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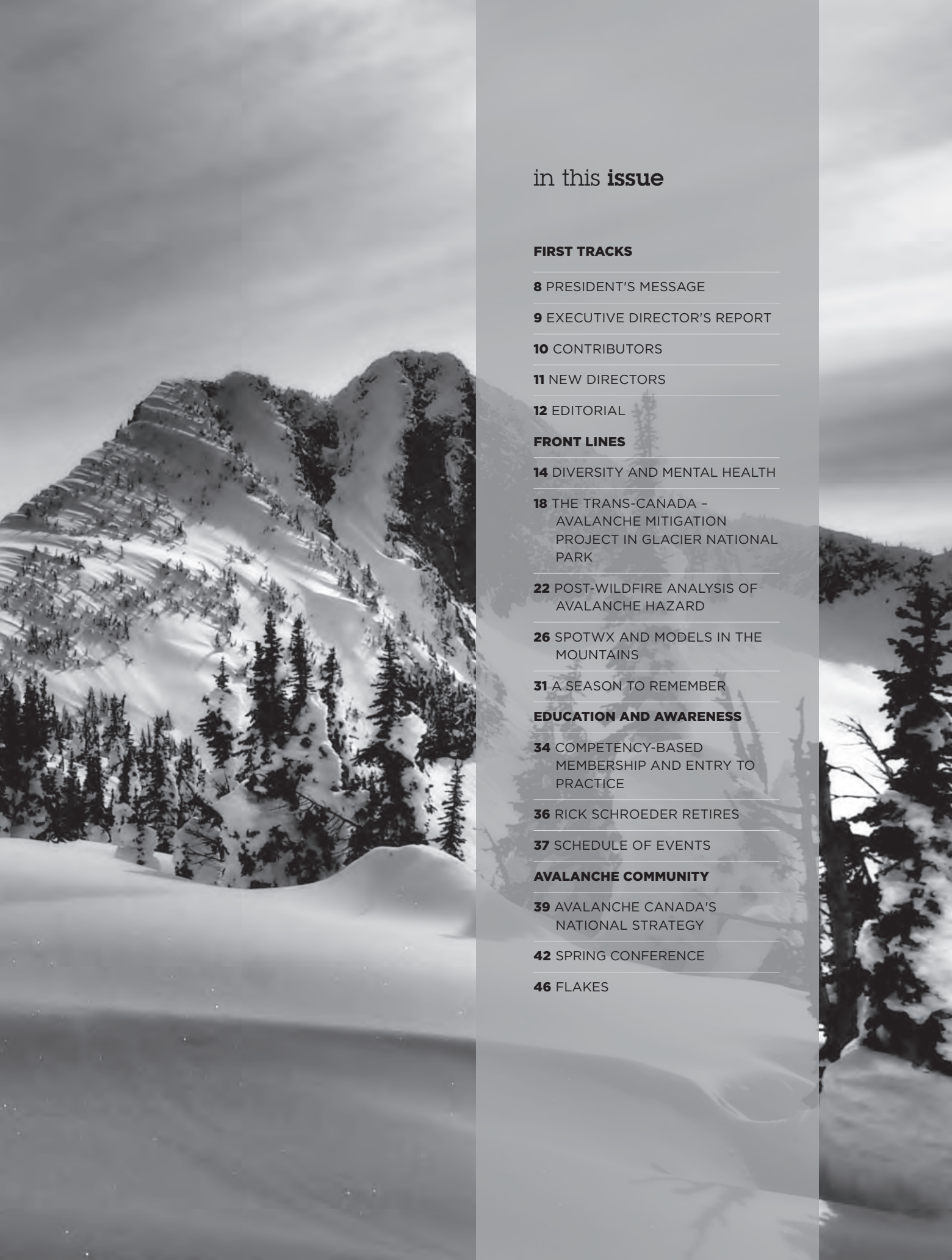

in this **issue**

President's Message

GETTING INVOLVED

Walter Bruns
CAA President

THANK YOU TO EVERYONE who attended the recent annual general meeting and technical sessions in Penticton. Beyond the great value on offer to participants (as Joe describes in his ED report on the next page), it is also a wonderful opportunity to interact with peers and to socialize with friends in the avalanche community.

Members elected four new directors to our nine-person board (see page 9). Kate Snedeker and Jeff Surtees, the new public directors, are also brand new to the CAA. At a recent two-day board session, we welcomed them with a brief orientation and overview of our association. Good to have you aboard (pun intended)!

Kathy McKay (who updates progress on the CAARAT project on page 32) and Brendan Martland were also present to brief the new board on their detailed project plan for the "Professional Path," expanding on their presentation to the membership in Penticton. The project has the required resources and is clear to proceed. They will continue to update us as the successive stages are developed and as their implementation is anticipated over several phases.

David Thomson, our facilitator, then led a detailed review of governance principles for non-profit organizations, with specific focus on the issues we face at the CAA. It quickly became apparent we need to develop more structure and rigour in our governance processes to better serve the interests of the association, its staff, members, and the public.

We can begin by clarifying the responsibilities of each individual director, the three-person executive, and of the board as a whole. There can be a process to assess the contributions of directors and to evaluate the effectiveness of the entire board on an ongoing basis. The review or renewal of the strategic plan, the monitoring of progress in annual operating plans, and monthly board conference calls can be more explicitly scheduled as routine and foreseeable cycles of activity.

Since a lot of governance activity is accomplished through, or informed by, the work of various committees, there is scope to refine their terms of reference (ToR) so they are better positioned to accomplish the tasks. As with the board and its directors, committees and committee members can be given clearer direction and can have their engagement monitored more effectively.

Specifically, Jeff and I propose to revise and expand the ToR for the governance committee. Jeff's training, work experience, and external perspective will provide great insight. David Thomson remains available to us as a resource. There are openings for new members and a chair, if you are interested in joining the effort.

Eirik Sharp, who is chair of the information technology committee, will collaborate with Steve Brushey, chair of the explosives committee, to review their respective ToRs. Ryan Buhler, chair of the membership committee, is looking for new members. Brendan Martland, who stepped down as chair of the ethics and standards committee, is also looking for a successor and new members.

Bottom line, there is ample opportunity for you to step up and be a part of the collective effort to make our association the best it can be.

Happy summertime!

Walter Bruns, CAA President

Joe Obad
CAA Executive Director

Executive Director's Report

MOVING FORWARD FOR OUR MEMBERS

IN 2014, AT ISSW BANFF, the question of ISSW timing between Canada, USA, and Europe needed to be resolved by the conference's steering committee. One proposal suggested fewer ISSWs for Canada because "Canada basically has an ISSW every spring in Penticton." Thankfully Canada remains an equal partner and we turn our eyes to Fernie in October 2020 with great anticipation.

Nevertheless, many members reported the quality of presentations in Penticton this year was excellent, approaching or equaling that of ISSW. These accolades serve as reminder the strength of the CAA is as much in its members sharing and engaging each other as it is in the many ambitious projects and challenges members take on every year.

CAA staff continue our work to support members at the Spring Conference and in other forums. Here are some highlights:

As I mentioned in the last edition of the Journal, we restructured our continuing professional development offerings, recognizing the audience for the sessions in Penticton differs enough from our fall offerings that we are able to showcase strong presenters at both with minimal overlap.

We also moved towards smaller sessions that require more advanced enrollment. This strategy has more chances of meeting members' needs than the previous large, one-size-fits all sessions common to past spring meetings. As with any change there are hiccups, and some members expressed frustration at not getting into the sessions they wished to attend. On our end, staff will work to improve our communications going forward. Likewise, if you were unable to attend your first choice sessions, please follow the example of fellow members who acted promptly on Spring Conference notices and register early.

Looking outwards to the majority of members who are not able to attend the spring meetings, some existing and new initiatives are designed to support you.

As we have done for several years, many of the case studies and technical presentations from Penticton were recorded. The recordings can be found in the *members only* section of the CAA website.

The board has committed to electronic voting for the spring 2020 AGM to allow eligible members not in attendance to vote to shape the future of the CAA. While the Spring Conference needs to be in a physical location, we hope these tools will bring the benefits of these meetings to all members, not just those who can attend.

In 2018, we signaled to members we would try to follow a pattern of more frequent, modest member dues increases where needed. This spring we did not seek any changes to dues. In part this was because of the work on partnerships. In particular, we would like to again recognize Mammut, who has joined the CAA as our first *Premier Partner* – the highest financial commitment available in our partnership tiers. The support of Mammut and other partners provides non-dues funding, allowing the CAA to work flexibly in support of the membership.

On other fronts, at the AGM we discussed the Industry Training Program efforts to secure instructors. ITP manager Emily Grady announced a survey of current instructors that we have since completed. The findings confirm some things we knew, but also give us insight into the best ways to secure instructors. Further, this research gives us a stronger sense of how to judiciously apply the $20,000 in training funds the board has set aside to diversify and potentially expand the instructor pool.

For InfoEx we listened to subscribers and identified automatic weather feeds and mobile use as our next major steps forward. There are several funding options and technical pathways we hope to iron out this summer before advancing these worthwhile feature sets.

For non-operational initiatives, the CAA partnered with the Association of Canadian Mountain Guides and the Canadian Ski Guide Association to study gender, diversity, and mental health within the guiding and avalanche professions. The initial work took the form of a baseline survey. Researcher and active member Rachel Reimer details the findings of the survey in this issue.

On one level, the findings point to many well-known facts. Our industries are dominated by white males and we have more work to do to support better mental health outcomes. Beyond the surface findings, the work points towards the loss of human potential for individuals both within and outside the dominant demographics as dated norms around gender, diversity, and mental health remain unquestioned or unaddressed.

The sponsoring organizations have expressed interest in learning from the findings of the study and moving forward constructively in our own contexts as well as engaging new partners like HeliCat Canada. There remain challenging questions to explore. How do practitioner associations explore solutions in the context of member professionalism? Conversely, how do industry associations help member operations foster workplaces that support better outcomes?

At this point, the questions pop out more than the solutions. Nevertheless, our shared commitment to work on better outcomes is a start. The participating organizations plan to meet in the fall and further explore introductory steps to tackle the challenges highlighted. We encourage all members to read Reimer's article. I began this piece by noting the leadership and engagement of members at spring conferences and ISSWs. As ever, member involvement will make all the difference to taking positive steps forward together.

Joe Obad, CAA Executive Director

Contributors

RACHEL REIMER
Rachel (MA, PhD Candidate) is a member of the guiding and avalanche community, and a social science researcher on diversity, leadership and mental health in mountain-based professions. Her research on leadership and gender in wildland fire was nominated for the Governor General Gold Medal's Award and the Nelson Mandela Award. She is currently undertaking PhD research on diversity and mental health in the avalanche and guiding profession, a comparative study between New Zealand and Canada. She lives in Revelstoke, B.C.
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DAVID JONES
David has years of experience forecasting, broadcasting and talking weather with clients. He appreciates the challenge of making weather understandable, especially to people whose life may depend upon it in the mountains. He spends the summer fire forecasting and his winters planning ski days around the weather.
26 SPOTWX AND MODELS IN THE MOUNTAINS

BEN JACKMAN
Ben has worked in the ski area industry for 15 years in Australia, New Zealand, France, and Canada. Originally from Australia (yes, just another Australian in Canada), he decided to settle and call Fernie home. He is currently employed at Fernie Alpine Resort as an avalanche forecaster in the winter and machine operator in the summer.
20 A SEASON TO REMEMBER

CHRIS ARGUE
Chris first cut his teeth in the avalanche patch as a ski patroller at Marmot Basin. Now based in Revelstoke, he has worked as an avalanche specialist and GIS technician with Dynamic Avalanche Consulting since 2011, where he has been involved with avalanche consulting projects in Canada, USA, New Zealand, and Argentina.
16 THE TRANS-CANADA – AVALANCHE MITIGATION PROJECT IN GLACIER NATIONAL PARK

CAM CAMPBELL, BRIAN GOULD AND SCOT THUMLERT
Cam, Brian, and Scott are avalanche specialists with Alpine Solutions Avalanche Services. Cam has worked in the industry for almost 25 years, first as a ski patroller and highway technician, then as a public forecaster, and most recently as a consultant. Brian doubles as an ACMG Mountain Guide, while raising two daughters. Scott is a guide with CMH, but previously dug lots of square holes at the University of Calgary's Applied Snow & Avalanche Research Centre, and Simon Fraser University's avalanche research program.
22 POST-WILDFIRE ANALYSIS OF AVALANCHE HAZARD

Welcome the **New Board Members**

JESSE PERCIVAL

Hailing from Vancouver Island, Jesse has spent more than 20 years working primarily in ski operations. Over the last decade his work has become increasingly diverse, with experience in public avalanche forecasting, AST course delivery, and work in a variety of industry settings. A current member of the explosives committee, he is keen to further serve the membership with his new role on the board of directors.

EIRIK SHARP

Eirik is a Whitehorse-based entrepreneur, avalanche professional, and ski guide with a background in research, public avalanche safety, and industrial avalanche risk management. He has been a CAA instructor, co-chaired the IT committee, and will use his experiences to further the objectives of the CAA.

KATE SNEDEKER

A lifelong skier, and more recently a climber and mountaineer, Kate works as a surveillance epidemiologist for Alberta Health Services and is an adjunct at the University of Alberta and University of Calgary. She is a trip leader with the Calgary section of the Alpine Club of Canada and is motivated to contribute to the organization that supports the avalanche professionals who have taught and mentored her over the past half-decade.

JEFF SURTEES

Jeff holds an economics degree and law degree, and recently completed his masters in environmental law. He was the CEO of Trout Unlimited Canada and is now the executive director of the Centre for Public Legal Education Alberta. An avid outdoorsman, he has sat on the board of several environmental non-profits and brings extensive understanding of non-profit management to the CAA.

Jesse Percival

Eirik Sharp

Kate Snedeker

Jeff Surtees

CAA **Service Awards**

KARL KLASSEN AND COLIN ZACHARIAS were recognized with CAA Service Awards at the Spring Conference in Penticton in May.

Klassen was recognized for his many contributions during a 35-year career as guide, researcher, author, filmmaker, mentor, instructor and examiner. He has been a professional member of the CAA since 1986, where he has served on many committees; a lead forecaster for Avalanche Canada since its inception in 2004; and both the executive director and president of the Association of Canadian Mountain Guides. Over the years he has left an indelible imprint on the public bulletin, InfoEx, and almost every other advancement of the avalanche community.

Zacharias was recognized for his many contributions to the CAA, the Industry Training Program, many working groups, curriculum development, and more both nationally and internationally. For over a decade, he has been at the cornerstone of curriculum development for the Avalanche Operations Level 2 program in particular and continues to be an incredible Industry Training Program instructor, as both student and instructor feedback avows.

KARL KLASSEN RECEIVES HIS CAA SERVCIE AWARD FROM DIRECTOR RYAN BUHLER AT THE SPRING CONFERENCE. COLIN ZACHARIAS WAS UNABLE TO ATTEND // ALEX COOPER

Alex Cooper
Managing Editor

Breaking **Trail**

IT'S ONE OF THE MEMORIES that stands out from early days in journalism. I was fresh out journalism school, having moved to Revelstoke from the big city to work at the local paper, and the backcountry was a strange place to me. I didn't think of a crust as anything but the worst part of a pizza.

It was late November 2009 and I'd heard of four snowmobilers who were caught in avalanche but managed to self-rescue, limping out an area known as Deadman's Creek on their one remaining sled. It was a dramatic story – one was buried for almost 10 minutes and nearly died and another was flown to hospital with a serious leg injury.

What I remember professionally is calling the head of Revelstoke Search & Rescue about the incident and naively asking if it was normal to have avalanches this early in winter. "You must be new," he replied. "If there's enough snow to ride, there's enough snow to slide."

Almost 10 years have passed since then and I now find myself split between editing this magazine and working at Avalanche Canada as the newest member of their communications department, the first hire of its ambitious growth plan.

Living and skiing in Revelstoke for a decade, it's impossible to not learn a thing or two about snow. Avalanches and snow safety stories were regular features in the paper, and I used (abused?) my position to further my own education. I obsess over weather as much as almost anyone, and I've had conversations about the Dec. 15 surface hoar layer.

Still, the more I dive into this world, the more I realize I still have much to learn.

For my first issue of the Journal, I've kept it simple. With a bit of a time crunch between being hiring at the end of April and my first deadline two months later, I approached people at the Spring Conference who were keen to write. For those who attended the Thursday and Friday sessions, some of this material won't be new, but I hope everyone still finds it valuable reading.

Ben Jackman from Fernie Alpine Resort provides valuable lessons on complacency and patience following a challenging 2017-18 winter. Chris Argue writes about the new avalanche detection, mitigation and control strategies in Rogers Pass.

An especially valuable article heading into what's expected to be another fiery summer out west is Cam Campbell's research into the impact on wildfires on avalanche hazard. I heard a few questions at the conference regarding SpotWX, and am grateful meteorologist David Jones agreed to write a primer about it.

Mary Clayton at Avalanche Canada wrote about the organization's ambitious national strategy, that will see it provide avalanche forecasting and education from Newfoundland to the Yukon.

The most important article in this issue is on Rachel Reimer's research into diversity and mental health in the guiding and avalanche professions. The findings regarding diversity and gender discrimination are disappointing, though they shouldn't be surprising as they closely match the findings of a 2017 study by the Pew Research Centre, which found, "women employed in majority-male workplaces are more likely to say their gender has made it harder for them to get ahead at work, they are less likely to say women are treated fairly in personnel matters, and they report experiencing gender discrimination at significantly higher rates."

Still, it is good to know these issues are being addressed and I hope we see positive moves to improve the work environment for everyone, particulary gender and visible minorities.

***

I'd love to hear what people think of the Avalanche Journal. As I sink deeper into my chair, I've come up with many different article ideas. I'd like to get an idea of what people want to read about. Do you want theme issues, or should the journal simply reflect the latest research and news from the industry? Do you want to read versions of presentations made at the Spring Conference, or is that information redundant? Let me know by emailing acooper@avalanche.ca.

Alex Cooper

front lines

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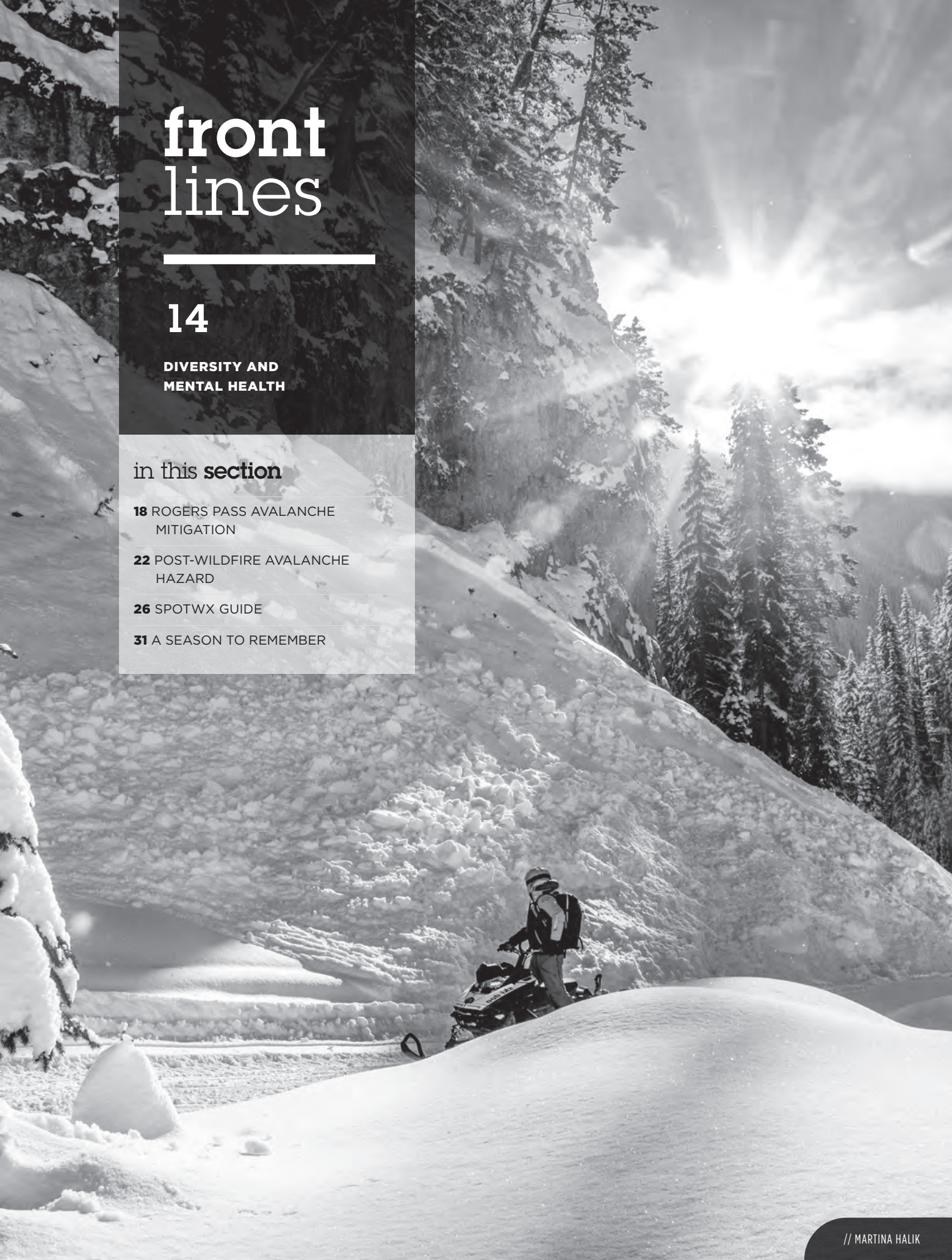
DIVERSITY AND MENTAL HEALTH

in this **section**

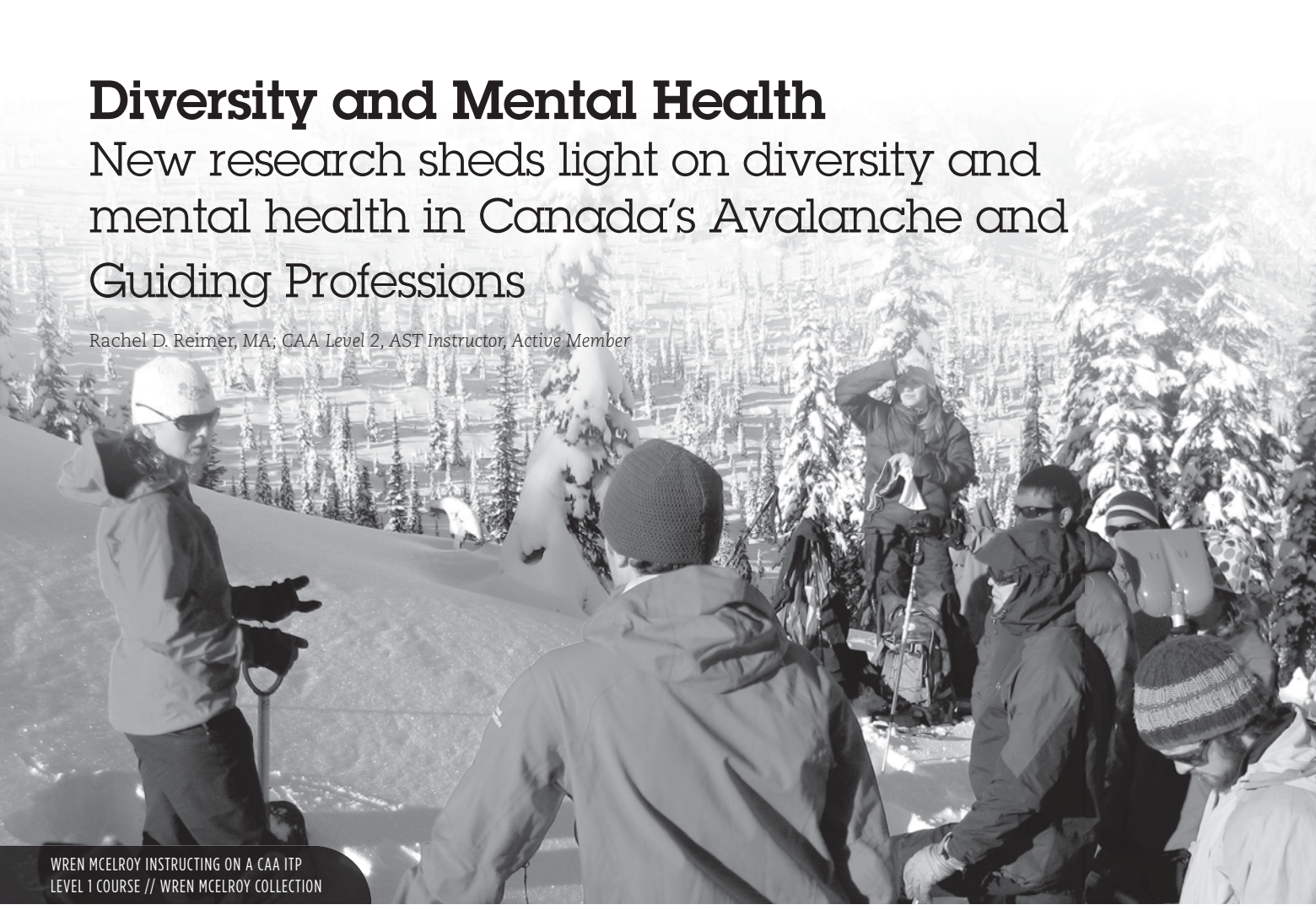


// MARTINA HALIK

Diversity and Mental Health

New research sheds light on diversity and mental health in Canada's Avalanche and Guiding Professions

Rachel D. Reimer, *MA; CAA Level 2, AST Instructor, Active Member*



WREN MCELROY INSTRUCTING ON A CAA ITP LEVEL 1 COURSE // WREN MCELROY COLLECTION

THIS PAST WINTER, the Canadian Avalanche Association partnered with the Association of Canadian Mountain Guides and the Canadian Ski Guides Association for a ground-breaking, collaborative inquiry into diversity and mental health in the industry. This study was commissioned after members of all three organizations raised concerns about mental health, including suicide; and diversity issues, including gender discrimination and sexual harassment. To develop a better understanding of their concerns, a survey was conducted of all three organizations' memberships from January until the end of March.

DEMOGRAPHICS

CAA - 74.64% (365)
PROFESSIONAL – 216
ACTIVE – 135
OTHER – 9

ACMG - 60.33% (295)
HIKE AND CLIMB – 103
ALPINE AND ROCK – 36
SKI AND MOUNTAIN – 189
OTHER – 7

CSGA - 15.75% (77)
ANY LEVEL
OTHER CSGA

AGE:
18-24 – 2.26% (11)
25-34 – 24.07% (117)
35-44 – 36.01% (175)
45-54 – 19.75% (96)
55-64 – 13.99% (68)
65+ – 3.91% (19)

EXPERIENCE:
LESS THAN ONE YEAR – 3.1% (15)
1-3 YEARS – 14.67% (71)
4-10 YEARS – 27.69% (134)
10-20 YEARS – 29.55% (143)
20+ YEARS – 25% (121)

GENDER:
MALE – 70.37% (342)
FEMALE – 27.98% (136)
PREFER NOT TO ANSWER – 1.03% (5)
TWO-SPIRITED – 0.41% (2)[1]
TRANSGENDER – 0.21% (1)

RACE AND ETHNICITY:
CAUCASIAN/WHITE – 94.02% (456)
VISIBLE MINORITY – 2.47% (12)
FIRST NATIONS – 1.44% (7)
METIS – 1.03% (5)
PREFER NOT TO ANSWER – 1.03% (5)

1 Two-Spirited: a First Nations/Metis traditional gender identity that describes individuals who hold both masculine and feminine spirits in balance.

A total of 514 guides and avalanche workers across Canada completed the survey. Unofficial estimates put the industry at approximately 15-20% female (CAA 2019, ACMG 2019), while survey respondents were 70% male and 28% female. This means the findings are representative of the industry given the high percentage of males who completed the survey. Thank you to all members of the community who took the time to participate.

FINDINGS

What is the avalanche and guiding industry culture?

The industry culture was defined, from strongest to weakest in the data, as:

1) Exclusive;
2) Professional;
3) Safety-oriented; and
4) Learning and evolving.

The words most frequently used to explain "exclusive" were "bro-culture," "male-dominated," and "old boys club."

"Proud, highly technical, high standards, good governance. Also – ego driven, not self-aware, male dominated, bro culture."

Is the avalanche and guiding profession diverse?

When asked if the profession is diverse, 60.8% said no and 28.2% said yes.

"No, and we have a long way to go. The success of an individual in our industry is dependent on many limiting factors like economic status, gender, race, etcetera, that play out in subtle but powerful ways to make it inaccessible. The result is a pervasive stereotype limiting what capability in our field 'looks' like."

Is the avalanche and guiding profession inclusive?

When asked if the profession is inclusive, 68.6% said yes and 23.4% said no. This reveals a self-image of inclusive behaviour, even with open acknowledgement the culture is 'exclusive' and the industry is not diverse.

Does gender make a difference in how people are treated in the avalanche and guiding profession?

59.9% said yes and 30.8% said no. Differences in perceived competence were the biggest factor.

"As a white male, I am the sought after 'ideal' of a guide and treated as such."

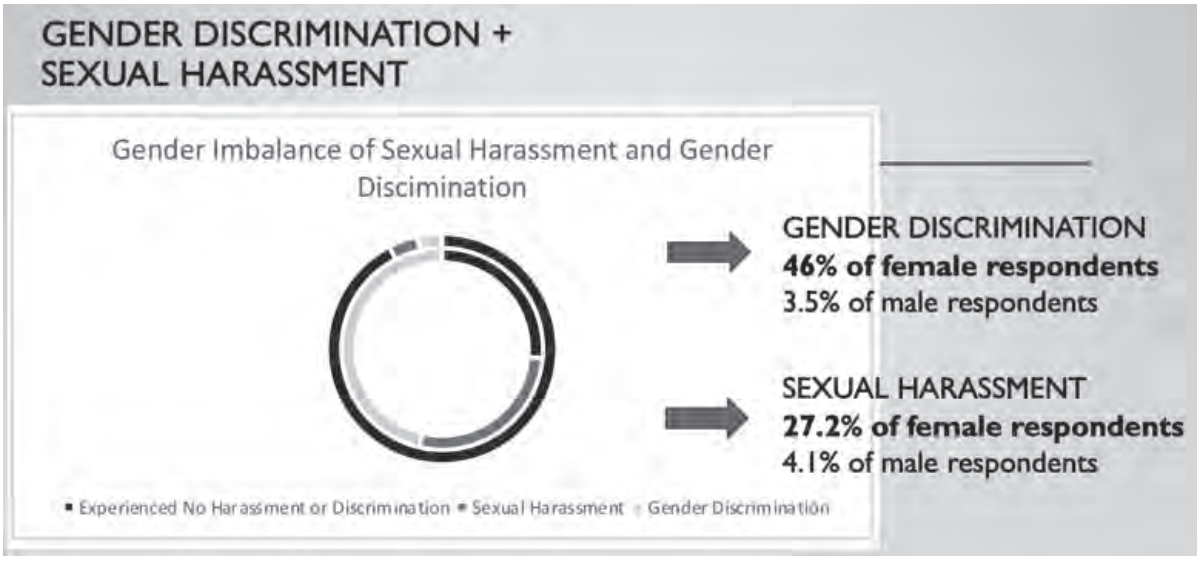
"Yes, there is a huge assumption of competence if you are a male. The opposite is true if you are a female at our workplace. I have personally heard the one more senior female state that the only reason the guys like her at work is because she hardly talks."

Gender discrimination in the avalanche and guiding professions

What does this look like? In order of most commonly experienced, gender discrimination in the profession is:

1) Females assumed less competent;
2) Family: work balance and motherhood;
3) Traditional gender roles; and,
4) Hostile, sexualized work environment.

Guiding and avalanche worker mothers were treated as if motherhood compromised their risk management abilities. They faced a double burden at work of both being away from their family and also experiencing a compromised sense of belonging and acceptance in their work environments.



OUTER CIRCLE REPRESENTS MALE EXPERIENCES; INNER FEMALE EXPERIENCES. THOSE AGED 45+ LESS LIKELY TO EXPERIENCE SEXUAL HARASSMENT.

Traditional gender roles were described as females being expected to be 'soft' or 'emotional', and take less physical and/or risky tasks, whereas males were expected to be 'hard', 'unemotional', and take on more physical and/or risky tasks. A hostile, sexualized environment was described as negative for many reasons.

"I am transgender. I am not 'out' to my coworkers. I fear that I would not be treated equally due to the comments and jokes I heard on a daily basis."
"I've been told by a male co-worker that my breasts are why guests like me,
I've sat in a guides meeting where my physical attributes were discussed. I've been groped by male guides and clients."

Sexual harassment in the avalanche and guiding profession

What does this look like? In ranked order:
1) Hostile, sexualized work environment; and,
2) Unwanted touching. 27% of sexual harassment included unwanted touching.

Only 14.6% of people who experienced sexual harassment chose to report it. The most common response when the incidents were reported was that the incident was "not resolved."

Nine incidents of sexual harassment shared in this study were initiated by a supervisor, mentor, instructor, or examiner. All three organizations (ACMG, CAA, and CSGA) were associated with different incidents.

Guest-initiated sexual harassment only makes up on average 40% of total sexual harassment incidents for ACMG guides and CAA members. This means roughly 60% of sexual harassment incidents in the avalanche and guiding profession are from other guides and workers.

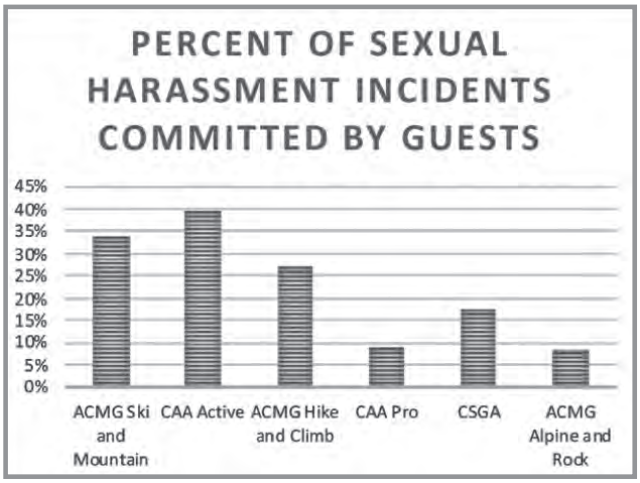
Mental health in the avalanche and guiding professions

The majority of guides and avalanche workers self-ranked their mental health mid-season as 'average' or 'above-average'. However, 57.7% indicated experiencing mental health challenges and 74.8% observed others experience challenges.

Minorities more vulnerable

Females experienced mental health challenges six per cent more than males. Everyone who identified as First Nations/Metis, and all who identified as transgender or two-spirited experienced mental health challenges.

One-quarter of First Nations/Metis and one-third of transgender or two-spirited members of the industry have had previous suicidal thoughts/attempts.



UEST SEXUAL HARASSMENT.

Accessing supports for mental health challenges

Barriers to support included cultural barriers, especially stigma from older generations. Informal support such as debriefs led by untrained personnel with alcohol were also listed as barriers.

FUTURE GOALS

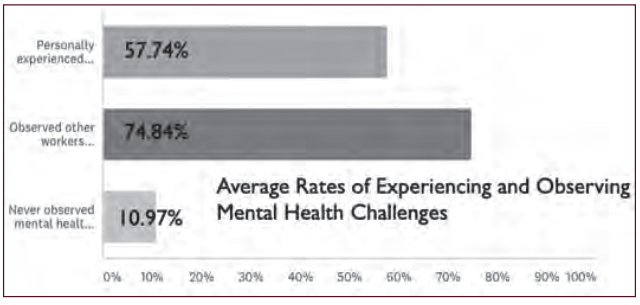
In this study, guides and avalanche workers shared their ideal goals for a diverse, inclusive, and resilient future in the profession. In ranked order of strongest in the data:

DIVERSITY

1) **Equality of opportunity:** This was described as removing barriers to entry, including changing cultural norms in the profession. This did not mean introducing quotas or fixed outcomes.
2) **Inclusive AND diverse:** This was described as becoming aware of the ways the industry is perpetuating an exclusive culture and limiting diversity; and choosing to consciously foster inclusivity as a new cultural norm.
3) **Respectful work environment:** This was described as recognizing the current hostile, sexualized work environment, and fostering respectful work environments as a new cultural norm.

MENTAL HEALTH

1) **Open discussion about mental health:** This was described as addressing stigma by fostering openness, especially through older generations leading by example and opening up about their own challenges.
2) **Relevant support is readily available:** This was described as introducing skilled and timely supports, and connecting guides and avalanche workers with the resources they need, both proactively and following incidents.



MENTAL HEALTH CHALLENGES.

3) **Structure the industry to prevent mental health crises:** This was described as addressing the cultural norms that create expectations of social drinking, excessive days worked, and limited time off following critical incidents. A healthy and proactive culture that values mental health and consciously cultivates well-being should be fostered.

ACTION STEPS

In this study, guides and avalanche workers suggested: more representation of minorities in leadership and mentorship roles; active organizational and employer engagement in diversity and inclusion issues through education, awareness, and policy; and, generational shift within industry leadership.

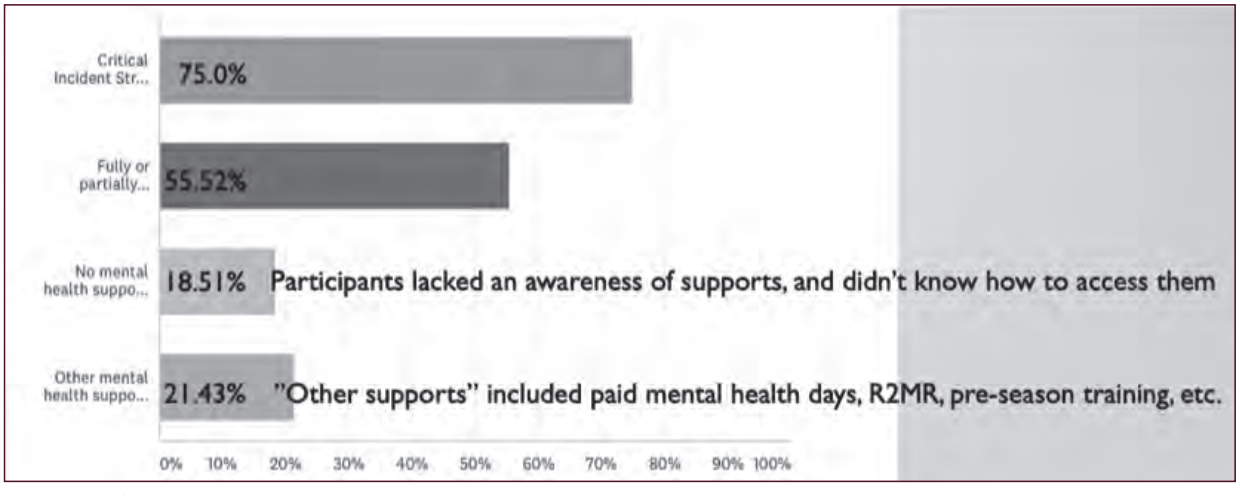
To address mental health concerns in the industry, guides and avalanche workers suggested: reducing stigma through open dialogue, increasing mental health supports (especially in smaller operations), and structuring the industry to prevent mental health crises.

Physical or mental **fatigue**	93.46%
Prolonged exposure to **high levels of workplace stress**	63.40%
Exposure to **critical incidents** in the workplace, including fatalities	61.44%
Loss of a friend, colleague or family member to **suicide**	37.25%
Social isolation	32.68%
No previous support from counsellor or doctor	26.80%
History of mental health challenges in self or family	26.80%

MOST FREQUENTLY EXPERIENCED MENTAL HEALTH CHALLENGES AND RISK FACTORS.

WHAT HAPPENS NEXT?

A strategic planning meeting is in the works for Fall 2019, with the aim to continue this collaboration. The summer is providing a time for reflection and absorbing the study's findings. This is an exciting and dynamic moment in the history of the profession, and Canada is pioneering a compassionate and research-based approach to cultural change. Together, the professional associations, employers, and academic community are engaged to create a plan moving forward that effectively address these issues. If you have questions or comments, or wish to add your voice, please reach out to the CAA board of directors.



MENTAL HEALTH SUPPORTS.

The Trans-Canada Highway - Avalanche Mitigation Project in Glacier National Park

Chris Argue[1], Ryan Buhler[1], Jeff Goodrich[2], Bruce Jamieson[3], Alan Jones,[1] and Jaime Sanderson[4]

[1]Dynamic Avalanche Consulting Ltd., Revelstoke
[2] Parks Canada, Revelstoke
[3] Snowline Consulting Ltd., Calgary
[4] McElhanney Consulting Services Ltd., Canmore

INTRODUCTION

Since 2015, Parks Canada has been adding improvements to avalanche mitigation infrastructure as part of the Trans-Canada Highway (TCH) – Avalanche Mitigation Project in Glacier National Park (GNP). Project objectives are to reduce avalanche risk to highway users and workers, reduce highway closure time, and optimize the efficiency of current avalanche risk management operations. Budget limitations precluded the construction or extension of snow sheds.

The TCH and Canadian Pacific Railway through GNP are affected by 134 avalanche paths, making it one of the most challenging transportation corridor avalanche programs in the world. The safety and reliability of this corridor has a significant effect on local and Canadian economies (NovaTrans, 2010), and relies on artillery and permanent avalanche defence structures to reduce avalanche risk.

Artillary Avalanche Control Program by the Numbers

- **TWO 105 MM HOWITZERS**
- **17 ROADSIDE GUN PLATFORMS**
- **270 UNIQUE TARGETS**
- **AVERAGE OF 700 ROUNDS PER YEAR**
- **CONTROL DONE DAY OR NIGHT IN ANY WEATHER**
- **4 MINUTES PER ROUND (AVERAGE)**
- **74 CLOSURE HOURS PER WINTER (AVERAGE)**
- **75% OF CLOSURES ARE TWO HOURS OR LESS. HOWEVER, MOST WINTERS HAVE AT LEAST ONE CLOSURE OVER 12 HOURS DUE TO HIGH AVALANCHE HAZARD AND/OR AVALANCHE DEPOSIT REMOVAL.**

CURRENT AND PROJECTED AVALANCHE RISK IN GNP

To evaluate project options, the avalanche hazard index (AHI) (Schaerer, 1989) was used to quantify the baseline avalanche risk. AHI is a numerical expression of avalanche risk to vehicles on a road or highway. It is calculated using:

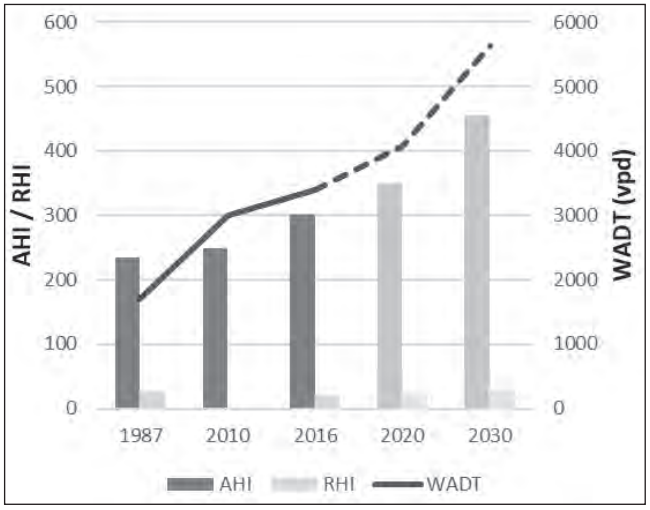
- The frequency of controlled and natural avalanches to the highway;
- A value representing the consequences of avalanche impacting vehicles;
- Traffic volume and additional traffic parameters to approximate the probability of a moving vehicle being hit, and then the risk from adjacent avalanche paths to the traffic stopped by the deposit blocking the highway.

The AHI is useful for identifying where mitigation measures are most beneficial. The residual avalanche hazard index (RHI) was also calculated, which only considers the frequency of uncontrolled avalanches affecting the open highway and represents the residual risk under the current avalanche program.

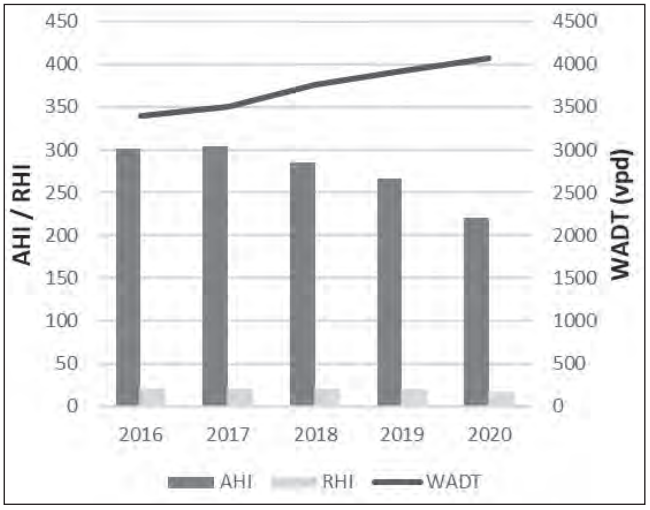
From 1979 to 2019, the winter average daily traffic (WADT) increased from approximately 1,000 vehicles per day (vpd) to over 3,000 vpd. Despite improvements in avalanche risk management, increasing traffic without changes in defence structures has increased the AHI. By 2020, WADT is predicted to increase to over 4,000 vpd. Without further mitigation, the AHI is expected to increase due to higher traffic volumes, which increases risk to highway users and will likely increase number and length of closures.

METHODS

To develop a strategy for selecting new avalanche mitigation in GNP, options at each path were evaluated using the following six scoring metrics: (1) reduction of AHI, (2) reduction of RHI, (3) effect on highway closure time, (4) effect on efficiency of the avalanche control program, (5) effect on future highway four-laning, and (6) capital cost. The scoring method is described in detail in the full version of this paper (Argue et al, 2018).



AHI AND RHI AS CALCULATED BY SCHAERER (1989), NOVATRANS (2010), AND FOR THIS PROJECT IN 2016. WADT IS SHOWN BY THE SOLID (OBSERVED) AND DASHED (PROJECTED) LINE ALONG WITH PROJECTED AHI AND RHI (GREY AND LIGHT GREY).



REDUCTION IN AHI AND RHI BY YEAR OVER THE COURSE OF THE PROJECT. INCREASING WADT IS SHOWN BY THE BLACK LINE.

Each of the 134 avalanches paths was ranked based on the sum of their normalized scores from the six scoring metrics. Adjacent paths with a shared mitigation strategy were grouped. Avalanche paths selected for mitigation were classified into phases for construction based on rank, ease of design and construction, and economic consideration.

NEW AVALANCHE MITIGATION MEASURES

Six mitigation measures were selected for construction in a total of 16 avalanche paths. These included remote avalanche control systems (RACS), retaining berms, and a comprehensive avalanche detection network (ADN).

RACS were installed in five paths, including three at the west end of GNP (Avalanche Guard system), and two at the east end of GNP (Wyssen Avalanche Towers). RACS in these five paths eliminate the need for artillery control near the park boundaries, allows RACS control concurrent with artillery in other locations, and improved coordination of closures with the BC Ministry of Transportation and Infrastructure (BC MoTI). These benefits represent a substantial gain in operational efficiency.

Snow nets were installed in the Cougar Corner 6, 7, and 8 paths, which have a history of affecting the open highway. 1,886 metres of snow nets were installed, as well as 55 metres of debris flow barriers to accommodate a deep gully in Cougar Corner 7. A deposit blocking the highway at this location results in traffic backing up into large, high consequence paths, so mitigation of these paths resulted in a large decrease in the AHI and RHI. Additionally, the ditch in the Cougar Corner 7 and 8 paths is being enhanced to improve catchment

SNOW NETS IN THE COUGAR CORNER 6, 7 AND 8 STARTING ZONES // DYNAMIC AVALANCHE CONSULTING

THE MOUNDS GLIDE SLAB AVALANCHE DEPOSIT, WHICH CAN BURY THE WEST PORTAL TO THE SINGLE BENCH SNOW SHED // PARKS CANADA

for smaller avalanches, which have been observed to initiate in the steep tracks below the snow nets.

A large retaining berm will be constructed this summer in the Mounds path to reduce the frequency of a large glide slab to the TCH to one-in-30 years. The glide slab releases mid-track each year and has a frequency to the TCH of one-in-eight years. Release is not predictable inside of a period of several days, and it is not possible to release artificially. The glide slab has a typical release depth of five to eight metres and is size four when it reaches the TCH, which is usually open on release. The deposit requires many hours to remove from the highway before it can be reopened.

A corridor-wide avalanche detection network (ADN) will be completed for the 2019-2020 season, which will be the largest network in the world. The network includes 13 infrasound arrays and four Doppler radar units that will focus on avalanche paths where confirmation of controlled or natural avalanches is critical data to forecasters. Benefits include improved timing of closures and control through early warning of avalanche activity, increased confidence in control results (e.g. during periods of poor visibility or at night) and increased worker safety due to reduced pressure to directly observe controlled avalanches.

RESULTS

Upon project completion in 2020, quantifiable benefits include an estimated reduction in AHI of 27% (to 220 from 301) and a reduction in RHI of 14% (to 18 from 21). These estimates account for projected increases in WADT. Without improvements to the avalanche program, the AHI was projected to increase by 14% over this period (2015-2020).

The reduction in closure time was estimated based on the decrease in artillery control and time required to remove deposits, which was estimated as a reduction in closure time of 15%, to 62.5 hours per year on average by project completion in 2020.

INSTALLATION OF THE DOPPLER RADAR AT THE MACDONALD WEST SHOULDER AVALANCHE PATHS // WYSSEN CANADA

SUMMARY

The TCH – Avalanche Mitigation Project will result in a major risk reduction and improvement in highway reliability upon completion in 2020. This project is the largest permanent infrastructure improvement to the avalanche program in GNP since construction of the highway in 1962.

Adjacent jurisdictions on the TCH, such as Yoho National Park to the east and BC MoTI to the west, are adopting similar strategies with the installation of RACS and rehabilitated or new, permanent avalanche defences. These projects highlight the trend towards highly reliable RACS and engineered avalanche defences within the TCH corridor and in North America.

ACKNOWLEDGEMENTS

The authors are grateful to the following for their important contributions to this project: Simon Armstrong-Bayliss, Naginder Jabbal, and Rob Parkinson (McElhanney); Jim Phillips, Rob Hemming and Johann Schleiss (Parks Canada); and Peter Schaerer for his contribution to the establishment of the avalanche program in Glacier National Park.

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TRAFFIC IS HELD UP IN THE ROGERS PASS SUMMIT PONDING AREA // DYNAMIC AVALANCHE CONSULTING

Post-Wildfire Analysis of Avalanche Hazard

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Alpine Solutions Avalanche Services, Squamish, BC

INTRODUCTION

In recent years, Western Canada has experienced the most severe wildfire seasons in recorded history. These wildfires have impacted avalanche paths that were previously assessed for avalanche hazard. Considering the drastic alteration of the landscape caused by wildfire, it is reasonable to consider avalanche characteristics will also be altered, creating uncertainty in previous avalanche hazard assessments.

As is well understood, forest cover is considered a key terrain feature influencing where and how avalanches initiate and flow. Forest cover reduces the probability of avalanche formation, with tree density of as little as 200 stems per hectare (seven metres average spacing) sufficient to inhibit destructive avalanches from starting (Schweizer et al., 2003).

Once started, dense forest cover can slow or even stop small- to medium-sized avalanches (Teich et al., 2012). After a wildfire, these effects can be altered for several decades or longer if forest regeneration is subsequently inhibited by an increase in avalanche frequency and size. Therefore, previously assessed avalanche paths that have been affected by wildfires may require reassessment to determine if deforestation alters avalanche hazard.

This article reviews the effects of forest cover on avalanche hazard and introduces methods to determine any increase in potential avalanche magnitude for paths burned by wildfire.

EFFECTS OF FOREST COVER ON AVALANCHE HAZARD

In general, forest cover reduces both the frequency and magnitude of avalanches through three main effects:

AN AVALANCHE PATH IN WATERTON LAKES NATIONAL PARK THAT WAS BURNED BY THE 2017 KENOW WILDFIRE.

1) Modifying snowpack structure

Forest canopies create a microclimate that alters height, stratigraphy, and spatial variation of the snowpack; and reduces the likelihood of avalanche initiation and propagation through:

- Moderation of the radiation balance at the snow surface, which leads to fewer persistent weak layers;
- Interception and subsequent release of snowfall (i.e. tree-bombing) that can interrupt the homogeneity of the snowpack and limit the extent of continuous weak layers; and
- Reduction of wind-transported snow, which limits the formation of deep and cohesive slabs.

In addition, trees that are either buried or extend through the snowpack can disrupt the homogeneity and limit the continuity of weak layers.

2) Providing structural support to the snowpack

Tree stems can effectively anchor the snowpack and reduce the likelihood of slab release. This structural support depends strongly on the tree species (Bebi et al., 2009) as well as forest density. Rudolf-Miklau et al. (2011) provide good guidelines of 500 stems/ha (4.5m average spacing) for 30 degree slopes, and 1,000 stems/ha (3.2m average spacing) for 40 degree slopes, which is supported by Weir (2002).

3) Modifying the dynamics of flowing avalanches

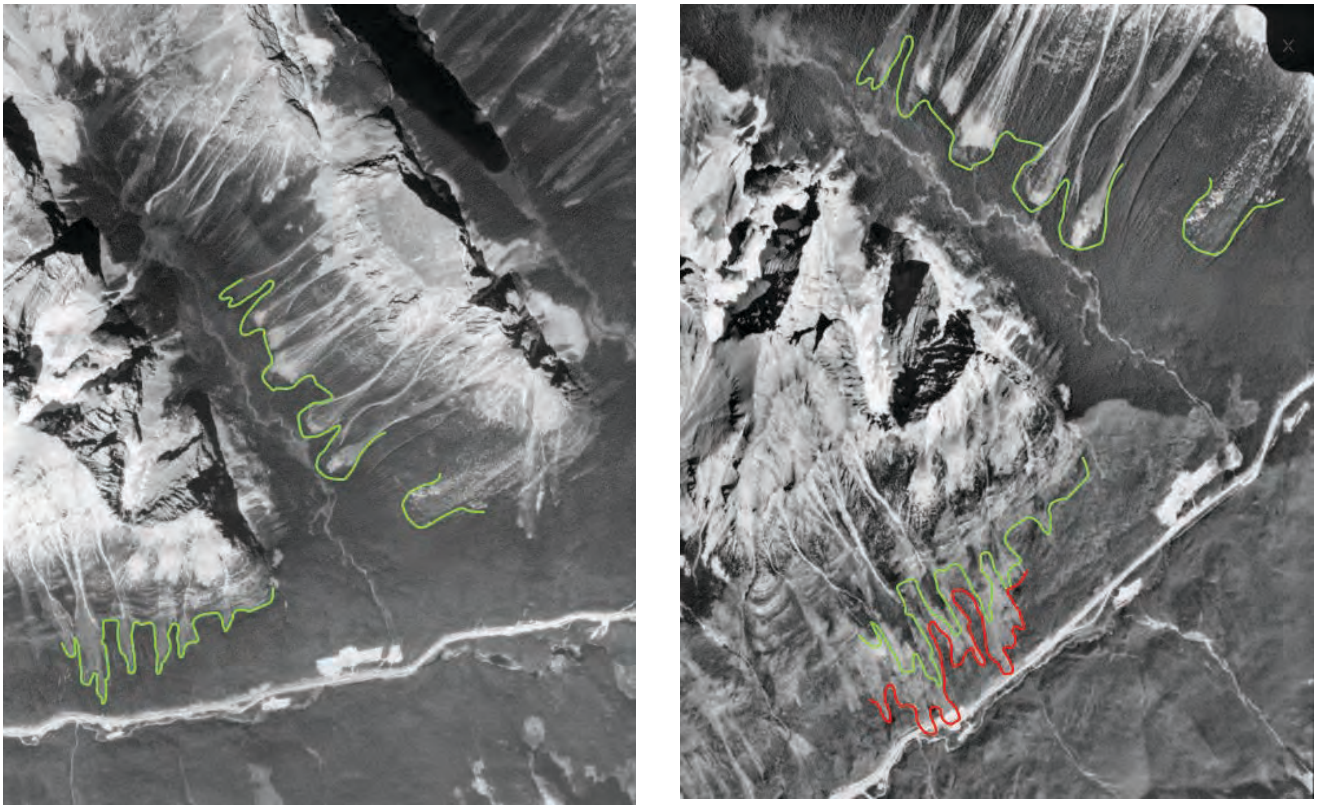
A dense forest can slow or stop small- to medium-sized avalanches through detrainment and increased friction (Teich et al., 2012). However, this effect is reduced for large avalanches. Bartlet and Stockli (2001) use a conservation of energy approach to explain why large avalanches can destroy forests without significant deceleration, and Margreth (2004) states broken trees can add mass to very large avalanches and actually increase the runout distance.

METHODS TO ASSESS THE EFFECT OF WILDFIRE ON AVALANCHE HAZARD

Post-wildfire reassessment of avalanche hazard attempts to answer the following questions:

1) What were the characteristics and extent of the pre-burn forest cover? Was the forest cover located in the starting zone, track, and/or runout zone? What was the tree species, crown diameter, and spacing? Spatial vegetation data such as B.C.'s Vegetation Resource Inventory can be a valuable resource.

2) What was the severity and extent of the wildfire? What was the spatial extent of the burnt forest? How severely did the canopy and the root systems of the forest get burned? How did the ground roughness change?



MT. WHYMPER PRE-WILDFIRE IN 1966 (LEFT) AND POST-WILDFIRE IN 1978 (RIGHT). THE MT. WHYMPER AVALANCHE PATHS ARE IN THE BOTTOM LEFT OF THE IMAGES AND THE PATHS OFF BOOM MOUNTAIN ARE SHOWN AT THE CENTRE AND TOP. PRE-WILDFIRE RUNOUT EXTENTS ARE OUTLINED IN GREEN AND POST-WILDFIRE RUNOUT EXTENTS ARE IN RED.

3) How are the avalanche characteristics likely to change? Will avalanches become more frequent? Will avalanches become more destructive?

The following two sections introduce methods that could be used to analyze any change in avalanche magnitude as a result of deforestation from wildfire.

Air photo and satellite imagery interpretation

Historical air photos and satellite imagery, specifically for locations where avalanches interact with forests creating trim lines, provide a rich dataset of large avalanches and are often used in avalanche hazard assessment (Jamieson et al., 2018). Information about historical wildfires including areal extents, severity of burn, and specific dates are often available for significant wildfires. The historical imagery is especially valuable if it is representative of the avalanche paths being reassessed and shows pre- and post-wildfire trim lines.

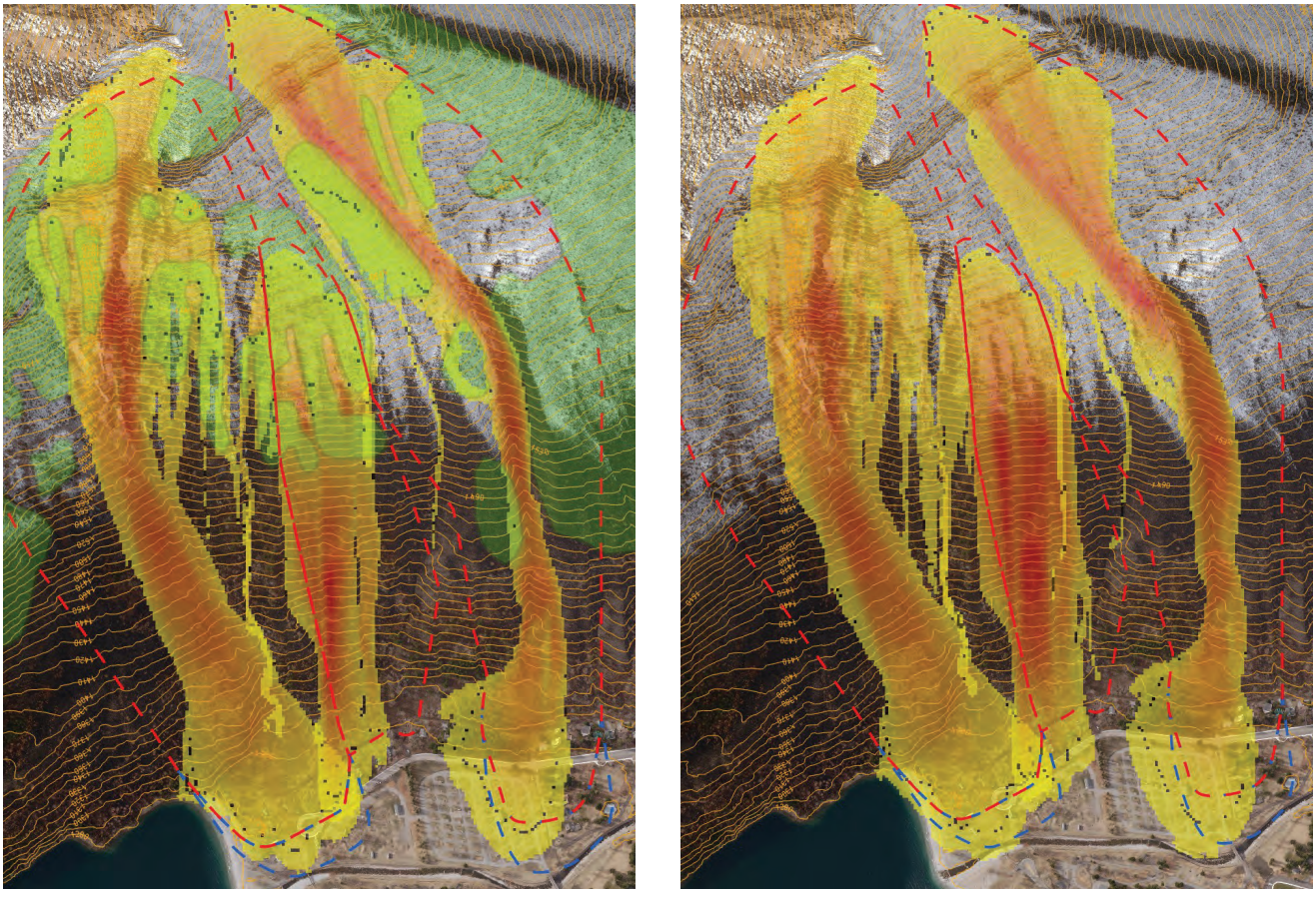
As an example, while revising avalanche path maps for Highway 93 South, we found an excellent series of images, with approximately one high-quality photo every decade from the 1940s to early 2000s. These show obvious trim lines from avalanches on the southeast face of Mt. Whymper before and after a large wildfire in 1968. The trim lines increased in runout distance when comparing the 1978 post-wildfire to the 1966 pre-wildfire photos (previous page).

Weather records show the early 1970s were large snowfall years, so it would be possible to explain the increased runout distance with larger snow years producing larger avalanches. However, when examining the avalanche paths off the southwest face of Boom Mountain, immediately northeast of Mt. Whymper, where the forest was unaffected by wildfire, no discernible increase in runout distance is observed.

RAMMS simulations

The two-dimensional RAMMS (Rapid Mass Movement Simulation) physical-dynamic model (Christen et al., 2010) can provide insight into the effect of wildfire on impact pressure and runout extent by simulating pre- and post-wildfire scenarios. First, the simulation is fit to the pre-wildfire assessment by:

- Adjusting release depth and friction parameters, while defining release areas to account for the structural support and snowpack modification provided by forest cover in the starting zone, and;



RAMMS SIMULATION RESULTS SHOWN IN YELLOW-ORANGE SHADING WITH (LEFT) AND WITHOUT (RIGHT) FOREST COVER, WHICH IS SHOWN BY GREEN SHADING. THE PRE-WILDFIRE AVALANCHE HAZARD ZONES (DASHED LINES) ARE ALSO SHOWN, AS WELL AS MODELED 30 KPA IMPACT PRESSURE THRESHOLD (BLACK PIXELS IN RAMMS MODEL RESULTS).

- Increasing the friction where avalanches flow into densely forested areas and have impact pressures of less than 100 kPa (i.e., small- to medium-sized avalanches).

Then, with all other parameters remaining constant, the post-wildfire scenario is simulated by:

- Increasing the release area to include the deforested areas within the starting zone, and;
- The areas of increased friction in the track and runout zone are removed where they are affected by wildfire.

As an example, we used RAMMS to reassess avalanche paths that threaten the town of Waterton in southwestern Alberta. RAMMS model simulations were initially fit to previous avalanche hazard zones by adjusting release volume while incorporating increased friction in areas of the path that were previously forested. The post-wildfire scenario was then simulated by using the same input parameters without the increased friction for forested areas, and the changes to impact pressure and runout distances were analyzed (Figure 3).

DISCUSSION

We present an overview how large wildfires alter avalanche terrain and introduce some ideas for assessing any resulting changes to potential avalanche magnitude. A complete reassessment of avalanche hazard would also consider any resulting changes to avalanche frequency, which would include a detailed analysis of snow climate and avalanche winter regime, and an assessment of wind exposure.

Given the increased risk of wildfire due to climate change (IPCC, 2018) and the increasing fuel loads from past wildfire suppression (Perry et al., 2011; Hessburg et al., 2016), the frequency and severity of wildfire altering avalanche terrain is expected to increase. This potentially drastic alteration of a key terrain parameter can create uncertainty in previous avalanche hazard assessments. Therefore, post-wildfire reassessments of avalanche hazard will likely become more common. The methods presented here, in combination with others, may be useful to determine any increase in avalanche hazard associated with deforestation from wildfire.

ACKNOWLEDGEMENTS

The authors would like to acknowledge Parks Canada for approving the use of Mt Whymper and Waterton as examples.

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SpotWX and Models in the Mountains
Tales of terror and seduction

David Jones

Everyone appreciates the beauty of SpotWx.com. Thanks to Garth@Spotwx, we have access to U.S. and Canadian model output in point-forecast format. The quick answers provided by SpotWx are invaluable and seductive, especially if you're rushed or lazy.

There are three concepts users should understand to counter the bewitching appeal of instant SpotWx solutions:

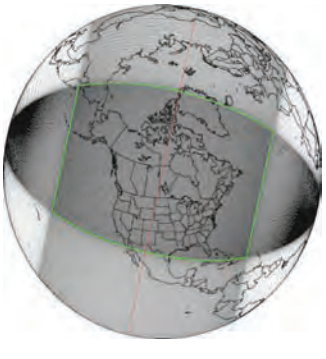
Issue: Model terrain does not match the real terrain	Issue: Mapping to the nearest grid point	Issue: Assumptions about snow density
Affects temperature, wind, precipitation type/amount	Affects snowfall/ precipitation amount	Affects snowfall amount

SOME DEFINITIONS:

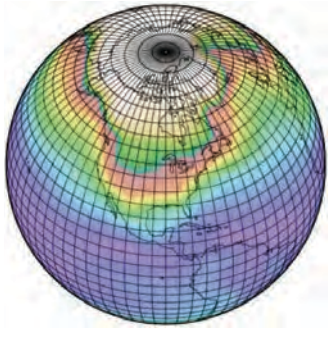
1. Quantitative precipitation forecast, or **QPF**, is a model forecast of liquid precipitation that must be converted to snowfall using a snow-to-liquid ratio, or **SLR**.
2. Individual numerical weather prediction (NWP) models are known as **deterministic prediction systems** or **DPS**.
3. Models have different **resolutions**, like cameras:

2.5km High-Resolution
HR DPS

10km Regional
RDPS

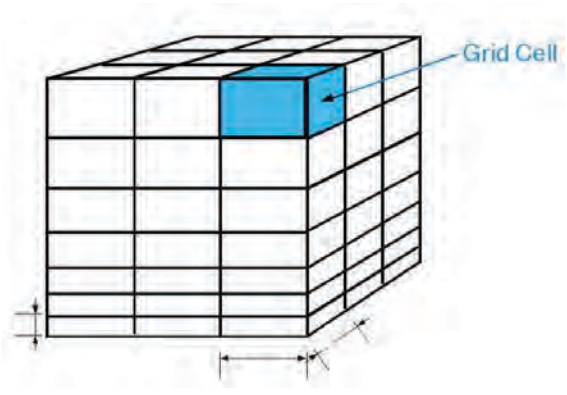


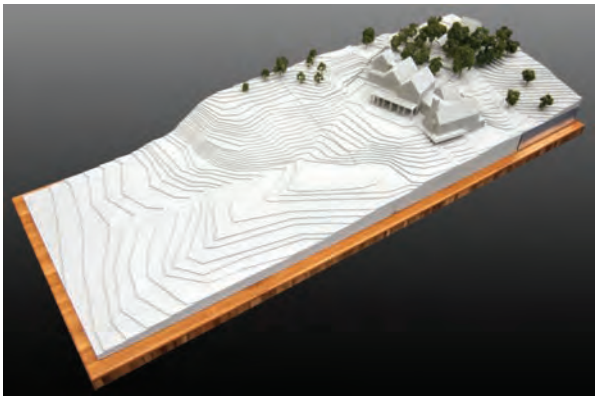
25km Global
GDPS



The larger the domain (the area covered by a model) the lower the resolution. The smaller the domain, the shorter the forecast. Low resolution models step out in time 240 hours. High-resolution models make predictions only for the next 12 to 48 hours.

The atmosphere and the terrain are three-dimensional, so a model grid is just the two-dimensional representation of the 3-D cells into which the models divide the atmosphere.



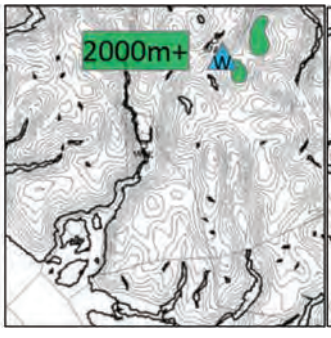
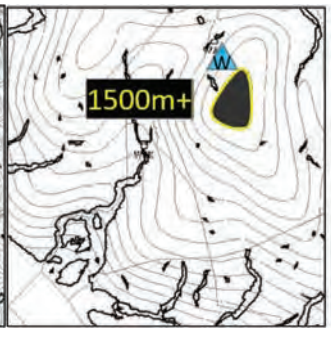
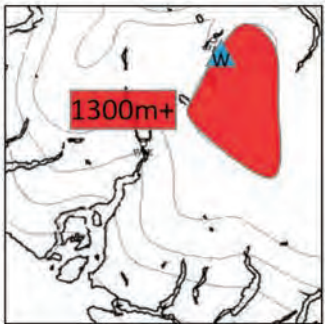


TERRAIN TERRORS

It's well known that the modelled atmosphere doesn't always reflect the real atmosphere. It's not well known that in complex terrain like the mountains of the west, the model terrain almost never matches the real terrain. Terrain enhances weather, so the mismatch has important implications in the mountains. On the Prairies, there's no need to worry! The following table shows the discrepancy between the real elevation of Blackcomb Peak and corresponding model elevations.

REAL ELEVATION	HRDPS	RDPS	GDPS
Blackcomb =2,436m	1,849m	1,419m	1,356m

Model terrain above 2000, 1500 and 1300m is highlighted in the images below in green, black and red.

REAL TERRAIN	HRDPS 2.5KM TERRAIN	RDPS 10KM TERRAIN	GDPS 25KM TERRAIN
			

Model mountains are mostly lower than real mountains, so temperature forecasts for Blackcomb Peak will be consistently warmer than reality. Precipitation-type forecasts (rain vs snow) are then skewed toward rain.

Furthermore, model valleys, fjords and inlets are mostly higher than reality. Here are the corresponding model elevations for Squamish:

REAL ELEVATION	HRDPS	RDPS	GDPS
Squamish Airport =52m	265m	763m	878m

As you would expect, the effects are reversed. Temperature forecasts for Squamish airport will be consistently *colder* than reality. Precipitation-type forecasts (rain vs snow) are skewed in the *opposite* direction, toward snow.

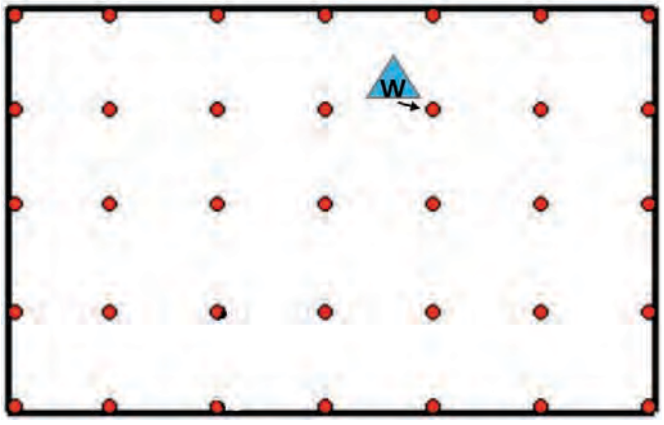
Shape, height, aspect and orientation of terrain to the wind or flow have a huge impact on local precipitation processes. If the terrain is not adequately modeled and precipitation is strongly driven by it, should anyone expect coarse resolution models to reliably forecast precipitation?

Be mindful of model resolutions. At the very least, always note the elevation difference between the point of interest and the corresponding *model elevation*. SpotWx output conveniently shows the model elevation in the header text of each forecast.

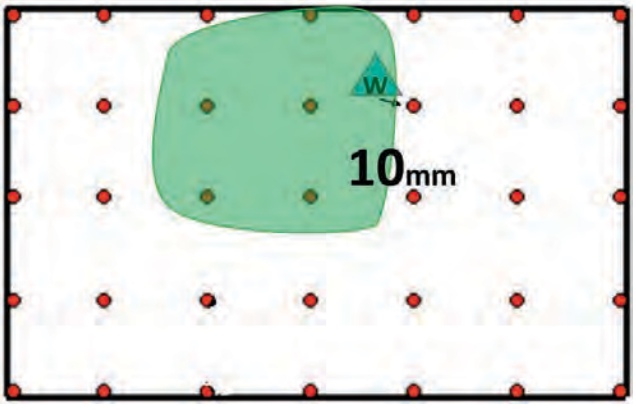
Terrain mismatches induce **Terrain Terrors** in meteorologists. You should be equally fearful (or at least cautious!) of precipitation forecasts in complex terrain.

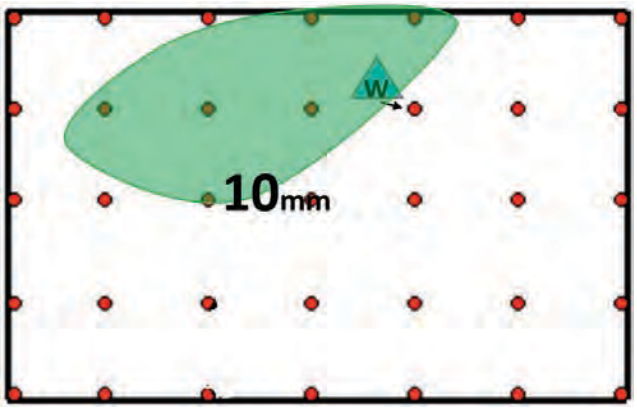
POINT-PRECIPITATION PERDITION

When you drop a pin on the SpotWx map or enter a specific latitude and longitude, SpotWx maps the point of interest to the nearest model grid point:

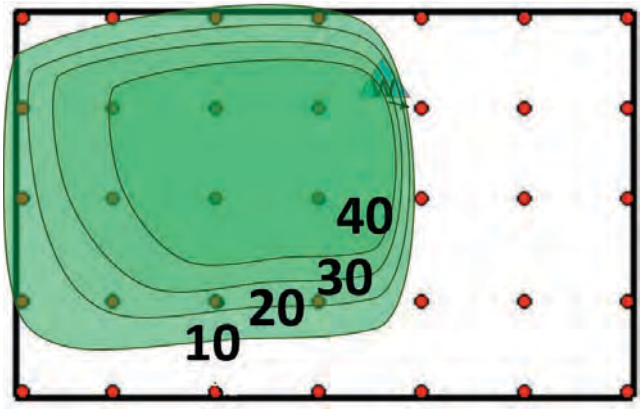


In the following precipitation forecasts, consider whether the nearest model point provides the best estimate of precipitation potential near 

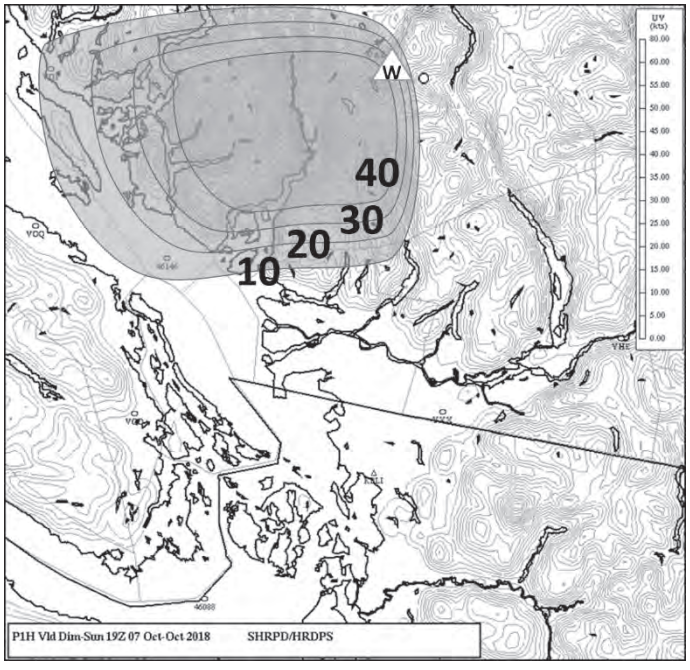




Clearly, for even the most straightforward precipitation forecast, mapping to the nearest model point can mislead. Now add the complication of steep precipitation gradients:



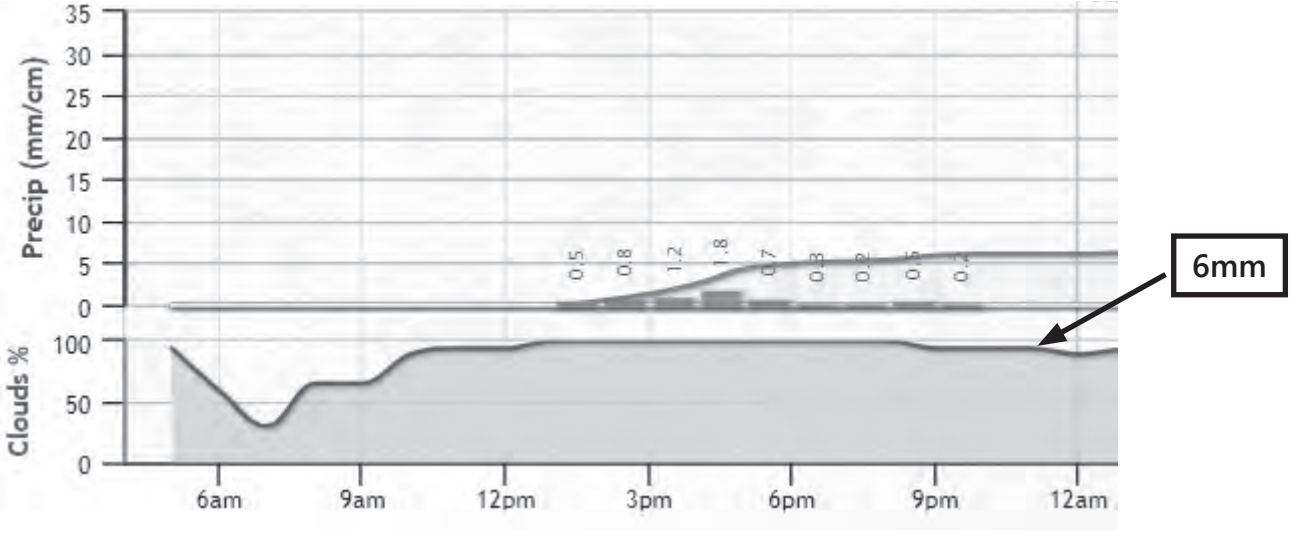
And the further complication of complex terrain effects:



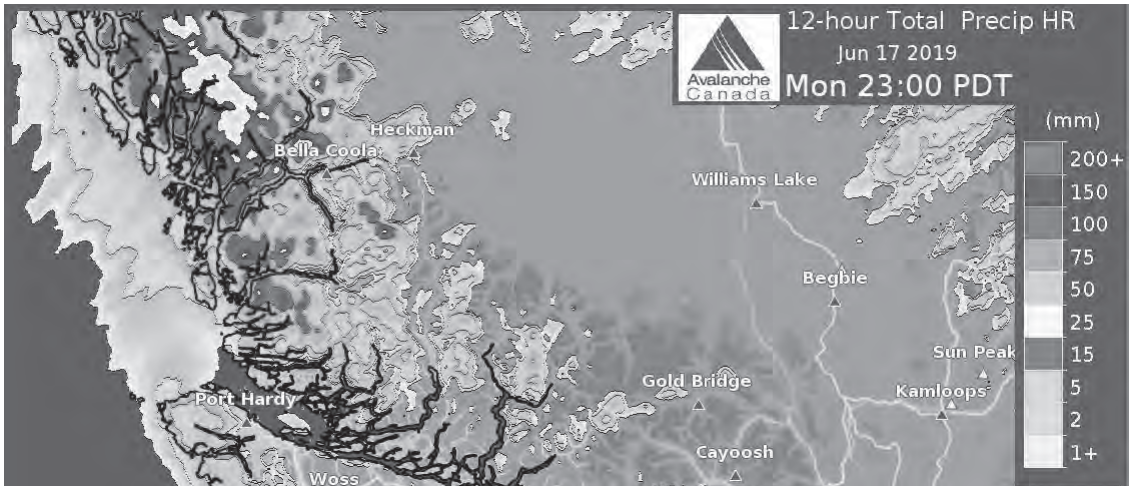
The examples speak for themselves; *the nearest model point* doesn't always provide the best estimate of *potential* precipitation, especially where gradients and terrain are steep. Without an appreciation for the special variability of the precipitation forecast, you can be seriously led astray by relying on a single point forecast only.

You can avoid **Point-Precip Perdition** by using a map (a spatial representation) in conjunction with a point forecast. Potentially misleading and precise spot forecasts can then be adjusted into a *range*.

For example, this is a SpotWx forecast for Latin Peak, north of Bella Coola Airport, for the 12-hour period ending at 11pm:



Here is the map version from www.avalanche.ca/weather/forecast/12h-precipitation



The point-forecast for Latin Peak suggests about 6mm rainfall. Using an SLR of 10:1, an appropriate snowfall forecast for Latin Peak, presuming it's cold enough to snow and considering the splashes of yellow (25+ mm) in the area, is 5 to 25 cm. Such wide ranges are appropriate in the mountains.

DENSITY DELUSIONS

Most models produce forecasts of liquid-water only. Since snow is less dense than water, the forecast must then be multiplied by a density ratio to convert it to snowfall. Snow density, represented by a snow-to-liquid-water-ratio or SLR, makes a HUGE difference to the snowfall possible from any given amount of water. Dense, wet coastal snow may have an SLR of 5:1. Fluffy blower snow in the Rockies may have an SLR of 30:1.

For example, given a liquid water forecast of 10mm, the following snowfall amounts are possible under different SLRs:

5:1→5cm 30:1→30cm

For a forecast of 30mm liquid water the corresponding snowfall forecasts are:

5:1→15cm 30:1→90cm

Most models use a standard SLR of 10:1. A static SLR is a crude estimate of a moving target because in most storms, snow density is continually changing as the incoming air warms or cools. The HRDPS model recently incorporated a dynamic snow-to-liquid water ratio, likely heralding a trend in modelling but most models just aren't there yet.

Be mindful of **Density Delusions** when using QPF forecasts and always stretch a point forecast into a range of potential snowfall.

SUMMARY

SpotWx.com is one of the best weather websites on the web. If you understand **Terrain Terrors**, **Point-Precip Perdition**, and **Density Delusions**, you'll maximize SpotWx satisfaction.

So remember,

1) Be mindful of model resolutions. At the very least, note the elevation difference between the point of interest and the model.
2) Use a precipitation forecast chart/map in conjunction with any point forecast of precipitation.
3) Be conscious of the huge variation in snowfall that result from errors in estimating snow density.

In general, when it comes to precipitation in the mountains, SpotWx clients should be as fearful as meteorologists. The best way to counter the uncertainty in precipitation forecasting is to continually observe how the models perform on your favorite slopes and use the observed variability and biases to interpret future point forecasts. Good luck!

A Season to **Remember**

Ben Jackman

AN EXPLOSIVE-TRIGGERED SIZE THREE OVERRAN HISTORICAL RECORDS AND MAPPED RUN LENGTHS // BEN JACKMAN

AS AN AVALANCHE PROFESSIONAL early in my career, the winter of 2017-18 at Fernie Alpine Resort (FAR) is one of those seasons I never wish upon anyone. From another perspective, I am glad to have experienced it and hope to remember some key lessons as my career evolves.

That winter, the snowpack delivered a volatile, deep persistent slab avalanche cycle that remained active from early January until mid February. This cycle brought unforeseen ripple effects that would benchmark the winter of 2017-18 as one of the most difficult for the avalanche risk management team at FAR.

The difficulties were due to an unprecedented amount of incidents and very notable near misses. These events consisted of three size two avalanches triggered by and involving guests, and six size two and greater near misses to staff. No physical injuries were incurred with any of these events, which one might strike up to sheer luck. Three events throughout the season were also historic occurrences, exceeding mapped run lengths and records.

The winter delivered 1,237 cm of accumulated snowfall, with 1,289 mm SWE. The two key layers of concern were a stout melt-freeze crust dated Nov. 27, 2017, and, about 20 cm above it, a facet layer dated Dec. 15, 2017. Both layers were widespread in distribution. The combination of these two layers contributed to 59% of the winter's avalanche problems in hazard assessments, including persistent slab and deep persistent slab concerns.

By the end of the winter the team was left with a sense of relief and a few questions: What just happened? Where did we go wrong? How do we move forward from here?

Over the following spring and the summer, the team had time to reflect on the season and by the fall discussions began on how to learn from it and move into the new winter with success. Here are some of the trends and concerns the team discussed:

- The forecasting team questioned the speed of operation in terms of opening terrain. Had we developed a level of comfort in our terrain over time where we were operating at a pace that was not commensurate to the nature and complexity of our terrain?
- At FAR it snows a lot, and it is our job to open terrain as safely as possible for the public to enjoy powder skiing. At times we questioned motivational biases to regain terrain. The group agreed we were not being motivationally driven. However, shortly after discussions, we would walk right into another incident or near miss. This led to questions of how aware we were of motivational biases existing.
- Most of the near misses and incidents involved similar anchoring and adjustment heuristics and therefore we fell into similar insufficient adjustment traps.
- Our forecasters generalized and worked in both of our forecast areas, despite the differing management strategies in each one. This led to questions weighing the pros and cons of forecaster generalization.
- We had extended periods of time removed from our terrain during January and February due to high levels of uncertainty with the sensitivity and magnitude of the deep persistent slab. When the time came to re-enter the terrain, we were doing so with a mid-winter,

ONE MEMBER OF THE PUBLIC WAS INVOLVED BUT NOT INJURED IN THIS SIZE TWO AVALANCHE ON FEB. 24, 2018 // BEN JACKMAN

unmodified snowpack as January delivered just shy of 400 cm of snow. Typically, by this time of the season we are dealing mainly with overnight and storm snow instabilities.

- We observed the volatility of a skier-built slab. Typically, we seek skier modification to aid in stabilisation of the snowpack. Two of the events that overran mapped run lengths were in terrain that had been open in the weeks prior, enabling the public to build a slab over the key layers. This reminded us of the added effects of a skier-built slab.
- Recording quality and an ability to review work was also highlighted as an area requiring improvement.

With hindsight it seems easy for us to acknowledge the areas of our program that required improvement and points where mistakes were made, or subtleties were missed. In saying that, the 2017-18 season simply highlights how difficult it can be to acknowledge biases and change pace once the wheels are in motion, especially when passion and emotions get involved. The most significant point of learning was to slow down – nothing in our operation is so time sensitive that we cannot take and extra hour or day to analyze the conditions and make good decisions.

Moving into the 2018-19 winter, we made some adjustments and took initiatives to aid in the forward momentum of the program. We enlisted a back-to-basics mentality, reminding ourselves of the fundamental elements of avalanche hazard assessment and operation at FAR to open terrain with risk as low as reasonably possible. These are some changes we made to our operation:

- More validation was required when moving into terrain. This meant more data collection and more testing than previous years. Despite an already heavy explosives program, an extra test was fine, as was any extra ski cutting required to ensure confidence and validation.
- The pace of the operation was slowed down. We accepted it could take a little longer than before to open terrain.
- Forecaster scheduling was focused more on specialization over generalization, dedicating two forecasters per area for the season. This enabled the forecasters to become intimate with the different zones.
- In order to increase buy in from key stakeholders, opportunities were taken at local public avalanche workshops and resort property owner meetings to educate on the complexities of our avalanche program.
- A third-party review of the program was conducted in January, with a report and list of recommendations delivered.
- A focus on mental health was given high priority. Road to Mental Readiness training was delivered to the FAR ski patrol by the Mental Health Commission of Canada.

The FAR snow safety program continues to evolve and operate with success. We will continue to find the humility in learning from our past and move forward with improvements to the avalanche risk management program at Fernie Alpine Resort.

education & **awareness**

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RICK SCHROEDER RETIRES

in this **section**

// TROY GRANT

AGM Recap: Competency-Based **Membership and Entry to Practice**

Kathy McKay

WHAT IS COMPETENCY-BASED MEMBERSHIP?

For the past few years, the CAA has been building a new competency-based process for both existing and future CAA members. The draft competency profiles released in 2014[1] define the competencies required when entering two levels[2] of membership:

- Practitioner 1 (P1) – most closely correlates to active membership;
- Practitioner 2 (P2) – most closely correlates to professional membership.

The competency profiles for both P1 and P2 span eight domains:

1. Emergency response
2. Observation and recording
3. Professionalism
4. Organization & decision making
5. Terrain use
6. Managing operational avalanche risk
7. Education
8. Communication

HOW ARE COMPETENCIES ASSESSED?

Using Miller's Pyramid, the CAA evaluated which competencies could adequately be assessed through the Industry Training Program (ITP). Under Miller's Pyramid, assessments meeting the "shows how" or "does" levels are optimal. Where assessment in courses likely could not reach this level, other assessment methods were considered.

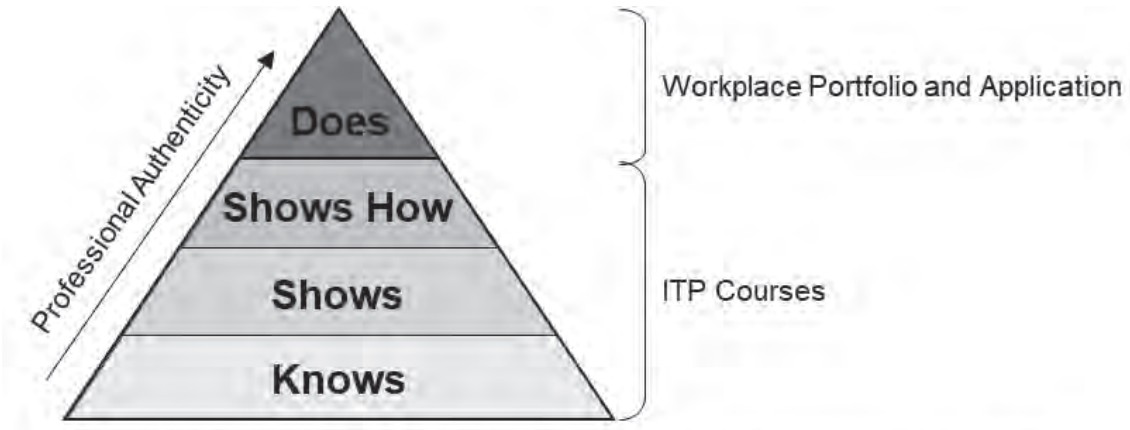
The resulting tools being developed to assess P1 competencies are revised ITP courses, a workplace portfolio, and the application process itself. A general breakdown of the domains assessed by each tool is:

ITP COURSES

The first ITP course to be redesigned, primarily using the emergency response competencies, was the AvSAR course & practical skills assessment. In conjunction with the AvSAR redesign, a gap analysis was conducted to identify how other CAA courses aligned with the competency profiles. A review of learning objectives was done in relation to individual competency statements:

- Does the current curriculum meet the competency or need modification, or is it best suited for an outside source to provide?

The results of the analysis primarily indicated the need to revise the Avalanche Operations Level 1 and 2 courses, with a subsequent effect on the Resource and Transportation Avalanche Management (RTAM) course.



Adapted from https://lo.unisa.edu.au/mod/book/view.php?id=611025&chapterid=105881

[1]CAA competency profiles are accessible via the members-only section of the CAA website.

[2]The CAA is exploring alternate names to the current membership categories to help better reflect the competencies of the qualified individuals.

	Competency Domain	Primary Assessment Venue
1	Emergency Response	CAA AvSAR and Practical Skills Assessment
2	Observation and Recording	CAA Avalanche Operations Level 1
3	Professionalism	Online Professionalism Course
4	Organization & Decision Making	Portfolio
5	Terrain Use	
6	Managing Operational Avalanche Risk	
7	Education	
8	Communication	Application Process

To conduct this extensive work, an application was submitted to the National Search & Rescue Secretariat (NSS) in 2016 for a Search & Rescue New Initiatives Fund (SARNIF) grant. The successful application resulted in the **C**ompetency **A**ligned **A**valanche **R**isk **A**ssessment **T**raining (CAARAT) project, which is now in its final year of three. The deliverables from this project include:

- Introduction to Avalanche Operations
- Revised Avalanche Operations Level 1
- Revised Avalanche Operations Level 2

In addition to the CAARAT project, the CAA is also developing a professionalism course. The course will be self-directed online and will take approximately two hours to complete. The course material is broken into eight modules:

1. Governance
2. Scope of practice
3. Competency-based training and CPD
4. Code of ethics, guidelines and standards
5. Competent practice
6. Professionalism
7. Code of ethics examples
8. Career path, individual scope of practice, supporting resources

True or false questions at the end of each module will confirm the students' understanding of the material and assist them to think about their own career path. In the future this course is likely to become a mandatory CPD requirement for all members.

PORTFOLIO

The goal of the portfolio is to prove the applicant meets the proficiency requirements of the applicable competencies in the workplace. In general, the portfolio consists of a description of the applicant's workplace role and responsibilities, and a collection of workplace experiences with evidence. Examples of evidence include copies of logbook pages, maps, reference letters, videos, and reports.

In December 2018, potential applicants from the sledding and skiing community volunteered to complete a beta portfolio and provided valuable feedback to the design team. Their input is now being used to finalize phase one of the portfolio package.

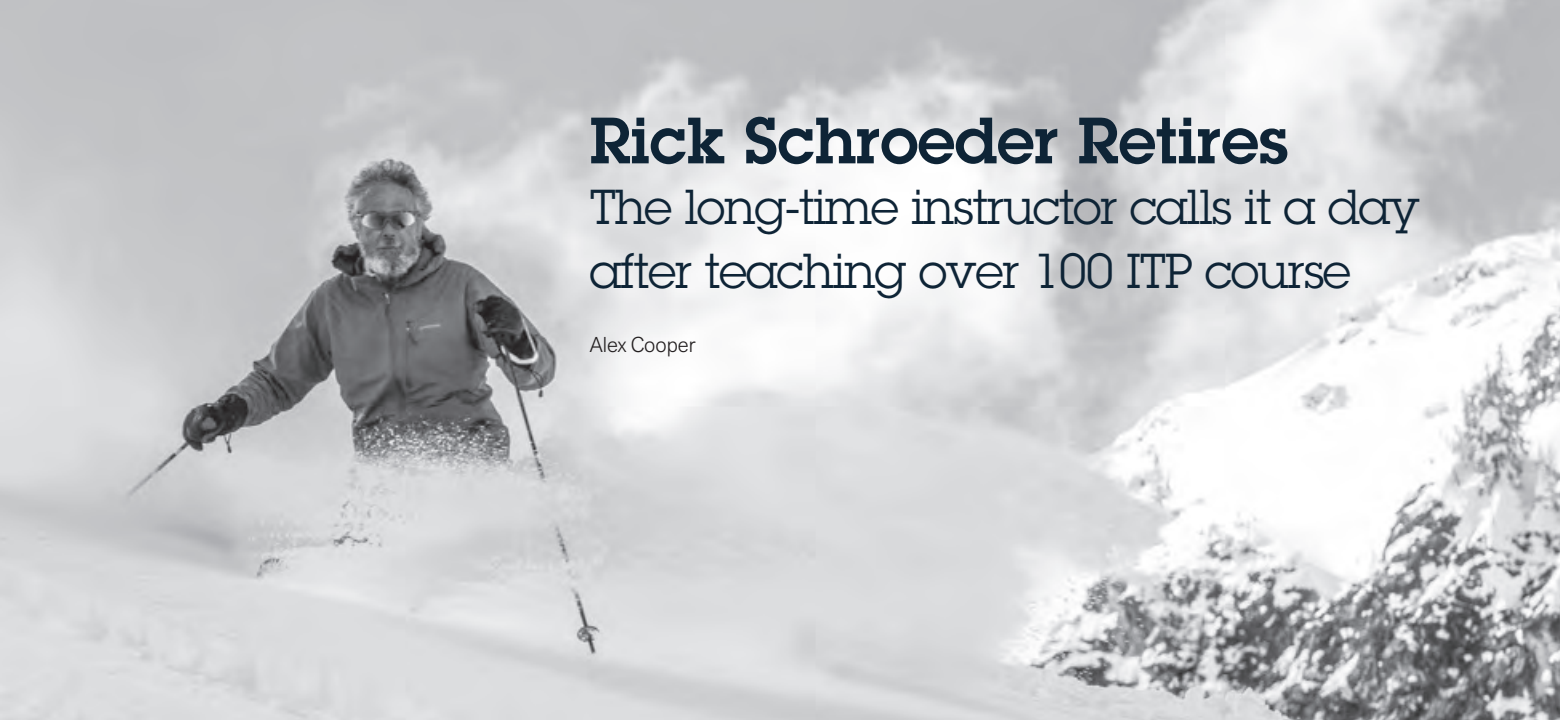
P1 APPLICATION

CAA members must be able to communicate effectively to function in the workplace. This is shown by describing communication in an applicant's workplace and through his or her writing in their portfolio. The ability to follow application instructions, ask for help, and provide information in a coherent manner also shows the ability to receive and give information.

ROLL-OUT

Keep a look out for newsletters providing information about the first components of the new system to be implemented and rolled-out this fall:

- Online Introduction to Avalanche Operations: registration and course open in August;
- Avalanche Operations Level 1: Registration opens in October for courses beginning November;
- Online Professionalism: Registration and course open in October;
- Phase 1 of the Competency Based Entry to Practice for P1 applicants.



Rick Schroeder Retires

The long-time instructor calls it a day after teaching over 100 ITP course

Alex Cooper

IF YOU'RE READING THIS, there's a moderate – maybe even considerable – chance you've been taught by Rick Schroeder at some point in your avalanche education.

Rick, 68, retired after teaching more than 100 ITP courses all over the country since 1985, leaving an indelible impact on hundreds of students he educated and mentored in the world of snow science.

"I liked the teaching aspect, I liked working with students in the field, and I liked working with the group of ITP instructors," he recalled from his home in Fernie recently. "They're a really good group of people and it was a pleasure to travel around, work with them, and get a good overview of the industry, which you don't get if you work in one location all the time."

Rick grew up outside Montreal and moved to Fernie in 1974, where he started his career as a ski instructor. Like so many who entered the field, skiing powder was his gateway. He realized he needed to learn a few things to do so, so he enrolled in the avalanche program at BCIT under Peter Schaerer.

His first job in the avalanche patch was as a heli-ski guide at CMH's original lodge in the Bugaboos. He did that for five years before moving to work in the avalanche program at a mine. In 1985, he returned to guiding at Island Lake Catskiing near his home in Fernie, which is where he taught his first CAA course.

Rick had taught skiing, swimming, tennis, and basketball; and he worked at the Colllege of the Rockies Mountain Adventure Skills Training program. He quickly grew comfortable as an ITP instructor. He imparted his knowledge and experience to the huge variety of students who took his courses across B.C., Alberta, and Quebec.

"When you're teaching, you have to understand how individual students absorb knowledge," he explained. "The smallest percentage have a strong academic background. The majority are strong experiential learners, so they don't do that well in the classroom but they really do well once you get outdoors."

He wound up teaching more than 100 Level 1 and Level 2 courses in B.C., Alberta, and Quebec – pretty much everywhere courses have been offered.

One of his students that he inspired was Jenn Coulter, an ITP instructor and field technician for Avalanche Canada. She took her very first Recreational Avalanche Course with Rick in Fernie in the late 90s. "He sparked a passion that led me to pursue work in the avalanche industry," she related. "To get to mentor under him as an instructor in CAA Level 1 program years later was a real privilege and reminds me to pay that passion forward to every new student."

Rick has retired from guiding and teaching, but he's remaining active in the CAA, sitting on the education committee, and helping organize ISSW 2020 in Fernie.

Rick has been a huge asset to the CAA and a key instructor within the ITP, said ITP manager Emily Grady. *"Rick has mentored the majority of new Avalanche Operations Level 1 instructors (including myself!)," she noted. "Throughout his years as an instructor, he has shared his knowledge, trained future industry workers, and passed on his passion for snow and avalanches to hundreds of students."*

Congratulations Rick on a well-earned retirement!

Schedule of Upcoming **Events**

SARSCENE 2019
Fall, 2019
Sydney, NS
For more information:
www.tulmar.com/2019/01/01/sarscene-2019/

35TH INTERNATIONAL CONFERENCE ON ALPINE METEOROLOGY
September 2-9, 2019
Riva del Garda, Italy
Contributions on all aspects of meteorology and climatology.
For more information:
www.emetsoc.org/events/event/icam2019/

INTERNATIONAL MOUNTAIN CONFERENCE
September 8-12, 2019
Innsbruck, Austria
Comprehensive international conference on mountain research.
For more information:
www.uibk.ac.at/congress/imc2019/

ICAR 2019 CONVENTION
October 9-12, 2019
Zakopane, Poland
For more information:
www.alpine-rescue.org

CAA CPD SESSIONS
October 18, 2019, Squamish, B.C.
November 22, 2019, Revelstoke, B.C.
Continuous Professional Development courses provided by the CAA.
For more information:
www.avalancheassociation.ca

WILDERNESS RISK MANAGEMENT CONFERENCE
Oct 30-Nov 1, 2019
Albuquerque, NM
Facing Challenges Together
For more information:
https://www.nols.edu/en/about/risk-services/wilderness-risk-management-conference/

ISSW 2020
October 4-9, 2020
Fernie, B.C.
The biennial International Snow Science Workshop is hosted in Fernie.
For more information:
www.issw2020.com

avalanche **community**

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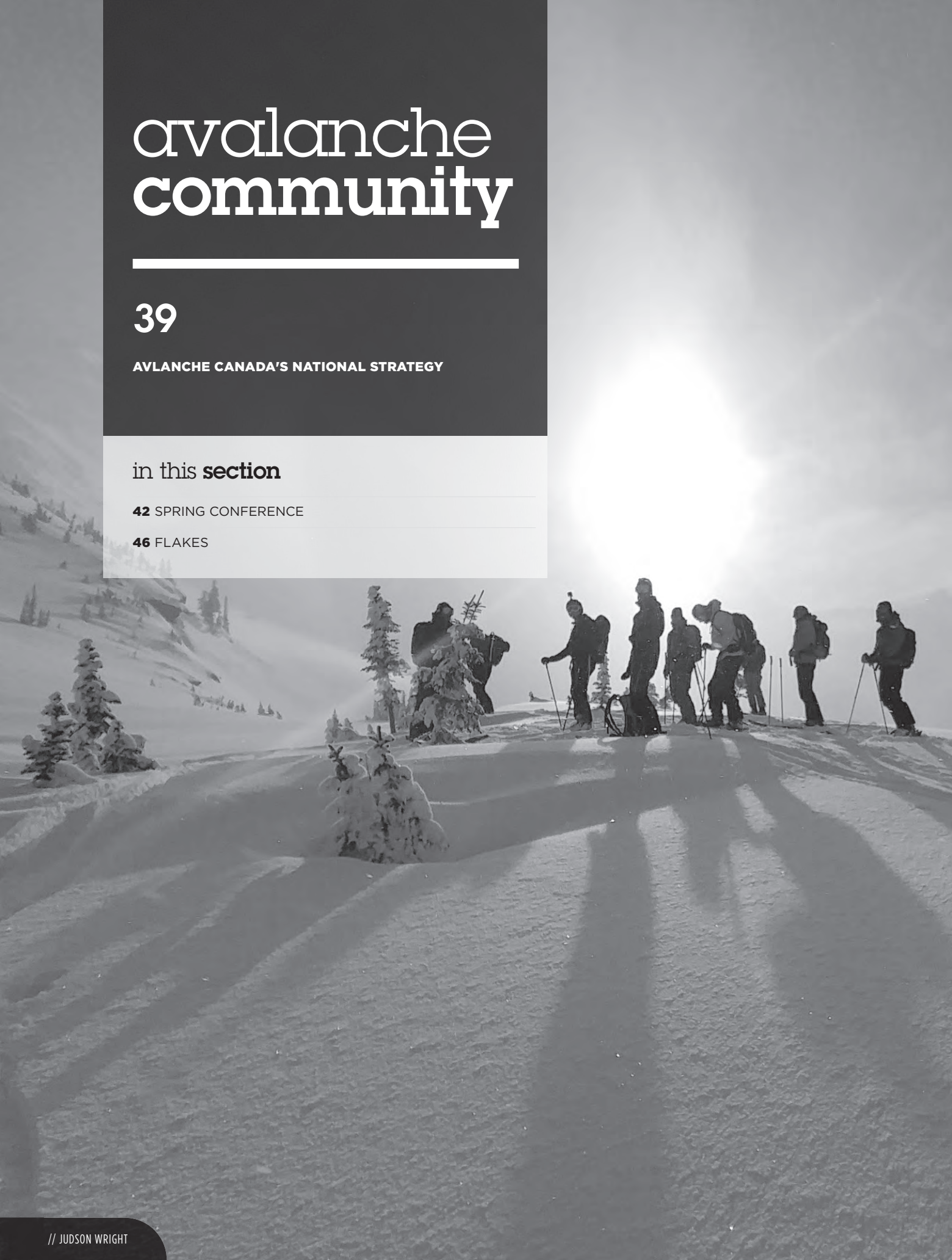
AVLANCHE CANADA'S NATIONAL STRATEGY

in this **section**



// JUDSON WRIGHT

Avalanche Canada's National Strategy

A $25 million funding boost from the federal government has AvCan looking to stabilize and expand its programs

Mary Clayton

FORECASTER FIELD TRIP IN THE DATA SPARSE NORTH ROCKIES REGION // RYAN BUHLER

THE JOURNEY TO STABLE FUNDING for public avalanche safety has been a long one. In November of 2018, we reached a significant milestone when the federal budget update included a line item for Avalanche Canada – a one-time endowment of $25 million. This was a place we could have hardly imagined reaching just 10 years ago and we worked hard to get here.

Responsible governments don't hand out that kind of money without a very sound business plan in place. And they rarely hand out money without strings attached. This endowment is no exception.

We've been fighting for stable funding almost since our inception in 2004. Over the past five years or so we've been getting closer to the tipping point, where demand for our services outstrips our resources, which threatens some of our programs. Our original funding model – 1/3 from the federal government, 1/3 from provincial governments and 1/3 self-generated – is faulty and failing. With few exceptions, government funding has been stagnant for many years and corporate support, which is a significant part of our self-generated funding, was precarious at best.

While MEC and Teck have stood by us for many years, other major funders have come and gone. Donor fatigue and corporate policies that restrict the number of years to support any one cause were some of the factors for this. We hired a professional fundraiser for three years to try and turn this around. This man had spent his career raising funds for universities and the Red Cross, but even his expertise and experience couldn't make a significant difference. Corporate Canada believes public avalanche safety is a government responsibility.

We began working on a business plan to the federal government in 2017. We envisioned a truly national public avalanche safety organization that incorporates Avalanche Quebec, provides services to eastern Canada, and is mainly funded by government. With Prime Minister Justin Trudeau in power, the time was right.

We hired Alan Latourelle to advise us. Alan was the CEO of Parks Canada when AvCan was incorporated, so he is very familiar with our mandate and provided good insight into navigating Ottawa. We are grateful to Chris Stethem and our local MP Wayne Stetski, whose close connections with Prime Minister Trudeau were very helpful. We're especially thankful to Marlo Raynolds, chief of staff for Minister Catherine McKenna, whose guidance and assistance were instrumental.

Our first task was to build a convincing case that avalanche safety matters – not always an easy job when you're talking to bureaucrats in Ottawa. Winter tourism is vital to Canada and winter recreation in the mountains involves avalanche risk. We reminded them that avalanches are the deadliest natural hazard in Canada and avalanche fatalities have occurred in every province and territory except Manitoba, Saskatchewan, New Brunswick, and PEI.

Since AvCan was established, the annual average number of avalanche fatalities has stabilized and declined. Today, it sits at 11, the lowest it's been since the early 90s. This is remarkable considering the exponential increase in winter backcountry use over those decades. We are confident our holistic approach to public avalanche safety, with standardized recreational training and an integrated suite of products complementing the information in the daily avalanche forecasts, has contributed to this trend.

But this is where it gets tricky. If we're doing such a good job, why do we need more money? This is where we made our point that although we've been doing great work and making a difference, we are not keeping up with demand. Winter backcountry use is exploding and recreationists are going further afield, into regions we aren't able to cover. And they are still being injured and killed in avalanches.

We also leveraged the fact that while we are doing world-leading work in this field, we are not being funded like world leaders. We compared the extent of our operations and our funding model to Switzerland, New Zealand, and the U.S. In terms of geography, Canada's forecasting program is the largest in the world by far and

SOUTH ROCKIES FIELD TEAM MEMBER JEN COULTER CONNECTING WITH USERS. OUTREACH IS AN IMPORTANT FACET OF FIELD WORK AND THE EXPERIENCE OF THE SOUTH ROCKIES TEAM WILL BE A MODEL FOR FUTURE FIELD TEAMS // MARTINA HALIK

yet, among leading alpine nations, we're the only program that isn't funded mainly by government.

Our original proposal to the federal government, a comprehensive five-year business plan, was submitted in June 2018.

After months of back-and-forth, clarifying and explaining, we got the good news. But that string attachment? The $25 million had to be part of a 15-year business plan and the original amount had to last a minimum of 10 years.

It was back to the drawing board over the winter as we reworked our plans. We have two main objectives – stabilization and expansion. Many years of minimal resources has taken its toll on our programs. Our stabilization plans include shoring up areas that were unable to keep up with increased costs, such as replacing aging equipment and addressing understaffed departments.

Expansion includes centralizing and coordinating efforts in Quebec, Vancouver Island, and the Yukon; developing programs for regions such as the North Rockies and Newfoundland & Labrador; and starting on bilingual services. Our priorities are the North Rockies and the Yukon, and we have begun hiring efforts to provide field teams for those regions for the coming winter.

—Stretching the budget to cover 15 years has its costs, and we've had to make some choices. Our business plan is also predicated on increased provincial and territorial funding and portions of the expansion plan remain uncertain without commitment from these governments.

Over the summer of 2019, we're planning a renovation at our office building so we can accommodate more employees. And we're spending a lot of money to outfit the new field teams with the necessary equipment, including trucks and snowmobiles. Thanks to help from BC Gaming's capital funding grants, we recently purchased three new trucks and we'll soon be buying nine new snowmobiles. We'll also be leasing equipment.

We remain hopeful B.C. and Alberta will come through with increased and stable funding, and we're working closely with the governments of the Yukon and Newfoundland & Labrador to ensure their commitment as well. The journey continues as we work to become the safety organization Canada deserves.

FORECASTERIN NEWFOUNDLAND ASSESSING AVALANCHE TERRAIN FOR ATES RATING MAPPING // MARK BENDER

2019 **Spring Conference**

CLOCKWISE FROM TOP LEFT: LISA DREIER FROM WYSSEN (LEFT) AND PENNY GODDARD HAVE A CHAT.; JENS OUROM FROM MAMMUT, THE CAA'S NEW PRINCIPAL PARTNER, SHOWS OFF THE COMPANY'S PRODUCTS.; DEB AND GORD RITCHIE REACT AFTER AVALANCHE CANADA PRESENTS GORD WITH ITS ANNUAL SERVICE AWARD AND RENAMES IT THE GORD RITCHIE SERVICE AWARD.; RACHEL REIMER PRESENTS THE FINDINGS OF HER SURVEY ON GENDER, DIVERSITY, AND MENTAL HEALTH IN THE GUIDING AND AVALANCHE INDUSTRIES.; COLLEEN GENTEMANN FILMS THE CASE STUDY PRESENTATIONS, WHICH WILL BE AVAILABLE FOR VIEWING ON THE CAA WEBSITE.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of avalanche professionals.
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The Avalanche Journal wants you!

WE'RE ACCEPTING submissions for upcoming issues of *The Avalanche Journal*. We welcome articles relating to the professional avalanche industry, public avalanche safety, teaching tips, research papers, avalanche accounts, book reviews, historical avalanches, gear reviews, hot routes, global updates, event listings, interviews, letters to the editor, humorous stories, and anything else interesting or relevant to those involved with avalanches. We are also seeking winter mountain photography: avalanches, terrain, touring, skiing, snowboarding, sledding, backcountry recreation or avalanche awareness activities.

Please email managing editor Alex Cooper at acooper@avalancheassociation.ca with your ideas and submissions.

The Avalanche Journal is published three times per year in July, November and March.

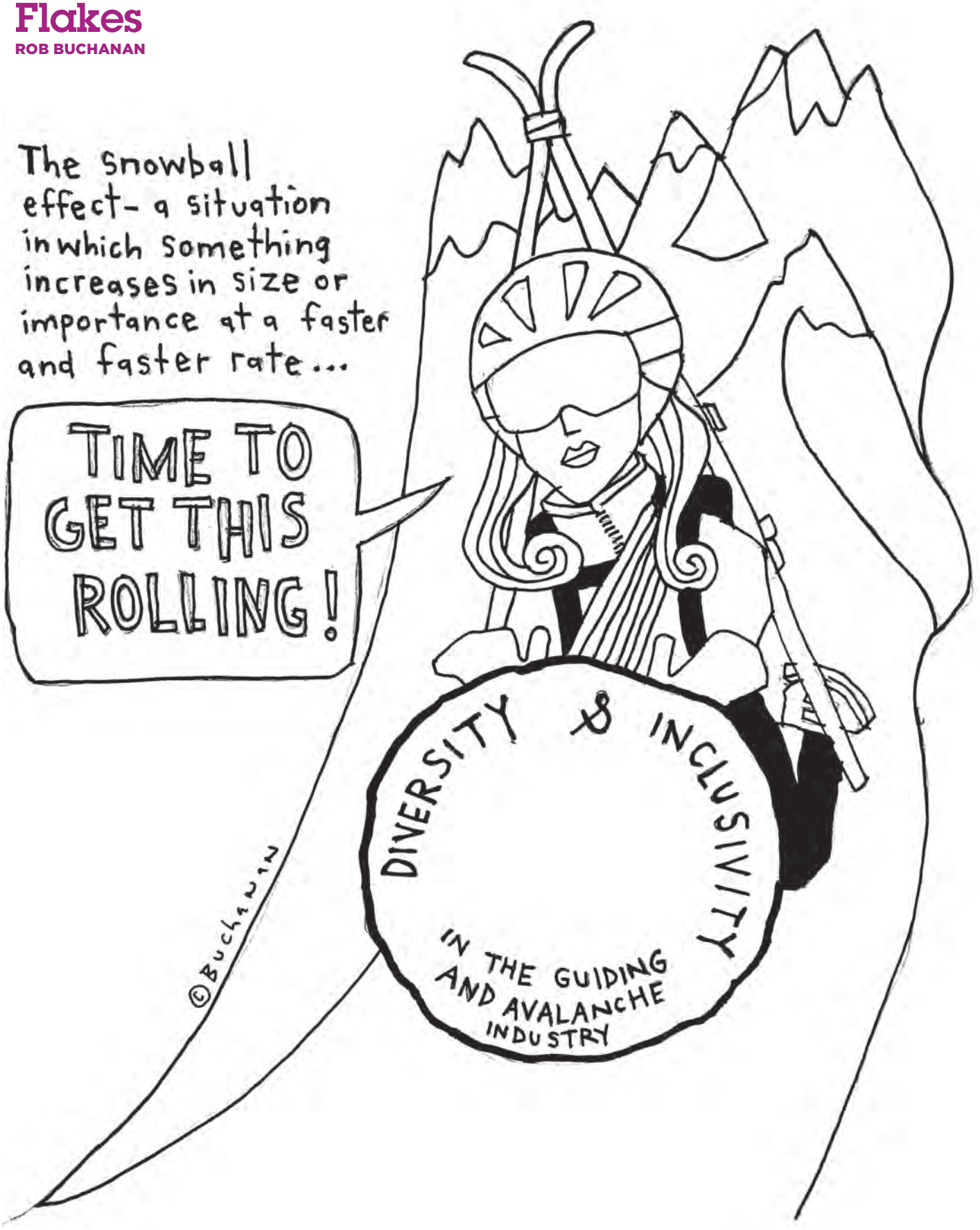
UPCOMING DEADLINES:
October 14 (fall issue)
February 17 (winter issue)
June 15 (summer issue)

MAMMUT
SWISS 1862

BREAK THE LAW OF GRAVITY – **BE SAFE**

Flakes

ROB BUCHANAN



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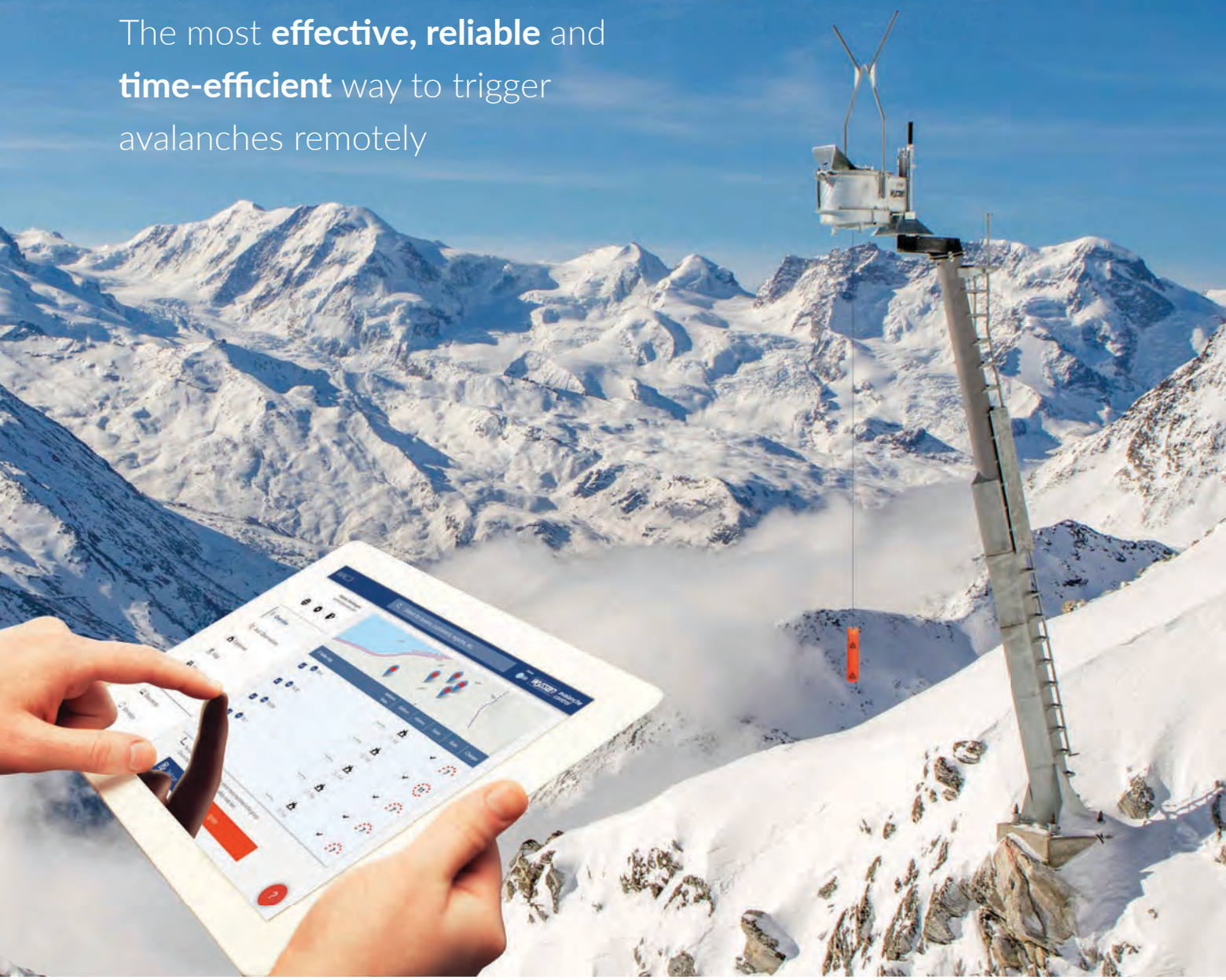

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