naturforschenden Gesellschaft*, wissenschaftlicher Teil 1978, Birkhäuser Verlag Basel, Boston, Stuttgart, 170–212.

SLF (Publisher), 2010. RAMMS 1.3.0 (Rapid Mass Movements) - A modeling system for snow-avalanches in research and practice. USER MANUAL v1.01. WSL Institute for Snow and Avalanche Research SLF. Davos. 2010. 96 pp.

SLF (Publisher), 2008. Avalanche Bulletins and other products. Interpretation Guide. Edition 2008. WSL Institute for Snow and Avalanche Research SLF. 40 pp.

FIG. 6: WHYMPER GLACIER, AUGUST 2013.

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FAQ – Smartphone **Avy Search Apps**

James Floyer and Ilya Storm

AS MANY READERS MIGHT KNOW, THE CANADIAN AVALANCHE CENTRE RELEASED A DISCUSSION PAPER IN THE FALL ABOUT SMARTPHONE AVALANCHE SEARCH APPS.

THESE APPS PROMISE TO DELIVER avalanche search capability on your smartphone, much like your trusted and true 457kHz transceiver. It is the kind of thing that a few years ago people would joke about while waiting for others to put their skins on in the parking lot: "Hey John, I left my transceiver behind, but don't worry, I've got the avy search app, so we'll be fine!" Well, that day is here. So, if parking lot chatter suddenly goes that way, you will need to think a little harder whether it's humorous banter or if deadly serious.

Savvy (and/or cynical) readers will identify a preconception here—a conservatism which makes us mistrustful of new technology. Choosing to investigate these new apps is deliberate, because their arrival raises important questions that need to be addressed. In the course of our review we went out of our way to approach the questions and issues independently and with an open mind. Our guiding principle was: what is in the best interest for public avalanche safety? The very purpose of our fact-finding and review was to form an initial position on an unknown new technology. The CAC's position and recommendations are based on what we currently know about the merits and shortcomings of these apps. As we learn more, our position may evolve, but we are confident our current position reflects the best knowledge we have on this technology at this time.

SNOWHERE APP IN SEARCH MODE

Why did you initiate the project to review smartphone avalanche search app technology?

First, we expected a lot of interest in the arrival of a new tool for finding people under the snow. Who wouldn't be curious about harnessing the power of their phone this way, and at a price point that doesn't cause sticker shock! But more importantly, we quickly realized this is a matter of significant concern for public safety among Canadian backcountry users. We felt it was important to conduct a thorough review to inform the CAC's position and to develop appropriate messaging. As already stated, our guiding principle throughout the review process was to serve the best interests of winter backcountry recreationists.

Briefly, what were your main conclusions from your analysis?

We determined smartphone avalanche search apps are not suitable for use in companion rescue. Moreover, we determined there is potential for them to have an overall negative impact on public avalanche safety by delivering a false sense of security. It is very plausible for users who might not have otherwise traveled into avalanche terrain to feel empowered and protected by this technology; however, in the event of an incident, the technology will most likely not perform at the standard expected from a life-saving device.

Our primary concerns are:

- Lack of adherence with international standards for avalanche transceivers.
- Lack of compatibility with existing 457 kHz avalanche transceivers.
- Lack of compatibility between the different apps.
- Lack of proven efficacy of WiFi and Bluetooth signals in avalanche debris.
- Insufficient battery life for the demands of winter backcountry outings.
- Insufficient accuracy of GPS for avalanche rescue.
- Smartphones not robust enough for the impact forces expected in an avalanche.
- Smartphone interfaces unsuitable for use in cold/wet/snowy conditions and inoperable with gloves/mittens.
- Potential interference issues.

Is it true you didn't test any of the apps in snow? Why was that, and doesn't it weaken your position?

Testing these devices is not our responsibility; it is the responsibility of the individuals and companies who developed the products. Our responsibility is to foster public avalanche safety in Canada. To this end, our report raises a large number

of significant concerns. In light of these concerns, we believe a public warning against using these apps in avalanche terrain is justified.

Even if we were to conduct field testing, we would only expect to learn pertinent information about one of the critical deficiencies of smartphone avalanche search app technology: range. The range discussion is interesting, and leaning more about how WiFi and Bluetooth signals travel through snow might eventually prove to be useful. However, each of the other critical factors—non-compatibility with 457 kHz devices, non-compatibility between the devices, poor battery life and lack of system robustness—are sufficient to preclude these devices from use in avalanche companion rescue.

The real question here is why none of the app manufacturers have submitted their apps for independent testing. For a time-critical, lifesaving rescue device that must be designed to survive the rigours of the mountain environment (not to mention being tossed around in an avalanche), we should absolutely expect such tests to have been conducted prior to these products coming to market. We believe it is incumbent on the developers and manufacturers of new avalanche rescue technology to provide evidence of its effectiveness, and show how it contributes to avalanche safety. Additionally, it seems reasonable that the burden of proof is greater when a new technology is disruptive; for example when the new approach is incompatible with an existing and universally adopted international standard.

SNØG AVALANCHE BUDDY IN TRANSMIT MODE

Who is most likely to be attracted to this technology?

Given how much we all love our phones, and the unbelievably creative and powerful things they do, to some extent we all are attracted by cool new apps. And who can refuse the download when it's free (or very affordable)? The profile for early-adopters of this new technology includes:

- Inexperienced or minimally experienced, young, and tech-savvy mountain users. Sounds like the out-of-bounds crowd, including youth and newly arrived workers and visitors.
- Infrequent users who only travel in the mountains for a few days. This could include sledders who come mountain riding just once a year, or local residents who only go out once or twice in any given year.
- People who are new to the mountains, are simply unaware of best practices, and have previously been well served by the mantra "there's an app for that."
- People who believe they have no real avalanche risk to manage. This includes people who only travel in ATES rated Simple terrain. However, it also includes people who don't recognize avalanche terrain as such, who quickly travel through tracks or runout zones, or people who figure "it's just one slope that never slides."

What can CAA members do to educate and inform?

CAA members have a long history of acting as ambassadors for avalanche safety in Canada. This tenet now forms part of our ethical standards to which professional CAA members are accountable. If you find yourself dealing with this topic, we suggest an approach that highlights the benefits of having a dedicated avalanche transceiver. For recreationists, we recommend everyone carries digital three-antenna transceivers (as well as probes and shovels, of course) due to their proven performance in a range of burial scenarios. Dedicated transceivers experience no problems with compatibility with other brands of 457 kHz transceivers. They are designed to withstand the rigors of a cold mountain environment and the forces associated with being caught in an avalanche. The signal is optimized for transmission through snow and 3-antenna transceivers are optimized for rapid directional search capability.

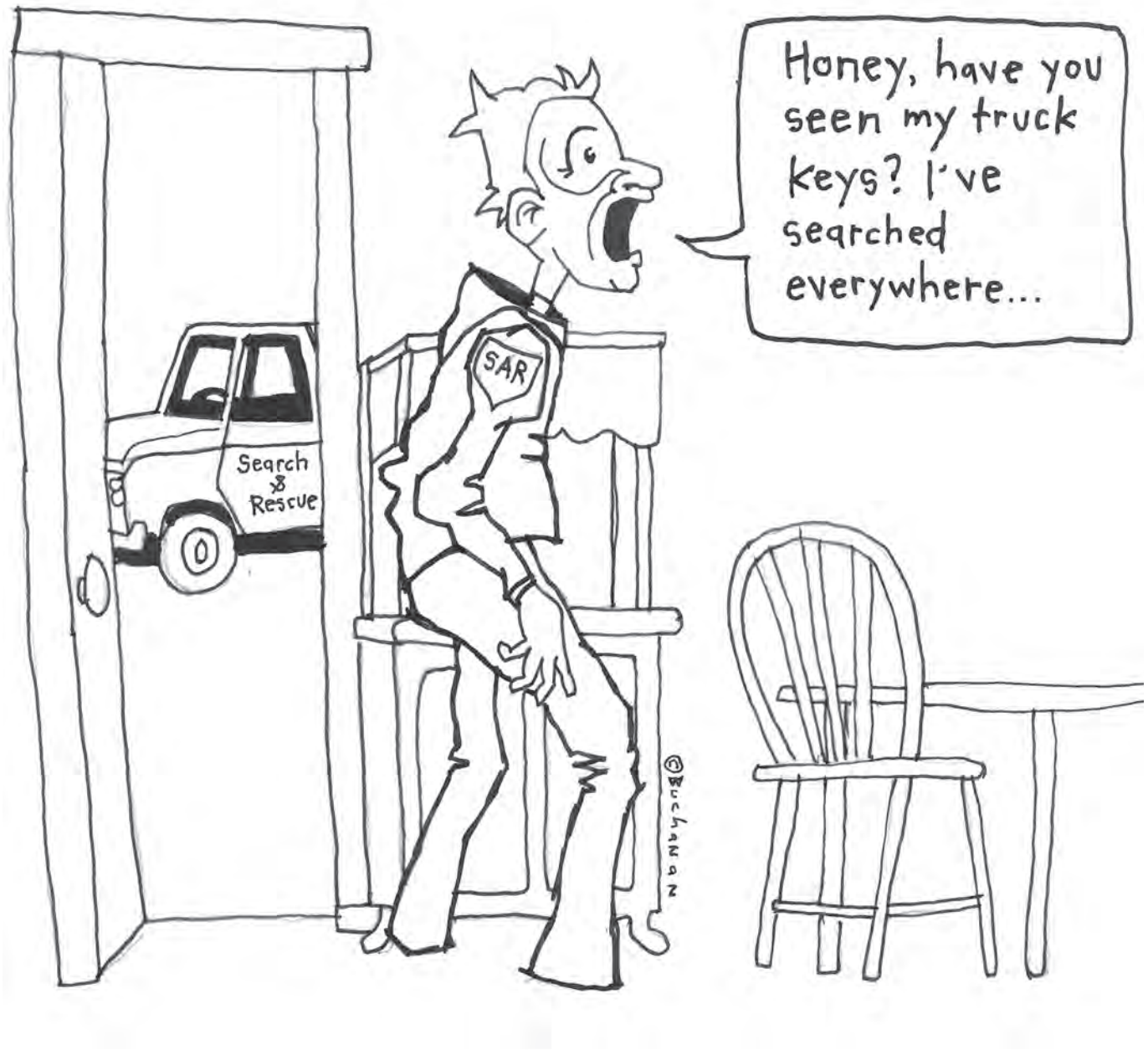
Likely those on the front line for this kind of messaging are those who interact with inexperienced, especially young, tech-savvy mountain users. This could be a guide in charge of a custodial group, a ski patroller interfacing with out-of-bounds riders, or a highway worker interacting with recreationists at a trailhead. This could be any professional giving public avalanche awareness talks in schools or theatres, whether as part of their professional duties, or on their own time for the cause of public safety. This could be your friend's son or daughter, who looks to you for advice on how to get into backcountry riding. Let's hope not, but this could be a CAA professional investigating an avalanche incident asking questions about what gear the group was carrying and how well they knew how to use it.

Where can I get a copy of the CAC's discussion paper?

The review is available at: http://www.avalanche.ca/cac/avalanche-search-apps-review.

Flakes

ROB BUCHANAN



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