

39.4

APRIL 2021

# THE AVALANCHE REVIEW

## THE AVALANCHE **PEOPLE** PROBLEM

THE DECISION-MAKING ISSUE  
SEE PAGE 26



AMERICAN  
AVALANCHE  
ASSOCIATION

**NO  
EXPLOSIVES.  
EASIER,  
BETTER,  
FASTER,  
SAFER.**

**GAS REMOTE AVALANCHE  
CONTROL SYSTEMS**

Alta, USA  
Ski Resort  
4 O'BellX in operation

  
**MND SAFETY**

The new name of TAS

[safety@mnd.com](mailto:safety@mnd.com) / [www.mnd.com](http://www.mnd.com)



ROPEWAYS ■ SNOW ■ SAFETY ■ LEISURE

**IMPERIAL**



**SNOWLAUNCHER**

[www.cilexplosives.com/Avalanche](http://www.cilexplosives.com/Avalanche)



## **YOU KNOW THE REST, NOW SHOOT WITH THE BEST**

- COMPATIBLE WITH ALL CIL SNOWLAUNCHERS (CLASSIC, SLUGGER)
- ELECTRIC REMOTE SWITCH CAPABILITY
- QUICK CHANGE SYSTEM ALLOWS ELECTRIC REMOTE OR MANUAL VALVE RELEASE
- 309 STAINLESS STEEL TANKS PREVENT RUST AND CORROSION
- REMOVABLE END CAPS ENABLE EASY CLEANOUT AND INSPECTION
- 360° AZIMUTH RING FOR EASY TARGET REGISTRATION
- NUMBERED INCLINATION SCALE
- EASY TO USE CLAMPING SYSTEMS FOR HORIZONTAL AND VERTICAL ADJUSTMENTS
- EASY TO USE OPERATOR INTERFACE PANEL
- BLAST SHIELD, TRAILER AND SNOWCAT MOUNT KITS AVAILABLE

## **STAY A STEP AHEAD WITH CUSTOM CIL AVALANCHE CONTROL PRODUCTS**

WHEN YOU REQUEST CIL EXPLOSIVES YOU ARE SUPPORTING YOUR INDUSTRY!  
A PERCENTAGE OF ALL PURCHASES GO TO THE AMERICAN AVALANCHE ASSOCIATION FOR TRAINING PURPOSES

CONTACT: BRADEN SCHMIDT 250 423 3302 [BRADEN.SCHMIDT@CILEXPLOSIVES.COM](mailto:BRADEN.SCHMIDT@CILEXPLOSIVES.COM)



AMERICAN  
 AVALANCHE  
 ASSOCIATION

**A3 STATEMENT OF PURPOSE**

The American Avalanche Association promotes and supports professionalism and excellence in avalanche safety, education, and research in the United States.

**A3 STAFF AND BOARD**

**Executive Director**.....Dan Kaveney  
**Pro Training Coordinator**.....Erica Engle  
**Special Projects**.....Emma Walker  
**Social Media**.....Will Flynn

**A3 Governing Board Trustees**

President\* .....Halsted Morris  
 Vice President\* .....Erich Peitzsch  
 Secretary\* .....Katie Warren  
 Treasurer\* .....Pete Woodring  
 Membership\* ..... Jake Hutchinson  
 Publications ..... Drew Pogge  
 Education ..... Eeva Latosuo  
 Governance ..... Tom Mattice  
 At-Large Pro ..... Sean Zimmerman-Wall  
 Member Affiliate ..... Jonathan Shefftz

*Executive Committee denoted by \**

**Editor**..... Lynne Wolfe

**Editors Emeriti**

Steve Conger           Blase Reardon  
 Sue Ferguson           Bruce Tremper

**THE AVALANCHE REVIEW**

The *Avalanche Review* is published each fall through spring by the American Avalanche Association, Inc., a nonprofit corporation. For a digital version of this publication, see [theavalanchereview.org](http://theavalanchereview.org). The *Avalanche Review* welcomes the submission of articles, photographs, and illustrations.

**Please send submissions to:**

Lynne Wolfe — Editor  
 tel: (208) 709-4073  
[avalanche.review@avalanche.org](mailto:avalanche.review@avalanche.org)

**Design & Production:**

McKenzie Long — Designer  
 tel: (513) 515-0723  
[mckenzie@cardinalinnovative.com](mailto:mckenzie@cardinalinnovative.com)

**Business, Subscriptions, & Advertising:**

Dan Kaveney — A3 Executive Director  
 tel: (307) 264-5924  
[dan@avalanche.org](mailto:dan@avalanche.org)

**Subscription:** \$35 per year (4 issues). Subscription is included with membership dues to A3. For subscription and membership information, see [www.AmericanAvalancheAssociation.org](http://www.AmericanAvalancheAssociation.org).

Articles, including editorials, appearing in *The Avalanche Review* reflect the individual views of the authors and not the official points of view adopted by A3 or the organizations with which the authors are affiliated unless otherwise stated.

© 2020 by the American Avalanche Association.

Materials may be reproduced for research or classroom use. Permission is also granted for use of short quotations, figures, and tables in scientific books and journals. For permission for other uses, contact *The Avalanche Review*.

**39.4 | CONTENTS**

THE HUMAN AVALANCHE PROBLEM

COVER PHOTO:

Ben Smith traversed into that face expecting a small storm slab to rip out when he loaded the convex bulge above the trees, he did not expect it to propagate up as much as it did. But he was at the bottom of the propagation and had intentionally kept speed and pointed it straight out with no issues. This was in the Snake River Range the first weekend of February. *Photo Ian Nelson*

**FEATURE STORIES**

**20 SLED SHED: MOTORIZED EDUCATION**

Fracture Mechanics <i>Eric Knoff</i>	Exposure Evolving <i>Travis Feist</i>
Teaching Terrain <i>Will Mook</i>	Terrain Analysis <i>Mike Duffy</i>
Rapid Mindset <i>Graham Predeger</i>	Education Tips <i>Jamie Weeks</i>

**THE HUMAN AVALANCHE PROBLEM**

<b>26</b>	We Have a Problem <i>Pete Earle</i>
<b>28</b>	Starfish <i>Jake Hutchinson</i>
<b>32</b>	Tired Bodies, Tired Minds <i>Russ Costa</i>
<b>34</b>	Group Decision-Making Tactics <i>Jayson Simons-Jones</i>
<b>36</b>	Avalanche Risk Management <i>Ben Reuter et. al</i>
<b>39</b>	How is the Avalanche Problem Used? <i>Pascal Haegli et. al</i>
<b>42</b>	The Case for Terrain Rating <i>Mike Richardson &amp; Steve Conger</i>

**DEPARTMENTS**

<b>6</b>	From A3
<b>12</b>	<b>News</b>
<b>14</b>	<b>Snow Science</b> The Radiation Snow Climate <i>David Lovejoy</i>
<b>16</b>	<b>Education</b> Teaching Courses in High Danger <i>Sean Zimmerman-Wall</i>
<b>45</b>	<b>Rescue</b> Psychological First Aid Case Study <i>Jen Reddy</i>
<b>47</b>	Pausing to Remember <i>Laura McGladrey</i>

**AVACASTER/TURBOCASTER  
 AVALANCHE DEVICES**



- The best and original proprietary design
- Machined at accredited engineering machine shop
- Tail fins and ammunitions available, with continued systems developments
- Qualified field technicians for training and commissioning



**Professional explosives, engineering, avalanche control, blast design, drone mapping and delivery services.**

David Sly, 250 661 3450  
[davidgsly@mapleleafpowder.com](mailto:davidgsly@mapleleafpowder.com)

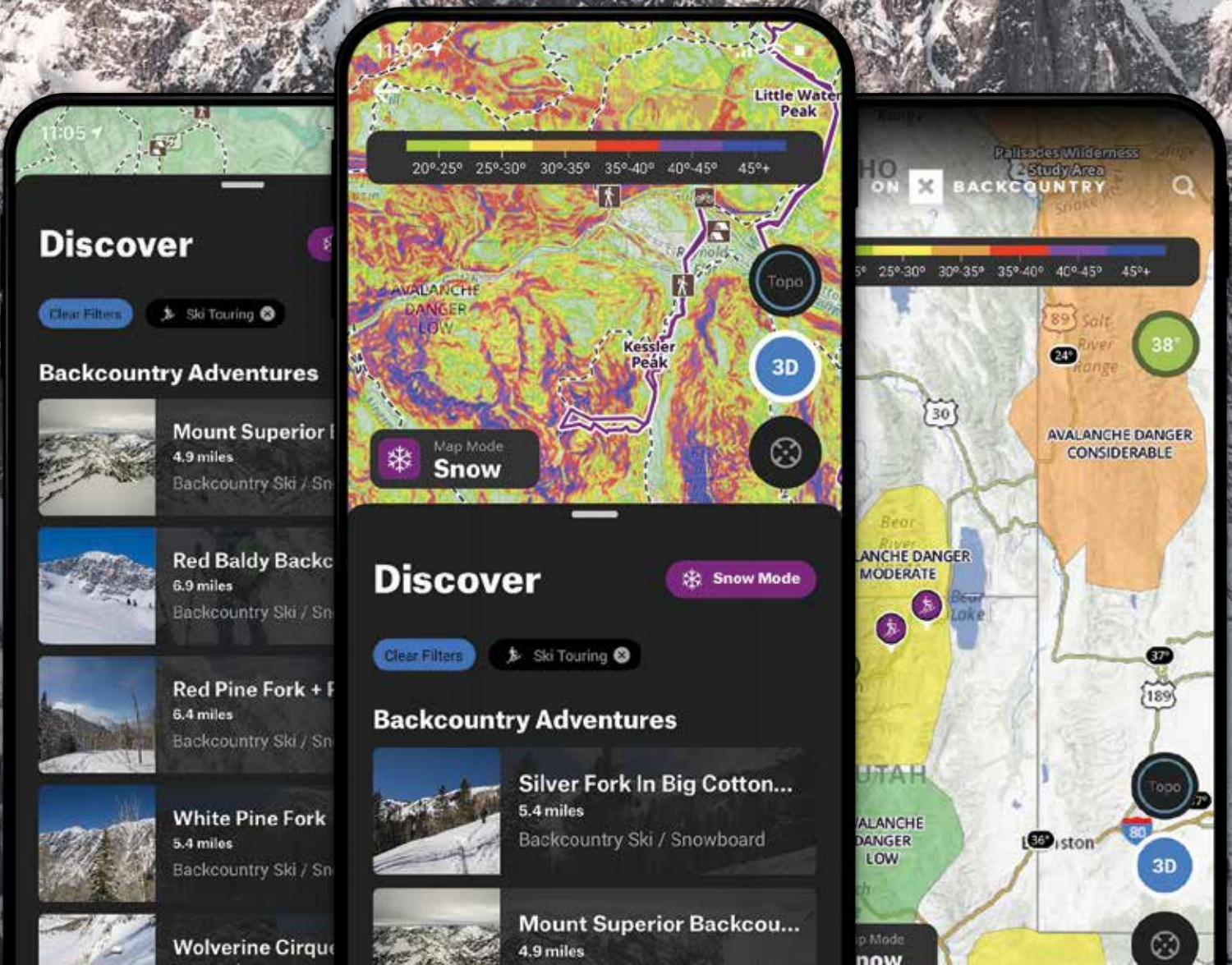
**Maple Leaf Powder Company**

ON  BACKCOUNTRY

# STAY SAFE, FIND NEW LINES, AND KNOW THE CONDITIONS BEFORE YOU GO WITH ONX BACKCOUNTRY.



7-Day Free Trial



## CONTRIBUTORS



**Pete Earle** works as a lead instructor for the American Avalanche Institute and as a guide and forecaster for Powderbird Heliski. He is hoping to ski avalanche terrain sometime this winter and is sick of being entrenched by Utah's poor snowpack.



**Jake Hutchinson** has taken twenty-eight years to learn there isn't any money in snow, but the wealth of experience, camaraderie, and freedom are a fair compromise. He spends his time teaching and learning from humans, teaching humans to understand and focus their dogs, and fulfilling his fantasy of being a cowboy.



**Russ Costa** is an Associate Professor of Honors & Neuroscience at Westminster College. He studies human minds and brains in high-risk and high-altitude spaces for work and play. Russ holds a B.A. from Middlebury College and an M.S. and Ph.D. from the University of Utah.



**Jayson Simons-Jones** is an IFMGA Mountain Guide who has spent 20+ years working in the snow and avalanche industry. His first TAR article was inspired by the widespread PWL snowpack in Colorado coupled with spending more time behind a computer...these things are not unrelated.



**Ben Reuter** is a researcher and avalanche practitioner. He has researched variations of snow instability at SLF in Davos, Switzerland. At Montana State University he looked into how weak layers fail. He is currently working in a project on climate change impact on avalanche activity at Météo-France in Grenoble.



**Pascal Haegeli** is an assistant professor at Simon Fraser University in Vancouver, Canada, where he holds the NSERC Industrial Research Chair in Avalanche Risk Management. His home office is slowly but surely getting a bit small.



**Mike Richardson** is a software developer based in Seattle. He writes about snow safety for recreational backcountry skiers. He can be reached at [mike@scenomics.com](mailto:mike@scenomics.com).



Identified by his team leader during his rookie ski patrol season as having an itchy swelling brain when it came to snow, **Steve Conger** has endeavored over the past three-plus decades to contribute methods and understanding to our avalanche craft. He lives in Golden, BC.

## FROM THE EDITOR

BY LYNNE WOLFE

**March 8, 2021.** As we put together the final proofs for the April TAR, I must admit that I am not sorry to see winter 20-21 flowing down the river. Some great skiing, for sure, but an early season dry spell laid a weak foundation for snowpacks across the country. In this TAR you'll see many iterations of the trouble caused by interactions between the resultant cranky snowpacks and backcountry travelers seeking fresh turns and respite from the Covid (starting p 26). Messaging from our hardworking avalanche centers was, as always, on point. Black roses and avalanche warnings still leave room for individual choice; however, that's the bottom line of America. In essays in this issue, many of our educators and forecasters mull over that gap between freedom and smart choices. As someone told me in the frenzy of February, "You can bring the plate to the table, but you can't make them eat." How do we make our messages appetizing for everyone?

We've tied this season's accidents in with our annual April decision-making issue. We begin by illustrating different aspects of the human factors problem and this year's dense spate of accidents: Jake Hutchinson, Pete Earle, our A3 President Halsted Morris, and peripatetic writer and thinker Drew Hardesty each chew on the statistics that represent so many people gone, trying to make sense of our irrational human choices. In equally thoughtful essays, Russ Costa, Ben Reuter, and Jayson Simons-Jones then offer some ideas and solutions. Mike Richardson and Steve Conger delve deeper into avalanche decision-making with paired contributions about terrain coding and the ATES system. Sean Zimmerman-Wall closes out this high-danger pandemic year with a roundtable of useful perspectives on teaching avalanche classes during High danger. Pascal Haegeli and his team deliver even more insight, this time on how different user groups utilize the avalanche problem portions of forecasts.

We also have a sled skills focus on teaching terrain use; thanks to our motorized avalanche instructor crew of Eric Knoff, Will Mook, Graham Predeger, Travis Feist, Mike Duffy, and Jamie Weeks for their insights. In another story, David Lovejoy describes the often-overlooked radiation snow climate that can be found in Arizona and other southern snow zones. Finally but no less importantly, Jen Reddy of Teton County Wyoming Search and Rescue uses a late-spring 2020 avalanche on Mt Taylor to explain how the principles of Psychological First Aid can be put into practice, while Laura McGladrey and Drew Hardesty expand on those principles, describing how the On We Climb group is supporting our hardworking first responders during this challenging winter.

As I finish up this final TAR of the winter, I want to wish you all a healing spring, filled with sunshine and corn snow, or whatever makes you smile. Let me know your thoughts about any of this material or any projects lined up for the summer. I am going to miss seeing everyone at ISSW in Fernie, but sure understand their concerns. Bend ISSW folks—how can we help make 2023 as fun and successful as possible?

—Lynne 



S2. Photo David Dietzgen



**SCARPA**  
MAESTRALE XT  
POWER BEYOND BOUNDARIES

Strong. Light. Precise.

SCARPA ATHLETE CHRIS DAVENPORT FRED MARMSATER RED MOUNTAIN PASS, CO

SCARPA.COM 



## FROM THE EXECUTIVE DIRECTOR

BY DAN KAVENEY

Unless you've missed my recent emails you know by now that I'll be moving on from my position as A3's Executive Director this coming May. Writing this final column is a bittersweet exercise. I've had a terrific time as your Executive Director, but after a lot of thought and reflection I'm convinced that a shift to a new director with fresh energy and ideas will be critical to continuing A3's progress. I'll miss working as our Executive Director, but I'm looking forward to witnessing the advancement and success I'm sure the new director will bring.

I still remember the call I got from Blase Reardon (currently the director of the Flathead Avalanche Center) during the early spring of 2018. The A3 needed a new Executive Director, and would I like to apply? At the time I had been working in publishing and that gig had unquestionably lost its glow, and the idea of serving both the avalanche profession and the cause of avalanche safety appealed to me very strongly. Over the course of the next couple weeks I thought a lot about the idea and spoke to a lot of A3 members, and eventually threw my hat in the ring. After the most stringent and demanding application process of my 30-year career I eventually ended up as A3's new Executive Director.

What I remember most about my first week was the warm welcome I received from our members and staff. I called a ton more A3 members during this time to talk about the organization and to learn more about what the members thought we could achieve together. Everyone wanted A3 to succeed—and therefore wanted me to succeed as well—and there was much to be done. While the organization had enjoyed many recent successes—particularly in the pro training arena—our financial situation was bad and needed to be turned around quickly. Time to get to work.

I'm proud of all the things we've been able to accomplish over the last three years. In my first column (TAR 37.1 in October of 2018), I wrote that we needed to expand our membership, work more effectively with corporate sponsors, continue and expand our focus on publishing, stay focused on the pro training program, expand our outreach activities on avalanche.org, and continue and expand our grants and scholarship programs. We've accomplished all of these goals and doing so has left us in a very strong position. Today A3 is a robust organization resting on a strong foundation; an organization with a bright future.

Despite the challenges posed by Covid, the 2020–21 season has been a good one for A3. We've focused hard on community since the need for social distancing has made community so much more difficult to achieve recently. In the service of this goal, we carried forward our support for Snow and Avalanche Workshops, initiated a new and successful online seminar series, launched an online version of *The Avalanche Review* ([theavalanchereview.org](http://theavalanchereview.org)), offered 1 year free memberships for those whose finances were impacted by Covid, began a program to supply free digital versions of our reference books, and carried on with our print publishing programs. We're closing the 2020–21 fiscal year with the strongest suite of services we've ever had, with a substantial increase in membership, a significant increase in corporate sponsors, and enjoying better financial health than we have in many years.

As of this writing the board and I have been interviewing candidates to replace me as Executive Director, and I'm pleased to be able to report that I'm pretty sure any of the candidates the board might choose will represent an improvement over your current Executive Director! I'm looking forward to watching the new ED—whoever it turns out to be—develop our strengths and guide the organization to new successes.

I'll close by thanking all of you for a fantastic three years. It has been a great pleasure and honor to have served as your Executive Director. ●



*Thank you for all your work Dan!  
You will be missed.*

—TAR staff

## METAMORPHISM

After hanging up his patrol coat four years ago and working as a guide and forecaster for Powderbird and the Park City Powdercats, as well as teaching for the American Avalanche Institute, **Pete Earle** is re-inserting himself back into the world of ski patrolling. He has recently been hired as the head of ski patrol and snow safety at Wasatch Peaks Ranch. Wasatch Peaks Ranch (WPR) is a new, "Class A" avalanche resort located in the Northern Wasatch range in Utah. Ski operations will commence during the 2021–22 ski season and Pete is busy planning for winter operations including hiring patrol staff, preparing the snow safety plan, and working through the logistical considerations of a brand-new ski area. ●

## ISSW STEERING COMMITTEE NEWS

After organizing a remarkable virtual ISSW in October 2020, the Fernie Organizing Committee was planning on hosting the in-person Workshop in October 2021. Unfortunately, the continued pandemic combined with economic challenges for the snow industry and uncertain travel restrictions has forced them to reluctantly cancel this year's ISSW. It was a very difficult decision for the Fernie community.

The chair of ISSW 2020, Steve Kuijt, the local organizing committee and the whole Fernie community had worked hard for over four years to host a large workshop in a beautiful mountain community. They had already demonstrated their creativity with the VSSW 2020 and that would have been seen even more at the Workshop. I think we all share their disappointment, but the pandemic continues to shape our plans.

After the cancellation of the Fernie ISSW there was discussion of moving ISSW 2023 back to the original October 2022 dates. However, after considering the uncertainties in recovering from the pandemic effects, it was decided by the Bend Organizing Committee to stay with the previously rescheduled dates in October 2023.

### UPCOMING ISSW SCHEDULE:

**ISSW 2023: Bend, Oregon October 8-13**

**ISSW 2024: Tromsø, Norway September**

**ISSW 2026: Canada (site to be decided) Fall**

Finally, sad news, Dr. Karl Kleemayr, the driving force behind ISSW 2018 in Innsbruck, Austria, passed away on February 26th. Karl (Charly to his friends) was an energetic and generous personality. He led the Austrian Research Centre for Forests since 2004. His work on ISSW 2018 produced a unique and wonderful gathering of the Snow and Avalanche Community from around the world. He was an active member and contributor to the ISSW Steering Committee. He will be missed. ●





Working dogs deserve recognition too. Photo Jen Reddy

## A3 DOG MEMORIAL LIST

The board of trustees of the American Avalanche Association (A3) is pleased to announce that at its last board meeting it approved the creation of a new memorial list for avalanche rescue dogs.

Trained avalanche search and rescue dogs are as much a part of a ski patrol or search and rescue team as their human counterparts. This will be a nation-wide list of dogs that have passed on. The dog does not have to have passed away in the line of duty. This list is intended to recognize the faithful service of the dogs and the time and effort their owners/handlers have spent in training the dog. The memorial list will be placed on the A3 website next to the human memorial list.

Handlers of dogs that have passed on and organizations (i.e., ski patrols and search and rescue groups) should submit the following information about the dog: 1) the name of the dog, 2) breed, 3) date of death, 4) where the dog served, 5) association memberships and certifications (i.e., CARD, SRDOC, etc.), 6) the name(s) of owner/handler and 7) a photo of the dog (ideally dog and handler in the photo).

Please submit this information to Halsted Morris at the American Avalanche Association. [BSFBSNOW@aol.com](mailto:BSFBSNOW@aol.com)

Patti Burnett and Hasty. Photo Halsted Morris



## FROM THE PRESIDENT: Is anyone listening?

BY HALSTED "HACKSAW" MORRIS

First off, I would like to extend the sincere condolences of the American Avalanche Association (A3) to all the families, friends, and communities of the individuals that were killed in the recent spate of avalanche accidents.


Just as I sat down to write this column I got a call that there have been two avalanche accident fatalities today here in Colorado (turns out there was a third fatality in Montana). Once again, I feel sad and discouraged. On Friday, CAIC issued a Special Avalanche Advisory. The current avalanche danger rating is at Considerable. The local media has been reporting the CAIC's message on every news outlet they can. It is hard to fully understand why these warnings were not heeded.

The biggest and most controversial avalanche I have ever been involved with was April 20, 2013, at Sheep Creek near Loveland Pass. Six snowboarders were caught and buried. Only one survived. I came away from working the Sheep Creek accident recovery with a lot of unanswered questions.

I see several similarities between the Sheep Creek accident and the recent spate of avalanche accidents. Several of these recent accidents involved large groups or solo victims, groups that were well aware of the current weak snowpack conditions, remote triggering of the avalanches from long distances, older more experienced victims, and deep burials.

A lot of avalanche folks I talk with have different thoughts as to why these fatalities have happened. Clearly, the pervasive weak snowpack across the west has played a major role in these accidents. But there is more to why these accidents have happened. One thing is clear is that all the avalanche centers have been doing a great job with their daily forecasts. Apparently, there is something getting in the way of folks following the forecasts. The information is there. Folks just need to follow it.

Four years after the Sheep Creek accident I ran across an article about the January 27, 1967, Apollo 1 launch-pad fire accident, in the *Smithsonian Air & Space Magazine*. The major conclusion of the author of why this fatal accident happened was "Perceptual Blindness." The article described perceptual blindness as, "in which even smart people (are) sure that they are paying attention and miss what is right in front of them." NASA had gotten so used to designing spacecraft by using what they had gotten away with previously that they did not realize that they were making bigger and bigger design mistakes, because they would not review their designs. Understanding perceptual blindness helped me to better understand my own unanswered questions about the Sheep Creek accident. All the victims were smart folks, sadly they just missed what was in front of them. Avalanche center forecasts have all been timely and accurate forecasts: the information is there for folks to use.

As frustrated as I feel, there are positives to record. We have had record numbers of fatalities, but it could be worse. YES, many people are listening to the forecasts, getting the gear, getting educated, and being conservative in the backcountry. I hope the backcountry community continues to listen. Please tell your family and friends to search out their local forecast(s) at [www.avalanche.org](http://www.avalanche.org). 

### SKI GUIDE JACKET.

Redesigned with the new **GORE-TEX PRO**

Most Rugged membrane with higher contamination resistance for longer lasting, fully waterproof protection.





# HONORING A3 PROFESSIONAL MEMBERS: NANCY PFEIFFER

## What advice would you give your 20-year-old self?

Go slow, make mistakes, but make small survivable mistakes. Mentors are great. Find a good one. But you will learn experientially anyway!

## What was your first job in the avalanche industry? How did you get your start?

I was nineteen years old, on my way to Alaska with a level one from Colorado under my belt. I read the Avalanche Handbook cover to cover for fun on the ferry ride north. I immediately took a level two from Alaska Avalanche School, and asked Doug Fesler for a job. Needless to say he laughed me off the block. (I had some close calls in those early years. I suspect Doug didn't think I'd live to be twenty.) Fortunately, I ended up caretaking the state park building at Hatcher Pass. Alaska Avalanche School classes took place in my living room. Eventually.... I got a clue.

Twenty years later Doug handed his school over to me. I worked for Alaska Avalanche School for much of my career. I am now avalanche forecasting for over a hundred miles of powerline and enjoying the new challenge.

## How have you seen the industry change since then?

New ways of thinking about snow have emerged, and new words to describe it seem to come and go. However, snow as a material hasn't changed, and isn't likely to change in the future.

Technology is giving us new methods of looking at things. Learning to read a snowpack from of a page of numbers has been a long hard climb for me. I still most enjoy paying attention to what the snowpack is telling me through my skis. I always said when I had to know as much about computers as I know about snow to do my job it was time to move on. That day is coming.

## Who were your mentors? How did they challenge you?

My mentors were Doug Fesler and Jill Fredston and I couldn't have had better. In the early years I was a good field instructor. I could easily wander around in the mountains with six people explaining the information about snow that came in through my eyes and up through the bottom of my feet.

Speaking in front of 20 people in a classroom terrified me. My mentors cut me no slack. My presentations needed to be perfect. Years later when I stood up-- fairly relaxed--in front of 625 people at the ISSW I had them to thank.

## What's the most useful feedback you've ever gotten?

The most useful feedback I ever got was from nature itself. While I understood intellectually, it took me a surprisingly long time to accept the facts at an emotional level. The laws of physics and gravity are really, truly not affected by my wants and desires.

## How would you describe your communication and leadership styles? Would you say those traits are typically described as "masculine" or "feminine?"

A non-snow story comes to mind here. I was leading an all-women's sea kayaking trip. It was obvious a heavy handed leadership style was not what this group wanted. I started each morning with, "What does everyone feel like doing today?"

One afternoon, we were paddling through a narrow spot with a growing swell. I looked behind me to see all my beginners coming in through the waves, against my instructions. A big wave set was building behind them.

**BACK PADDLE NOW!** I hollered, to their shocked and immediate response. Everyone was fine. One woman said, "Wow, you barked at us like a Marine Sargent."

I guess I did. I don't really see one style as feminine or masculine. I use more whatever I think might work in the moment.

## How do you fuel yourself when you're not thinking about snow?

Riding horseback through Patagonia and... soon living off of a tiny (17') rowing and sailing boat in Southeast Alaska. ●

*Throughout Volume 39 we've been honoring some of the unsung heroes in our community. For 39.4, both our honorees have long and interesting careers in the avalanche world. We hope you're able to gain some insight from their stories.*



I got to... Witness some amazing acts of nature, Ski some great snow, Do a few things you might not want to tell your mother about. Photos Nancy Pfeiffer collection

## Snowpro Plus+

Create High Quality Snow Profiles  
"Improving Your Profile"

Save 25% Until October 31, 2020  
Only CDN\$149 Annual Subscription 2 Licenses

- \* Works offline for field use
- \* Photo attachments
- \* Improved Latitude/Longitude entry with Maps
- \* JSON Data Format
- \* Conforms to CAA OGRS and AAA SWAG Standards, IACS 2008 Symbols

- \* Snow and Shear Layer Nicknames
- \* 9 Categories of Grain Shape Classifications Symbols with detailed Grain Shape Sub-classes
- \* Implements Flags/Lemons Analysis
- \* Computes Snow Pack Average Density, Cumulative Shear Stress, Ramsonde, Snow Loads and more...

### Gasman Industries Ltd.

Victoria B.C. Canada  
Telephone: +1-250-999-1490  
Email: info@gasman.com  
Order or download free trial at  
www.snowproplus.com

# HONORING A3 PROFESSIONAL MEMBERS: TED STEINER



Photos Ted Steiner collection

## What advice would you give your 20-year-old self?

I'd advise myself to get actively involved with a ski patrol with a well-established avalanche control program. If you are fortunate enough to get a job there, fantastic! If not, don't stop trying. Make it happen. This job will open doors to mentorship, friendships,

and perhaps a career that will last a lifetime. It's not an easy job. But if you like what you do and are good at it, you'll be rewarded with the opportunity to assist others in staying safe while working in avalanche-prone terrain.

## What was your first job in the avalanche industry? How did you get your start?

In 1987 I was fortunate enough to get my first avalanche job working as a ski patroller on Big Mountain (Whitefish Mountain Resort) in Whitefish, Montana. Although I was happy to be there assisting injured skiers and performing daily patrolling duties, it was the snow safety and avalanche control work that appealed to me most.

## How have you seen the industry change since then?

Although substantial changes have occurred in our industry over the years, one change I was so happy to see come along was improvements in transceiver technology. When I started working with a beacon, Skadi was on the way out but they were still analog with the 2.275 kHz frequency.

The first beacon I owned was an Ortovox and just to get into receive (search) mode required plugging your earpiece wire into the transceiver housing. To ensure you continued your search to fruition was totally dependent on hearing and ensuring that your ear piece didn't disconnect from the transceiver housing while searching. I had a really hard time with those transceivers, not just because function was clunky but because my hearing is not so great. Moving onto the Pieps, Pieps 2, and Ortovox F2 a couple years later was a great improvement because the ear piece was hardwired to the transceiver and frequencies included both the 2.275 and the European 457 kHz.

Then things really got better when I acquired my first Ortovox F1. Now my beacon had one frequency, 457, and it displayed a lighted signal strength, had an external speaker, and a varying audible tone. Since that time, digital technology and, transceiver technology in general, has improved to a point where function is relatively smooth and significantly improved compared to the olden days.

## Who were your mentors? How did they challenge you?

In the early 80s I was fortunate enough to get a job at a local mountaineering shop. One day,

a gentleman came in and started talking with the owner of the shop about an upcoming avalanche awareness presentation he was giving and needed someone from the shop to assist him. I asked the shop owner if I could do it and he said yes. With that, I attended my first avalanche awareness class in the Flathead Valley, Montana. That gentleman, who I was so fortunate to become friends with, was Cal Tassinari. Cal had previously been on the Big Mountain ski patrol and was also the former Patrol Director. With Cal's encouragement and his vivid patrolling stories, I became hooked on pursuing a job in snow safety myself.

Years later I was telling this story to Doug Abromeit. Doug told me Cal was the instructor for his first Level 1 avalanche course at the Izaak Walton in Essex, MT. Small world.

When I finally, FINALLY, landed a patrolling job at Big Mountain, my Patrol-Chief, John Gray, began teaching me the practical side snow-safety from a ski area management perspective. During the same time I was volunteering with the National Ski Patrol as a member of the Flathead Nordic Ski Patrol (FNSP) where I was fortunate to be mentored by Mark Johnson and Mark Behan. Both of these individuals became wonderful friends, schooled me in organized rescue, and encouraged me to teach avalanche education to aspiring patrollers.

Sixteen years ago, I was fortunate to meet and start working for Dave Hamre. I'm so fortunate that Dave has been there to patiently assist and/or provide valuable feedback during

some of the most stressful times I've experienced as an avalanche safety professional.

While working with Dave, I've had the great fortune to be mentored by, and work with Darwon Stoneman, Onno Wieringa, and Daniel Howlett (Howie). All of these individuals have been there for me with advice and assistance when things are getting hot in the frypan. Thank you!

Merging with my mentors in the avalanche arena are my peers. I've been so fortunate to work alongside Mark Dundas, Adam Clark, Erich Peitzsch, Zach Guy, Lel Tone, and Blase Reardon. Thanks for your patience, support, and for having my back.

The overall challenge-mantra of all these individuals, both mentors and peers, has been to provide objective-based guidance to clients and/or students with patience and professionalism.

## What's the most useful feedback you've ever gotten?

From my father, who often reminded me; "Who you choose as friends is one of the most important things in life... They're the ones you can trust your life with and will be there for you, not just when things are easy but when times get tough." He reiterated this invaluable yet simple feedback days before he passed November 22nd, 2011.

## Describe a time you made a bad decision and got away with it—a time you got lucky. What did you learn?

I've been fortunate to have made plenty of



**IPA CONNECT** SUPPORTS THE  
**AMERICAN AVALANCHE ASSOCIATION**  
 WITH DIRECT **PRO DEAL** ACCESS TO SOME  
 OF THE BEST BRANDS IN THE  
**OUTDOOR RECREATION INDUSTRY**

REGISTER TODAY  
[WWW.IPACOLLECTIVE.COM/AAA](http://WWW.IPACOLLECTIVE.COM/AAA)



bad decisions over the years that have resulted in solid learning experiences.

This particular “bad decision” is related to an avalanche I unintentionally triggered and was caught in while at work. I was with my co-worker Mark Dundas, and we were working our way on touring gear to upper elevation starting zones in our Program Area above the BNSF Railway on the southern edge of Glacier National Park, MT. While ascending we were traveling along a ridge and checking out some relatively small avalanche paths we call the “Test Slopes.” This particular area has avalanche-prone terrain that is excellent for manually testing snowpack instability. On this particular day we were intentionally triggering numerous soft slabs and having a great time doing it.

We worked our way up to what we call “Test Slope 3.” While Mark watched from a safe area to the side, I worked onto a wind-exposed ridge, kicking some small cornices with no results. The slope of this feature is initially steep and then shallows out quickly to a sub-ridge below. With no concerning results, I dropped off the ridge and down onto the slope below. I made one kick turn and worked my way back across the relatively low-angled terrain, I’d guess around 34 degrees. I stopped my traverse where the slope became a bit steeper and more exposed to larger connected terrain. I made a second kick turn to exit the avalanche-prone area. Snow surface conditions here were solid, so solid that as I began my return traverse across the slope, I began sliding on my edges, with skins on, down a steeper small-featured roll on the slope into a slight depression.

When I came to rest in the depression, the slope fractured about 30 feet above me as a hard slab. I was instantly knocked off my feet and made a quick move to point down slope in a sitting position. Fortunately, I was able to direct myself over to a tree, which I impacted hard- skis first. Debris flowed past and piled up behind me. But lucky for me, the magnitude of the slide was small enough that I was able to stay put against the tree, without injury.

Upon looking closely at what had happened, we could identify that Human Factors revolved around Familiarity and Complacency. But what really burned into my mind as a learning experience was the terrain change between the “Snow-Surface Terrain” and the “Actual Terrain.” Due to wind loading the ~34 degree slope I had been traversing and feeling comfortable with pre-release was now ~40 degrees. The wind-transported snow in this area had “transferred” the slope convexity further down slope. As it turns out, the steeper slope I had slid down was the convex roll of the hard slab, packed in place.

In retrospect, I had been totally deceived into thinking I was on a lower slope angle than I actually was. Hands down, a serious mistake that provided a tremendous learning experience for me in regards to decision-making as well as “terrain interpretation.” And, no more test slope work without being roped and on belay!

**Say you’re working in the field, and a colleague you respect proposes taking a run you don’t think is appropriate, given the conditions. How would you respond?**

When conducting field work on the job, we’re dedicated to avoiding situations like this.

Before we go into the field, our objectives are defined based on a preliminary actual risk assessment. Once in the field, we’ll re-assess field conditions and make a call as a team as to what terrain is appropriate given conditions that exist. It seems to be a continuing dialog focused on avalanche, snowpack, and weather along with rhetorical questions that keep us on the same page.

Our choices of which run to ski, although driven by agreement, are not always perfect, but if we blew it, chances are we blew our assessment of conditions together.

**How would you describe your communication and leadership styles?**

I’m a quiet person... a bit introverted. Perhaps even anti-social. This is all true until I get fired up about something or am specifically called upon. Then I’ll certainly ensure my thoughts are known and my intent established.

In regards to leadership style, I think my style is casual but I strive to be preemptively prepared and organized when facing a particular goal or task(s). When it’s go-time, I’ll place myself where I have a good “big-picture” view, rely on the holistic strength(s) of my team for task accomplishment, and utilize resources available to maximize success in a safe and efficient manner.



**Have your leadership and communication styles changed over time?**

Yes. From my perspective, one’s leadership style is derived from experience. Therefore, traits related to leadership style change over time. In regards to communication, I’m listening more than talking, but I’ll certainly let you know what I am thinking if called upon or I find it necessary.

**How can newcomers to the field build sustainable avalanche careers? Have you done that?**

Strive to keep learning. Don’t let ego get in the way of listening and adapting. Respect your supervisors and be professional. Join the American Avalanche Association. You’re not going to find a better organization and/or membership to promote your aspirations to progress and continue in the avalanche-safety arena.

**How do you fuel yourself when you’re not thinking about snow?**

Family-time is my number one priority when not working. When we get to adventure, our outdoor activities revolve around rafting, hiking, fishing, hunting, a bit of mountain biking, and maybe even some climbing.

I also enjoy spending time on our tree farm, a 60-acre woodlot with an off-grid cabin. Forestry activities on the tree farm revolve around planting seedlings, weed management, and fuels reduction. I enjoy putting sweat-equity into the tree farm; filling firewood orders keeps me busy through the fall. ●

## DeltaLancer Avalauncher Ammunition

Designed & Developed by Delta K EES Ltd. in the UK  
Cooperatively Distributed by Avalanche Control Logistics LLC and  
Accurate Energetic Systems LLC In the USA



### Key Design Characteristics:

- Safe replacement of Slip-pin ammunition variants.
- Turbine controlled safe arming mechanism.
- Pentolite or enhanced RDX based loading options.
- Low inertial loading of blasting cap to improve safety.
- RECCO reflector cast into main filling.
- Advanced aerodynamic profile.
- Inert and powder marker loads for ranging and/or training.
- Future proof design supports on-going product optimisation programme.



ACL - Dan Dobrowolski - [dan@avconlog.com](mailto:dan@avconlog.com) Cell: 434-960-0558

# BEND SNOW & AVALANCHE WORKSHOP SUMMARY

BY ALLISON HARTZ



Looking at layers in the Bend backcountry. Photo Jon Tapper, COAC Board Member

**The Central Oregon** Avalanche Center (COAC) Bend Snow & Avalanche Workshop took place on Saturday, Nov. 14. It was COAC's third annual SAW event, and due to the pandemic, was held virtually as a half-day speaker series.

As expected, the COVID-19 pandemic was a theme woven through the day. Dan Kaveney kicked things off, sharing updates and priorities from A3. COAC forecaster Gabe Coler followed with an update from our own local avalanche center. COAC was excited to announce that it would be shifting from offering two avalanche advisories per week to offering four avalanche forecasts per week, including its first ever danger ratings.

The next four talks built on each other to discuss and reinforce themes that are especially important in the context of backcountry travel and decision-making during a global pandemic. Colin Zacharias discussed situational awareness—and what types of things can heighten or diminish our ability to perceive and understand what's happening around us, as well as the potential consequences of an outcome. Things like good communication, steady pace, pre-planned checkpoints, and curiosity will heighten situational awareness. Colin also talked about the importance of paying attention to feelings like fear and anxiety—emotions that indicate a perceived threat and uncertainty, which are critical to be aware of while traveling in or near avalanche terrain.

On the other hand, lack of fitness, sleep, or focus can lower our situational awareness. Distractions, mental or physical illness, fatigue, and generalized patterns or dulled senses can also work against us. Any number of these things are more common during a pandemic, and it's critical to be considering how our situational awareness is being heightened or reduced as we make plans, communicate, and travel in the backcountry.

Margaret Wheeler spoke next, beginning with the proposition that, “We might be wrong more often this year.” So, what do we do? Margaret suggested using margins to add room for error and mitigate the consequences if we're wrong.

Margaret offered a “margins list” and “tour budget.” The margins list is a personal commitment that we make to ourselves as we head into the season—extra measures that we can apply to our normal planning and decision making process to anticipate reduced situational awareness caused by the

pandemic. It includes terrain margins, time margins, people margins, and gear margins.

The tour budget is a pre-planned list of options for simple and complex terrain, so that when avalanche danger or uncertainty is heightened, we have a catalog of simple terrain from which to choose. The tour budget also allows us to define our upper boundary and preset limits on the complexity, exposure, and length of our tours for the season.

Next up, Liz Riggs-Meder discussed how to be an “optimistic worst case scenario thinker”; in other words, keeping an overactive imagination in visualizing what could go wrong, while also having a plan. Liz pointed out that we've been doing “cognitive cross-training” all summer by managing risk to COVID-19 in the same way we manage risk to avalanches—in a low likelihood, high consequence environment.

Liz suggested five habits to work on this season: have a system or routine for managing risk and reflective learning every time you head into the backcountry, maintain situational awareness by naming the things you're keeping track of and freeing up your cognitive bandwidth to actually notice these things, make a plan beforehand (“Don't go to Trader Joe's when you're hungry”), go with people who will challenge you but also respect your veto, know when to fold and have realistically fun alternatives, and become a reflective learner through thoughtful debriefing.

Sarah Carpenter built upon these talks by discussing how to develop competence in an ever-changing, uncertain, and high stakes environment. Like Margaret, Sarah suggested widening margins to allow room for mistakes and to make errors less catastrophic. Also, learn to recognize when you have wide versus narrow margins.

As tools for building competence, Sarah suggested developing a common vocabulary or language around risk, exposure, vulnerability, consequences, and how these terms interplay. She emphasized developing a culture of communication, particularly one of dissent and in which every voice matters. She offered five tips for making an assertive statement,

asking “What am I missing?” (which heightens group situational awareness), and having a system for communicating in high-stress, high-consequence environments.

Finally, like Liz, Sarah emphasized the importance of having a system for reflection and learning. She suggested developing an opinion or hypothesis for the day and documenting findings based on conditions and observations in the field—and keeping a documented record through the season.

Pascal Haegeli closed the day by sharing the latest research on avalanche risk communication.

Beginning with Abby Morgan's research on how users perceive the avalanche danger scale, Pascal shared that roughly half of users perceive the danger scale as linear with equal and non-overlapping ranges. Other key takeaways showed that avalanche training does not seem to affect people's perception of the danger rating, about two-thirds of participants choose to stay home when the rating is high or extreme, and perception does not seem to affect use of the danger scale in making basic trip planning decisions. Pascal said that next steps for this research will include working with avalanche centers to further explore whether the danger scale does the best job of communicating danger to the users that rely on the scale.

Pascal then moved on to Katie Fisher's research on how information presentation (namely, the graphics) affect recreationists' ability to use that information. This study used online surveys that presented information in the United States style of graphics, the Canadian style, and a new style. Results showed that the American style was the best overall performer in regards to users' ability to comprehend and their preference. Other learnings were that combining elevation and aspect in one graphic requires considerable effort to comprehend (takes longer and has more errors), and familiarity affects preferences (Americans like the US style and Canadians like the Canadian style). This means that people like the style they're used to, and any changes to format will likely meet resistance among those users.

Pascal concluded that design matters, and research like this can help make the information better to understand and help people make better decisions with the information that is provided. Getting meaningful feedback on personal avalanche assessment skills is difficult, and recreationists are hungry for training opportunities and feedback. Avalanche forecast centers have an opportunity to provide more than just conditions reports on their websites. The key question is whether users are getting the message the avalanche centers are trying to convey. ●

Allison Hartz is an AIARE Course Instructor, AMGA apprentice ski guide, and COAC board member. She lives, plays, and works in Bend.



# INSPIRED SUMMIT MENTORSHIP

BY SHAUN DEUTSCHLANDER

**Guide a person** into the backcountry and they enjoy it for the day. Mentor a person in the backcountry and they enjoy it for a lifetime.

In 2018, we created the Inspired Summit Backcountry Mentorship program out of a desire to help our clients cultivate a skill set all their own. From snowpack to terrain evaluation, movement skills to gear management, our backcountry mentorship program is all about meeting our clients where they are and helping them reach their goals.

As a long time avalanche educator and guide, I saw there was a missing piece to the progression of continued education, especially for students who had completed a Rec 2 class but still needed direction. Missing was the contextual landscape of gaining experience under the watchful and supportive eye of a mentor, someone who can help you dial in your terrain evaluation while also giving you advice on the best way to pack your gear for the day.

There are so many avenues people find their way to the sport of backcountry skiing/riding, and there are infinite stages in that progression of novice to expert. The Backcountry Mentorship program takes a practical approach to helping people evolve their skills. Whether novices looking for a first-time introduction to the sport or an advanced recreationist looking to get into the pro track, it's all about sharing skills, creating relationships, and fostering community.

We all operate at our best when we feel supported and a mentor/mentee relationship offers that type of security. It's a bond that can become transformative for so many of us and this program gives each of our clients that opportunity.

Our mentorship program starts with an in-depth discussion of what our clients' goals are and what their past experience is. From there we create a custom agenda that hits on learning objectives and field locations. These can be anything from days in the Wasatch to the Uintas (we are based in Park City), learning basic companion rescue skills to ski mountaineering techniques and everything in between. The programs are designed in three-day packages, but we do have some clients who opt in for longer programs that span the course of a season. The idea with having a multi-day program is that it not only gives us more time fostering the practice and application of skills, but it gives us more time in the mountains to track trends, experience more weather, and encounter more of the dynamic components to backcountry travel. All of this is really what makes the mentorship program so powerful- the flexibility to take time exploring and explaining the nuances and help sharpen situational awareness in a fluid environment.

When we are in the backcountry we are abiding by certain black and white rules such as: if you are in terrain between 30-45 degrees you are in avalanche terrain. But there are

often so many times we find ourselves operating in the grey, where the answers to our questions or the way we ought to move is so situational that the only way one learns the answer is through building an encyclopedia of past experiences. The answer "it depends" is then followed with a kaleidoscope reference of experience where one can see multiple options and possible outcomes. That reference guide is what we, as mentors, hope to share with our mentees. Understanding what your solutions depends upon can help give context, patterns to recognize and search out, then ultimately make a decision clearer, not to mention quick, efficient, and accurate.

Mentorship can be a powerful cornerstone for those looking to progress their personal and/or professional development, diving deep into a person's experience level and then elevating it through time in the field.

The popularity of the program certainly speaks volumes about our growing community. People are hungry to get into the backcountry and they are willing and ready to immerse themselves in the educational process to reach their goals and to become responsible members of our community.

At the end of the day we are trying to promote a conscious community of backcountry travelers who find lifetime joy in this sport. ●

**Guide a person into the backcountry and they enjoy it for the day. Mentor a person in the backcountry and they enjoy it for a lifetime.**

Founder and lead guide for Inspired Summit Adventures, **Shaun Deuschlander** is a seasoned mountain guide, pro skier, and AIARE educator.

Born in New York, she currently lives in Park City, UT, with her husband, four-year-old daughter, and their two dogs. All of her adventures, combined with her desire to inspire others, have brought her to this current moment of mountain living.



Backcountry Mapping Evolved



Enable live tracking and seamless collaboration with a team account

Plan | Collaborate  
Adventure | Share

Get started: [caltopo.com/teams](https://caltopo.com/teams)

# THE RADIATION SNOW CLIMATE

BY DAVID W. LOVEJOY

## INTRODUCTION

In low latitude, high altitude mountains' insolation and rapid long wave radiant heat loss from snowpack to the atmosphere are dominant contributors to weak layer formation, and therefore to avalanche character. The main factors controlling insolation are: 1) the high number of clear sky days occurring during winter, and 2) the influence of solar altitude angle at lower latitudes. For example, on San Francisco Peaks in northern Arizona, an average of 12 clear sky days occur in January, compared with two to nine clear days in most mountains in western United States (Ruffner and Blair, 1979). Also, the sun's midday arc is higher in the sky contributing to greater radiant intensity on slopes upon which it shines via a more direct (closer to perpendicular) angle of incidence.

The concept of radiation snow climate is not new. Edward LaChappelle recognized this distinction (Ives et al., 1973) in his characterization of the San Juan Mountains in southwestern Colorado. He wrote "the combination of high altitude, low latitude, and predominantly continental climate produces what we now define as a radiation snow climate."

The designation of radiation snow climate has been lost during the intervening years. A simplified set of snow climate descriptions is customarily used in avalanche education: maritime, intermountain or transitional, and continental. These designations describe what mountain geographers call continentality (Price, 1981). In western North America this has come to mean how far downwind a location's distance is from the Pacific Ocean. In wintertime, continentality describes meteorological influences at mid and northern latitudes, primarily considering those factors related to mountain precipitation and snowpack depth, but marginalizes the impact of radiant energy on the snowpack.

## DISCUSSION

In the United States, the radiation snow climate can be loosely defined as the Southwest Region. In terms of mountain ranges this encompasses those within a belt between approximately 30°–38° N, where sparsely situated mountain ranges reach altitudes capable of forming and holding seasonal snowpacks.

The prime feature of this region is highly variable precipitation. Winter snowfall fluctuates both seasonally and within a single season. Unlike northerly geography, where mid-latitude cyclonic storms migrate regularly from west to east, the southwest mountains get the scraps, or storms that dip below or break away from the customary jet stream-driven flow. On San Francisco Peaks winter snowfall ranges from 460" to less than 100" per season.

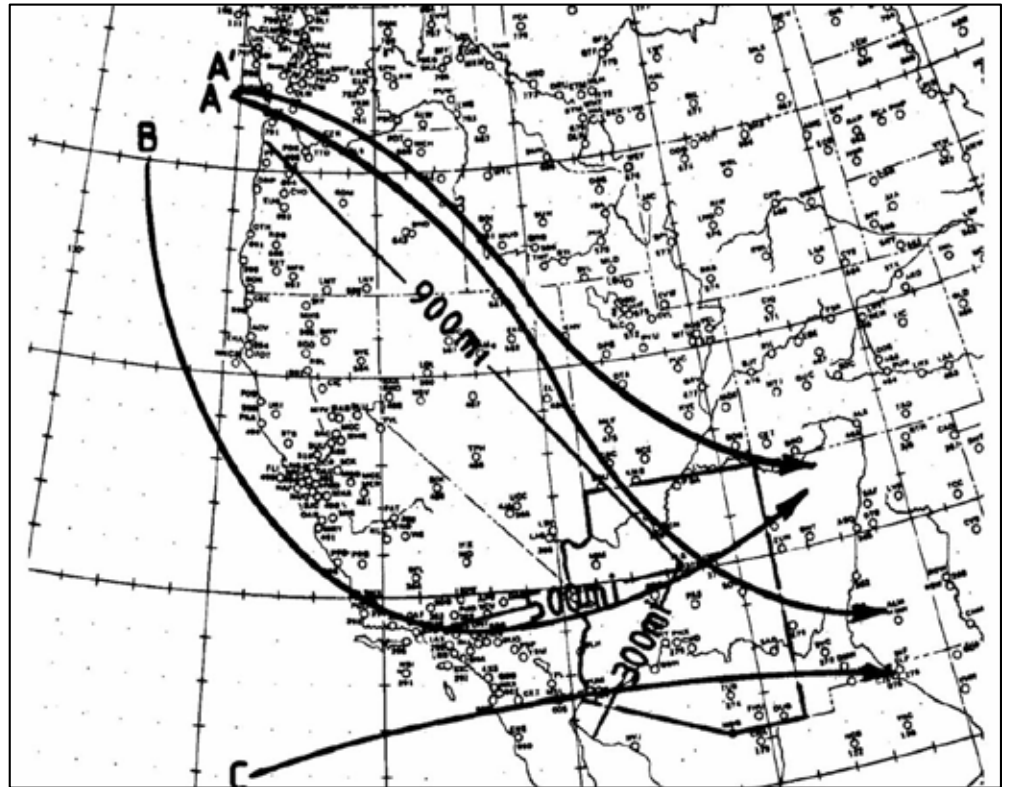


Figure 1: Four semi-discrete storm tracks impacting the Southwest. (Dexter 1981)



Figure 2: Near-surface facets on crust, San Francisco Peaks, AZ. Photo Phil Straub

Drought winters are characterized by weeks to months of high pressure, with episodic windy conditions as storms track to the north. Even during the more snow-blessed winters, lots of sunshine with low humidity is typical between storms.

The specific trajectory that a storm follows tends to foreshadow its ensuing characteristics, reflecting environmental conditions over which the storm passes. This is true for such variables as temperature, precipitation amount, intensity, and snow density. Since these are the

factors that characterize traditional snow climates, the challenge is applying them to this region. Four semi-discrete storms tracks have been described (Dexter 1981) for the Southwest: A and A' (northern), B (western) and C (southwestern).

Storm tracks A and A' bring cold dry snow in modest quantities of 3–12" (continental); track B delivers medium density snow in greater amounts 12–24" (intermountain), and track C brings large quantities of wet snow or high elevation rain, of up to 30" (maritime).



Figure 3: North Core Ridge avalanche cycle, San Francisco Peaks, AZ, D 3.5 avalanches in 2015. Photo Troy Marino

The proportion of storms from each of the designated tracks varies by geographical location, and by season with a weak correlation with ENSO anomalies, positive or negative.

Due to concentrated insolation, sun crusts develop on southern aspects as soon as the sun appears in the aftermath of storms, even when ambient air temperatures linger below freezing. Warmed surface crusts on cold snowpack can foster sub-crust faceting in surprisingly short time frames. Nighttime radiant heat losses as skies clear create optimum conditions for facet development on top of crusts. Over time, repeated diurnal cycles and additional light snowfall events commonly result in development of complex crust/facet sandwiches throughout the upper snowpack on southern aspects. On San Francisco Peaks, these weak layers have contributed to a number of ski-

er triggered wind slab avalanches, particularly when these aspects are loaded by post-frontal wind slab deposition.

During periods of clear skies, the result is extensive and continuous radiant heat loss. Similar to conditions notorious in the Colorado Rockies, deep-seated temperature gradients result in basal faceting (i.e. depth hoar) within the bottom of the snow cover where the ground provides the thermal mass from which vapor diffuses. Perhaps more unique to the radiation snow climate is formation of early season crusts on north-facing slopes. Pauses between shallow early season snow storms (Type A and A') often produce warm Indian summer conditions. These can result in development of high elevation melt/freeze crusts up to an inch thick. From October through December, warm periods can last for months, sometimes eliminat-

ing most of the snowpack on warmer aspects. Depending on the specific storm patterns, multiple crusts can become interbedded with mature facet layers. Rather than inhibiting vapor movement, as one might expect, the crusts appear to provide the fresh heat source, driving vapor flux and furthering kinetic metamorphism. The result can be a fragile layer cake of fully developed depth hoar between sequences of crusts. Historical records conclude that these complex weak layers on north and northeast aspects are responsible for many of the medium to large direct action avalanches on San Francisco Peaks. The common scenario is the conditions described previously, followed by a large dump of 2' of moderately dense snow (Type B).

**CONCLUSION**

Currently adopted snow climate labels do not adequately describe the complexities of snowpack properties in the low latitude, high altitude mountains of the southwestern United States. Avalanche educators should consider offering a more comprehensive description that addresses the special conditions inherent in southwestern mountain geography.

**REFERENCES**

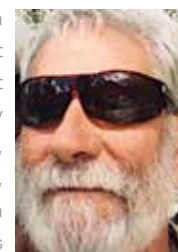
Dexter, L.R. 1981, *Snow Avalanches on San Francisco Peaks Coconino County, Arizona*; MS Thesis Northern Arizona University, p. 73, 92, 100.

Ives, J.D. et. al., 1973, *Development of Methodology for Evaluation and Prediction of Avalanche Hazard in the San Juan Mountain Area of Southwestern Colorado*; Interim Report for the Division of Atmospheric Water Resources Management, Bureau of Reclamation, 122 p.

Price, L. 1981 *Mountains, and Man: A study of process and environment*; University of California Press, 62 p.

Ruffner, J.A. and Bair, F.E., 1979, *The Weather Almanac*; Avon Books, New York, New York. 728 p.

David Lovejoy served on the faculty in the Adventure Education Department at Prescott College for 37 years. He spent many years as a snow safety specialist at Arizona Snowbowl, and was a founding member, forecaster, and education coordinator for Kachina Peaks Avalanche Center. He is currently enjoying retirement, taking long hikes in remote southwestern landscapes with his wife Amparo.



**NEW KANE JACKET**

**DON'T TURN THE SKINTRACK INTO A SAUNA**




**FEATURING**  
 **INTUITIVE PERM**

  
**FLYLOW**  
 FLYLOWGEAR.COM

# TEACHING AVALANCHE COURSES IN HIGH DANGER:

Round Table Discussion with Leading North American Educators

BY SEAN ZIMMERMAN-WALL

**The gravity of the mistake was audible.** “Boop-Boop-Boop.” The sound of a Mammut transceiver booting up. I turned from my pit wall and stared at my students with a grave look on my face.

“We didn’t perform another beacon check after we finished our rescue scenarios, did we?”

I looked down at my beacon under my jacket, no flashing light. We had just walked 15 minutes with all of our beacons in the off position. This critical error occurred for the first time, not during my premier season of teaching, but during my 12th. After a brief pause, our group methodically performed a function test, stowed our beacons, and looked quizzically at each other.

“This was my fault as the group leader, but we failed as a team,” I said.

“It’s ok, we aren’t entering avalanche terrain today,” said a student.

“That does not absolve us of our sins,” I replied.

During our group debrief that afternoon at the trailhead, we discussed what we would do differently next time. We also summarized the day’s weather and snowpack conditions. The danger rating of High seemed justified based on our observations of wind transport along the ridgelines, the documented presence of an insidious weak layer one meter below the surface, and the latest notification on our phones: “4 Dead in Millcreek Avalanche.”

My instructor team and I talked about all the factors that evening and discussed how we approach teaching in High Danger. Those thoughts stuck with me beyond the course’s close; the desire to better understand how educators deal with challenging conditions rattled around in my mind for days. It also coincided with a conversation I had been having with a mentor about the importance of instructor risk management practices. Colin Zacharias, a consultant and educator in the avalanche and mountain guiding industries, has been someone I’ve admired for more than a decade. His thoughts on the matter of margins, procedures, and terrain added more insight into the idea I was trying to articulate.

“A High danger rating significantly limits your opportunities to travel safely in mountainous terrain. High danger is usually accompanied by large avalanches, a great extent of unstable snow, and the possibility of remote triggering adjacent slopes. Therefore unless you have familiar non-avalanche terrain available where you can eliminate exposure completely, travel in mountainous terrain is never recommended. However, travel in Considerable or even the upper end of Moderate danger is in some ways riskier as a greater range of terrain opportunities are considered, the instabilities less omnipresent, and the chance of avalanches harder to identify. When persistent slabs are the primary problem, natural avalanches may be infrequent, but a specific slope may still be human triggered. With notorious persistent weak layers it can remain high hazard on a slope or feature scale days after the danger rating has dropped.

I think what instructors sometimes forget is that in order to observe and analyze the avalanche problem you don’t need to expose yourself to unstable slopes. You work within your operational risk band—which in rough terms states no triggered avalanches on an avalanche course. That’s your goal when

managing the risk. You avoid the current avalanche problem. It is more important to train students to use their resources to identify and then plan to avoid the problem than to observe the problem in the field. While there may be some irreducible (residual) risk, i.e. chance of injury or a remote chance of overhead hazard, an instructor’s bottom line is, (regardless of the rating) if it isn’t low danger where I’m are skiing then there is a problem with my risk assessment.

To err is human. Common errors include failing to estimate the terrain’s potential for avalanching (i.e. lower angled terrain and I’ve never seen that slope go before), or avalanche size or runout (with a 30cm new snow load it usually stops mid track). And probably the most common error is the instructor overestimating their ability to manage the group. Or if the exercise is student led, the ability of the group leader to manage the group. Our job is to simplify a complex subject. Don’t try to outthink the problem when you are breaking things down for the student. Our mitigation strategy means our applied margin for error on avalanche courses has to be significant,” says Zacharias.

Eventually I reached out to Lynne Wolfe and asked to put together a round table of professional avalanche educators to share thoughts on the matter of teaching avalanche courses to professionals and recreational users during periods of elevated avalanche hazard. Given the spike in demand for courses during the pandemic aligning with a historically weak snowpack across the West, my inclination was that more instructors were doing this than ever before. I utilized an open format of email to gather input on the following questions. Here are some of the responses I received; they have been condensed for brevity and clarity, and in order to make the print deadline. Perhaps this will spur a deeper conversation among our ranks. I would also encourage readers to check out one of the few pieces of research on the matter of close calls on avalanche courses, a poster from Steve Conger, found in the ISSW 2016 Proceedings.



**Sean Zimmerman-Wall** splits his time between patrolling at Snowbird, working as AIARE’s Pro Program Director, and serving on the A3 Board of Trustees. Free days are spent chasing two groms through the mountains.

## EDUCATORS



**Chris Brown** is based out of Salt Lake City and works year-round in the mountains, namely the Wasatch, Uinta, Teton ranges as well as others. He wears many different hats in the ski, avalanche, rock, and alpine realms.



**Bruce Engelhard** has worked as a guide and educator since 1996, teaching avalanche education and backcountry travel in winter months and rock climbing in the summer. He loves the opportunity to connect with the younger ones who are just starting their mountain quests.



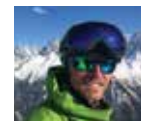
**Scott House** is a communications and operations professional, small business owner, consultant, guide, and AIARE educator working and living in the Wasatch Mountains of Utah.



**Eric Knoff** is an A3 certified instructor and has been involved in avalanche education for more than 15 years. Currently, Eric is a full-time avalanche educator focusing on both motorized and non-motorized avalanche education.



**Eeva Latosuo** is a big fan of stable snowpack, Associate Professor of Outdoor Studies at Alaska Pacific University & Senior Instructor at Alaska Avalanche School.



**Caleb Merrill** works as a mechanized and human powered ski guide, avalanche forecaster, and occasional AIARE instructor. His skis are recently getting more and more jealous when they don’t make it on the snowmobile rack...

## HOW OFTEN ARE YOU TEACHING IN THIS KIND OF ELEVATED DANGER, AND IS IT USUALLY IN THE SAME (FAMILIAR) TERRAIN?

**Eeva Latosuo—Alaska:** It is not common, but it happens. It is almost easier to work with High hazard than Considerable hazard. With Considerable, the type of avalanche problem you are dealing with makes decisions trickier.

**Chris Brown—Utah/Wyoming:** I’ve taught courses in High hazard six days this season. I



am familiar with doing so. A few seasons ago I taught courses in historic avalanche conditions in the Tetons. This year is unique with the entrenched style PWL that is part of the Wasatch.

**Caleb Merrill—Oregon:** I have a nomadic winter migration pattern, and pick up courses where I can, mostly in the early season. For this reason, I am often teaching in unfamiliar terrain. Avalanche hazard is always going to fluctuate, and when faced with teaching in elevated hazard, I have asked myself several times if we should be in avalanche terrain.

**Eric Knoff—Montana:** I teach during High avalanche danger whenever it presents itself, which isn't that often in SW Montana. Classes are usually conducted in familiar terrain no matter what the hazard.

**Bruce Engelhard—Utah:** As I work for several entities, the answer here is mixed. This season it has been five times in High, five times in Considerable. All classes regardless of the hazard are held in familiar terrain.

**DOES YOUR COURSE TERRAIN SUPPORT THIS LEVEL OF DANGER FROM A MOBILITY AND ACCESS STANDPOINT?**

**Scott House—Utah:** From a travel perspective we can get hemmed in a bit, but I feel we still can give students the reins and let them work through terrain without having to overly guide their decision-making or terrain choices even in elevated hazard.

**EL:** Terrain access is minimal for high hazard days. In our common course areas, Hatcher Pass and Turnagain Pass, we get into the runout zone of medium to large paths almost everywhere we travel. If the high hazard comes with poor visibility, it further limits the options. This makes it difficult to have standard field days at High hazard, and it takes some creativity to find appropriate locations. This year additionally, the volume of other recreational users and increased number of cars due to lack of carpooling amidst the pandemic has created a shortage of parking spots.

**CB:** Yes, again the limitations come from the increased public use, many operators utilizing the same terrain, and low snow coverage as opposed to the High hazard. I am a disciple of working terrain instead of areas and specific runs. Guides, educators, and snow professionals fall victim to familiarity more than others.

**HAVE YOU BEEN ABLE TO SUCCESSFULLY MANAGE THE LEARNING OUTCOMES AND PROVIDE A VALUABLE EXPERIENCE WHEN THE DANGER IS HIGH?**

**BE:** Yes, in fact I have found that learning outcomes appear to come easier during times of elevated hazard. It appears that students are more focused and willing to accept and understand the serious realities of traveling in avalanche terrain when they are confronted with the intense realities that elevated hazards have to offer.

**EL:** If we can find safe terrain to observe the reactivity of snowpack on High hazard, it is

a very valuable learning experience. This is true through all levels of training from Rec L1 to Pro 2. What students will get relates to course-specific learning objectives. L1 students might actually see with their own eyes for the first time how snow fails in pits or very small test features; Pro 2 students will consider operational terrain margins or mitigation options. Regardless of increased learning potential, the risk of traveling in avalanche terrain on a High hazard day is not worth the educational punch provided by the conditions.

**EK:** Yes. Class outcomes during a High avalanche danger are typically positive. Instructors and students learn a lot by observing unstable conditions. Similar to writing a forecast during High avalanche danger, teaching a class is simplified. There is no question about traveling in avalanche terrain therefore there are no expectations.

**CM:** With elevated hazard teaching, we think outside the box of our "ideal learning conditions", and I would guess students might even gain more from these experiences. We should strive to model and discuss adjusting our desires to the current conditions.

**WHAT DOES THE INSTRUCTOR TEAM DYNAMIC LOOK LIKE WHEN TEACHING IN HIGH DANGER?**

**SH:** My experience is that the team is much more conscious of the margins they are building and how they are modeling things to students. Our team has great communication (in my opinion) both amongst instructors and the admin side.

**EL:** High hazard conditions ask for more flexibility of instructors from the planning perspective and creates decision-making stress and potentially fatigue if the cycle continues the whole course duration. It is helpful if the team can pool their experiences and spread the responsibility on formulating options.

**CB:** Increasing communication, discussion, and solid debriefs with team members, especially newer or less experienced instructors is necessary. It is essential to talk through and plan very well with the team, emphasize where you need to be, where you need to avoid, and where the margins shrink. It also important to keep an open and friendly discussion that induces an environment where every member feels comfortable to ask any question.

**EK:** Communication is always a top priority during any class, but it is elevated during a High avalanche danger. This generally means sticking close to the other group, more so than during a Moderate or Considerable danger. Visual comms are just as important as radio comms.

**HOW DO YOU ADJUST TERRAIN MARGINS AND DEVELOP A PLAN TO MITIGATE EXPOSURE?**

**EL:** This shrinks the terrain to very low slope angles out of runout zones. With low visibility,

**WHERE THE SNOW PROS GO.**

Comprehensive avalanche training in the heart of avalanche country.  
**Professional, rescue, recreational, industry and tactical.**

[www.avyschool.org](http://www.avyschool.org) Silverton, CO 970-387-8329

it could be even harder. I have made decisions to go take a look at the trailhead and then pulled the plug on the activity and returned to the classroom to stay out of exposure.

**BE:** During our daily morning meetings with our Instructor Staff we specifically discuss terrain margins when we are developing our open and closed run lists. This is an open discussion that allows for any veto to be the ultimate final decision-making answer/action.

**CB:** Taking it back to the most basic element of BC skiing, terrain, terrain, terrain. Also, front loading and being honest with students about low snow hazards, increased usership, and the gravity of the avalanche problem and hazard is vital. It helps to think critically and ingrain best practices in the team as well as spending more time to line out newer instructors

**EK:** The plan to mitigate is avoidance. During a High avalanche danger there is brief to no exposure to avalanche terrain.

**ARE STUDENTS ABLE TO STILL HAVE A SELF-GUIDED EXPERIENCE WHEN THE LEARNING OUTCOMES CALL FOR IT?**

**SH:** Yes, I feel students get to take the reins still in this hazard. That said, we as an instructor team are also presenting them with options that are going to facilitate this vs just opening up the box and letting students run wild in planning.

**EL:** I definitely have a more decisive risk manager hat on when dealing with Considerable and High hazard, which limits the students free rein over terrain choices and group management techniques. At the same time, this creates a very real learning environment for the whole group.

**CB:** As always, some students are capable of having a self-guided day, for other students this is inappropriate even with good stability. If progress to meet learning outcomes is inhibited by inadequate student guiding than more coaching, direction, or demonstrating needs to happen. When the margins get thinner, the instructor needs to know when to take over to facilitate the conversation and learning.

**WHAT ARE STRATEGIES FOR SPEAKING WITH STUDENTS ABOUT FATALITIES THAT OCCUR IN NEARBY TERRAIN WHILE YOU ARE TEACHING?**

**CB:** There is always learning to be had with any accident, focusing on that is key. Judging individuals and armchair quarterbacking accidents is useless. Identifying, emphasizing, and putting yourself in some element of the accident is key for us all to learn. I was recently deeply affected by the back-to-back accidents including the quadruple fatality. Carefully sharing some of this with students proved to be great learning. Desensitizing, acting mechanical and “tough” when these things happen is not good modeling to students. When accidents happen it is a great opportunity to

show students that there are very high consequences to our decisions in the mountains.

**EK:** Gathering as much information as possible and discussing the accident with students is a powerful learning experience. There is a strong emphasis that no guilt, shame, or judgment should be placed on the individuals involved.

**BE:** Unfortunately, this season has seen multiple weeks with sudden/current fatalities in our local terrain. Specifically, we have made sure that when discussions arise surrounding these incidents we speak only to the known facts. Of note: I personally utilize my own experiences and or accident involvements as opportunities to share these situations. During these opportunities, we typically have a question and answer session.

**EL:** I have not had an experience teaching while there has been a fatality in the course area. It would create a very specific need for briefing and debriefing the students and instructors. This would include talking through the educational activities within our group and decisions made by us for the day and expanding sympathy to the very different experience that others had.

**ANY OTHER THOUGHTS ON THE SUBJECT THAT YOU THINK PEOPLE WOULD BENEFIT FROM HEARING?**

**CB:** Breaking habits is good for us and having to think and act creatively with new increased margins is beneficial to the instructor team. Long term development and experience in

unique conditions is what leads to a “seasoned and wise professional” down the road. I feel fortunate to have the opportunity to manage and work in these unusual conditions.

**CM:** I think recently, there are added pressures on course instructors from increased traffic amongst avalanche education courses and increases in recreational use in the backcountry...I could see how terrain margins could get trimmed too thin even in an avalanche educational context. It is our duty to not enter inappropriate terrain.

**EK:** The number one rule when teaching during a High danger is to avoid avalanche terrain. In most cases, this makes teaching easier. Unstable conditions can offer great opportunities for students to experience Mother Nature’s Red Flags first-hand.

**BE:** It is my belief that Recreational Students need to build their route selection knowledge and skills, as well as their safe travel techniques by understanding and practicing these skills first off in “Simple Terrain.” Learning in “Simple Terrain” reduces/eliminates the stressors associated while in potentially risky avalanche terrain.

**EL:** After one of the multiple fatalities in early February, I reached out to a friend who is a seasoned educator, who told me that all the folks that passed had been their students. When I asked how many students they had lost over the years, the answer was that they had stopped counting. Brutal. Let’s stay caring and sensitive even though callousness might be sometimes easier. ●






Photo: G. Gunderson      S. Zimmerman-Wall      Duncan Lee

**Training for Backcountry Enthusiasts and Mountain Professionals**

Rec Level 1, 2, & Avalanche Rescue Curriculum  
 Instructor Training Courses  
 Professional 1 & 2 Courses

avtraining.org      719-221-0762

# BTAC & WYOMING STATE TRAILS PROVIDE AVALANCHE EDUCATION TO SNOWMOBILE COMMUNITY

BY REBECCA REIMERS

It's no secret that COVID has driven new levels of participation in backcountry activities, and snowmobiling is no exception. New and experienced riders alike are seeking avalanche education, and the Bridger-Teton Avalanche Center (BTAC) and Wyoming State Trails are working together to provide classes throughout the state.

Over the three-day New Year's weekend, the BTAC hosted and funded outdoor three different avalanche education training segments for over 40 snowmobilers. The class attendees included male and female riders of various ages associated with the Rev It Up Girls Motorized Sports Club, The Jackson Hole Snow Devils, and young racers and members of their families who participate in the Rocky Mountain States Hillclimb Association racing circuit.

The class participants learned avalanche rescue skills, received avalanche awareness training, and Avalanche Level 1 field training skills. The instruction was provided by Mike Duffy of Avalanche1 based out of Eagle, Colorado, and Matt Schebaum and Will Mook with the Mountain Riding Lab based out of Victor, Idaho, and Jackson, Wyoming. The classes took place in Darby Canyon and in the Squaw Creek area out of Alpine with a 1 to 6 student to instructor ratio.



January 2 & 3 class in Darby Canyon. Photos Matt Schebaum of the Mountain Riding Lab

"Thanks again to Wyoming State Trails, Bridger-Teton Avalanche Center, and Teton Performance for putting on the training course surrounding avalanche burial rescue and basic avalanche training. Plan A and Plan B," says participant Jake Demarais. "I've been snowmobiling in the Mountains for approximately 10 years. I definitely lacked the knowledge of safely riding in the mountains



**Plan tours**  
**Navigate**  
**Share tracks and obs**  
**Analyze terrain**

With Gaia GPS, you can track your location and use topo maps offline. Plan tours and share tracks and observations with your team. Analyze terrain with satellite imagery, satellite-topo hybrid maps, and slope-angle shading.

Available on both iOS and Android



until I had the opportunity to take the class. I am definitely going to share the information gained with other snowmobilers so others can minimize RISK and keep enjoying the sport!"

Other classes held in January included: Six Points Avalanche Education gave an awareness course to 50 members of the Cody Snowmobile club; BTAC forecasters provided awareness training at the Smiths Fork Trailhead on Salt River Pass hosted by Star Valley SAR; and the BTAC team gave a level one class to 18 skiers from Sheridan at the Antelope Butte ski area in the Big Horn Mountains. We're happy to report that all classes were full.

Funding for these efforts was generously provided to the BTAC from the Wyoming State Trails Program via the BTAC Foundation. 🍷

Rebecca Reimers has been an avid Teton backcountry skier for over 30 years. She is proud to be working with the Bridger-Teton Avalanche Center Foundation to raise awareness of their important work and help ensure that it continues.



She can often be found lapping Glory in an attempt to wear out her insatiable powder pup, Calvin.

# FRACTURE MECHANICS AND REMOTE TRIGGERING

A remote trigger occurs when a fracture in a buried weak layer initiates and then propagates—creating an avalanche some distance away from the initial trigger point.

## Why teaching instability tests is important in motorized avalanche education

STORY AND PHOTO BY ERIC KNOFF

One common place to remotely trigger an avalanche is from ridgelines.



Another common location to remotely trigger an avalanche is from low angle or flat terrain connected to steeper slopes above.

**Remote triggering plays** a significant role in motorized backcountry avalanche accidents and fatalities. Over the past five years (including 20/21), there have been 36 motorized avalanche fatalities in the United States. During the same time period, there have been 71 non-motorized avalanche fatalities.

The 36 motorized fatalities are the result of 33 separate incidents, 22 of which could be considered the outcome of remote triggers (remote triggers do not have a standard definition so this is a rough estimate). Three out of the 33 incidents resulted in multiple fatalities, all of which involved remote triggering the avalanche from low angle terrain. Twelve out of the 33 incidents resulted in a single fatality but involved multiple riders being caught; all of these were the result of remote triggers from low angle terrain connected to steeper slopes above.

What exactly is a remote trigger? A remote trigger occurs when a fracture in a buried weak layer initiates and then propagates—creating an avalanche some distance away from the initial trigger point. One common place to remotely trigger an avalanche is from ridgelines. In this scenario, the rider or riders who remotely trigger the slide are usually safe.

Another common location to remotely trigger an avalanche is from low angle or flat terrain connected to steeper slopes above. When an avalanche is remotely triggered from low on the slope, riders become exposed to a higher volume and velocity of avalanche debris. This can lead to deeper burials and often more challenging rescue scenarios. It is also common for remotely triggered avalanches to involve more than one rider. This generally has to do with multiple riders being caught in an avalanche runout zone.

The bottom line is that motorized users can easily get into trouble when they remotely trigger avalanches, mainly from low angle or flat terrain connected to steeper slopes above. In most cases, it appears the victim or the victims party are unaware of the overhead danger. This suggests a general misjudgment of avalanche terrain and snow stability. From an avalanche education standpoint—teaching terrain recognition and management is the fundamental cornerstone of all motorized Level 1 classes.

While terrain recognition is paramount, it is also important to focus on the role that snowpack structure and stability plays in guiding terrain selection. When the snowpack is

relatively stable, there is much less hazard when riding in avalanche terrain. However, if the avalanche danger is elevated and there is a collapsible weak layer capable of propagating a fracture buried in the snowpack, it's important to consider how this may produce a dry slab avalanche a long distance from the trigger point.

A vast majority of remotely triggered avalanches occur when there is a persistent slab avalanche problem. Buried persistent weak layers such as depth hoar, surface hoar, or near-surface facets can propagate hundreds, or even thousands, of feet under the right conditions—making them especially tricky and dangerous. Knowing what the primary avalanche problem is and where it exists can allow riders to better select terrain and avoid being surprised by a remotely triggered avalanche.

Before heading into the backcountry, reading the local avalanche forecast is an essential first step in making informed decisions and a safe travel plan. Once in the backcountry, digging snowpits and conducting instability tests is a great way to assess snowpack and conditions first hand. Digging snowpits isn't high on the to-do list with most motorized users, but it should be emphasized as high priority for motorized avalanche education. Digging snowpits and performing instability tests such as the ECT and PST can be helpful when explaining to students the process of weak layer collapse and propagation. Watching and hearing a weak layer collapse and propagate during an instability test can be a real eye opener for snowpit newbies. It is also a great illustration of how remote triggering works.

It is important to remember that snowpack and terrain are interconnected. Understanding the basics of remote triggering is key to safe decision-making in the backcountry. Teaching snowpits and instability tests to recreational Level 1 students is a great introduction to the concept of weak layer collapse and propagation. Without an understanding of the basics of remote triggering and avalanche release, there won't be a full understanding of avalanche terrain. ●

# TEACHING SLEDDER TERRAIN USE

BY WILL MOOK

One of the things that makes snowmobiling such an exciting sport is the variety of terrain we can access on lightweight, agile, and powerful modern snowmobiles. Of course, this enables riding in big, obvious avalanche terrain, but over the past decade, the sport of mountain riding has also gravitated to steep gullies and trees. In addition, as a sledder, it's easy to suddenly find yourself in steep terrain unintentionally. With these shifts, it's imperative that snowmobilers develop their skills in recognizing avalanche terrain, working effectively with their riding partners, and knowing how to move through it in a way that keeps themselves and their group safe.

As a motorized-specific avalanche educator, I teach the AIARE motorized curriculum, heavily based on the AIARE field book, which serves as a checklist for riding groups. The day starts with an in-depth planning process that asks riders to review their group. In this stage, we identify potential challenges that could lead to decision-making errors: group size, health issues and human factors are overall categories. Then we discuss the weather and avalanche conditions. We view these first two stages of the planning process as an equation—our group plus the conditions equals our terrain mindset which is either “keep it simple,” “limit exposure,” or “step it out cautiously.” These labels are similar to the Canadian Avalanche Terrain Exposure Scale or ATES ratings of simple, challenging, and complex.

Once we identify our terrain mindset, we consider local riding zones where the terrain fits our mindset. The idea of classifying “riding zones” is fairly new, and similar to how skiers use run lists. By classifying riding zones in terms of the exposure to avalanche terrain, we can start to understand which areas are appropriate for certain groups and conditions.

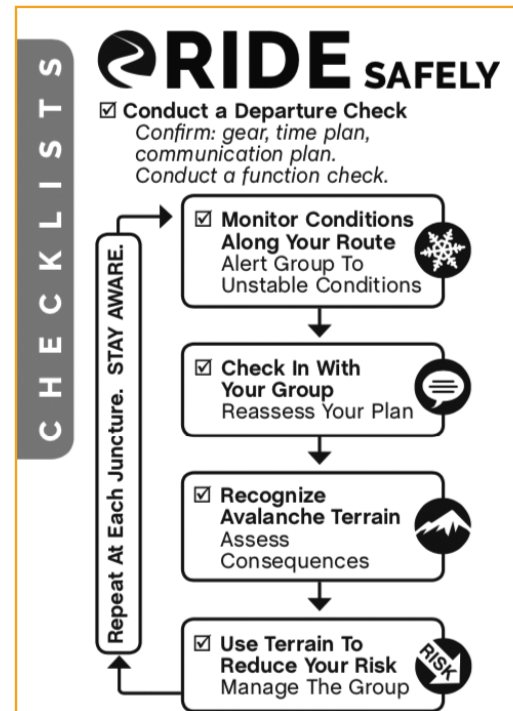
Once we're in our riding zone, we rely on our “Ride Safely Checklist,” which involves monitoring conditions, group check-ins (with motors-off), recognizing

avalanche terrain, and using terrain choices to reduce our risk. Riders use sleds to monitor conditions while out on their ride, seeking out inconsequential steep slopes to test the presence and reactivity of slabs. We also use our sleds to dig deep trenches as a form of a quick pit and look for weak layers in the snowpack. It's important to group up and discuss what we've seen and relate it to the terrain before moving into a new zone.

Before moving on, we identify where the avalanche terrain is located and discuss travel techniques such as riding one at a time with eyes on the rider, identifying islands of safety to re-group, and using radios to maintain good communication. We use this model to move through avalanche terrain, as well as when we stop and play on steeper slopes.

By using this planning process and Ride Safely Checklist, we can create a riding group that functions as a team. The process can feel awkward at first, but as it's practiced it becomes an easy, repeatable, and life-saving process that fosters rides where sledders make good, informed decisions instead of getting lucky. ●

Will Mook lives in Victor, ID, and is a full-time motorized-specific avalanche educator. After guiding at Togwotee Mountain Lodge for seven years, in 2017 he co-founded The Mountain Riding Lab, a company that teaches the AIARE motorized curriculum in northeast WY, southeast ID, and west central MT. When he is not teaching avalanche courses, or riding snowmobiles, Will is training his 5-month-old black lab to be an avalanche rescue dog.



Group check-in spot with a view. Which terrain is appropriate for today's conditions?  
Photo Will Mook



# A RAPID-FIRE MINDSET

Do snowmobilers think more than skiers?

BY GRAHAM PREDEGER

DECISION-MAKING CAN  
FEEL TEN-FOLD GIVEN  
THE FAST-PACED  
SPORT OF MOUNTAIN  
SNOWMOBILING  
COUPLED WITH THE  
EXTRANEOUS HAZARDS  
OF MANEUVERING A  
600-POUND MACHINE  
THROUGH A DYNAMIC  
WINTER ENVIRONMENT.

Seattle Ridge is on the motorized side of Turnagain Pass, with spectacular views south up Turnagain Arm. Photo Graham Predeger

Whether you use a snowmobile to access far-fetched zones or gluttonously lap easy-to-access pow stashes, the mountain snowmobile really is the greatest invention in winter recreation since plastic ski boots. Prove me wrong! More and more backcountry skiers (and forecasters) have come to this realization in recent winters. Chances are that if you're reading this and you don't have a snowmobile, you've considered the purchase, or at least dreamt about riding a machine into favored zones only to arrive with fresh legs and a full day of blissful pow ahead.

As someone who spends equal time on both sides of the highway at Turnagain Pass (west side is motorized; east is non-motorized) in southcentral Alaska, I feel confident in saying that sled skiing and snowmobiling in avalanche terrain assumes a different, more intensive and taxing thought process than ski touring. As we know, machines can cover a magnitude of 10x more terrain on a given day than a ski tourer. Concurrently, decision-making can feel ten-fold given the fast-paced sport of mountain snowmobiling coupled with the extraneous hazards of maneuvering a 600-pound machine through a dynamic winter environment.

As a professional educator and 'sometimes' forecaster, I dig snow pits most days to track and test weak layers, but as a Rec Level 1 instructor I stress high-quantity, quick observations, and rapid-fire decision-making to motorized students. We spend time in the snow pit as well, but it's

the rapid fire, on-going info gathering that students find most useful. Scanning for red flags, side-hilling small test slopes, and simply stepping off your machine to feel the snow all build confidence in managing terrain, identifying an avalanche problem, and developing or changing our strategic mindset (Atkins, 2014) throughout the day. At every stop, students are challenged to vocalize how they will manage the next piece of terrain based on their assessment thus far, identify a route and the next safe spot to regroup. This is done potentially dozens of times throughout the day giving students a chance to practice and provide feedback to each other.

While this isn't groundbreaking information or all that different from a skier-based rec Level 1 course, I would argue that the quantity of decisions and access to information is greater than that of our ski touring friends. In an hour I can be three ridges back and 15 miles from the trailhead with a group of skilled snowmo-students. As a group we have tested a dozen or more slopes, traveled through several elevation bands and touched aspects on all four quadrants of the compass en-route to an objective. On any given day, when motorized users travel like that, likely hundreds of decisions are made. In class, dozens of these decisions are made in the conscious mind with opportunities given for level 1 students to practice and gain experience in rapid decision-making. The goal is to start building solid pattern recognition for all the other subconscious decisions where we rely on mental shortcuts to cut out the noise, not simply relying on luck.

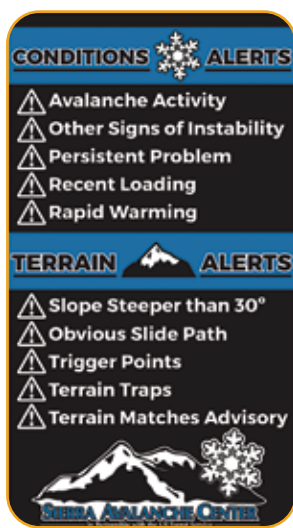
Appropriate travel protocol (one at a time in avalanche terrain, seeking out true safe zones, etc.) and strong rescue skills will continue to be two pillars of any Rec Level 1. However, we may be able to improve as educators demonstrating and practicing decision-making on a temporal and geographic scale useful to snowmobilers if we can continue to train mountain riders to gather, analyze, and internalize information at speed throughout the course of a day. With this emphasis we truly bring decision-making to the forefront of our travel through avalanche terrain. ■

Graham Predeger works for the Chugach National Forest in Girdwood, Alaska managing recreational opportunities in the summer and winter. He's a 'sometime' forecaster with the CNFAIC and a senior instructor focusing on motorized avalanche education with the Alaska Avalanche School. It's no surprise to him that after a couple days of sled-skiing he's physically and mentally spent.



# MOTORIZED EXPOSURE EVOLVING

BY TRAVIS FEIST



Paying attention to recent avalanche activity.  
Photo Will Mook

Many non-motorized avalanche pros might not know how significantly motorized terrain use is changing with lighter and more maneuverable machines. This change is flipping the script regarding avalanche exposure. The old style of mountain riding had a default position of exposure, and required riders to identify and seek out areas with less exposure (no longer called “islands of safety”). The new style has a default position of less exposure. The difference in style is like that between skateboarders riding a halfpipe one-at-a-time, and a group “sessioning” a skatepark all at once but spread across a variety of smaller features.

Old snowmobiles were difficult to ride, and limited terrain options. To move from one drainage to another, riders had to “highmark” treeless slopes, with each rider using the previous rider’s packed trail to sequentially gain more elevation. Like skaters in a halfpipe, the riders highmarked one-at-a-time, with spotters watching from a distance. Although the basis was utilitarian, highmarking became its own thing, and continues to be a high visibility activity.

But because the default position for this style of riding is exposure, many avalanche accidents occur when its participants fail to identify and use areas of less exposure. Fortunately, savvy riders have an alternative that’s gaining popularity.

As snowmobiles become lighter and more maneuverable, and dirtbikes get converted to easy-riding snowbikes, terrain use is shifting



away from big, open slopes and towards more nuanced terrain. Like skaters sessioning a skate park with several small features, modern snowmobilers and snowbikers “play ride” simultaneously through treed slopes, gullies, and steep lumps and bumps. Riders use group management techniques appropriate for less exposed terrain.

The difficulty with this new, more dynamic style is for participants to recognize when their default position of less exposure shifts to more exposure, and to make spacing and spotting adjustments accordingly. They need a simple, well-defined way to maintain awareness and manage their group without overburdensome interruptions.

The Sierra Avalanche Center teaches riders such a process. It’s printed on two stickers to place on machines for easy reference. One sticker describes the overall process, while the other helps riders maintain awareness of conditions and terrain. SAC teaches avalanche classes where students learn to use the process, and also to appreciate the new style of riding in less exposed terrain. ●



Travis Feist works as Education Coordinator and Professional Observer for the Sierra Avalanche Center, and loves the smell of a two-stroke in the morning.



# MOTORIZED USERS ANALYZE TERRAIN ON THE FLY

BY MIKE DUFFY

**Situational awareness** in avalanche terrain comes from years of training and experience. The primary focus with many riders when looking at terrain: they're wondering if they will get stuck, if they can make the line, or what their plan B is. I'm definitely looking at those things, but my primary focus is different. I'm analyzing the terrain and snowpack as they relate to avalanches.

## REALITY:

Motorized users cover terrain at a fast pace and must analyze as they go. We don't plan exact routes, we go where it looks good and where the snow is untracked. We don't have to be efficient, we have horsepower. It can be easy to miss things and you have to be constantly engaging the brain for success. **To avoid getting caught in an avalanche, you must analyze quickly on the fly.**

## YOUR VEHICLE CAN TELL YOU ABOUT INSTABILITY.

Are you getting stuck in snow that is faceted? Is your ski suddenly diving or breaking through to deeper layers on powder turns? Are you trenching and shouldn't be? Is there a distinct slab between your ski and track impression? Is the snow cracking, collapsing, or feel hollow? We can miss many clues due to the sound of our machine and the pace we are going. When I stop, I shut off the sled and listen for the feel or sound of collapsing as other sleds approach.

## WHAT I'M OBSERVING WHILE RIDING:

- Slope angle. Is it steep enough to slide? Practice with an inclinometer.
- Aspect in relationship to avalanche problems of the day?
- Where would the avalanche take me? This includes: trees, cliffs, rocks, creek beds, depressions and v-shaped valleys
- Where is the mass (if it avalanches) in relationship to where I am? More likely to survive if the mass is below you.
- What's above me? Can I remotely trigger.
- **Am I stopping in a good place or am I in the runout zone for an avalanche?**
- How far are the avalanches running?
- Where are other riders in relationship to me? Can they trigger something and take me out.
- What's my plan B or escape route to get out of this situation? Is there an escape route?
- What are the potential trigger points on the slope and what is the best route to avoid triggers?
- Are remote triggers a possibility today? What's the avalanche problem? Persistent and deep persistent slabs can often be triggered remotely.
- Does someone have an eye on me if something goes wrong?

It's a lot to think about; it becomes second nature when you do it all the time.

A rider cuts above you? You're automatically looking for an escape and keeping an eye

on what's happening. You're boondocking and break onto a slope that isn't a good place to be on that day, you're pulling a quick 180 or getting to a better location quick. Someone drops down into a suspect slope, you don't have to follow. Find an alternative route. You're riding a creek bed and it gets narrow and steeper with larger open slopes above you? Time to change your plan. Someone stops, you analyze right away if it's a good spot. A rider gets stuck, do you help? Will your weight trigger an avalanche and both of you get caught? This happens every year. Let them dig themselves out. It's a thinking game, picking the right terrain and route for the avalanche problems.

## SLOW DOWN THE PACE, STOP AND LOOK.

As you're driving to the trailhead be looking for recent avalanches and wind activity. While you're riding, if the sky clears, stop and look around for instability. Those few minutes can open your eyes to what is really going on. Forecasters can't be everywhere, you may be the first into the area, observing is essential. Those who are the most observant tend to win.

## SPEAK UP.

We've all been in the situation where someone is making a bad terrain choice for the conditions. If you're not comfortable with it, the best advice I can give you is to speak up. Hit the brakes, get on the radio and let them know why you're not good with it. Don't just follow. So many accident reports state that other people in the group thought it was a bad idea, but didn't say anything. Most accidents involve the human factor in decision making, meaning we don't make good decisions all the time and there are other things influencing the decision. Speak up. ●



**Mike Duffy** is Director and Lead Instructor at Avalanche1. He travels annually across the country presenting sled-specific avalanche safety training at snowmobile dealer and club locations.



Terrain discussion spot.  
Photo Will Mook



# TIPS TRICKS INSIGHTS FOR MOTORIZED AVALANCHE EDUCATION

BY JAMIE WEEKS

**TOUR PLANNING** Any day in the mountains should have some sort of Tour Planning component. A day of motorized travel in the mountains may cover numerous miles and many different types of terrain; your travel is complex therefore your Tour Plan should be as well. Using resources such as Gaia, Cal-Topo, and Avenza, I introduce the **Avalanche Terrain and Exposure Scale**, (ATES). I will have the students identify, label, and color code Non-Avalanche, Simple, Challenging, and Complex terrain features and install this layer onto their mobile device for use in the field. After reviewing the Daily Avalanche Forecast we choose which terrain features are appropriate and Tour plan accordingly. While using these digital mapping resources I introduce the concept of “**Test Slopes**,” which are small, low consequence sites that have a similar aspect, angle, and elevation to an area you may want to highmark. When in the field I will encourage students to evaluate and potentially ride these test slopes before heading into larger and more committing terrain features. I also use the Tour Plan discussion to identify smart regathering spots using alpha angles near any potential highmarking zones but more importantly will demonstrate alpha angle measurement in the field.

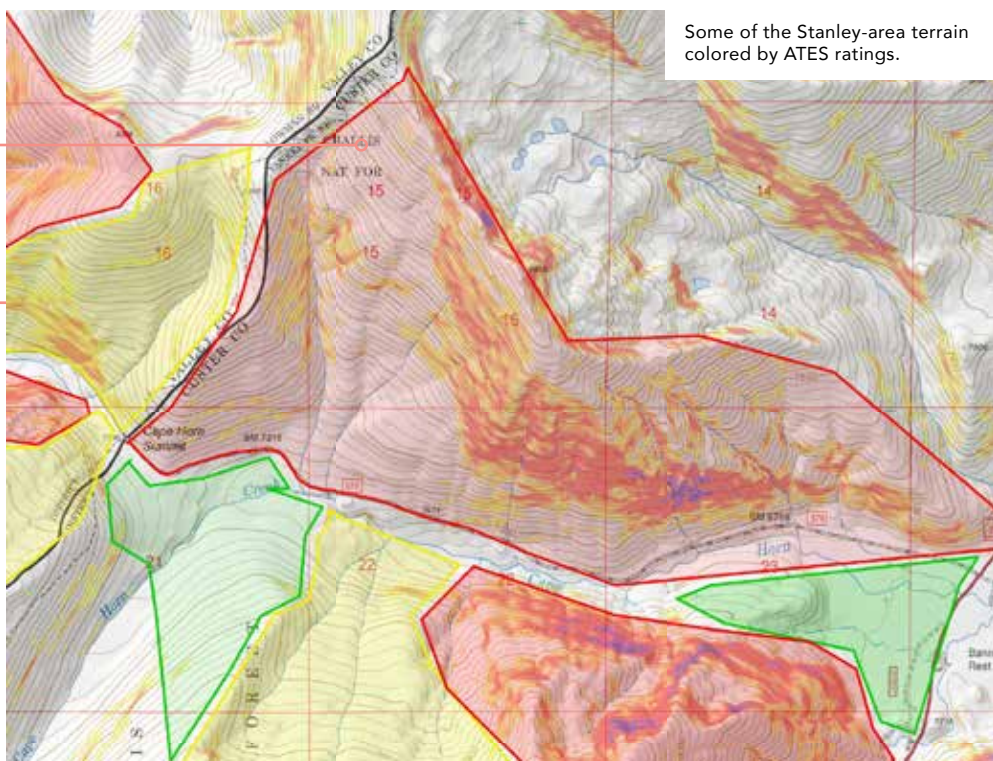


Photo Will Mook

**COMMUNICATION** Communicating with students on a motorized avalanche course is incredibly challenging. Full face helmets, engine noise, and distance between riders are only a few of the difficulties an instructor will face. I have found that frequent stops at relevant terrain features have more benefit than one long bone-chilling stop. I kill the engine at every stop and remove my helmet to interact face-to-face with the students. These frequent group stops encourage group discussion but do not allow for any 1 on 1 time with students who may not be engaging or need some privacy to ask the questions they may have. I will find an excuse to interact with a student like this when the rest of the group has started up and begun moving, preferably into a meadow for some pow riding vs. trail travel.

## HIT THE BRAKES.

GET ON THE RADIO AND LET THEM KNOW WHY YOU'RE NOT GOOD WITH IT. DON'T JUST FOLLOW. SO MANY ACCIDENT REPORTS STATE THAT OTHER PEOPLE IN THE GROUP THOUGHT IT WAS A BAD IDEA BUT DIDN'T SAY ANYTHING.



Some of the Stanley-area terrain colored by ATES ratings.

**DEBRIEF** The debrief after a day of motorized avalanche instruction absolutely has to happen somewhere other than the parking lot. The parking lots are way too busy these days and the noise and other distractions make it impossible to communicate. I usually choose a site about a mile away from the trailhead to review the day. ●

**Jamie Weeks** is an AMGA Certified Splitboard Guide. Jamie's guiding career has taken him from Jackson, Alaska, New Zealand, Norway, to now Idaho. He has used chairlifts, trams, nutcrackers, snowcats and helicopters to access terrain and now prefers to burn fossil fuels with his SkiDoo. When the snow melts Jamie follows it down the Middle Fork of the Salmon and the Selway each summer.



**We've lost our way with  
backcountry messaging.**



Early last year I was very lucky to capture an avalanche in motion on Mount Shuksan while my camera was on the tripod. *Photo Sergio Rojo of Bellingham, WA*

**We can't do much worse,  
how can we do better?**

# We Have a Problem

BY PETE EARLE

often than not, Dad held the gate open for the wife and kids.

What do we do? Chalk it up to Darwin and natural selection? Tell that to the husbands and wives, let alone the children of those who died. Tell that to the patrollers and SAR responders who attempted CPR on the one-hour burial and who were exposed to the elevated risk of a backcountry rescue/recovery. No one is winning here.

Erect memorials to former victims? Grisly photos showing victims in burial position—that'll change their minds, right? That strategy certainly attempts to solve the empathy gap, but in this case, that gap is a mile wide. These folks don't even realize what they're doing is unsafe.

Tap the local backcountry community? Encourage and enable peers to educate the fish out of water? That's great until frustration mounts and discussions morph to insults and "jerry" callouts.

How about a transceiver/shovel/probe to exit? That's a start, and at least they're searchable for the patrol/SAR team. They can leave their dogs and probe lines within the resort where they belong. Whose responsibility is this? Patrol has a full-time job managing the resort that's paying them to keep guests safe. There are hundreds of users using the exit gate every weekend, better hire a few more patrollers for the backcountry, that's the point.

Move the gate somewhere else? Make it a longer hike? There are slidepaths along the whole ridge, nowhere is free from danger. If the gate moves lower, folks will put in a traverse at mid-slope instead of upper-slope. Might be more dangerous in the end.

Remove the gate? Hell no. That's public land and I have every right to access it! It's not my fault that folks who didn't know better died! That's the only non-private backcountry access for thirty miles. Don't punish all for the actions of a few! All flippancy aside, there are enough backcountry access issues, let's not voluntarily create new ones.

At this point I'm asking for help. What changes or messaging has worked for you or your resort? What hasn't? Please reach out to [peter.l.earle@gmail.com](mailto:peter.l.earle@gmail.com) if you have possible solutions. Just under half of the avalanche fatalities in Utah since 99/00 have been from resort access users. That's 17/37 if you're counting at home. Over half of those (9) happened at my former resort. We can't do much worse, how can we do better? ●

BY DREW HARDESTY

So there's this guy who stumbles out of a bar and wanders over to the streetlight. It's late at night. He bobs and weaves, squinting down at the ground beneath the lamppost. He steps a little to the left, and trips a little to the right, all the while staring at the ground.

After awhile, a cop pulls up and asks the man what he's up to.

The man says, "I'm looking for my car keys. I dropped them when I got out of my car."

The cop replies, "Where'd you park your car?"

The man says, "Down the street, but this is the only place that I can see."

Since 1980, we at the Utah Avalanche Center have grown in so many ways in order to spread the gospel of avalanche safety and while it's true that avalanche fatalities have flatlined (or slightly diminished) while backcountry use has skyrocketed, we still have work to do. The avalanche fatality in Dutch Draw on Friday January 8th was particularly troubling. A 31-year-old male leaves the 9990' lift at the Canyons resort and center-punches the run Conehead without avalanche gear or realization that avalanche accidents are more than an abstraction. He is dead within 30 minutes. He is the third avalanche victim in Dutch Draw since 2012.

The question I have is this—

How will we ever find the keys to the car if we're only looking where we can see? What are other solutions that we haven't considered?

We, and the family and friends of avalanche accidents prevented in the future, thank you.

—Drew

*Editor's note: since the January 8th avalanche, another skier was killed on Squaretop in the Canyons sidecountry on 1/30/21.*



**W**e have a problem. We've lost our way with backcountry messaging and our user numbers have grown exponentially. I'm not here to debate "side-country" or "slack-country," that's so 2013. (see TAR 31.4 and 32.1). It's all out-of-bounds and un-mitigated. We seem to agree that it's all backcountry, but we also know different users are utilizing varying parts of the BC. Low hanging fruit outside a resort exit point attracts a different crowd than a multi-mile approach.

The question becomes: how can we impactfully alert the resort-exit user that they are entering the backcountry? There are lots of tracks on the slope, it funnels back to the resort, and everyone else is doing it! BTW, the resort is totally tracked out. "You can die" signs with skull and crossbones and wordy Forest Service warnings are not getting the job done. The posted avy report that you just walked past? Meh. Automatic beacon checker? What's a beacon?

As a former patroller at a resort with many fatalities from resort-access backcountry use, I can also tell you that having informative discussions at the gate with unprepared users is a non-starter. Talking to uneducated, ungeared, potential users resulted in maybe 20% turning around after learning the scenario and risk. More



# STARFISH

STORY AND PHOTOS BY JAKE HUTCHINSON

**Authors Note:** This article was started in the closing days of January 2021, just after the Square Top (Park City, UT) fatality and just before the world came a bit unhinged. From 1/30-2/8 the US saw a streak of 16 avalanche fatalities, a number unmatched since 1918. But really this article started long before that, as a 20+ year avalanche educator, my goal has always been to provide tools so people can make appropriate decisions based on their personal risk thresholds. A conversation with a student in mid-January turned a nagging thought into one I couldn't shake. We are missing the mark with messaging in a significant chunk of our target audience. To be clear, I am not trying to sound defeated or defeatist, quite the contrary actually. I am acknowledging that we do quite well, and what we do DOES save countless lives, but I am also acknowledging a gap that we need to find a way to address. As the events of early February unfolded, this piece evolved from my own stream of consciousness into a collective one. You will see excerpts from various conversations I've had in person, on social media and through text. The goal here is to evoke thought, not to condemn or discard any efforts to date. Thanks.

**I**t all started with an Instagram post. As a few details leaked my way via various sources on the morning of January 31, I was filled with a sense of dread. First for my friends and former co-workers on the Park City Ski Patrol who would be first making Square Top safe, and then venturing to recover and transport another avalanche victim. Second, I couldn't help but think this was potentially someone I know. The limited info I had certainly seemed to point in that direction. (Turns out we had met; I can't say I knew him, but a few friends were quite close to him).

## 2021-01-31 From Instagram:

Took the time to sit and be still for a few minutes this morning. Thinking about my friends who are gearing up to go outside and recover another avalanche victim in the Wasatch. It's a thankless and depressing task and I appreciate what they do. I've been an avalanche professional and educator for nearly 30 years. I watched the evolution of our understanding and the messaging around it, I've learned, evolved, and tried various ways to help people understand the nuance of snow and tried to provide methods and tools to help people make better decisions.

In the last two years I feel as if the message keeps missing the mark. Despite best efforts, we (educators and forecasters) sound like nagging parents, Chicken Little screaming the sky is falling, or even worse, Nancy Reagan preaching to 'Just say no.' I think the harder we've tried to not sound like this the more we actually have become what we set out to never be.

I don't have the answers. It isn't closing access or more signs. It isn't more apps and gadgets and it isn't over dramatized 'scared straight' type videos and forecasts. As the backcountry explodes, more accidents will occur; it's just the law of averages...

Anyway, to those mourning the loss, I know it hurts and it sucks and I'm sorry for you. For those going in to do the dirty work, make sure you take care of yourselves and each other. And for everyone else, chill the fuck out. It's a ski run and it ain't worth dying for, not in a lean year or a fat one. It's about coming back for more runs day in and day out, year after year, and hanging up your boots when you can no longer walk up the hill.



**So what?** In the coming days, this post would trigger dozens of comments, conversations and reposts, some very public and some very private. As details became public, and subsequent avalanche events began to occur, something was very evident: these weren't novices, unknowingly walking into the lion's den. These were people with experience and education. They carried the requisite tools and seemingly understood the forecast. The avalanche in Utah on 2/6 would be the scene of a both heroic rescue effort and the greatest single incident loss of life since the early 90s (Talking Mountain Cirque, La Sal Mountains Feb. 12, 1992). I've been at this a long time. I only remember a handful of accidents involving two or more people, but three mass casualty incidents in one week is still hard to fathom, let alone digest. Sprinkle in six more accidents involving single fatalities (including one in New Hampshire) and you have the most devastating single week the US has seen in modern times. I am a critical thinker, I'm also not satisfied with good enough. My brain has been in overdrive. I don't expect it to find a solution, but I believe we need to take a hard look at how/what the messaging around avalanche safety is delivered.

\*\*\*

Let's face the music. As a species, humans are generally not great decision-makers. We make incorrect or wrong decisions all the time. The good news is that we are generally quick learners, we make a mistake, we look at the other possible outcomes, and try again a different way, often succeeding and putting the two experiences into our memory banks and moving forward, very rarely repeating the same mistake. And herein lies the problem with avalanches. In so many cases the person (or people) who made an incorrect choice are never afforded the opportunity to evaluate, learn, and try again. Each venture into the mountains and each line dropped is a potentially one and done event. There is no opportunity for hindsight and those not involved are left trying to put the puzzle together.

\*\*\*

In the next few days, numerous avalanche professionals would start conversations with me like this:

*"What a dark week..."*

*"This is kind of an out of control week. Head is spinning a bit heading out to teach last day of L1 today."*

*"Is this the new normal?"*

We're all thinking it. What could we have done better? Could we have done anything better? Have we unlocked a door into the mountains that people may not have been ready to step through?

\*\*\*

A student in mid-January called me a hypocrite. He alluded to the fact that I kept preaching to people not to ski things, but I was out skiing. I was taken aback. I don't think I ever said not to ski something, I thought I always encouraged people to make appropriate

Hanging snowfield tracks, headed to look at natural avalanche on the Park City Ridge.



A quiet day in White Pine, Wasatch Range, UT.

terrain choices for the avalanche problem. But if this is how my message is landing, something has gone horribly amiss in the delivery.

\*\*\*

*"I feel like we are all doing what we can. But how does the cultural shift occur where people stand back and say—"I cannot manage this problem." It would appear people believe they can be their own expert and outmaneuver a problem in the terrain."*

—Text message from a fellow educator

So let's talk margins. The concept that you give yourself enough room that a fall won't carry you over the edge, a minor mistake will stay a minor mistake, and we live to ride another day. I like to think of margins as the padding that help protect me from human bias and decision-making folly. Run a wide margin, you may miss out on a good ski run, run too narrow a margin and your day could go to absolute hell.

I've always looked at avalanche education as a way to help people set appropriate margins, give them tools to go out and enjoy things with some peace of mind and confidence. Which means we are by default, helping people narrow margins. My question: is a moderate level of knowledge, reinforced by some years of experience (we rarely get feedback that we 'got away with it'), fooling us into thinking we know more than we do? Shrinking the margins even more and by default, pushing people to an edge that will not tolerate mistakes?

We are a fragile species, ill-equipped to survive the wild world around us without clothes, tools, shelter etc. We are also an irrational species, one that will observe signs of obvious danger and justify our actions based on training and experience or a tolerance for

**In so many cases the person who made an incorrect choice is never afforded the opportunity to evaluate, learn, and try again.**

risk. We also have a tendency to see how close we can get to the edge without going over. The problem with this risk threshold experiment is that we often miscalculate the edge, or the consequences of that edge.

*"There's a definite disconnect that is further amplified by a culture of doom, despondency, and dread. The idea of a hero's death rests in our collective head space as a means to feel less finite and more relevant. Risk taking doesn't have to be a neurotic endeavor. Unfortunately, when we deify risk takers this makes individuals who are feeling the heavy weight of finitude more vulnerable to the idea that a hero's death in the mountains is worth the risk. Neurosis needs balance. It's pretty cliché, but maybe we should celebrate the mountains more than the woman or man who takes risk in them. An honest connection to landscape holds a wealth of value for the troubled human mind. This is not to take away from the value of the visceral stoke that comes from stepping out of a heli or suffering to a lofty summit. Just a bit more balance and a dose or two of gratitude for life on earth might do us good."*

—Ryan Howe (from a Facebook conversation)

Dopamine. It's the drug of choice for nearly all of us. The dopamine hit from an epic powder run is amazing. The dopamine hit from attaining a summit for the first time, or enjoying a post ski day beer with the amigos is pretty epic as well. Dopamine is how we use positive reinforcement to train dogs, and in the same way it unwittingly trains us. Each ski run we make that doesn't have a consequence subconsciously reinforces a behavior. It's like bad dog training. If my dog, Colt, gets away with a particular behavior or action multiple times, he no longer thinks of that behavior as having a negative consequence. If I reward said behavior, he begins to enjoy it and it becomes normal and is performed without much



Breckinridge patrollers investigate their handiwork during a Pro 1 course.

thought. But if I come home one day and decide that behavior is no longer desired and punish him for performing it, he is completely lost and confused. He did the exact same thing that has rewarded him so many times in the past, but this time he was punished. What gives? Skiing the backcountry is no different, with one major exception—we have no way to truly know how close we were to getting punished on any given day, therefore we begin to get desensitized to danger and consequences. When things go wrong, we are hurt, confused, and unclear about how an established behavior suddenly went so wrong. A quality debrief can help us learn, but too often this is overlooked or disregarded in the aftermath of a traumatic event.

Each *like* on our Instagram feed is a tiny hit of dopamine. A comment or *like* from a respected peer or athlete is even bigger, which is a primary reason why social media has such a grasp on us. And, like all drugs, over time we require a bigger dose to get the same pleasure. People want to see photos of the steep and deep, big air, pushing on in the face of punishing weather conditions and the occasional blooper shot. The pictures of turning around or group discussion aren't that sexy. While I don't think any of the recent accidents were unduly influenced by social media, I do think it plays a part. Information overload. We have more information about current and past conditions at our fingertips than ever before. Mapping apps to show us slope angles, access to remote weather stations and cameras, current avalanche observations, and the social media feeds of all of our friends and influencers. I think it's too much. Decisions are no longer being made about the snow under people's feet, they're being made with all of these other factors in our heads. Someone skied X today, so I should be able to ski Y today. Ski destinations once described as 'Suptours' that we planned for days or weeks in advance now happen as an afterthought before sunrise, before people go to work. Going fast in the mountains can be the safest way to move, it can also be the most deadly—you just don't give yourself time to absorb and sort

all of the information the mountains have to share.

\*\*\*

I've rambled enough, although I could go on. As each thought spills out of my head, three more pop in. I know that for the majority of the users out there, our education paradigm is working well, and I also know that however or wherever we evolve it, it will likely continue to work for them. I've never been satisfied with good enough. I will continue to ask hard questions, I will not shy from critical thinking and evaluation in an attempt to preserve feelings. Feelings mend with time, but dead is dead and it's game over. In the end, people made mistakes, choosing inappropriate terrain given the avalanche problem and snow conditions of the day, causing accidents in which 16 people died (*editor's note: 33 fatalities as of March 15 in the 20–21 season, 26 of those in February*). This isn't shaming, this is fact. In some of these cases the avalanche conditions were less subtle than an oncoming train and in others they were a little trickier, but still not completely unforeseeable or unpredictable. So, as I always have, I will dissect and evaluate the reports, I will read the witness statements that are available and I will continue to look for keys to unlocking better ways to communicate with more people. In the end, I have no hallucinations of grandeur that I can save humanity from itself, nor will I walk away from a career I truly enjoy. But if I can help one more person to make a better decision than I did yesterday, we are moving the right direction. ■

**Once upon a time,** there was an old man who used to go to the ocean for exercise.

One day, the old man was walking along a beach that was littered with thousands of starfish that had been washed ashore by the high tide. As he walked he came upon a young boy who was eagerly throwing the starfish back into the ocean, one by one.

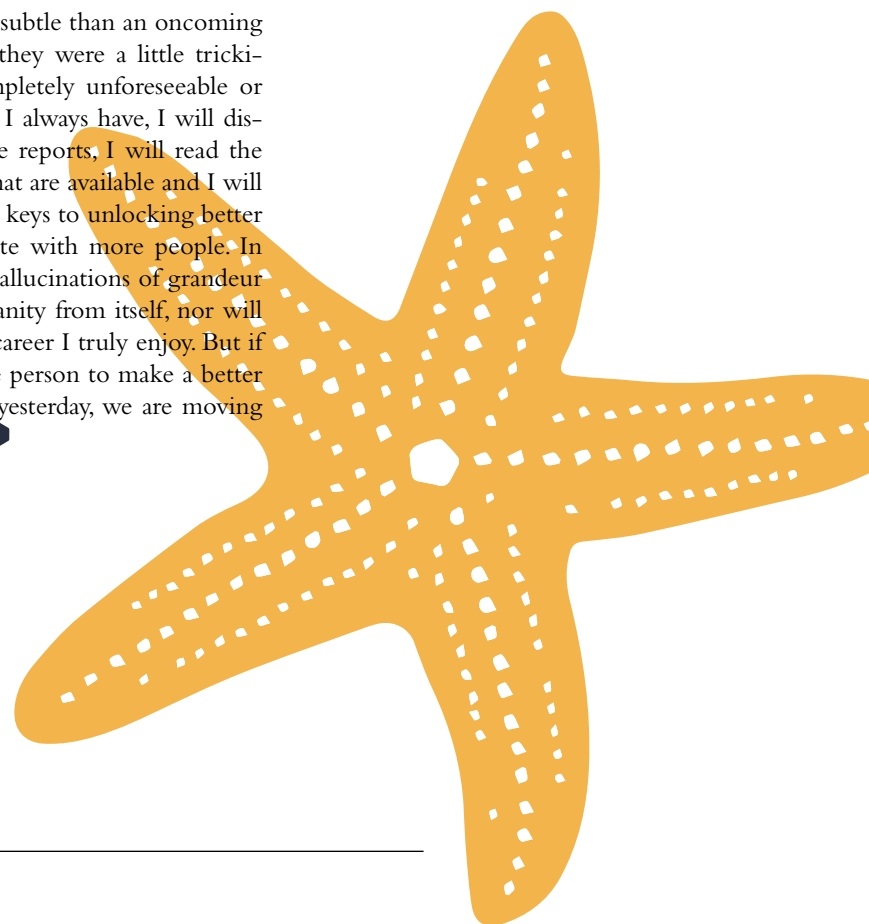
Puzzled, the man looked at the boy and asked what he was doing.

The young boy paused, looked up, and replied "Throwing starfish into the ocean. The tide has washed them up onto the beach and they can't return to the sea by themselves," the boy replied. "When the sun gets high, they will die, unless I throw them back into the water."

The old man replied, "But there must be tens of thousands of starfish on this beach. I'm afraid you won't really be able to make much of a difference."

The boy bent down, picked up yet another starfish and threw it as far as he could into the ocean. Then he turned, smiled and said, "It made a difference to that one!"

—Loren Eiseley



# It's Not Your Fault

BY DR. SARA BOILEN

**D**ear Avalanche Professional,  
It's not your fault.

Trust me, I'm a doctor.

Well, not that kind of a doctor but I'm a Doctor of Clinical Psychology and perhaps that is even a bit more relevant to this discussion.

I see you: riddled with guilt as you wander among the debris piles and wander, loosely dissociated, into the burial pit. I have heard your daily anxieties as you overthink your forecast and obsess over your words. I've gotten emails from you in the night, when you should be sleeping, but can't.

And I need you to know this: it's not your fault.

Hang with me as I explain. As a clinical psychologist, I often find myself in the unique position of feeling fiercely compelled by the stories of my clients, fantasizing, perhaps desperately even, that my words may shift their path, get them back on track, resolve their anguish, somehow alleviate their suffering. And sometimes it even feels like they do; that my care and accountability offer something of a protective factor to those who need it most. But often, they do not. My words have little effect on eroding years, decades, perhaps even generations of adaptive structures that at some point worked well to keep this person afloat. Perhaps in my office, they will find clarity and at the bar, they order another.

And I, like you, have to let it go.

For two reasons.

First, it simply isn't yours to carry. People are these (rather predictably) irrational beings who make decisions frequently outside of their own best interests. Stoke and fear are master manipulators of logic and send people down slopes only hours earlier they swore off for the day. Communication and interpretation are impossible enemies; they collude to make decision-making a challenge for even those of us who converse for a living. Mistakes are a part of life and while the mistakes in our lines of work are sometimes profound, even fatal, they are still a part of the process. As parents must acknowledge both their weighty influence and profound irrelevance in their children's lives, we must hold this truth: we cannot predict how the things we write (say) land with our intended audience and that how someone behaves is quite literally beyond our control. Read that again, if you have to, which you might.

Second, it just isn't sustainable for you. It is just not possible to carry the weight of an entire forecasting region's uncertainty. Your plight is noble and your intentions good, but I suspect that many more years of this burden will render you less able to help those you set forth to benefit. Your community needs you to build a tiny little semi-permeable membrane around your heart so that you continue to feel the grief and sadness right alongside your brethren but so that the guilt and self-blame are kept out, where they belong.

Sincerely,  
Dr. Sara Boilen

Sara Boilen holds a doctorate in Clinical Psychology from the University of Denver. She runs Sweetgrass Psychological, a community minded practice in Northwest Montana. She is a committed skier and mountaineer and has been working to combine her professional and personal passions by advancing the avalanche community's understanding of human variables for the past five years.



BY DREW HARDESTY

**H**i Sara,  
What wonderful timing. I've been forecasting for 20 years now.

You sent the letter to Lynne (my dear friend Lynne) Saturday morning. I put out a HIGH avalanche danger that morning.

The avalanche that killed four people occurred a few hours later.

Lynne forwarded your *Dear Avalanche Professional* letter to me that night.

I don't feel guilt but I do feel sorrow and grief with the families and friends. I know people look to us to help with that. As a young avalanche forecaster, I had no idea that we would be one part snow scientist, one part risk communication specialist, one part "country doctor," if you will. I have long worked in the Tetons as a Jenny Lake climbing ranger and life, death, joy, sorrow have always been front and center to me and my wife.

I remember your piece in TAR from a few issues back. Thanks Sara. You are doing important work and making an impact with our community.

—Drew

Drew Hardesty is in his third decade of avalanche forecasting at the Utah Avalanche Center. He's given up writing essays for other art forms: letters, parable, and satiric cartoons (see TAR 39.2). He and his wife Zinnia welcomed a new trailbreaker into the world in March.



Don't you want to peel your skins and drop in right this minute? Photo of Maybird by Billy Haas

# Tired Bodies, Tired Brains

## Decision Fatigue in High Risk Environments

BY RUSS COSTA

**Distraction and fatigue deplete cognitive resources, which leads to increased reliance on heuristics in decision-making by all individuals, whether expert or novice.**

I'm tired. I'm tired at the end of a long semester, and tired of having to re-learn how to do everything in new ways. I'm tired after a year of managing unexpected new demands and stresses placed on my own health and safety, as well as on that of my students, colleagues, family, friends, and neighbors. Oddly, I'm tired from spending more time sitting and staring at laptop screens as opposed to working on my feet. But I'm not fatigued like I often am after a long ski tour or a bicycle ride. I'm mentally fatigued from making a lot of arduous decisions for the year. And I'm sure many of you are feeling this mental fatigue as we are deep into this snow and avalanche season.

Early in my training in neuroscience, and later from a Buddhist backcountry mentor, I was taught to eradicate the Western notion of dualism of mind and body from my understanding of human thought and behavior. The brain, and thus the mind, IS the body. As such, mental fatigue is physical fatigue, even if humans don't typically notice, or respond and adapt to tired minds/brains like we do

tired legs or lungs. And this mental fatigue has consequences—consequences that can be serious, even deadly, in high-risk spaces such as avalanche terrain.

Theories and empirical data from many corners of cognitive science suggest that mental energy is limited in supply. Neurologist and psychoanalyst Sigmund Freud theorized that the rational ego could become depleted, allowing for the instinctual and irrational id to dominate behavior. Cognitive psychologist and behavioral economist Daniel Kahneman argues that attention is like mental fuel, and when in short supply in times of distraction or fatigue, humans are more likely to default to cognitively cheap and easy *heuristics*, or mental shortcuts, in their decision-making. Social psychologist Roy Baumeister coined the term decision fatigue to explain how the quality of decisions deteriorates as individuals tire during long sessions of decision-making. Models of decision fatigue have been applied to many high-stakes settings, including parole decisions by judges, where researchers found that favorable decisions decreased as judges' daily decision-making sessions went on, concluding that tired judges deviated from more rational, deliberative reasoning as they tired mentally. Interestingly, decision quality rebounded significantly after judges took food breaks. This is all worth pausing to think about in your backcountry outings and decision-making sessions, especially as they become crammed into busy life schedules with new demands and altered routines during this global pandemic.

Moreover, there is reason to believe that beginning backcountry users, a population that will continue to proliferate, may be more prone to decision fatigue and its effects. Cognitive models of skill acquisition suggest that, as we learn a skill, we spend less mental effort executing it. For novices, practice is deliberate and effortful, physically AND mentally. For experts, it is efficient and “autonomous,” and can be performed relatively effortlessly and intuitively (reflect on your own experience learning to ride a bicycle or drive an automobile). These 20th century cognitive-behavioral models have also been supported by 21st century cognitive neuroscience research, where experts not only show greater behavioral efficiency in performing tasks from chess

Chris Marshall, left, the lead instructor, and Andrew Kiefer, right, who was working for Kling Mountain Guides at the time, on a tour with Prescott College in Prospect Basin. They didn't see this avalanche but arrived shortly after. The avalanche was an HS-AS- R2-D2. Photo Josh Kling





memory to radiological diagnosis faster and more accurately, but also with less associated brain activity. While the human brain constitutes only 2-3% of the human body's mass, it expends 20-25% of the body's oxygen supply! Physical fatigue means mental fatigue.

While experts are more efficient in their decision-making, many scary near misses and tragic avalanche accidents this season have involved experienced backcountry users, illustrating that efficiency of information processing does not equal immunity to error. Distraction and fatigue deplete cognitive resources, which leads to increased reliance on heuristics in decision-making by all individuals, whether expert or novice. Digging deeper into landmark research on human factors in avalanche accidents we find that experts may be uniquely susceptible to certain heuristic traps in ways that novice users are not. Interestingly, in his watershed paper, McCammon (2002) writes of the familiarity heuristic, "In unfamiliar terrain, people with advanced avalanche knowledge appeared to use their risk-reduction skills to their advantage. But in familiar terrain, these groups exposed themselves to the same level of hazard as other groups with less or no training." Numerous times this season, at home in the familiar Wasatch, I've had to step back from assuming a slope is safe to travel on or under because I have skied it often in the past without avalanche incident. While this logic is cognitively easy, and exactly what my tired and distracted brain wants, it isn't valid, especially when reasoning about our historically weak and poorly structured snowpack this winter. So what can we do about this? First, **develop checklists** and adhere to them, especially through the chaos of this pandemic. Such checklists can serve as external memory aids for novices, who have not routinized the intricacies of backcountry travel and preparation, and as speed checks for experts who have stopped thinking about them consciously. Many sectors that deal with risk, including aviation and medicine, have adopted such procedures to reduce rare but critical errors that result from the fast, automatic performance of experts. Pre-trip checklists, especially relating to terrain choices, also have the benefit of offloading decision-making from trip time, freeing valuable cognitive resources for other decision-making effort.

Second, and with apologies to the skimo-ers, **slow down** or, in the words of longtime avalanche professional Blase Reardon, "give it a rest." High-quality thinking and decision-making take time and, given the consequences of decisions in high-risk environments, you owe it to yourself and your



loved ones to take this time to think about the snowpack, weather, and terrain and your decisions about these elements. Use the decision points throughout your day to breathe and eat to replenish the brain's oxygen and nutrient supply, and to communicate with partners about their perceptions and about critical decisions. Try the Timeout presented in TAR 39.2 by Shawn Davis.

Finally, **debrief**. Cognitive science tells us that it's a long path to developing expertise, and there are no shortcuts to the top of that hill. But reflection and feedback help. Put in the time and maximize learning from your time in the backcountry by, in the words of Reardon again, in his classic Mr Magoos essay from TAR 32.4, "expand[ing] your end-of-day conversation to more than high fives." What did you do well? What didn't you do so well? What can you do better next time out? Routinely exploring these reflective questions with your partners will lead to better, safer performance as individuals and as a team. I note all of this not only as a cognitive scientist, but also as a ski mountaineer. Most of the close calls I have had with disaster in my two decades in the backcountry have come during times when I was distracted, rushed, and/or fatigued. Those "free lessons" have not just been lessons about snowpack or weather or terrain, but also cognitive science lessons about my own mind/body state when I was making decisions, cognitively or intuitively in the backcountry. As a result of the pandemic, many of us found ourselves in these mentally fatigued states more than usual late last season and will surely find ourselves in them again during this one. ●

From Northwest Avalanche Center: On Monday morning, we received word of a very large avalanche that occurred on Chair Peak in the Alpental Valley. The slide happened sometime between 4:00 pm on Sunday and 8:00 am on Monday and has a crown depth estimated to be over 10 feet in the deepest part.

This is the second time Chair Peak has produced a very large (D3+) avalanche in the past week. It also ran last Sunday night or Monday (2/21-2/22) during the most recent atmospheric river event. The slide descended more than 2000', crossed Source Lake, overran a small knob, and traveled 300' into the small trees beyond. Debris from this event covers numerous common travel routes and a very popular lunch spot.

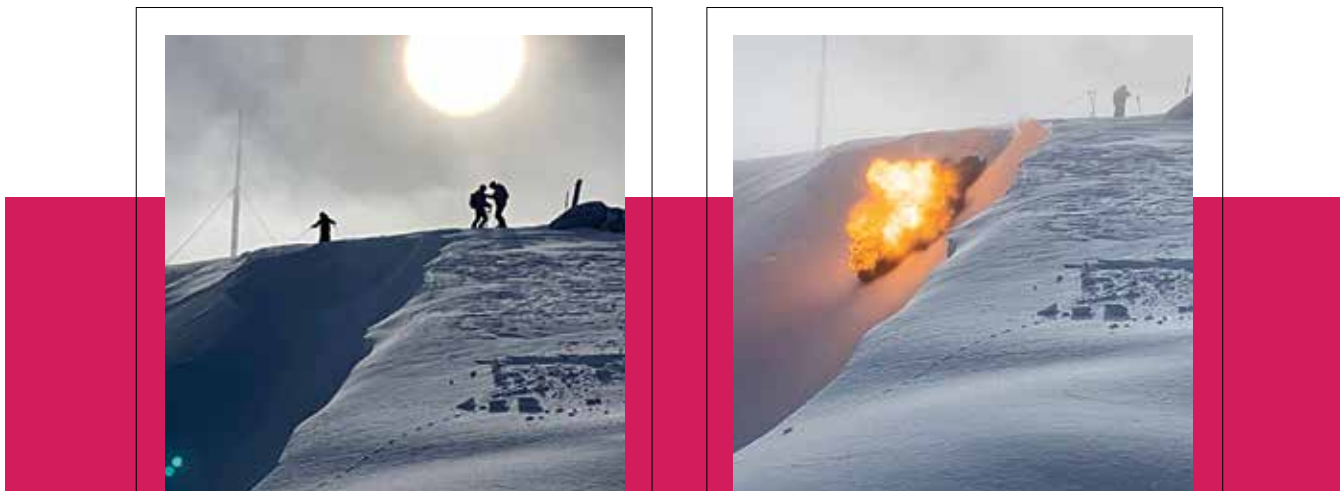
The slide may have been triggered by a cornice fall, but that has not been confirmed. It is confirmed that this avalanche broke trees and almost ran to its historical maximum as it descended. This previous weekend, similar avalanches occurred in the West South and on Stevens Pass (see their forecasts for details). We have had at least one very large (D3+) avalanche almost every day for over a week throughout these zones and the mid-January layer has plagued us the entire month of February.

NE-E-SE 5800; HS-N-D3.5/R4-O  
Crown estimated ~10-15' across entire bowl ~1000'.

Photo by Bryce Hill, a full time guide/avalanche instructor at Alpine Ascents International who lives at Alpental. Bryce was the first skier to run across this avalanche and he just happened to bring his good camera that day.

# Group Communication and Decision-Making Tactics

BY JAYSON SIMONS-JONES



Avalanche control teams rely on extensive communication prior to, during, and after mitigation. The implementation of inquiry-based communication among team members builds equality, trust, and respect. Without effective communication, people could get injured or worse.  
*Mt. Ashland Professional Patrollers performing avalanche mitigation; December 2020. Photos CJ Sveta*

Over my 20-plus years in the avalanche and snow world, I have watched it become much more commonplace to talk about and study how decision-making and group dynamics play into the operation of successful teams in avalanche terrain.

I admit that maybe my early association with Outward Bound gave me a taste for putting these ‘softer skills’ at the forefront of the backcountry experience. My career started in the later 1990s running winter expeditions in the below-zero temps and wind-board-capped faceted snowpack of the Sawatch Range outside Leadville, Colorado. Weeklong backcountry excursions on snowshoes—pulling epically heavy sleds of cheese, butter, tents, and zero-degree sleeping bags with a bunch of teenage snowboarders in the highest, coldest, and windiest peaks of Colorado—gave me an early and pointed appreciation of group dynamics and their importance to a successful adventure.

Fast forward to the present and I’m still working as a snow professional, albeit in a more hospitable and civil context. Over the years I have been involved with many different facets of the snow and avalanche industry, gaining experience and benefiting from the wisdom of mentors at places such as the Crested Butte Ski Patrol, Crested Butte Avalanche Center, AIARE, Irwin Guides, and Crested Butte Mountain Guides, and spending almost two decades ski guiding in Colorado, Alaska, Europe, and elsewhere around the globe.

Throughout this career arc I have had pretty continuous—and at times intense—

involvement in avalanche education for the recreational user, and now more recently with the professional user while working within the Professional Programs of the Silverton Avalanche School and the American Avalanche Institute, and with the AMGA Ski Guide Programs. Along the way I’ve seen an interesting evolution, led by smarter professionals than I, looking at other industries and thought scholars to see how collective decision-making can help our industry become safer and deliver better education to our clients.

But while the avalanche education curricula for the recreationist has become increasingly heavy on group communication dynamics and how they lead to better decision-making practices and protocols, these processes are not as evident or robust at the professional and operational level. I see a clear trend on educating the recreational user about the interplay between communication and decision-making, but less application of these principles in the professional world of group and team operations and organizations of working professionals. This is not to say the process isn’t technically in place, it just seems less an open part of the culture at the higher stages of professional operations, and I wonder if it is time to change the narrative and work harder to bring practices and protocols into these processes from the top down in the industry, so to speak.

A seminal study in 1998 published in the Harvard Business Review (Hammond, et al. 1998) explained that researchers studying the performance output and success of business

and corporate organizations found certain themes that were critical to diagnosing success and failure. Amongst those organizations that made good, quick, effective, and thus successful decisions, and those organizations that did not, the key overarching theme in general was HOW the groups communicated throughout the decision-making process. The research found that in general bad decisions were a fundamental consequence of the group of individuals becoming victim to one of the following ‘Six Hidden Traps.’

When I put these ‘Six Hidden Traps’ into the context of my experience in the professional avalanche world, I most certainly can see where and how some of them came to play in certain situations, and with groups of colleagues where there seemed to be a difficult working atmosphere, significant communication or decision-making challenges, or just simply a challenging work culture. They also seemed to feed into the process when reflecting back on avalanche accidents or incidents as well. The danger and trick with trying to navigate these ‘Six Hidden Traps’ is that they are somewhat a cyclical cycle, each feeding into itself and into the others, to create a negative feedback reinforcement loop. No one individual, group, or organization is immune to any of these, and it is on us as professionals to constantly monitor through self awareness and emotional intelligence how each of these factors can be influencing our communication processes and thus decision-making processes amongst our friends and peers.

1. **Anchoring Traps** weighing the first idea or evidence-based data set in a group more heavily and equally than subsequent ones.
2. **Status Quo Trap** favoring conventional wisdom and operational procedures when tasked with new problems or uncertainties.
3. **Sunk-Cost Trap** tendency to keep on keeping on with a specific process or procedure because so much time and energy has been invested in it, despite the evidence that it is not the best for the situation.
4. **Confirming Evidence Trap** seeking confirmation bias when targeting and presenting evidence and data that favors a specific outcome.
5. **Framing Trap** using language to 'frame' a specific situation or set of observations to achieve a certain outcome or bias.
6. **Forecasting Trap** adhering to our estimates on what we thought would happen, despite the presence of new data and evidence proving the contrary

### SO WHAT CAN WE DO IN ORDER NOT TO FALL INTO THESE TRAPS?

To set a team up for success, and avoid falling into these traps, it is crucial to note the importance of communication dynamics and the influence of HOW communication is undertaken and displayed. Communication about decision-making needs to be thought of as a process not an event. It is always ongoing, and if reframed as a process that is inherent in an organization and its culture, not a singular event with a starting point and an ending point, then we can begin to shift how we implement this into our psyche and subconscious way of performing on the job.

This idea of communication processes can be broken down into two distinct and somewhat opposing sides. The idea of 'Advocacy vs. Inquiry', first described by Garvin & Roberto (2001) is an interesting idea when super-imposed upon the group communication and decision-making dynamics inherent to avalanche professionals. The concept is simple in scale and easy to apply.

Communication as a form of Advocacy leads to an atmosphere of individuals in a group trying to suppress dissent as people use one of the Six Hidden Traps like 'anchoring' or 'confirming evidence' to bolster their argument and the evidence supporting it. This can be an effective form of communication in the short term, but it's inherently more event focused, and thus over time can have a negative effect on group and team dynamics throughout the course of a long and arduous season of high consequence decision-making. As team members become tired of both the physical and mental demands of the job, they also begin to lose emotional resilience. Having to communicate from a place of 'advocacy' to either defend or question parts of the group decision-making process is not a sustainable place for a team to operate in, and inevitably, the authors argue, leads to operating amongst the 'Six Hidden Traps.'

Conversely, teams, groups, and individuals can instead learn to communicate from a place of 'Inquiry, 'thereby inquiring from a place of constructive critique and healthy conflict and dialogue in place of defensive advocacy for a particular stance on an issue' (Garvin & Roberto, 2001) ... say opening or closing terrain at a backcountry operation.

The Advocate will present unilateral evidence to their argument and continue to pile it on (correctly or incorrectly) in a way that simply tries to bolster their position. Again, exhausting when viewed over the course of a season. However, someone embracing 'Inquiry' as a form of communication strategy introduces an inquisitive mindset into the decision-making process. Inquiry-minded communication strategies illicit multiple perspectives and a high amount of quality of information and data to be presented in the decision-making process. **The process of inquiry-based communication looks something like this.**

I am sure as avalanche professionals, or professionals in general, we can all reflect back on various difficult decision-making processes we were a part of, or bore witness to over the years and how these two differing strategies were at play in the process.

Maybe it was a morning meeting at a snowcat or heli-guide operation where the team was discussing terrain options for the day based on the current avalanche problem at hand and certain people used advocacy to try and support their argument of evidence and data to open or close terrain for the day?

Or at a top shack ski patrol morning meeting discussing how best to deploy patrol resources for the day; the question is how to balance working closed terrain towards opening vs keeping manpower on the hill for accident response and the like? Were senior patrollers

advocating for their position with more and more fervor and specific data to bolster their position, or were they inquiring about all the options available and laying out a transparent process to decide what is the most effective course of action?

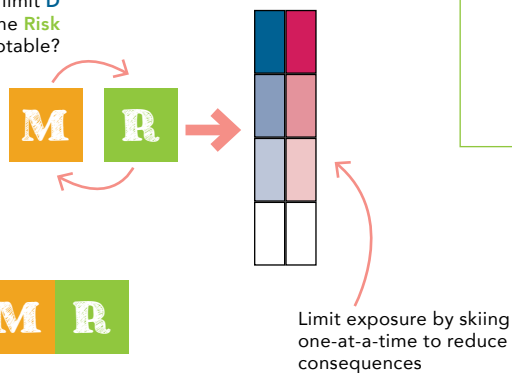
When these experiences (or others similarly) are reflected upon, we will be able to see the processes of 'Advocacy vs. Inquiry' at play amongst the many individuals and personalities of our respective teams and colleagues. We will also see who was able to communicate information in a way that was advocating for a position, or inquiring about the best course of action, and then we will see which style we tend to both hear and interpret more clearly and open-mindedly. I realize in the time

1. **Multiple Alternatives** Always seeking to identify and bring into the process multiple alternatives and ideas discussed in relation to others.
2. **Assumption Testing** Revisiting what the current ideas on the table are based on evidence wise, and challenging their weight.
3. **Well Defined Criteria** Making sure the group has explicit standards by which ideas, and thus consequent decisions, are assessed by.
4. **Dissent & Debate** Trust amongst the group to go back and forth among the pluses and minuses of the alternatives at play, and to not take the process personally.
5. **Perception of Fairness** Is there a fair, reasonable, and transparent process at play to come to a conclusion on the best idea or decision that is easily separated from personalities and biases that everyone on the team can agree on, even if their idea is not accepted?

pressure of an operational morning meeting the idealism of this group communication process towards better decision-making is easier to theorize than it is to apply; however, I challenge you the reader to re-visit operational team decision-making dynamics from your experience; which style lead to better team dynamics and more effective decision-making processes throughout the season?

These study results and group communication tactics, although not aimed at the avalanche industry in general and certainly not groundbreaking, do seem to offer us as professionals yet another set of tools for communication processes and protocols to help us be safer and more efficient and effective as working groups of professionals tasked with making difficult decisions in a consequential environment. It is by no means the crucible by which to judge all interactions amongst a team of our colleagues and peers, but simply an overarching framework of how to recognize what could possibly be at play when, on difficult and challenging days, both communication and group decision-making strategies seem to bog down or personalities balk at reaching consensus. We already all have a challenging and difficult profession with more high consequence decision-making on a micro and macro scale daily than many other professionals, so we owe it to ourselves as well as our teammates, peers, and colleagues to introduce a process and strategy that makes it easier to thrive across a long career. ●

Mitigation measures derive from the unfavorable answers to **D** and **C**: Can you limit **D** and/or **C** so that the **Risk** becomes acceptable?



A framework guiding your thought and helping to communicate the main point before you ski.

**D**=Danger **C**=Consequences  
**M**=Mitigation **R**=Risk

# An Intuitive Path to $D \times C - M = R$

## Avalanche Risk Management

BY BENJAMIN REUTER, CHRIS SEMMEL, ALEXIS MALLON, DOUG CHABOT, KARL BIRKELAND, AND JÜRIG SCHWEIZER

Since the old days, humans have been dealing with natural hazards in the mountains. It's no surprise that nowadays different approaches for risk management exist. In this article we present one approach that we find intuitive to assess avalanche risk. It is a path that many of us already take when we're traveling the backcountry, so all we're doing here is putting it together and trying to explain why. We'll see that our approach does not lie far from current research.

### TWO PERSPECTIVES ON AVALANCHE DANGER

The starting point for most decisions we take when it comes to avalanche danger assessment is the avalanche forecast—but forecasters and skiers usually have different view angles. Skiers are typically focused at the scale of one or a few slopes, while avalanche forecasters look at the problem at a regional scale. Maybe these two different views, or what we would call a scale mismatch, are at the root of the confusion we sometimes run into?

Forecasters typically discuss: "What are the chances that we'll see skiers triggering avalanches today?" With Considerable danger, human-triggering is typical. So, on a sunny day in the forecast region the answer could be: "Skier triggering is likely." Indeed, researchers found that on average two to three avalanches are released daily in a Swiss forecast region, which has several 100 km<sup>2</sup> (Figure 1).

Forecasters look at what happens in a region. Skiers may rather ask: "Will the slope avalanche?" A Considerable danger, however, doesn't mean the answer is "likely." If this was the case, there would be no snow left on the slopes after one day of skier traffic. The probability of triggering an avalanche on a slope described in the forecast region will be on the order of 1:1000\*—even with Considerable avalanche danger. So, the chance that a particular slope comes down is way different from the chance of seeing avalanches in the region. Avalanches remain rare events. Even if you're hard at it, you won't trigger more than a handful or so of avalanches—unless you're talented.

Now the question arises: How the avalanche forecast can be useful for our risk assessment? Well, the danger level does not describe the individual slope since the scale of the forecast is not slope specific—they're two different pairs of boots. Still, the forecast is a

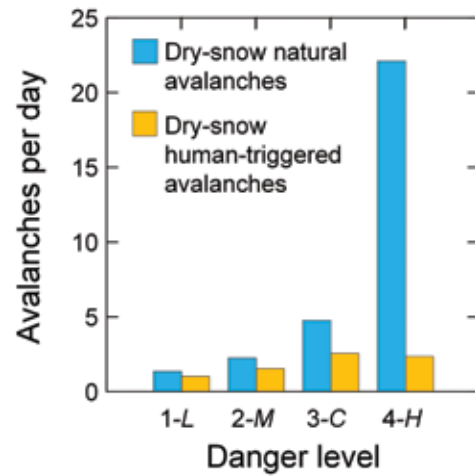


Figure 1: Thanks to 21 years of observations, we can compare the frequency of avalanches with the danger level in a forecast region (Schweizer et al., 2020). More than 4000 avalanches were counted over these years in the region of Davos. The number of natural avalanches clearly increases with increasing danger level. On days with "high" danger many natural avalanches were observed. This increase is also seen in human-triggered avalanches—even though less pronounced, as we stay away from more terrain the higher the danger is.

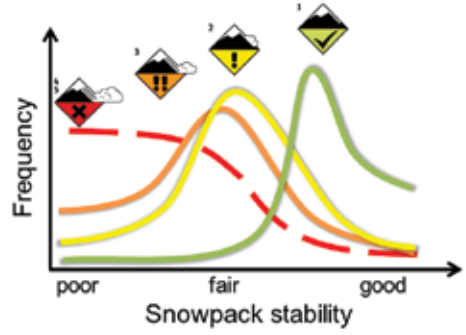


Figure 2: Sketch illustrating the frequency of snowpack stability with the different danger levels (Schweizer et al., 2003). The curves indicate for the different danger levels how likely it is that poor, fair or good stability will be encountered on a slope. The higher the stability the lower is the likelihood of triggering. Each graph relies on many expert observations including snow pits from a forecast region. During danger level "high" only limited data were available (dashed line).

choice they make before they go: Likelihood of avalanches, frequency of trigger locations, and avalanche size melt into our avalanche danger level.

The next decision, however, is about choosing a trip or looking at a particular descent. So, what about pulling the same lever again? Now we're talking about slopes and not about regions. So we pull up some data describing the distribution of snow stability of slopes in a region (Figure 2). Picking a slope from the frequency distribution of the danger level High we likely won't hit the stability class "good." If we choose randomly from the frequency distribution at danger level Low, we likely don't end up with poor stability. In other words, if danger levels are High or Low it is easy to keep poor and good stability apart.

This is no longer the case for Moderate and Considerable. The graphs have quite some overlap as frequency distributions look much alike. Let's get this right, Moderate danger does mean that fewer avalanches are expected in the region compared to a situation with Considerable danger. But when we look at a particular slope, we don't want to rely on the subtle difference that Considerable means every second and Moderate means every fourth or fifth slope has poor stability (left tail of the graphs in Figure 2). Besides, we can't locate those potential avalanche slopes within the hazard locations described in the forecast. Slope stability assessment is beyond the power of the number. When the danger level is Moderate or Considerable, which happens on about 80% of the days in winter, we need a different tool.

That's no big deal, because the forecast offers more than a number, as long as we take the time to dig into that forecast. Some forecasting services even describe the terrain where the avalanche problem is most present. In the end, the description of the avalanche problem helps us to focus and find complementary information in the field. Our behavior in the field eventually derives from the avalanche problem—rather than the danger level alone.

multi-tool and may help us in different ways as it offers more than a number 1 through 5.

### THE MULTI-TOOL

When his friend asks: "where are we gonna go?" Karl pulls out his phone and looks at a colored map. Choosing to go in an orange region exposes them to a higher danger than a yellow region with level Moderate. The danger level is the big lever Karl pulls for the first

### DANGER = RISK?

Well, that would only be true if the consequences were always the same. But climbers and skiers know better: we have a healthy respect for large slopes. In case of doubt, we hold back and choose the mellower run, even though we may be tempted by the big face.

Indicator	Reason	Limitations	Conclusion
<b>Slope angle (1,2,3,4)</b>	The steeper the slope the higher the likelihood of triggering.	<ul style="list-style-type: none"> <li>Remote triggering is possible also from low-angle terrain.</li> <li>Natural avalanches can run out into low-angle terrain.</li> </ul>	Consider all steep slopes along the intended route—depending on the type and spatial pattern of the avalanche problem.
<b>Danger level (1,2,3,4)</b>	Number of locations with poor snow stability and number of avalanches in the forecast region (>100 km2) increase with increasing danger level.	The danger level gives a poor estimate of the likelihood of triggering at a slope. With <b>High</b> danger unstable slopes are clearly more common than stable slopes, and with <b>Low</b> danger stable slopes are more common than unstable slopes. But <b>Moderate</b> and <b>Considerable</b> don't discriminate well between unstable and stable slopes and are the most common levels: about 80% of the season.	<ul style="list-style-type: none"> <li>Use to select region or mountain range you plan to travel.</li> </ul> Limited relevance for trip selection within an area. Clearly, there are trips that don't go well with most situations of <b>Considerable</b> danger, but finally it comes down to the type of avalanche problem and its spatial pattern. Not useful for slope evaluation, as stability distributions overlap too much.
<b>Combination of slope angle and danger level (1,2,3,4)</b>	With increasing slope angle, the likelihood of triggering increases. With increasing danger level, the number of locations with poor snow stability increases and so does the probability for avalanches in the region. Slopes with lower slope angle required to balance higher danger level.	Regional danger level (>100 km2) and local slope angle (1 km2) refer to different scales. Combining both parameters could work, but the danger level is a poor indicator for the likelihood of triggering at the slope. Locations with poor snow stability increase significantly with the danger level. The influence of the slope angle on stability is more subtle. Balancing the danger level with slope angle i.e., to ski less steep terrain, does not work.	Consider all potential avalanche slopes, no matter what the danger level is. Avalanches may release from 30° slopes and skier triggered avalanches have similar sizes.
<b>Hazard locations (1,2,4)</b>	The described avalanche danger is prominent at the hazard locations (aspects/elevation band in forecast).	Descriptions merely based on aspects and elevation band cannot always nail down the hazard locations, e.g. persistent weak layers can remain prone to triggering where the snowpack is shallow.	<ul style="list-style-type: none"> <li>Hazard locations may indicate the crux slopes of the trip.</li> <li>Need to double check hazard locations with local observations.</li> </ul>
<b>Group size (4)</b>	Likelihood of human-triggering depends on the additional load. Release is more common if we gather or climb nose to tail.	Locations where a single person can trigger an avalanche almost always exist, even if they're sparse and human-triggering is rare.	Traveling in small groups does not reduce the chances of triggering. It comes down to our behavior as even with <b>Low</b> danger a single person may be sufficient to trigger in isolated locations.

Table 1: Indicators for the likelihood of triggering that are used in trip planning methods (1 SnowCard, 2 Graphical Reduction Method, 3 Stop or Go, 4 Classic Reduction Method).

While in daily life danger and risk may get muddled up, science wants to keep them apart.

Risk means the combination of danger and the consequences. In other words, risk summarizes the likelihood of avalanche release and the consequences of being caught. Climbers and skiers are trying all the time to keep dangers and consequences between the fences: We spread out while we climb (to reduce the likelihood of triggering) or ski one by one from one safe spot to another (to limit the exposure and hence, the consequences). If chances to trigger are zero, the risk is zero and there's no need for mitigation. The higher the likelihood of triggering, the lower the consequences we want to see and the more effective our mitigation strategy needs to be.

We have not always drawn this clear line between the danger or the chances for avalanches in a region and the risk or the individual chances for injury at the slope scale. Many trip planning methods developed in the 1990s missed this distinction; they combine indicators for the likelihood of triggering (Table 1). The idea is clear and aims at reducing the number of accidents by omitting terrain where the danger is higher on average. As it is common for straightforward approaches in complex worlds, this comes at a price. Here is one example. Remote triggering of dangerously large avalanches can be an issue even at danger level Moderate if a persistent weak layer poses an avalanche problem. Sure, if the danger level is Moderate only few locations exist where triggering is possible, but consequences would be severe due to avalanche size and the risk is not low.

We can use the indicators described in Table 1 for trip planning to get a rough danger estimate for the intended slope or route. However, if we use the indicators not only for trip planning, but also for slope evaluation, the limitations shown in Table 1 set us on

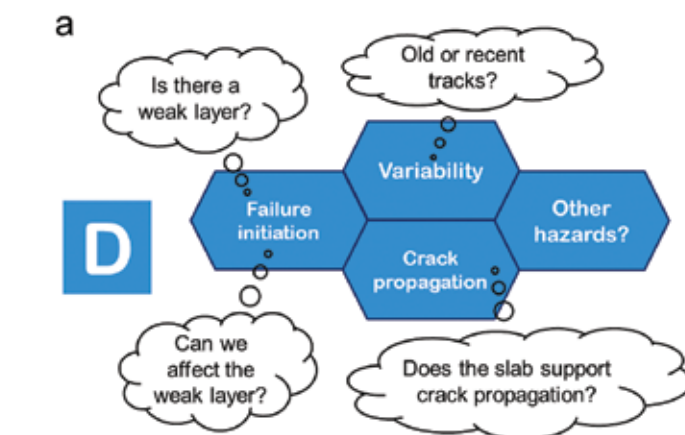


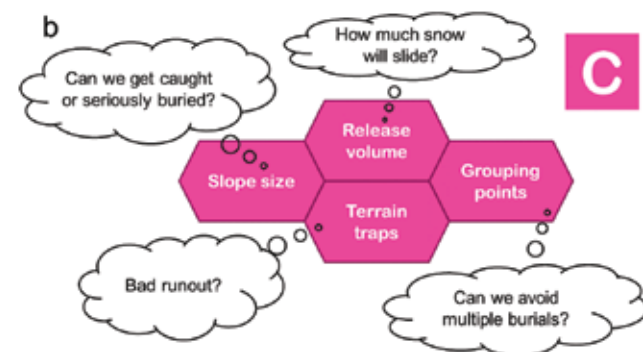
Figure 3: DCMR combines elements describing **danger** and **consequences** to conclude on the **risk** we are exposed to. Four key words each trigger questions concerning (a) the **danger** and (b) the **consequences**. Appropriate **mitigation** measures derive from the unfavorable answers to the eight questions.

the wrong path. Undoubtedly, the indicators contain valuable information, but usually on larger scale, and only concerning the danger and not the risk. Hence, they can be used to describe danger as long as we're lacking local information—that is before the trip, at home.

### CONSEQUENCES FIRST!

Just because it's often easier, we start with the consequences. Climbers often ask themselves intuitively, "what's above?" and "what's below?" In other words, if the slope came down what would be next? Here are four keywords that should trigger the questions that follow:

- **Slope size:** Is the slope rather large? Would release mean serious burial? It may depend on where you ski or climb the slope.
- **Release volume:** How much snow is going to move? Release width and possible crown thickness? Larger slides tend to be more harmful.
- **Terrain traps:** Are there terrain traps that increase the consequences of being caught? Cliffs, trees, rocks in the runout? Gullies or unfavorably shaped runout terrain?



- **Safe spots:** Can we avoid multiple burials? Is only one person exposed at a time? Is the group near to help in case of a burial?

Unfavorable answers give clues for what's at stake—how serious the consequences would be, if we triggered an avalanche (Figure 3b).

### DANGER

Estimating the danger is typically the harder part, as we're dealing with a question that has no simple straightforward answer: "Will the slope release?" In fact, there is no black or

white—all we can do is look at the odds. “Is triggering a likely or a rather unlikely scenario here?” As we’re lacking reliable indicators, any method involves considerable uncertainty and hence has to be conservative by nature. This yields a high number of false alarms—even though in hindsight it seems that its application could have prevented many accidents. That’s the nature of rare events.

To come up with a reasonable estimate of the odds, we need solid information regarding the key indicators. Research can’t do our job (yet), but it can give us directions in the decision process. The likelihood of releasing an avalanche depends on a number of fracture processes that chase each other. If we initiate a failure in a weak layer, a crack may form that can propagate—possibly across the entire slope if weak layer and slab properties sustain self-propagation. Failure initiation and crack propagation can be both observed in field experiments and modeled in computer simulations. The models teach us what it takes that snow layer fails and a crack starts to run. A comparison of observed signs of instability and indicators of snow instability shows that for a slope to be unstable it takes both the propensity for failure initiation and for crack propagation. (Figure 4).

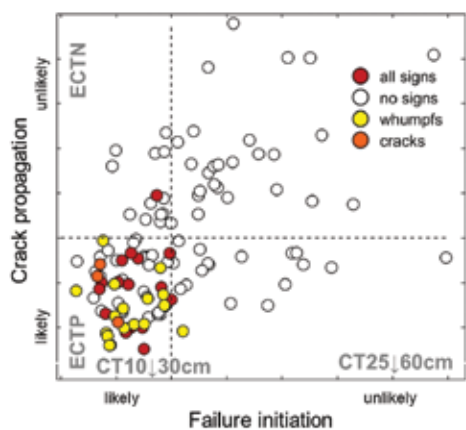


Figure 4: Likelihood of failure initiation and crack propagation describe the release probability at one point on a slope. In 37 of 60 days signs of instability, such as recent avalanches, whumpfs or shooting cracks, were observed in slopes (color filled circles). Signs of instability were observed only if both criteria yielded low values (dashed lines) indicating that failure initiation and crack propagation were “likely.” Signs of instability do not always reveal the instability and hence, some white circles remain in the lower left corner. For illustration, examples of snow stability tests are given in gray (Reuter and Schweizer, 2018).

To make it short, we want to know if a weak layer is present that we can affect. Once we fail the weak layer, the snowpack may support the propagation of the crack—or not. The weight and the layering of the slab determine the amount of energy that is available to drive the crack against the weak layer’s resistance. Once the crack is running you may think it’s too late. But still, spatial variations in weak layer and/or slab properties can stop the shooting crack—imagine surface hoar crystals have flipped before the storm and the “healthy” weak layer ends. Fracture models have identified the described requirements for slab avalanche release and here we try to make the link with field measurements that eventually allow us to develop a method. We wrap it into four keywords that are supposed to trigger the questions that follow:

Figure 5: “Hang on—this roll looks weird...” We’ve seen snow blowing across ridges yesterday that has released avalanches naturally. Today the wind is less strong, but whatever the weak layer was, I believe it may still be triggered. The weak layer may be deep now, but to the sides the slab on the picture is shallower (Minus). Recent wind slabs always propagate well (Minus). No tracks. No idea whether the surface was smooth or very rough before the storm (Minus). The probability for release is rather high with three unfavorable answers to our four questions. The consequences look rather mellow, but we’re not keen. When we reach the foot of the slope where the slab is shallower...



Figure 6: ...the sound of a whip. We hurry away. But the slab does not move our way. Despite the short slope the thick crown fed the slab with substantial volume. We take home that looking at slope size only is not sufficient. We’ll be good and ask all four questions.

- **Failure initiation:** How likely is failure initiation? Are there weak layers? Can we affect them along the intended route or at grouping spots?
- **Crack propagation:** How likely is crack propagation? Do slab and weak layer support crack propagation?
- **Variability:** Has the slope been skied much? Skiing is a stability test and triggering is less likely on tracked slopes. Skier traffic increases variability that can help stop crack formation later on. Persistent weak layers can remain sensitive to triggering despite skier traffic.
- **Other hazards:** Is the group threatened by other hazards? Natural release? Falling seracs? Crevasses? Other people who may trigger an avalanche above us?

Having estimated the **Danger** and anticipated the **Consequences** (Figure 3) we can now think about suitable **Mitigation** which may help us lower the **Risk** to an acceptable level. The method **DCMR** brings together the key elements for risk management in avalanche terrain and is guided by latest research. There is a good chance that we learn something new when we discuss the risk along these lines with our backcountry partners. Figures 5 and 6 tell a short story.

## SUMMARY

**Danger is not risk.** Forecasters refer to regions not to slopes. No surprises here. Obviously, this is not rocket science. We have just presented a method for framing up the important questions—based on our present understanding of avalanche formation. We tried to explain why we ask these questions and how to filter the relevant pieces of information.

The danger level highlights the differences

between mountain ranges. In the next steps, when we look at trips or slopes, we need to link local data to forecast avalanche problems and check out where the avalanche problem type is present in the terrain. Picking up the words from the forecast sets our focus in the terrain—what to look out for.

The workflow **DCMR** supports us during all stages. By answering the four questions about the likelihood of releasing an avalanche and the consequences of being caught, we eventually estimate our individual risk on a particular slope. And this is exactly what we’d like to know eventually before we ski or climb the slope.

The questions on snow instability are hard to answer because the topic is complex, but also because often we just don’t know enough. Data on the snowpack are not easy to obtain, particularly at hazardous locations. If we’re lacking knowledge we’d better hold back. So, let’s think about alternatives when we plan a trip, and maybe we’ll find the missing pieces that complete the puzzle outdoors. ●

The concept **DCMR** was presented at *ISSW 2018* and *CSAW 2020*. A workbook for professionals and interested recreationists is currently being tested by some of you. Thank you, we’ll keep you posted.

## FIGURES FROM:

- Reuter, B. and Schweizer, J., 2018: Describing snow instability by failure initiation, crack propagation, and slab tensile support, *Geophysical Research Letters* 45(14): 7019-7027.
- Schweizer, J., Kronholm, K., Wiesinger, T., 2003. Verification of regional snowpack stability and avalanche danger. *Cold Regions Science and Technology*, 37(3): 277-288.
- Schweizer, J., Mitterer, C., Techel, F., Stoffel, A. and Reuter, B., 2020: On the relation between avalanche occurrence and avalanche danger level. *The Cryosphere* 14(2): 737-750.

# How is Avalanche Problem Information Used?

What else we have learned from our forecast user surveys

BY PASCAL HAEGELI AND THE SARP RESEARCH TEAM

Over the last few winters, my research team and I have conducted several large online surveys to better understand how backcountry recreationists use avalanche forecasts. We are typically interested in big questions like “What are the different types of forecast users?”, “Do our users have the skills they need to apply the forecast information in a meaningful way?” or “How does the presentation of the information affect users’ ability to apply the information?” However, not all the data we collect make it into our final analyses and presentations. This article shares some

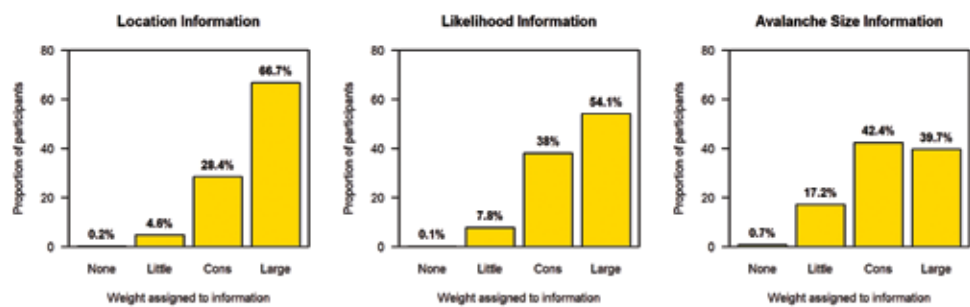


Figure 1: Overview of responses to question about weighing of avalanche problem information.



Colorado’s persistent weak layers have been especially challenging this winter. After incrementally building up slabs for several weeks in late January, we raised the danger to HIGH on February 3rd in advance of a potent system that dropped 1” to 2” of SWE on the snowpack in eight hours. The next day, I went for an off-the-clock tour with a friend up Mount Emmons to ski some low angle glades above the town of Crested Butte. We were a bit surprised and disappointed at the extent of the natural cycle, and even more disappointed to watch a group of five skiers center punch Red Lady Bowl despite our stern warnings in the forecast that day of Persistent Slab and Storm Slab problems. The bowl faces town and once a few tracks go in, often a mob follows suit. It was unnerving to watch all five skiers regroup a short ways into the runout, knowing the bowl was teetering on the edge of a wall-to-wall avalanche that would easily overrun their “safe zone.”

Once the skiers had exited the runout, I skinned out to a small, low angle feature that connects into the bowl and gave it a few ski stomps. Nothing happened—the layer was four feet deep and I wasn’t touching it. I stepped out of my ski and sunk my boot down to the ground. BOOOOM! The collapse propagated 1800’ across the east facing ridge, releasing a D2.5 into the bowl. Two days later, the other half of the bowl ran during a smaller storm and stronger windloading event that ultimately delivered the cycle that we had anticipated earlier—a widespread D2-D3.5 cycle with over 90 natural persistent slab avalanches. *Photo Zach Guy*

additional insight we gained from our 2020 survey on how people use the avalanche problem information provided in avalanche forecast.

## How often do you check the avalanche problem information when you read the avalanche forecast?

Of the 3,328 participants who completed this part of our survey, 71% said they always check the avalanche problem information when they read the forecast, 22% check it most of the time, and less than 1% stated they never read it. This high engagement is not surprising because our sample had a fairly high level of avalanche training. Eighty-one percent had at least an introductory recreational level course, and our analysis showed a clear association between level of training and how often people say they check the avalanche problem information.

## How much weight do you give this information when you check it?

Checking avalanche problem information is one thing, but how important is this information in people’s decision-making process? To examine this question, we asked everybody who said they check the avalanche problem section at least ‘rarely’ how much weight they give each of the avalanche problem components (location information, chances of avalanches, and expected size). The response options were ‘none,’ ‘a little amount,’ ‘a considerable amount,’ ‘a large amount,’ and ‘a large amount depending on the avalanche problem.’ These terms, though general, can provide us with a sense of how avalanche forecast users

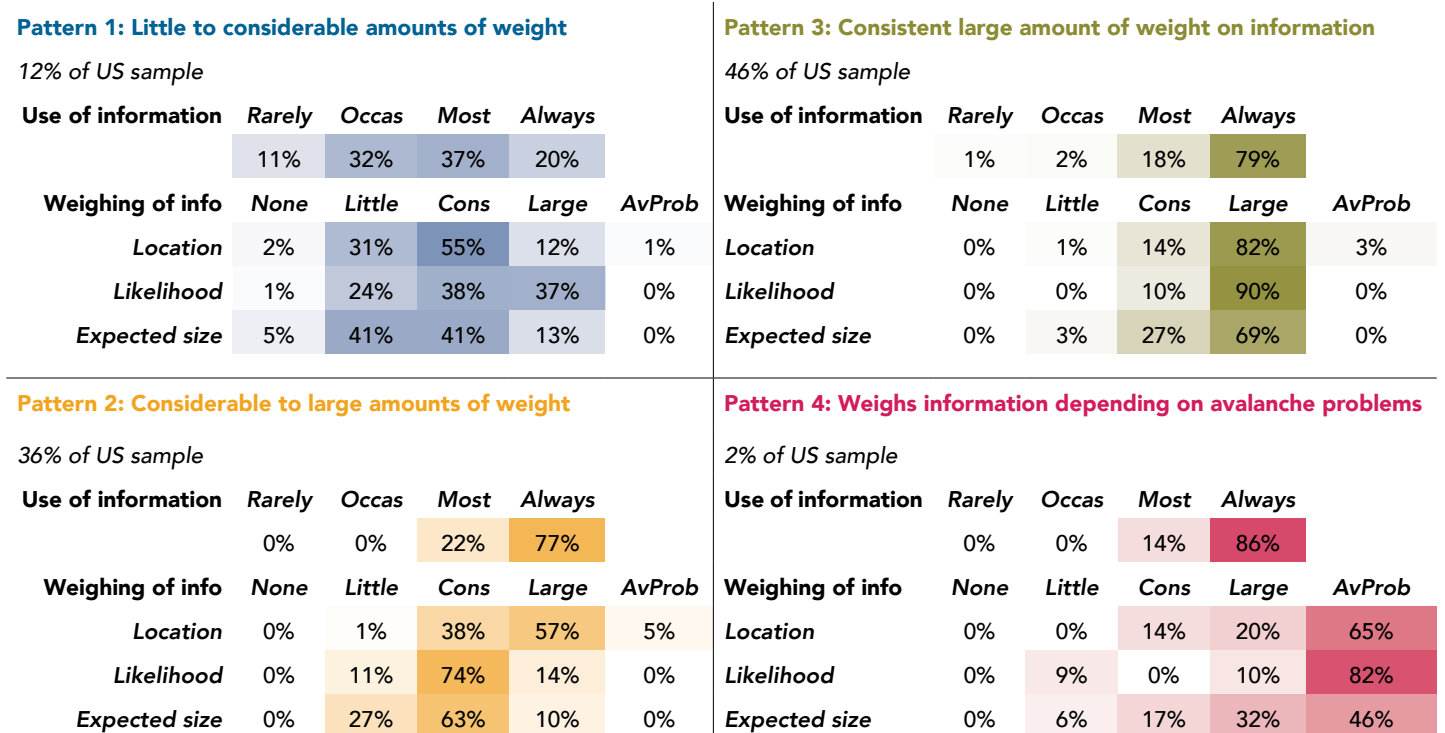


Figure 2: U.S. response patterns for the use and weighing of avalanche problem information with shaded percentage values. Darker shades indicate higher likelihood of the response option being picked.

value this information for their decision-making process.

Figure 1 provides a first overview of the responses from American participants (n = 2,284). For this perspective, we combined the ‘a large amount’ and ‘a large amount depending on the avalanche problem’ categories. Overall, participants stated they weigh the location information the most, followed by the likelihood information, and the size information is distant last. These differences are statistically significant.

While these statistics are interesting, we can gain deeper insight by exploring whether there are distinct patterns in how our survey participants answered these questions. To shed light on this, we used a statistical method called latent class analysis, which not only identifies the patterns but also determines which pattern each participant belongs to. Because the avalanche problem information is presented differently in the U.S. and Canada, where elevation and aspect information are presented separately, we conducted a separate analysis for each country.

The analysis of our U.S. sample revealed four distinct patterns in how people answered our avalanche problem questions. The results are illustrated in Figure 2, where the shaded percentage values indicate how the participants assigned to the different patterns responded to our questions. For example, 20% of the participants that were assigned to Pattern 1 picked ‘always’ as their answer for the use questions, whereas it was 77% for the participants who were assigned to Pattern 2.

When you look at the shaded percentage values in in Figure 2, you can see the four patterns that emerged can be organized into a hierarchy where both the checking the avalanche problem information and the weight it receives in participants’ decision-making processes continuously increase.

At the very top of this hierarchy is **Pattern 4**, which covered only 2% of our U.S. sample. Almost all of these participants

always look at the avalanche problem information and tend to weight the information depending on the avalanche problem type—especially the likelihood information. However, there is an interesting split in the distribution of the weight of likelihood with 9% giving it only a little weight. Participants assigned to this pattern give considerably less weight to the location and size information.

To find out more about the avalanche problem-dependent interpretation of the information, our survey included a follow-up question where participants who chose the ‘a large amount depending on the avalanche problem’ option could indicate for which avalanche problem types they weigh the information heavily. Wind slab, persistent slab, and deep persistent slab avalanche problems were consistently among the problem types where the detailed problem information was weighed more heavily, but their order differed between the location details and the likelihood and size information. The location information was weighted more heavily for wind slabs, whereas the weight of the likelihood and size information was higher for persistent and deep persistent slabs.

The avalanche problem types where location information got less weight seem to either be widespread problems like dry loose avalanches, or problems like glide avalanches where ground cover properties are much more relevant than aspect or elevation. These results show these users have a nuanced understanding of avalanche problems and use the avalanche problem information accordingly.

**Pattern 3** consists of survey participants of whom the majority still always check the avalanche problem information, but the distinct characteristic of this pattern is they give the avalanche problem information a large amount of weight regardless of the problem type. However, similar to what we saw in Pattern 4, they seem to give the likelihood and location information more weight than the expected size information. With 46% of U.S.

participants assigned to this pattern, it is the largest that emerged from the analysis.

In **Pattern 2**, which covered 36% of our U.S. sample, the proportion of participants that always look at the avalanche problem information is almost as high as in Pattern 3, but the weight participants in this pattern assign to the information decreases. Different from the previous two patterns, the participants included in Pattern 2 tend to pay substantially more attention to the location information than the likelihood and expected size information.

The remaining 12% of the U.S. survey sample was assigned to **Pattern 1**, where the proportion of participants who always check the avalanche problem information dropped to 20%, and even less weight is put on this information. Similar to Patterns 3 and 4, the likelihood information gets more attention than the location and expected size information, but the distribution of the likelihood information weight is pretty broad. Expected size definitely gets the lowest amount of attention with 41% giving it a large amount of weight and another 41% giving it only a considerable amount.

### Who are the participants using the avalanche problem information in these different ways?

Knowing these use patterns is interesting, but to make this information more useful we need to understand who uses the avalanche problem information in these different ways and why. To examine this question, we used a method called conditional inference tree to see what participant characteristics are associated with the different patterns. For this analysis, we included participants’ age category, self-identified gender, primary winter backcountry activity, level of formal avalanche training, years of experience, and days of winter backcountry activity per season.

The results are illustrated in Figure 3. The tree structure highlights which characteristics



**Avalanche problem information is being used in distinct ways, and while education plays an important role in how people use the information, other characteristics seem to have an effect.**

have a statistically significant relationship with the avalanche problem information use patterns. The bar charts show the distribution of the use patterns among the participants with the particular combination of characteristics. Overall, you can see that Pattern 3 is the most prevalent among all combinations of characteristics, which is simply a reflection of the fact that almost half of the U.S. sample were assigned to this class.

The characteristics that were identified as having a significant relationship with the information use patterns were avalanche awareness training, number of days of backcountry activity per winter and age. Not overly surprising, **avalanche awareness training** emerged as the most important background characteristic, which is shown at the very top of the tree in Figure 3. Participants with no or only informal avalanche awareness training (e.g., an evening seminar) had a higher chance of belonging to Patterns 1 and use avalanche problem information in a less sophisticated way than participants who completed at least a recreational level avalanche awareness course. On the very right of the tree, you can see an additional split between participants with recreational and professional level training. The distinguishing characteristic of the professionally trained participants is that they had the highest proportion of Pattern 4 (7%), which are the participants who weight the avalanche problem information depending on the problem type.

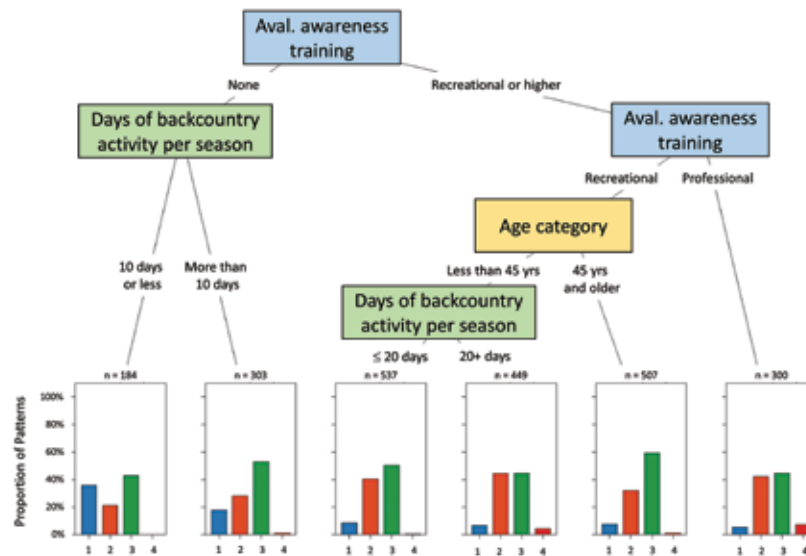


Figure 3: Conditional inference tree illustrating how participants' characteristic in the U.S. sample relate to avalanche problem information use patterns (2088 participants).

Among the participants with no or only informal avalanche awareness training, **days of backcountry activity per season** emerged as the second most important background variable. Participants with less than 10 days per season had a substantially higher proportion Pattern 1, whereas the 53% participants who spend more than 10 days in the backcountry every season look at the avalanche problem information all the time and give it a lot of weight (Pattern 3). However, the proportion of Pattern 1 was with 18% still quite high.

Among the participants who completed a recreational avalanche awareness course, the analysis identified **age** as the next most important background variable. Participants older than 45 had the higher proportion of Pattern 3 (60%), whereas younger participants were split once more according to **days of backcountry activity per season**. While the proportions of Patterns 2 and 3 are quite similar between those two bar charts, the distinguishing characteristics of the participants who spend more time in the backcountry is that they have a noticeable proportion of Pattern 4, similar but smaller than the professionally trained on the very right.

### Conclusion

I hope this analysis gave you some interesting insight about how users of American avalanche forecasts use the available avalanche problem information. Our analysis of the Canadian survey sample (1,014 participants) showed very similar patterns and confirm the general trends presented here. My main conclusion from these analyses is the avalanche problem information included in avalanche bulletins is being used in distinct ways, and while avalanche education plays an important role in how people use the information, other characteristics such as age and number of days in the backcountry per season also seem to have an effect. Somewhat surprising, years of backcountry experience does not emerge as a significant determining factor.

At this point, I do not have a good explanation for the influence of these background characteristics yet, but their presence is consistent with the results of other recent SARP

risk communication research projects by Anne St. Clair, Henry Finn, Katie Fisher, and Abby Morgan. To me this means the factors affecting people's use of the bulletin information are manifold and the relationships are messy. However, working towards a more systematic understanding of the different ways people use avalanche bulletins, who these people are, and why they use it that way is critical for improving the bulletin and making our products resonate better with all types of users.

If you have any comments or suggestions about this study, please contact us as we are always keen to hear about your perspectives and new ideas for this type of research. ●

### Recent SARP articles on our social science research on avalanche bulletin users

- St. Clair, A. Finn, H., Haegeli, P., Klassen, K., and Gregory, R. (2020). How getting to know the recreational audience can improve the effectiveness of the avalanche bulletin. *The Avalanche Journal*, 123, 28-31.
- Finn, H., St. Clair, A., Haegeli, P., Klassen, K., Clayton, M., and Gregory, R. (2020). Do recreationists have the skills they need to use avalanche bulletins effectively? *The Avalanche Journal*, 124, 32-34.

Shooting cracks in the Idaho Palisades. Photo Chris Roy



# The Case for Terrain Ratings

BY MIKE RICHARDSON

Over the last ten years, Lynne and I, along with others like Dale Atkins<sup>1</sup>, have tried to make central the importance of managing uncertainty in decisions around snow safety. As Dale Atkins wrote, *“Instead of focusing solely on risk, we must also focus on uncertainty, a term that is out of favor in the avalanche community.”* The avalanche community has done outstanding work on uncertainty related to cognitive biases (human factors and psychology), and of course a lot of work has been done on resolving uncertainty during terrain selection. For example: teaching students to analyze slope angles during route planning and while on the snow.

The recent tragic avalanche at Ophir Pass<sup>2</sup>, Colorado, US shows us that terrain selection remains hazy for some recreational backcountry skiers. Looking at the photos where the avalanche occurred, one cannot help but wonder if a terrain rating system could have provided a life-saving reminder to not enter the gully in which the skiers ultimately perished. ParksCanada has published maps with

ratings and annotations for popular backcountry ski terrain<sup>3</sup> in Canada. The map of “Loop Brook” explicitly states that the area is a terrain trap and that the first 2.5km of the route are subject to “multiple, overlapping runout zones.” The map of “Asulkan Valley and Illecillewaet Név ” explicitly states that the area referred to as the “mousetrap” is a terrain trap with similar dangers.

I have been thinking about some of these issues, and it seems like some notion of terrain ratings has been part of my process for a long time. Terrain selection is made uncertain by the chaotic interaction of terrain and weather, and high uncertainty makes room to justify bad decisions that put us on top of the slippery slope that leads to accidents. It is in the terrain itself that we find the most basic potential for danger, and the most accurate potential for avoiding that danger

Are terrain ratings a part of the process for many others? In the US, I haven’t to date heard recreational backcountry skiers discuss terrain ratings, except perhaps in the most informal

terms with respect to terrain that is off limits on a particular day. I believe terrain ratings, like human factors before it, need to become part of American backcountry ski culture.

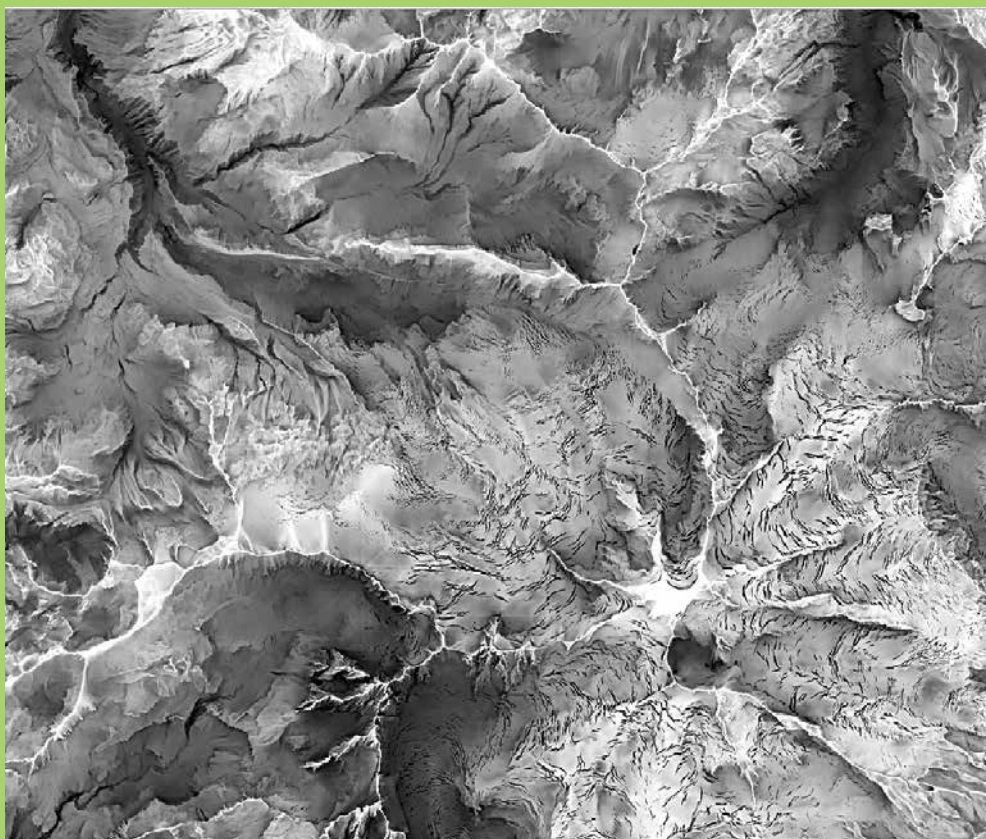
## WHY ARE TERRAIN RATINGS SO IMPORTANT?

For any professional mountain guide, avalanche forecaster, or researcher, the general history of an area is an indispensable component of decision-making. And even in areas without formal ratings, professionals accumulate knowledge of a particular area and have a good sense of which slopes are frequent fliers, what kinds of avalanches they produce, and whether an indicator slope is telling the truth. The accompanying worksheet by Steve Conger<sup>4</sup> provides an excellent framework for developing run lists that can be applied during the terrain rating development process. Recreational backcountry skiers may develop a similar sense about a specific area, but in general they simply do not spend enough time in the field to develop the same level of expertise as a professional.

Terrain ratings can be of significant value here because they enable the direct transfer of professional knowledge to recreational skiers, and this information is critical during the trip planning phase. To this point, an ATES rating can tell us whether a particular route is appropriate for current conditions. If recreational backcountry skiers are still choosing terrain that is inappropriate for current conditions, then I believe that they should adopt a more objective way to assess backcountry skiing terrain, which is a critical component of the trip planning phase.

Viewed through this lens, it seems obvious to me that formal terrain ratings can be an incredibly valuable tool for reducing uncertainty about exposure to avalanches. For example, mountain guide and author Matt Schonwald includes ATES ratings in his guidebook “Backcountry Skiing: Crystal Mountain, Washington.”<sup>5</sup> These ratings make it much easier to reduce uncertainty about exposure to avalanches for many routes, and I think ratings like this are every bit as valuable as the avalanche forecast and public danger rating. Of course you don’t have to take my word for it:

Topographic openness for Mt. Baker, WA. Open terrain is lighter and enclosed terrain is darker. This visualization makes convoluted terrain and terrain traps clearly visible to the naked eye.



Terrain in Purcell Mountains of BC. Pick any line then go through the worksheet tick boxes on the next page. Photo Steve Conger

recent past and includes current data about weather and snowpack. Put the current weather and snowpack into context using the ATES rating. In light of what you know about conditions this winter, what does the ATES rating say about what kind of avalanches are likely? What are their likely destructive effects? Is this zone or route a good choice? This is the 1000-foot view.

leading experts such as Grant Statham at ParksCanada developed the ATES terrain rating system<sup>6</sup> in response to tragic events that stemmed directly from uncertainty about terrain.

(It's important to note that ATES is undergoing an upgrade that looks like it will better align the information layout of the ATE classifications with the information layout of the public danger scale. This is an exciting development and I would suggest that this makes ATES ratings even more important—and useful—in the process of managing uncertainty about terrain choices.)

#### CONNECTING TERRAIN RATINGS TO SITUATIONAL AWARENESS

There is a great opportunity here to connect terrain ratings with situational awareness during trip planning. We could consider the ATES rating relative to three separate periods of time: the past in general, the current ski season, and today.

- **The Past In General.** What is the ATES rating? What is the overall history of this area? Historical data tells us that the area has a quantifiable exposure to avalanches of specific size, frequency, and destructiveness. What are the avalanche terrain characteristics such as start zone density and runout zone overlap? What about terrain traps? This is low uncertainty information since it involves events from the past and evaluation of the terrain and travel route. This is the 10,000 foot view.
- **The Current Ski Season.** What has happened this winter regarding layering and avalanche activity? This is low or medium uncertainty information since it involves events from the

- **Today.** What is happening today? What does the forecast say? What is the danger rating? Uncertainty varies by danger rating but is generally highest for “considerable”. Investigate the travel advice that accompanies today's danger rating. Does the ATES rating contain information that can inform your travel plans? Are there traps to avoid? Should you use even larger spacing than normal? Ask how this plays out in your ATES scheme. Can you point to the isolated/specific/widespread locations where your problem is likely to be found? Ask yourself why you want to travel here. This is the 10 foot view.

Having a formal system in place for evaluating terrain could be a valuable tool to help recreational backcountry skiers, and professionals alike, make more objective terrain choices, develop stronger safety plans, and increase awareness of how specific avalanche problems could affect their terrain choices. Terrain ratings can increase situational awareness by connecting recent conditions to the history of an area. Or in other words, terrain ratings help people know when to hold 'em, know when to fold 'em, know when to walk away, and when to run.

#### NOTES

*Risk: Sometimes We're Focusing On the Wrong Action* by Dale Atkins in *The Avalanche Review* 31.4 is one of the best things I have ever read about avalanche safety. It is an absolute must-read (or re-read) in my opinion.

Uncertainty should be considered for each time period, and the amount and character of uncertainty should be used to condition decisions along the way: always make conservative decisions when uncertainty is high, regardless of the reasons. ●



## Terrain selection is made uncertain by the chaotic interaction of terrain and weather, and high uncertainty makes room to justify bad decisions.

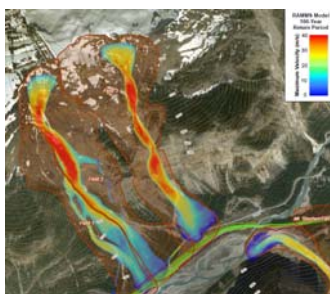
#### BIBLIOGRAPHY

1. Atkins, Dale. *Risk: Sometimes We're Focusing On the Wrong Action*. *The Avalanche Review*, Issue 31.4. April 2013. [https://static1.squarespace.com/static/59d2a0f0e9bfdf20d6d654b77t/5a5fbc9e2c483de0bf70920/1516223665354/TAR3104\\_All\\_LoRes-1.pdf](https://static1.squarespace.com/static/59d2a0f0e9bfdf20d6d654b77t/5a5fbc9e2c483de0bf70920/1516223665354/TAR3104_All_LoRes-1.pdf)
2. Colorado Avalanche Information Center. *The Nose, Middle Fork Mineral Creek southeast of Ophir*. [https://www.avalanche.state.co.us/caic/acc/acc\\_report.php?acc\\_id=770&accfm=rep](https://www.avalanche.state.co.us/caic/acc/acc_report.php?acc_id=770&accfm=rep) 2021/02/01.
3. ParksCanada. *Terrain Ratings*. <https://www.pc.gc.ca/en/pn-np/mtn/securiteemontagne-mountainsafety/avalanche/terrainsav-avterrain> Ca. 2004-2008.
4. Conger, Steve. *Terrain Coding at Route, Run, or Path Scale: Tutorial and Worksheet*. In Press. *The Avalanche Review*, Issue 39.4. April 2021.
5. Schonwald, Matt. *Backcountry Skiing: Crystal Mountain*, Washington. *Beacon Guidebooks*. 2018. <https://beaonguidebooks.com/product/backcountry-skiing-crystal-mountain-washington-pre-orders-available-now/>
6. Statham, Grant, & McMahon, Bruce, & Tomm, Ian & Canadian Avalanche Association. *The Avalanche Terrain Exposure Scale*. ParksCanada Agency. 2004. <https://www.pc.gc.ca/en/pn-np/mtn/securiteemontagne-mountainsafety/avalanche/echelle-ratings#scale>
7. McClung, David & Schaerer, Peter. *The Avalanche Handbook*. *Mountaineers Books*. 2008.



### Professional Snow Avalanche Expertise

Hazard mapping • Risk assessment • Engineering design • Protection structures  
Avalanche safety plans • Worker training • Avalanche forecasting • Risk control



Revelstoke, Whistler, and Kimberley BC

250.837.4466 | info@dynamicavalanche.com | www.dynamicavalanche.com

# Terrain Coding

BY STEVE CONGER

In the publication *Technical Aspects of Snow Avalanche Risk Management*, we described terrain coding as an operational risk evaluation strategy that relies on detailed terrain identification. Using terrain coding in operations reduces the effect of biases on field decision-making. It's a process ingrained in Canadian mechanized guiding where a run (i.e. specific terrain) is coded open (green) if it fits within the Operational Risk Band (ORB) or closed (red) if it doesn't. Fitting within the ORB means that the residual risk following applied mitigations is acceptable. In this

sense, closed ski area runs that are opened after control is another example of terrain coding. I've specifically avoided talking about yellow coded runs because there are numerous, operation-varied definitions of what constitutes yellow.

This is different from terrain identification/classification where the severity of the terrain with respect to the exposure of the element at risk is categorized. The most common method is the ATES rating.

I've noticed a gap in how new avalanche workers are instructed/mentored. This gap

seems to be an expectation that a novice can intuitively connect specific terrain to specific snowpack conditions.

As one works through the conceptual model of avalanche hazard, one determines where in the terrain the avalanche problem type can be found at a slope, run, or path spatial scale. These locations are typically incorporated further along in the process whether it's in the trip plan or avalanche hazard rating as descriptions of the features or slope scale locations to avoid. If you end here and head into the field, the world is your oyster and all terrain is available to assess at a slope spatial scale as to whether or not the avoid locations are present. Associate the color orange because if you've read this far, you need a really bad pun, this is terrain for consideration (i.e. considerable). Realistically, terrain is coded conditional. I'm not against this mode of planning, just listen to the Avalanche Hour episode 5.3 to understand why orange terrain coding as opposed to green or red is valuable.

In the practical world, you could communicate it this way: strategic mindset—assessment, all runs/routes are conditional, access is restricted where exposure to these locations/features exists.

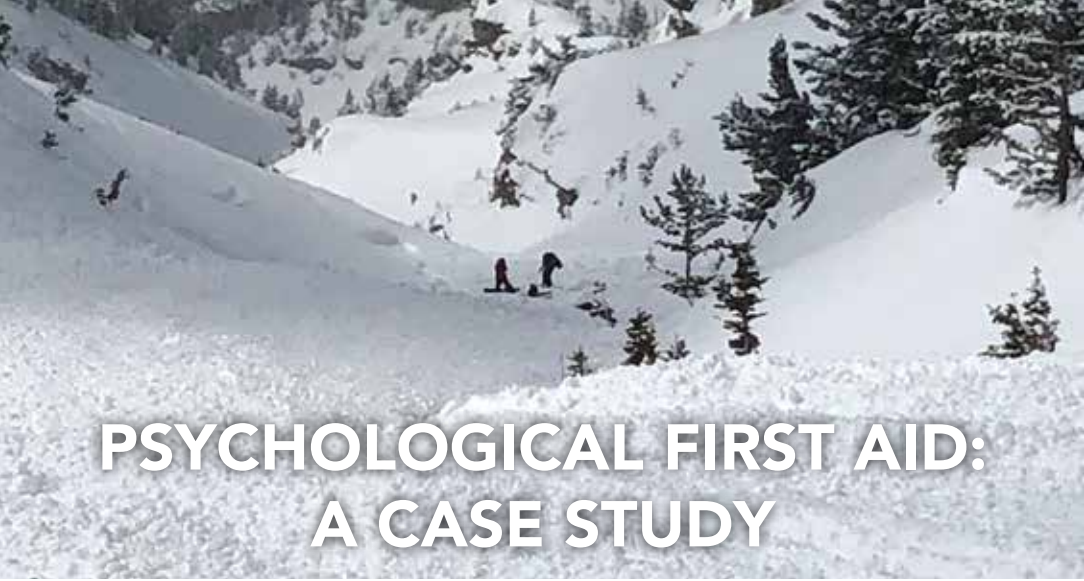
So, the instructional gap is created when we expect a student to distill the hazard to the slope spatial scale for operational open or closed run decision-making without having the opportunity for on-the-job learning where this is daily practice. To provide a roadmap and learning exercise, I created the attached tutorial and worksheet. It comprises a step-by-step flow beginning with a detailed terrain identification of the elevation bands, aspects, and features encountered along a route or run. This is followed by breaking down the current avalanche problem type(s) in the same manner. Next the terrain characteristics where observations could add to knowledge about the avalanche problem type are identified. (Targeted observations should be made at locations with these characteristics and a lack of potential consequence if the observer is mistaken about the presence, sensitivity to triggering, or size of avalanches.) Lastly the run or route is coded (e.g. open, closed). This exercise is a work in progress. The slope scale descriptors have been gathered from various avalanche terrain characteristic sources and are open to modification. I think where it fits in a curriculum depends on the nature of the students and objectives of the course. Use of the detailed terrain identification with the slope scale descriptors could be included in the path analysis lesson for professional courses. An instructor-completed example of three runs/routes could be used to lead recreational students through an exercise where they apply the problem to specific terrain.

ROUTE, RUN, OR PATH NAME	
<b>Terrain Coding</b>	
( __ to __ ft m ) ALP	
( __ to __ ft m ) TL	
( __ to __ ft m ) BTL	
NORTHWEST	
NORTH	
NORTHEAST	
EAST	
SOUTHEAST	
SOUTH	
SOUTHWEST	
WEST	
Open slopes	
Planar slopes	
Steep*** slopes near ridge tops	
Treeline rolls	
Avalanche fans	
Moraine slopes	
Highly featured or convoluted terrain	
Glaciated terrain	
Solar affected	
Shaded	
Burnt forest	
Cut block	
Dense forest	
Open canopy / glades	
Overhead path runout	
Overhead cornice runout	
Overhead icefall runout	
Gentle or <20 deg	
20 to 30 deg **	
Steep or 30 to 40 deg ***	
Steep*** pitches (< 6 to 8 turns)	
Sustained steep*** (>10 turns)	
Extreme steep (faces)	
Destructive size 1 exposure	
Destructive size 2 exposure	
Destructive size 3+ exposure	

\*\*Sufficiently steep to produce sizable avalanches under specific conditions.

\*\*\* Sufficiently steep to produce sizable avalanches under typical conditions.

Editor's note: Email Lynne or Steve Conger if you would like to have a copy of the full worksheet. 📄



# PSYCHOLOGICAL FIRST AID: A CASE STUDY



TCSAR volunteers search debris in the big terrain of Mt Taylor's South Face. Photos courtesy TCSAR

BY JEN REDDY

**Mt Taylor S-SE Face Avalanche  
SS-AR-R2-D2**  
1 snowboarder caught and fully buried,  
Fatality.  
Southern Teton Range  
Teton Pass WY  
2020.04.01.

The heart-breaking video from a young woman filming her friend with her iPhone begins with the typical hoots and cheers of riding untracked powder but moments later turns to the shrieking yell of his name as he is carried out of sight in an avalanche. Until a few years ago, we at Teton County Search and Rescue (TCSAR), did not recognize the person filming this video as an additional patient in an avalanche rescue scenario.

We would help these bystanders back to their car and wish them well. We did not fully realize the impact of their having to drive home or go back to their hotel room with their loved one's shoes sitting on the floor of the passenger seat.

Our mission as rescuers is to do the greatest good for the greatest number, and we were failing to do that.

## CONDITIONS LEADING UP TO THE ACCIDENT.

April 1, 2020. In the previous 24 hours 11" of new snow had fallen with 1.30" SWE accompanied by 28mph SW winds with gusts of 58mph. Storm totals were ranging from 15"-18" with strong southwest to west winds. The forecasted avalanche danger was rated at Moderate for the day and the report discussion stated, "Do not travel in areas where wind loading is suspected."

Rider 1 and Rider 2 planned to tour from the Coal Creek parking lot on the west side of Teton Pass. They followed the standard approach route up the Coal Creek drainage and ascended the southeast ridge of Mt Taylor. At the summit ridge (10,350') Rider 1 and Rider 2 traversed south above the South Face, also known as the "Poop Chute," a 2800 vertical foot relief averaging 35°.

## AVALANCHE EVENT

Rider 1 descended through the uppermost bowl stopping on a sub-ridge to watch Rider 2. On the third or fourth turn Rider 2 triggered an avalanche at approximately 10,100'. He was caught and carried out of sight from Rider 1. Rider 1 attempted a beacon signal

RESCUER STRESS CONTINUUM			
READY	REACTING	INJURED	CRITICAL
<ul style="list-style-type: none"> <li>Sense of Mission</li> <li>Spiritually Healthy</li> <li>Emotionally Healthy</li> <li>Physically Healthy</li> <li>Emotionally Available</li> <li>Healthy Sleep</li> <li>Enjoying</li> <li>Sense of Joy/Vitality</li> <li>Room for Complexity</li> </ul>	<ul style="list-style-type: none"> <li>Critical of Rescuers &amp; Patients</li> <li>Avoiding Rescue Types</li> <li>Loss of interest</li> <li>Distance from Others</li> <li>Short Fuse</li> </ul> <p><b>CHANGES:</b></p> <ul style="list-style-type: none"> <li>Life feels "bleh"</li> <li>Lack of Motivation</li> <li>Fatigue / Weariness</li> <li>Sleep Disturbance</li> </ul>	<ul style="list-style-type: none"> <li>Sleep Issues</li> <li>Emotional Numbness</li> <li>Activity Avoidance</li> <li>Burnout</li> <li>Nightmares</li> <li>Disengaged</li> <li>Exhausted</li> <li>Physical Systems</li> <li>"Tusta" be a climber / rescuer identity</li> </ul>	<ul style="list-style-type: none"> <li>Helplessness</li> <li>Anxiety</li> <li>Depression</li> <li>Intrusive Thoughts</li> <li>Feeling Lost or Out of Control</li> <li>Thoughts of Suicide</li> <li>Self Blame</li> <li>Hiding Out</li> <li>Brokers</li> <li>Relationships</li> <li>Careless Mistakes</li> <li>Panic</li> </ul>

search and was unable to locate a signal from Rider 2. Distraught, unfamiliar with the terrain, and fearing a secondary slide, Rider 1 returned to the Coal Creek parking lot for cell service to call 911 at 1505.

Teton County Search and Rescue was immediately paged for an avalanche with a known burial. Within an hour, three ground teams and a drone team were in the field. A beacon search was performed with no signal located. Teams began a probe line with no success in locating Rider 2.

A fourth team, trained in Psychological First Aid (PFA), was dispatched to specifically work with Rider 1 who was distraught and despondent. Rider 1 was deeply concerned about putting TCSAR at risk to COVID-19 and ashamed for failing to heed the repeated public warnings to recreate responsibly. She had a profound sense of feeling powerlessness and guilt at not being able to perform a companion rescue.

Operational period 1 was concluded at nightfall with all teams out of the field and Rider 1 connected with friends who would stay with her through the night. The assigned PFA team provided an operational debrief with Rider 1 and established a plan for the following day.

Operational period 2 began at 0600 with a multi-agency effort. Jackson Hole Ski Patrol assisted in avalanche mitigation in the adjacent connected terrain, while two dog teams, a WYDOT Avalanche Technician, and a Bridger-Teton Avalanche Center forecaster assisted TCSAR ground teams in the field. A dog team alerted shortly after the conclusion of avalanche mitigation and Rider 2's body was recovered near the toe of the avalanche debris, approximately 2500' vertical feet below the crown. He was wearing a Pieps beacon that was recovered from his thigh pocket in the off position. The party did not perform a beacon check.

A TCSAR Psychological First Aid team contacted Rider 1 prior to start of avalanche mitigation on the morning of April 2. They continued to work with her during the recovery and transport of Rider 2 from the field, keeping her informed of the recovery process, requesting her assistance in gathering information, and reassuring her of actionable next steps. Moreover, the team reinforced that the avalanche was not her fault. This was instrumental in ensuring the immediate safety and wellbeing of Rider 1. At the conclusion of the rescue and recovery, the PFA team connected Rider 1 with a trained Trauma Counselor for continued support.

## TREATING THE NON-PHYSICALLY INJURED

TCSAR has been working to develop a standard of care and has trained in multiple forms of Psychological First Aid (PFA) for the past two years. As a team, we have created a SOAP note to document our interventions just as we would for orthopedic or medical calls.

## TRAUMATIC EXPOSURE PROTOCOL

### POTENTIALLY TRAUMATIZING EVENT (PTE) CRITERIA

- FAMILY CONTACT
- PERSONAL CONNECTION OR EMPLOYEE INVOLVEMENT
- DUTY TO ACT
- MISSION INJURY/HELPLESSNESS
- EXTREMES OF EXPOSURE
- OVERWHELMED/DEPLETION
- INCIDENTS INVOLVING CHILDREN
- COMPLEXITY OF INCIDENT
- FIRST TIME EXPOSURE

### 3-3-3 EXPOSURE PROTOCOL

3 DAYS POST INCIDENT	3 WEEKS POST INCIDENT	3 MONTHS POST INCIDENT
<ul style="list-style-type: none"> <li>Stress Continuum Check-in</li> <li>Normalization/Education</li> <li>Leverage GREEN Choices (make a plan)</li> <li>Self &amp; Partner Awareness (Support Return to Baseline)</li> <li>Life Stressors Check-in</li> </ul>	<ul style="list-style-type: none"> <li>Complete TSQ</li> <li>Scores &gt; 6 = increase risk of stress injury development</li> <li>Provide Resources for Professional Help</li> <li>Stress Continuum Check-in</li> <li>Increase Self-Awareness of Stress Injury</li> <li>Revisit Plan to return to Green Baseline</li> </ul>	<ul style="list-style-type: none"> <li>Stress Continuum Check-in</li> <li>Revisit Plan to return to Green Baseline</li> <li>Offer Resources and Connection</li> <li>Offer Further check-ins if requested.</li> </ul>

LAURA MCGLADREY | RESPONDERALLIANCE.COM

This normalization of psychological care has helped to destigmatize traumatic stress injury and fostered a culture of caring for the whole person. This approach has been implemented as both an outward facing care for patients and an inward facing practice of checking in with team members following particularly difficult missions.

**PSYCHOLOGICAL FIRST AID**

The clinical definition of Psychological First Aid is “an evidence-formed modular approach to help in the immediate aftermath of disaster, terrorism or other significant traumatic event” (National Child Traumatic Stress Network, *Psychological First Aid Manual*). In this context Trauma can be defined as “a stimulus that overwhelms one’s capacity to integrate it.” (McGladrey, 2020) The individual exposed to trauma experiences the normal fight, flight, freeze response but never receives the “All Clear” signal that the threat has ended, so they become stuck in the fight, flight, freeze response.

**WHAT TO LOOK FOR ON SCENE**

- The person with the 1000m stare.
- Checked out or disassociated.
- Inability to think clearly.
- Disoriented and confused.
- Not following directions or answering questions clearly.
- May even have shock-like symptoms of being cold and clammy.

**MECHANISM OF TRAUMATIC STRESS INJURY**

Not all rescues or accidents will result in a traumatic stress Injury, however there are several correlated mechanisms that increase the potential for traumatic exposure. They are as follows:

- Family contact during accident or rescue.
- Close personal connection to the victim.
- Duty to act.
- Helplessness.
- Extremes of exposure.
  - Ex. Multiple victims, particularly gruesome injuries, natural disasters, acts of violence.
- Overwhelmed/ stressed out by daily life. Reduced coping capacity.
- Incidents involving kids.
- Complexity of incident.
  - Ex. challenging to access the victim, multi-agency efforts, no comms.
- Outside stress.
  - Ex. Remoteness, weather, darkness, bystanders, media presence.
- First time exposure.

**PROVIDING PSYCHOLOGICAL FIRST AID**

The key words in this term are “First Aid.” First Responders do not need to be clinical psychologists to provide PFA. The following five steps can be considered as the A.B.C.D.E. (Airway, Breathing, Circulation, Disability, Exposure) of PFA.

Five components to providing Psychological First Aid.

TRAUMATIC STRESS QUESTIONNAIRE		
Complete at the 3 WEEK Check-in. Asking the question: HAVE YOUR RECENTLY EXPERIENCED ANY OF THE FOLLOWING?	YES	NO
1. Upsetting thoughts or memories about the event that have come into your mind against your will?		
2. Upsetting dreams about the event?		
3. Acting or feeling as though the event were happening again?		
4. Feeling upset by reminders of the event?		
5. Bodily reactions (such as fast heartbeat, stomach churning)?		
6. Difficulty falling or staying asleep?		
7. Irritability or outbursts of anger?		
8. Difficulty concentrating?		
9. Heightened awareness of potential dangers to yourself and others?		
10. Feeling jumpy or being startled by something unexpected?		

**1. Safety**

Shield the patient from negative details of the event and rescue.

Give accurate information.

Provide for their basic needs of food, water, and shelter from the elements.

**2. Calm**

Model calm behavior.

Decrease their arousal.

Give positive feedback.

Support calm breathing.

Guided Box Breathing

Model calm breathing as the rescuer.

**3. Connection**

Connect with the patient.

Simple as using their name repeatedly when you address them.

Connect the patient with others.

Friends, family, or trauma counselors

Keep the patient engaged in the mission.

**4. Self-Efficacy (Combat Helplessness)**

Assign a task to the patient.

Ex. Ask them to help dig a platform for a helicopter LZ or carry the litter.

Emphasize the patient’s role in the rescue, tell them what they did right.

**5. Hope**

Hope is NOT empty optimism that no matter what they do or do not do it will all be okay.

Hope is giving them agency, that their ACTIONS will have meaningful outcomes.

Reflect on specific, accurate, positive facts, and predictable realistic next steps.

This framework informs the patient care that TCSAR provides on scene. Local non-religious affiliated chaplains and a network of professional mental health providers trained in trauma therapy can provide a higher level of care if indicated.

**TURNING PFA INWARD**

First Responders are not immune to Traumatic Stress Injuries and studies indicate that the repeated subacute exposure to potentially traumatic events greatly reduces the capacity to effectively cope with future traumatic exposure. In cooperation with several regional organizations including the Jackson Hole Ski Patrol, Fire/EMS, Police and Sheriff Offices, Grand Teton National Park, and the US Forest Service, TCSAR has created a peer support initiative to provide a resource for those first responders who experience traumatic stress injuries on the job. The core of this initiative is the 3-3-3 Protocol which allows for a simple screening of trauma exposure and identifying red flags indicating a need for referral to a trauma specialist.

**EXPANDING THE STANDARD OF CARE**

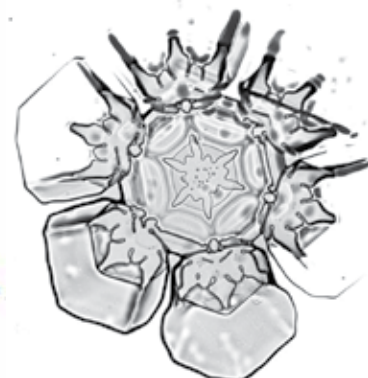
Rescuers have been conditioned to focus attention on those injured or killed in an avalanche, but we are leaving the partners and potentially fellow rescuers untreated by these traumatic exposures. If our objective as First Responders is to do the greatest good for the greatest number, then we must broaden the standard of care to include basic Psychological First Aid. Following the five simple steps of establishing safety, promoting calm, fostering connection, creating self-efficacy, and communicating hope, First Responders can help facilitate the “All Clear” signal in a patient and reduce the impacts of Traumatic Stress Injury. 🗨️

Jen Reddy is a Jackson, Wyoming-based illustrator, avalanche educator, and member of Teton County SAR. A founding member of the Teton Interagency Peer Support (TIPS) program, Jen has helped to foster the culture shift within the first responder community to identify and address traumatic stress injuries. Her art and illustrations can be found at JenReddyInk.com.



snwmetrics

**Tools for Avalanche Forecasting**



Snow Research since 1985

# PAUSING TO REMEMBER

BY LAURA MCGLADREY

**We gathered last week**, 60 of us from all over the country, rescuers, patrollers, responders, forecasters, nurses, guides, to talk about strengthening community resources in a time of grief and loss, in a conversation between Drew Hardesty and me. This came as we near the one-year milestone of COVID in our lives, and in the wake of the many calls I've gotten this season to support communities, rescuers, and companions in this year's avalanche season.

Drew told us that when Utah Avalanche Center reviewed the Wilson Glade Avalanche online, a thousand people showed up. We need these gatherings; we know that grief and loss and meaning were meant to be shared. You can find a transcript of the review at the Utah Avalanche Center, blog entry from March 4, 2021.

We knew going into the season that this was going to be a tough year. The usual things that help us love our jobs; watching the snowpack, comradery, the normal ebb and flow of the winter season, were all in short supply. We added to this new complexity; changing COVID restrictions, masked faces, eviction from shared patrol shacks, or gathering after a patrol day, and challenging, to say the least, conditions. Add to this the nearly constant news of another avalanche, another inbound fatality.

As we have an emerging understanding of the impact of acute stress on chronic stressors, we could predict that many would find themselves exhausted, depleted, and just making it through. For those of us who lost someone or something during the last year, we've lost our rituals of gathering by a bonfire, scotch by a fire, meals at each other's houses, all places where grief and loss find their natural place in us.

So we gathered to connect and remember. To call out the phenomenon of delayed grief, to tell a few stories of what we'd seen and lost, and to look toward our collective resources, first and foremost, each other. We named that, for many of us who have lost someone in an avalanche at the same time we've been rescuing, the real grief won't likely hit until after the season, when many of us are off to the next adventures. We talked about reaching out to each other on purpose, long after the first waves of grief had passed; being a community that keeps the rituals we cherish going, even in some untraditional ways, because of how much it all matters.

Finally, we shared resources that are emerging; an intentional way of checking in on each other and supporting each other. We shared a commitment to being elders in the community. If we have lost, we become willing to reach out to each other, to listen and share silence. We remembered, together, that there are those in our community who will just be starting to grieve these losses when the COVID numbers recede.

Drew, as only Drew can, shared his writings and invited us into a place of silence, gratitude, and the hush and weight of so much of what the avalanche community has lived this season. I'll let his words speak to what we can do in times like these.

## MAKING SENSE OF THE WILSON GLADE TRAGEDY

by Drew Hardesty

Six people are deeply buried in an avalanche in the Wilson Glade. One was caught but held onto a tree, safe but not sound. Three of the six burials are from a completely independent party; strangers he never knew until now. He acquires the first signal, digs, and allows the first stranger to live. He acquires the second signal, digs, and allows the second stranger to live. Now the third signal. He digs to find his wife. She's blue. Pulseless. Not breathing. CPR for thirty minutes and she's not coming back. He leaves her to dig up three other deep burials. They're not coming back either.

So. How do we make sense of these things in life and death? How can we come to understand tragedy or, worst of all, indifference from God\* and the natural world entire? It may be that we can never fully understand events and outcomes. Norman Maclean, in the telling of his brother's death in *A River Runs Through It*, writes that we can love completely without complete understanding. The key is only that we love at all. This alone helps us, if not to understand, then to continue to move through this world. We can also be grateful for that which we have and for that which we had.

For now, squeeze one another, friends. Hug your children, your loved ones. Hug the trees, ski the snow. Go make a difference in this world. (We all got a second chance at life...) That's what our contemporary Job said despite the tears and the anguish.

*\*Post script: It is in stories like these that I am often reminded of the Book of Job in the Old Testament. You'll recall that everything (health, family, wealth) was taken from him by God and he suffered the great injustices of the world. Job shook his fist at the Old Man and demanded to understand, How Can This Be Justice? God appeared as a whirlwind...but didn't answer the question.*

## RESOURCES:

<https://www.responderalliance.com>

<https://americanalpineclub.org/grieffund>

<https://amga.com/the-rise-project>

<http://soar4life.org/>

<https://soundcloud.com/user-23585762/the-avalanche-hour-podcast-episode-52-laura-mcgladrey/s-UkITDj8QMve>

Laura McGladrey has

been instructed for NOLS Wilderness Medicine for 20 years and is a Nurse Practitioner with dual certification. She is the Stress and Resilience advisor for Portland Mountain Rescue, Colorado Outward Bound, and Eldora Ski Patrol.



## Be Searchable



The new **RECCO SAR Helicopter Detector**:  
an evolution in RECCO technology from avalanche rescue to year-round search and rescue.



**RECCO**  
ADVANCED RESCUE TECHNOLOGY

[recco.com](https://recco.com)

# BOOK REVIEW

*Avalanche Search and Rescue* by Alexis Alloway



**It is fortuitous timing** to write a review on *Avalanche Search and Rescue* by Alexis Alloway. Local SAR groups have gotten a significant amount of practice with avalanche rescues and recoveries in the San Juans since the pandemic began last March. As I type, a slew of SAR teams are working on extracting three bodies from a large slide north of Silverton, CO near Ophir pass. This is now the third multi-person burial in the San Juans in the same number of years. I am a huge fan of guidebooks and manuals. That said I am always skeptical of the usability of field manuals for actual use. *Avalanche Search & Rescue* by Alexis Alloway breaks that mold. This will likely become my new go-to fall reading material in prep for the winter & avalanche season.

At first glance, this field manual appears to be very similar in style to the *Technical Rescue Riggers Guide* by Rick Lipke. However, what sets this backpack and field-friendly book apart is the combination of information. Imagine combining *Staying Alive in Avalanche Terrain* with Lipke's *Riggers guide*, then sprinkled with a NOLS WFR manual. That's exactly what Alloway has accomplished here. As somebody that has been in and out of SAR involvement and winter response teams for 20+ years, this manual spoke to me with reminder after reminder of how an organized team should function. Most avalanche rescue resources focus on companion rescue, and this book seems to be the first mainstream book on the market to specifically address the organized SAR.

The book is divided up into sections that would flow with a typical SAR response: Planning and leadership, Risk Management, Search, Medical, Rigging & Evacuation, Mission Termination, and a full appendix. One would hope that a well-dialed team doesn't require a refresher, but rather a reference. *Avalanche Search & Rescue* will serve as that reference functioning as a single spot to find the bottom lines. We all know how valuable checklists are in stressful and/or high-risk situations. Each section, beginning with Planning & Leadership, does just that, by providing a

quick checklist for a team leader to have close at hand when delegating roles and organizing a rescue. This section, like the rest of the book, is filled with eye-catching icons and graphics.

I especially like how in each section, anything significant has page references to elsewhere in the book where the applicable information can be found. The paper, while not too thick, is durable and waterproof, and a blank notes page can be found at the end of every section, allowing you to record mission notes and field observations.

Overall, the book is stuffed with a wealth of information from a variety of sources in a field friendly package. While it is primarily aimed at SAR and ski patrollers, I can see where it could be useful for avalanche educators and everyday backcountry enthusiasts as well. Anyone who ventures into the backcountry can use a refresher at the start of the season, and the visual style of this book makes it an easy and appealing read.

That said, the book seems more appropriate for a ski patrol headquarters or SAR barn rather than in my response pack. SAR members often already have stuffed packs. I would not be psyched to now have an additional 125-page manual, and another five ounces, to

shove into the brain of my pack. Now if Alloway was able to put it into an app or even a PDF I could load on my phone, that would come with me every time.

This is a resource definitely worth checking out. The compilation of material and information from so many respected sources is great. These waterproof paper flip style manuals are awesome for preseason reading and refreshing as well as instructional purposes while on a course. While a rescuer may not be inclined to bring it into the field during a live mission, I predict that SAR teams and patrollers may choose to carry them during trainings and exercises.

—Josh Kling

Josh Kling is the coordinator of Permitting and Programming for the Outdoor Pursuits Program at Fort Lewis College. He is the founder of Kling Mountain Guides, now San Juan Expeditions, and author of *Silverton Backcountry Skiing*. An AMGA Certified Alpine & Rock Guide and Assistant Ski Guide, he has been working and playing in the San Juan Mountains for over 20 years.



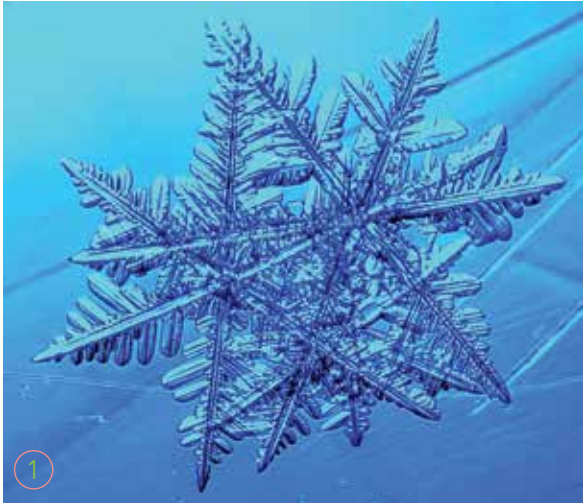
## BEST CHOICE FOR THE WORST CASE

MAMMUT AVALANCHE SAFETY PRODUCTS.

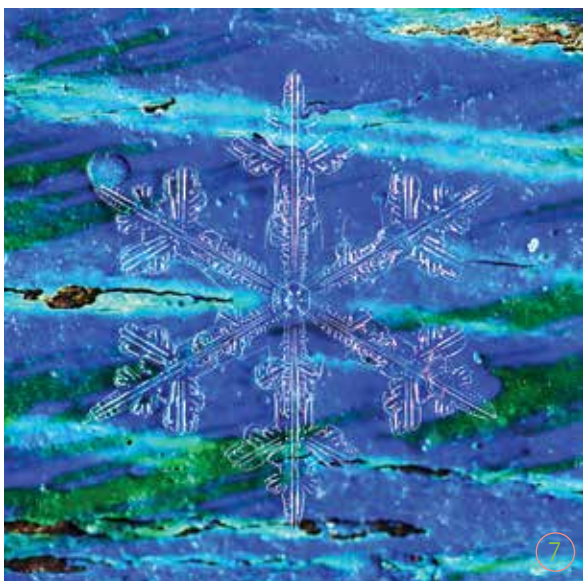
MAMMUT.COM



# LAST LAP



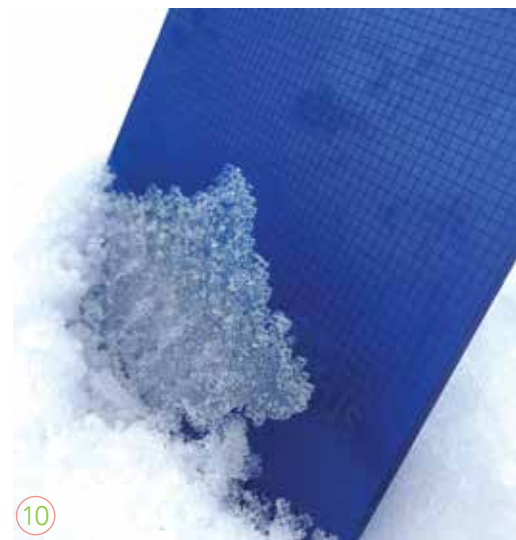
**SNOW CRYSTALS:** Snowflake photography is a hobby that I recently picked up. Anyone can get good photos of Surface Hoar because the crystals are easy to separate and hard to damage. Also the weather is generally pretty nice when you are shooting them. Stellars are the real prize, and they are much harder to get because there is usually a small window during a storm when Stellars are falling. For my set up I use a Specwell M830-S Microscope which has a 30x magnification. This version has a scale that can be turned on or off which is not helpful for snowflake photography but is nice when you need to note sizes of crystals. Really any lens with 10x magnification or greater should work. I also use a tripod which I clamp my crystal card to. I use my phone for all of my photos, and I have glued a 1 1/2" inside diameter washer to the case of my phone to help me center the camera over the eye piece of my lens. The blue background is a plastic Snow Metrics crystal card, the black background is a metal BCA crystal card, and the white background is a piece of glass. Photos 1-6 by Aaron Dahill



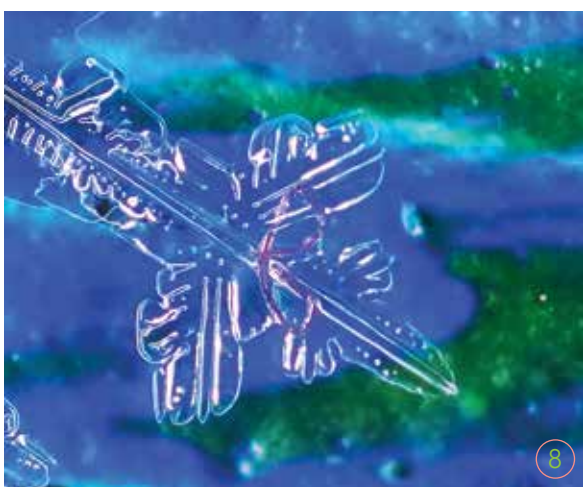
**MICROPLASTICS:** This spring, I captured an image of a microplastic embedded in a fresh snow crystal that had just fallen from the sky. I believe this may be the first photograph of its kind.

The image was photographed in Utah's Wasatch Range, home of the "Greatest Snow on Earth" at the Snowbasin Resort. I ski toured to about 8000' to photograph a snowflake on the mountain for my friend Jesse Vanderhoof. April 2, 2020 was his 40th birthday. Instead of celebrating, he was fighting for his life in the ICU after contracting COVID. He is a nurse and got sick after doing drive-in swab testing. Since there wasn't anything tangible I could do to help him get better, I decided to capture a snowflake from one of his favorite places, in hopes of giving him a print when he recovered.


I didn't notice the microplastic until a couple of weeks later. Fortunately, I captured a series of images that shows the microplastic melting out of the snow crystal, which confirms that it was embedded within it. I contacted researcher Marco Tedesco at Columbia University, who is studying microplastic in snow. He confirmed the likelihood of it being a microplastic. The only logical explanation is that the microplastic collided with the snow crystal in the atmosphere while it was forming. Photos 7-8 by Doug Wewer, DesertSnowPhotography.com



**SURFACE HOAR:** Huge surface hoar crystals from Ushuaia, Argentina, July 9, 2020. Photos 9-11 by Gonzalo Valdes





BD Athlete Mary McIntyre | Rishiri, Japan  Garrett Grove

To live, is to rise.

And whether you like it or not, adventures don't fit  
conveniently into a 9 to 5.

So wipe that sleep out of your eyes.

Wake up. Gear up. Click in.

Now, fly.

It's a new day, and there's daylight to burn.

It's time to rise.

**FOR  
THOSE  
THAT  
RISE.**

 **Black Diamond**



***COOL, CALM, AND  
PROTECTED.***

## ***BC AIR HELMETS IDEAL FOR TOURING.***

The new BC Air touring helmet is so light and airy you can wear it on both the ascent and descent. ASTM-rated for ski/snowboard impact, with integrated headlamp clips, Boa® fit system, and massive ventilation.

*Learn more: [backcountryaccess.com/helmets](https://backcountryaccess.com/helmets)*



# Wyssen Avalanche Tower



**Innovative  
avalanche technology**  
from Wyssen Avalanche Control  
in **Little Cottonwood Canyon** makes for  
**efficient** and **safe** avalanche mitigation



**avalanche  
control**

**Wyssen USA Inc.**  
80301 Boulder CO  
+ 1 208 891 95 43  
usa@wyssen.com  
[www.wyssen.com](http://www.wyssen.com)



**AMERICAN  
AVALANCHE  
ASSOCIATION**

PresortStandard  
US Postage Paid  
Permit #592  
Pontiac, IL

A Publication of the  
American Avalanche Association

**THE AVALANCHE REVIEW**  
PO Box 7019  
Bozeman, MT 59771