

THE AVALANCHE REVIEW

When the Cracks
Begin to Show

a science perspective: pg 30

DECEMBER 2020: Cardiff Fork between Little and Big Cottonwood Canyons in the Wasatch. There was a fairly widespread avalanche cycle overnight and I went up to check it out. The slides were running on a PWL formed earlier in the season, basically a layer of facets at least a foot thick, sitting on dirt. That night we got a new load of snow and fairly strong winds from the NW. This slide was on a test hill I use at the bottom of Ivory Flakes, NW facing and protected. I remotely triggered the slide from 20 feet away while walking across the top. It had a two-foot crown and was 50 feet wide with debris piling up to 10 feet deep in the gully at the bottom. *Photo Mark White*



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Silverton guide Calvin Davenport lights up the San Juans, Silverton, CO. Photo: Jolietterica



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THE AVALANCHE REVIEW

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“Does anyone have any strategies for forecasting for this problem?”

“It would be nice to predict it before it happens; that’s our job.”

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The April TAR theme revolves around decision-making and human factors. Got a story, an opinion, a question? Contact the editor.

CONTRIBUTORS



Meghan Twohig joined CalTopo in May 2020 as part of the training and support team. She lives and plays in the mountains outside Vail, CO, where she is a volunteer member of the Vail Mountain Rescue Group. She is a big fan of type 2 fun and her dog.



Mark Saurer has been a ski patroller and avalanche hunter for most of his adult life. He's been a proud member of the UDOT Avy LCC team for eight years, and honored and humbled every day to be working

in the footsteps of Monty, Binx, Liam, and all snow mentors who have called Little Cottonwood and Alta home. While he enjoys the powder snow as much anyone, he's getting to the point in his career where he prefers water under his boat, sand between his toes, and buff singletrack under his tires.



Tyson Bradley is Chief Guide at UMA, Author of BC Skiing Utah, and first descender of the Wickersham Wall. He lives and plays in and around Utah w/ Julie, Roman, Diego, et al.



Karl Birkeland is the Director of the Forest Service National Avalanche Center and has spent the past forty years as a ski patroller, backcountry avalanche forecaster, and avalanche researcher. When

he's not working, he loves chasing his daughters around the mountains on skis, foot, or mountain bike, an increasingly challenging task.



After three years of getting night bushed as the Director of the Flathead Avalanche Center, **Zach Guy** recently returned to his forecasting roots in Colorado. He's working as the lead forecaster for the

Crested Butte Avalanche Center. Zach now enjoys wading through knee-deep depth hoar instead of head-high alders.



Joe Stock is an IFMGA Mountain Guide based in Anchorage, Alaska. He's passionate about skiing in remote Alaska, but he fantasizes about clipping bolts in the sun with his wife Cathy.

FROM THE EDITOR

BY LYNNE WOLFE

Hello friends. I just did a final spin through this fabulous issue before we send it off to the printer; there's a story for every taste, from the initial science focus to forecasting, storytelling, and decision-making. Here are some highlights:


Karl Birkeland of the National Avalanche Center genially agreed to my request for him to write up the proceedings of the CSAW session on avalanche release (page 30). He has a gift of explaining complex concepts so that the less science-literate among us can understand them, and once again TAR benefits from that gift. Thanks so much, Karl. If you're struggling with a Deep Slab problem this winter (who isn't?), then you'll appreciate the careful analysis and wry tone of Zach Guy's story of last winter's Flathead avalanche cycles (page 34).

Translating theory to practice, Joe Stock helps us incorporate the CMAH into careful trip planning and dealing with uncertainty on expeditions to remote Alaska with some remarkable photos and helpful graphics (page 38). If you like high resolution images and stories of impressive avalanches, go directly to our suite of articles on the February 2020 cycle in Little Cottonwood Canyon (page 24), where Mark Saurer shares a UDOT perspective and Tyson Bradley writes from the guide's viewpoint. You will also find a graphics-heavy tips and tricks piece on using CalTopo to understand and refine your terrain choices (page 22), thoughts on Covid and avalanche decision-making from thoughtful ski patroller Tony Daranyi of Telluride (page 41), plus lots more to pique your interest.

photo Peter Thurston



Check out our A3 member spotlights on longtime avalanche professionals Becs Hodgetts of the CAIC and Mike Ferrari of Mt. Rose (starting page 9). These two have been quietly capable in our community for years now, and it's time to see how they got to where they are and then for a round of applause. We will be honoring hidden hero avalanche professionals in an ongoing fashion in TAR—let me know if you want to nominate someone. We extend that applause and heartfelt appreciation for his career achievements to retiring CAIC forecaster Mark Mueller (page 12). As Halsted mentions in his From the President column, our community sustains us in many ways, and honoring our mentors and their stories brings insight and inspiration to the rest of us.

Finally, I am tremendously proud of all of you, persisting through Covid, crowding, snow drought, and deep slab conditions this winter. Here's hoping you all get to ski or ride some deep stable powder soon! 



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FROM THE EXECUTIVE DIRECTOR

BY DAN KAVENEY



One of the things I like best about my job is working with all the terrific people who make up A3—the members, the board, the sponsors, and the staff. We’ve done a good job publicly appreciating the efforts and accomplishments put forward by TAR Editor Lynne Wolfe, former and current Pro Training Managers Kate Koons and Erica Engle (respectively), and our hard-working Board of Directors, and here I’ll renew my thanks to them for all their good work.

Today I’d like to highlight the efforts of a few other staff members whose dedication has been instrumental to our success in recent months and years: Social Media Manager Will Flynn, A3 Administrator and TAR Special Projects Editor Emma Walker, and TAR Designer and Composer McKenzie Long. These folks have been doing fantastic work for us, mostly behind the scenes, so I thought it was time to pay attention to the people behind the curtain in order to offer thanks and appreciation for jobs very well done.

WILL FLYNN has been serving as our Social Media Manager since the fall of 2018, and during that time our social media outreach programs have grown exponentially. When Will assumed his position our social media channels were almost entirely inactive, and under his hand they have grown to the point where our best posts get as many as 70,000 interactions. Now that we have that kind of reach, our social channels serve as an effective means to promote the American Avalanche Association and to disseminate information about avalanches and avalanche safety. Will recently earned his bachelor’s degree in marketing from Montana State University. He’s also an avid backcountry skier, so he gets to practice what he preaches about avalanche safety and education.



EMMA WALKER’s name will be familiar to many of you, because she has authored articles for *The Avalanche Review*, most recently her profiles of female avalanche professionals. What you may not know is that she also plays a critical role as A3’s Administrator and as Special Projects Editor of *The Avalanche Review*.

As A3 Administrator Emma helps keep the trains running on time and plays a critical role in a lot of the important back-office aspects of keeping an organization like A3 running. If you’ve had a problem with your membership profile, or an order that didn’t arrive, a payment failing to go through or anything along those lines you’ve probably had help from Emma. If you’ve gotten a thank you gift for a donation, you’ve had help from Emma. Her administrative efforts have been indispensable to the organization, particularly as we’ve navigated the whole Covid crisis, which has produced a lot of extra work for us all. Aside from her articles, Emma’s most obvious contribution to *The Avalanche Review* has been *The Avalanche Review Online*. Emma was instrumental in the design and planning of TAR Online and now manages the day-to-day aspects of maintaining the site, adding new material, rotating advertisements, and continually freshening the articles presented.



When not working for A3 Emma has a diverse professional career as a writer and essayist. She has many articles and one book to her credit. Look for her next book, *Dead Reckoning: Learning from Accidents in the Outdoors*, forthcoming from Falcon Guides in June of 2021.

If you’ve ever appreciated the presentation and layout of *The Avalanche Review* or the look and feel of *The Avalanche Review Online*, then you’ve appreciated **MCKENZIE LONG**’s fine work. McKenzie, based in the Sierra Nevada, is TAR’s designer and compositor. She has been instrumental in TAR’s success for many years, helping to update our format from the newsprint days. She was also an important member of the development team for *The Avalanche Review Online*. When she’s not working on *The Avalanche Review*, McKenzie is an accomplished designer and writer. Through her design company, Cardinal Innovative, McKenzie has designed many books and other kinds of publications. As a writer she has authored two guidebooks and many articles, was named the Terry Tempest Williams Fellow for Land and Justice at Mesa Refuge, and was accepted into the Association of Writers and Writing Program’s 2020 Writer to Writer mentorship program. Look for her upcoming (non-guidebook) book, provisionally entitled, *This Land: A Personal Exploration of our Country’s Most Controversial National Monuments*, scheduled to be published by the University of Minnesota Press in spring of 2022.



Please join me in thanking these consummate professionals for all their work on our behalf. It’s a privilege to be working with them, and to have them as a part of A3. ●



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The pandemic has taken in-person gatherings away from the avalanche community. A3 has a unique membership community that I would like to see remain connected.



SKI PATROL SURVEY

A call-out to ski patrol directors and medical directors of ski patrols:

Have ever you wondered what other ski patrols are doing with regards to their medical training, protocols, and patient care?

My name is Lindsey Fell, and I am a medical student at Oregon Health and Science University. In my former life I was a professional ski patroller in the US and New Zealand.

I am conducting a research project that aims to **compare the medical direction, patroller training, and patient care of U.S. ski patrols**. The project consists of a 5-10 minute survey for either the patrol or medical director. Responses will be released in an aggregated manner that will not divulge the individual patrol or medical director's information. The data will be securely stored on an encrypted hard drive.

If you are a ski patrol director or medical director for a ski patrol, your response and help with the project would be greatly appreciated. If interested, please email skisurvey@ohsu.edu for more information and a link to the surveys. Those who complete the survey will be entered to win a **\$500 gift card**.

Thank you for your consideration, and I look forward to your participation.

Lindsey Fell
2022 MD candidate, Oregon Health and Science University
fell@ohsu.edu
skisurvey@ohsu.edu

A3 PRESIDENT: WE ARE A COMMUNITY

BY HALSTED "HACKSAW" MORRIS

The other day was my first ski day of the 2020–2021 season. As usual I was at Loveland Ski Area, where I got my start in the snow business. This season it felt kind of strange with all the mandatory mask-up rules. Opening day of the ski season has usually felt like the first day of high school to me, where you caught-up with all your old friends about what each of you had done over the summer. But this season it is hard to recognize old friends with masks on and while social distancing.

As I was surveying the new lift line set-up, I noticed a guy taking a picture of my skis. I walked over and asked if I could help him. All of a sudden he said, "Hi Halsted, its Seb!" (aka: Sebastien Barlerin = Canadian heliski guide friend and A3 pro member. He saw a sticker on my skis.) In an instant we were getting caught up on what each of us have been doing and other friends. It is true that in our "business" we are a community of friends and coworkers. Running into Seb I did not feel lonely behind my mask.


In this issue of TAR, we are spotlighting profiles of two long time A3 pro members who represent how knowledgeable and experienced our A3 membership is. **Becs Hodgetts** and **Mike Ferrari** have both been in the snow safety business for many years and each has served on the A3 board of directors; Becs was the Rockies Rep and Mike was the Treasurer. I have not seen either of them face-to-face in quite a while. But I know if I ran into either one on the street or ski area, we would be caught up in no time.

Speaking of old friends, recently Mark Mueller of the CAIC retired after a long and distinguished career. I had worked at CAIC with Mark and also when he was Executive Director of A3. When CAIC posted on Facebook about Mark's retirement, I knew the photos I wanted to post, (nothing too embarrassing), of our days at CAIC. You may retire from the "business," but you are still a part of our community. That is how it should always be.

The pandemic has taken in-person gatherings away from the avalanche community with events like ISSW and SAWs being shifted to primarily virtual online events. I have missed getting to see old friends and making new ones at these events. These in-person meetings are more than just education meetings, but where trip reports, research, and adventures are discussed and plotted over beers. Sharing a beer on Zoom is not the same as in person.

Dan Kaveney, (our A3 executive director) and I have really been pushing for building and maintaining our avalanche community during this pandemic. If you have not, please check out the online version of TAR and join in on the A3 webinars. If you cannot afford to renew your A3 membership now, because of the pandemic, call Dan, we will work something out. We want you to still be a member of our community.

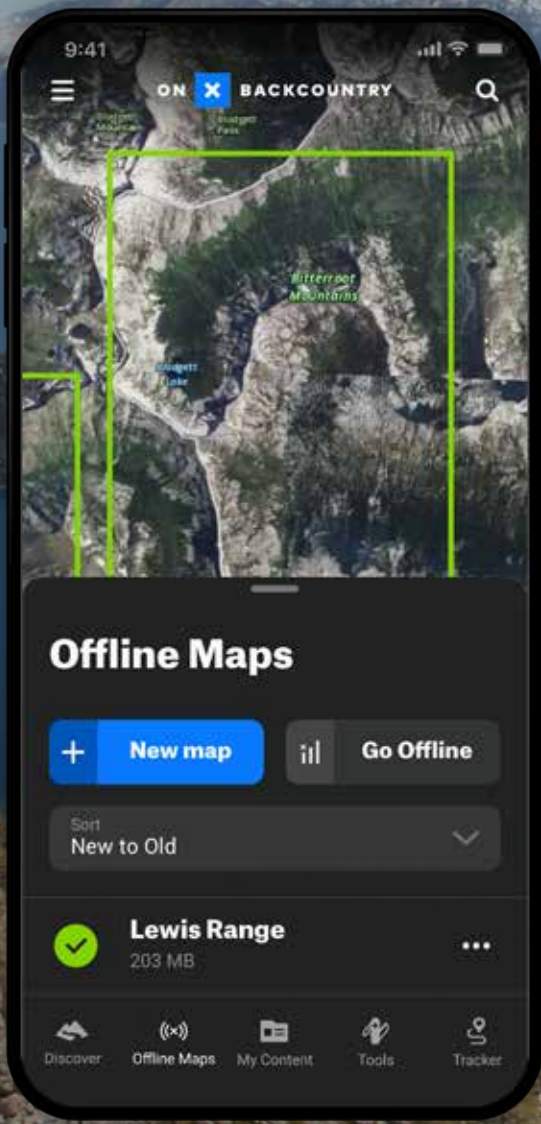
Eventually things have got to get better, right? The virus will one day be in the rearview mirror, and we will get back to normal. In the meantime, take care of yourself and your friends. A3 has a unique membership community that I would like to see remain connected.

Thanks, Seb for a great day of skiing and reconnecting. 



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HONORING BECS HODGETTS AS AN A3 PRO MEMBER:



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

I started ski patrolling in the mid-nineties in New Zealand. I soon was engaged in the back-to-back winter work that appeals to many Kiwis. It's a great way to quickly gain a lot of snow experience, not to mention a ton of fun. While I was in Canada, I started in the CAA professional program, as it has reciprocity in NZ. I was young and impressed by the athleticism and enthusiasm for life that so many mountain people possess. I grew up close to the ocean, so the whole avalanche and snow recreation scene was inspiring.

How have you seen the industry change since then?

We have let go of a lot of the "good 'ole boys club." Being of diminutive stature, I felt I needed to prove myself early in my career. I'm not sure if that was from outside pressures or something I placed on myself. I think probably the latter. From the time

that I started paying attention to workplace culture, I have experienced encouragement and inclusion. Hard work and commitment are what create opportunities. I feel incredibly fortunate.

Also, the avalanche and snow recreation industry has blown up; most of my family no longer describe my job as a ski instructor.

Who were your mentors? How did they challenge you?

I always thought mentors were people that encouraged you and nurtured your growth. I realize many of the people that helped me most gave honest feedback that felt harsh at the time.

Now, I consider the entire group I work with at the CAIC as my mentors. You'd be hard-pressed to find a more brutally honest, dedicated, and encouraging team.

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

"Pace yourself; it's a marathon, not a sprint." —Mark Mueller

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

I turn my phone off. 📴

Hard work and commitment are what create opportunities.



Photos courtesy of Beccs Hodgetts

HONORING MIKE FERRARI AS AN A3 PRO MEMBER:

Mike and Kona this COVID season.



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

Slow down. Learn through the process of things in life instead of the end result. Try new things instead of always working on improving what you are already good at doing. Lastly, as my mother always told my siblings and me, act in a manner so you do not “should” on yourself.

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

My first job in the avalanche industry was as a ski patroller at Mt. Rose in 1994 where I still work to this day. I had started working as a ski instructor trying not to teach at Mt. Rose during the 1988/89 season. My primary job at that time was helping to manage the Crown Motel in King’s Beach that my Grandparents had built in 1955. The winter business at the motel was such that I was able to work in the early morning and night and spend my days in the mountains. I had a pass at Squaw Valley

and taught at Mt. Rose. Many days I would ski Squaw in the morning and teach at Mt. Rose in the afternoon. After seven years of living where I worked and with family which can have its difficulties, I decided it was time to move on and go back to school to finish my degree in the spring of 1995. Needing a full-time job for that winter I called Pat Walker who was the patrol director at Mt. Rose at the time and asked if he would hire me for the winter. He did and I’m still here.

How have you seen the industry change since then?

Cheap passes, high speed lifts, and short fat shaped skis. The best thing that ever happened to skiing was snowboarding. The evolution of ski design brought about by snowboarding has increased the ability level of the core skiing community tremendously and extended the ski life of many a patroller. With that has come the problem of people’s avalanche and travel skills being outpaced by their ability to go downhill fast.

On the avalanche mitigation side, at Mt. Rose and elsewhere, the rigidity of how a given area is “controlled” has evolved to be more dynamic and to rely on judgments in the field as a result of the recognition of spatial variability. This is especially important because of the pace of the sport due to the high ability level of so many users that results in the public accessing all of an area’s avalanche terrain in a very short period of time compared to 20 years ago.

On the education/communication side, for me, the development of the Conceptual Model of Avalanche Hazard has been a game changer. By putting a consistent contextual framework to what many have been trying to accomplish through a variety of methods in all segments of the industry we are all in a better position to communicate with each other more concisely.

Who were your mentors? How did they challenge you?

My first mentors were my high school football coaches. I was incredibly blessed to have group of coaches who wanted to be competitive and win but whose primary purpose was to develop good people. At the ski resort, I have had a unique experience where I transitioned from rookie to patrol director in a little under four years and that was only possible because I had a handful of mentors who worked with/under me. Paulette Schneider, who was the Assistant Director when I joined the patrol and then came back to be my Assistant Director for over ten years, really kept me grounded and called me out if my directives or decisions needed tweaking during my early years in charge of the patrol at Mt. Rose. Tom Carter was someone that Paulette introduced to me and encouraged me to develop a relationship with as we opened the Chute terrain at Mt. Rose in 2004. The Ruby Mountain Heli-Ski operation usually did not start up until the middle of January and I was able to work out an arrangement with Tom where he would come in prior to that and provide some feedback on the snowpack and operations and mentor forecasters in training. During the early years of the Chutes being open, Tom was invaluable as a third-party sounding board and mentor to me. Although an incredible storyteller, Tom is an even better listener. I will forever be indebted to him for the numerous times where he let me work through scenarios out loud with few interjections as I worked towards or was guided to the solution of a given issue. One of my greatest honors as the patrol director at Mt. Rose was to have Tom become a member of the Mt. Rose patrol for a number of years after he retired from the Rubies.

What’s the most useful feedback you’ve ever gotten?

Tom Carter, “You want to know what you don’t know.” As humans we tend to make decisions based on and focus on what we know. In avalanche terrain it is always what we do not know that will cause problems. Reduction of uncertainty is only possible by reducing the number of things you do not know.

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

In February of 2007, I ski cut across a run/chute called Yellowjacket mid-slope and got away with it. My partner was not so lucky. To this day I am thankful and amazed that Pat



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Early Chute (or 2005) avalauncher mission with Carl Williams and Paulette Schneider.

Robertson, a mentor of mine, is alive. I will never forget him screaming to me “Keep your eyes on me” over and over again as he rode the largest piece of intact snow I have ever seen slide down a mountain. That piece of snow stayed together until it started to hit an island of trees in the run-out zone and then I lost sight of him but then saw both his skis shoot fifty feet in the air going different directions. I was sure he was dead. By the time he woke up from his skull fracture, his broken leg was healed. What did I learn? I learned that 50–60 pounds can make a difference when conditions are ripe for an avalanche. I learned that explosives are not perfect and should not impart a false sense of security when other things are obviously not right. I learned that most accidents have reversible moments and both my partner and I failed to recognize or act upon the signs available.

https://arc.lib.montana.edu/snow-science/objects/ISSW_P-099.pdf

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? Having a conversation about my perception of consequences of the hazard is where I would start. Is the run worth your life? What will be the consequences to others in your life if something goes wrong? At some point

you have to put your foot down, convince the other person you are in this situation together and you are not comfortable in making that decision and provide the safer alternative. Our bad decisions rarely only impact ourselves.

How would you describe your communication and leadership styles?

As much as possible, I try and lead from the front. When it comes to dealing with avalanche hazard and mitigation, I try have open communication and lead by consensus. I am not all places and I do not like to dictate to others to make decisions based on my perceptions of the hazard on whatever zone I’m responsible for on a given control day. The opening or closing of complex terrain needs to be done collectively. At Mt. Rose, we use a scribe on control mornings and try and verbalize results on the radio for all to hear as much as possible. Real-time communication between teams as mitigation is occurring is critical to reducing the chance something gets missed and to reduce uncertainty.

Would you say those traits are typically described as “masculine” or “feminine”?

I would hope that my communication and leadership styles come across as gender neutral as possible. We have probably a higher percentage of female patrollers compared to other resorts and I value the female input as much as the male input if not more. Those that work with me would probably be more equipped to determine where on the spectrum my communication or leadership skills fall.

Have your leadership and communication styles changed over time?

As my responsibilities at the ski resort have expanded beyond the patrol, I have become better at letting others lead. Mentorship is important to me and part of that is developing leadership. Relinquishing the leadership role in certain situations is good for me and good for the patrol and resort.



Mike and Mac getting oriented to the CareFlight. All photos Mike Ferrari collection

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

During the 25 years I have been the Patrol Director at Mt. Rose, we have primarily been a training ground for future firefighters and a few doctors. Most of the firefighters have continued to be part-time avalanche hunters. There are also a handful of full and regular part-time patrol at Mt. Rose that include Kevin Devine, our Chute supervisor, who been instrumental in our mitigation program at Mt. Rose for the last 25 years. Building a sustainable avalanche career in my personal experience was a matter of happenstance and not by design. With that being said, in some small part I had something to do with Dallas Glass developing a sustainable avalanche career and Andrew Hennigh maintaining a sustainable avalanche career. In addition, my current assistant director Devin Hiemstra, forecaster Wendy Antibus, and Charlie Jennings-Bledsoe, who is now at Alpine, are all avalanche professionals who could work anywhere.

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

This season, a lot of my thoughts have been focused on operating all facets of the resort during Covid. Outside of work, I have a wonderful wife who has tolerated and supported my obsession with snow and three wonderful, unique, trying daughters. I love to garden, to cook and to preserve what I garden. I see a food truck in my future. ●

AVALANCHE BOOK CLUB

BY ANDREW PIERCE

Last spring as ski areas shut down and some backcountry access closed, I refocused my energy on consuming all of the avalanche-related media I claimed to never have had time for in the past. After easily winning several arguments with myself about said material, it dawned on me that something was missing. It was the skin track conversations, the control route chatter, and the in-person feedback and observations that I have relied so heavily upon to develop, maintain, and build my skills as an avalanche professional. To fill this void, a couple of my touring partners and colleagues started meeting virtually every week for a “book club” aimed at replacing the lost dialogue that normally happened face to face.

It started with a lively debate surrounding TAR 38.3’s articles on Likelihood and Probability and eventually progressed deep into TAR’s digital archives, ISSW proceedings, and more. I do not think we can claim to have solved any of the (avalanche) world’s problems but research and opinions were discussed, adult beverages were consumed, and common ground was eventually found. Nothing can replace time spent in the field, but the book club reinforced the value of continuing the discussion beyond the pages of TAR, no matter the setting. It also, perhaps just as importantly, kept us sane through the early stages of the pandemic as the snow continued to fall. Q&B, as we eventually came to call it, continued throughout the summer and into the fall with our eyes and minds focused on a new winter season. Hopefully, as this winter rolls on we are able to continue these discussions together on the snow and finally agree on what “likely” means. ●



Andrew Pierce is an Avalanche Forecaster and Control Specialist for the WSDOT South Central Region and a ski patroller. In his free time, he enjoys long walks on the skin track, skiing fresh pow, and endlessly watching winter storms track on radar.

METAMORPHISM

THANK YOU MARK MUELLER FROM THE CAIC

BY ETHAN GREENE

Today, December 1, 2020, is the last day in Mark Mueller's 27-year career at the Colorado Avalanche Information Center. It is a bittersweet day for us as we're sad to see him go, but also excited for him as he moves on to new endeavors and adventures.

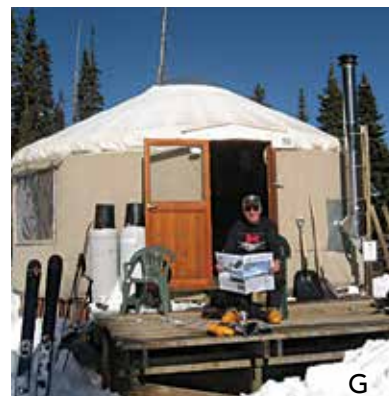
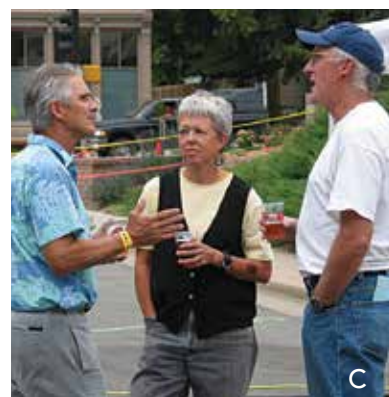
Mark came to Colorado already a seasoned avalanche worker with 12 years as the ski patrol director at Squaw Valley. Ed Fink (CDOT) and Knox Williams (CAIC) were a year into building a new avalanche safety program for Colorado's highways. Mark's focus became the highways over Wolf Creek Pass (US160), Monarch Pass (US50), and Cumbers and La Manga Passes (SH7).

Mark and his coworkers in CDOT built a successful program with an

excellent safety record. He eventually took over forecast operations for SH149 through North Canyon and over Slumgullion Pass and became the Lead Avalanche Forecaster for the Southern Mountains of Colorado.

In addition to working at the CAIC, Mark served as the Executive Director for the American Avalanche Association as it grew from a small organization focused on avalanche workers into a national group striving to help everyone learn about avalanches.

Please join us in congratulating Mark on a long and successful career. Thank you Mark Mueller for everything you have done for our industry and community, and for your service to the people of Colorado. We wish you the very best in whatever you decide to do next!



A: Mark, Halsted Morris, and Stu in Silverton. B: At a hot springs in the desert on the way home from ISSW 2010, photo courtesy Mark Mueller C: Mark, his wife Sandy Kobrock, and former CAIC Director Knox Williams tell stories over beers, unknown CSAW. Photo CAIC D: CAIC staff 2013, photo courtesy Halsted Morris E: Mark and Jason Konigsberg hard at work paying attention in the backcountry. Photo CAIC F: Mark thanks outgoing A3 Board President Janet Kellam for her service, ISSW 2010. Photo Halsted Morris G: Mark takes in TAR on the deck of the Pass Creek Yurt. H: In great appreciation for his 12 years as ED, the A3 Board gave Mark a framed copy of Jim Harris' cover art from TAR 31.4. Photo courtesy TAR

FROM SAN FRANCISCO TO PAGOSA SPRINGS:

Mark Mueller shares his snow forecasting journey

Reprinted from the CAIC's 2020 Annual Report.

I grew up in the San Francisco Bay Area and started skiing while I was in high school. I worked in several Bay Area ski shops, so when I decided to move to the mountains and ski I found it easy to

find ski area employment. While working in the Alpine Meadows ski shop in the Tahoe area I met Dave Beck, a Sierra legend and developed an interest in ski mountaineering. As an aspiring ski mountaineer I needed to know something about avalanches. This led to an unplanned early encounter with an in-bounds avalanche at Alpine. It had a very fortunate outcome, and did nothing to squelch my enthusiasm. If nothing else, being in an area with a large avalanche mitigation program only stoked my interest. Tossing explosives and skiing powder, now that sounded very interesting and fun.

I left Alpine and enrolled in the new Ski Area Technology (now called Ski Area Operations) at Colorado Mountain College (CMC) in Leadville, CO. My enthusiasm for avalanches hadn't dimmed and I took a five-day Professional

Avalanche Course from Rod Newcomb's American Avalanche Institute in Jackson Hole. At CMC, Ken Host, the Ski Tech instructor encouraged me with this advice: "you can make a life out of this." How very true that became. After graduation from CMC in 1976, I wrote to a number of western ski areas looking for patrol work, but it was a drought year and there was nothing available.

I returned to the Sierra and scored a lift operator job at Squaw Valley. The next winter that turned into a patrol job when abundant snows returned to the Sierra. My first day of patrol work in November 1977 was a snow safety day on Gold Coast Ridge and I was in—tossing explosives, triggering avalanches, and skiing powder! Many more snow safety days followed on the numerous control routes at Squaw Valley with tons of



adventure and abundant opportunities to learn about mountain weather, snow, avalanches, and myself. I rose through the ranks and became Ski Patrol Director. I held that position for 12 of the 15 winters I spent on the Squaw Valley Patrol. I worked year-round at Squaw and put to good use many of the skills I learned in the Ski Area Tech program at CMC.

All good things must come to an end and the end at Squaw was timely as a new highway avalanche forecasting program was beginning in Colorado. I spent one winter on the Wolf Creek Ski Area Patrol waiting for the funding to kick in for the highway forecaster position at Wolf Creek Pass. Talk about getting in on the ground floor. Don Bachman and Denny Hogan in the Silverton Forecast Office and CAIC Director Knox Williams and Nick Logan, Assistant Director, offered guidance and encouragement, but I was pretty much on my own and was allowed to create the position as I saw it. Learning to forecast without the instant access to explosive testing was a challenge. But that improved and enlarged my snow knowledge and every winter since has added to that accumulation of knowledge, experience, and intuition. My wife Sandy, an avalanche professional in her own right, and I made our home in Pagosa Springs. Along with Wolf Creek, I also monitored and forecasted for other highways in south central Colorado: Cumbres, La Manga, Monarch, and Slumgullion Passes. From this vantage point the years seem to have flown by.

All that we've accomplished together—both at CAIC and with CDOT, leaves me with a tremendous feeling of gratitude and appreciation for the role that I've been able to play.

It's not hard to remember how little we had to work with in the early 1990s. Not much in the way of internet resources, limited real time weather and snow condition info, and limited tools for mitigation. Progress seemed slow at times, but we always were moving forward. Our tools now include numerous weather models, widespread remote weather information, the ability to communicate almost anywhere by radio or cell phone, and very effective and efficient mitigation tools—Remote Avalanche Control Systems (RACS) and howitzers.

All that being said, I learned the job on skis and for me nothing has replaced being out on a stormy day poking around in the snow, feeling the snow under my skis, making up my mind about spatial distribution and sensitivity to triggers and most importantly: is snow going to reach the highway? When and where?

It is really easy for me to see how far the two organizations, CAIC and CDOT have come. As I get ready to leave CAIC after 27 winters, I'm so impressed with my colleagues at CAIC—their passion, expertise, and commitment—as well as the dedicated and skilled crews I have worked with at CDOT. It's been a pleasure and a privilege to be a part of it all!

Although I won't be a professional anymore, I know my passion for the mountains in winter, snow, and avalanches won't diminish. Sandy and I have lots of plans to travel and see the world, both on skis and off. ●

WELCOME ANDREW SCHAUER TO THE CHUGACH!

WENDY WAGNER, DIRECTOR, CHUGACH NATIONAL FOREST AVALANCHE INFORMATION CENTER

The Chugach National Forest Avalanche Center is thrilled to welcome **Andrew Schauer** to the Girdwood, AK avalanche forecasting team! He will be filling a full-time seasonal backcountry forecaster role for the center.

Andrew comes to Girdwood after forecasting for the West Central Montana Avalanche Center in Missoula, MT last season. He earned a M.Sc. in Earth Sciences from the Snow and Avalanche Laboratory at Montana State University, where he studied associations between atmospheric patterns and deep persistent slab avalanches. While finishing school, he spent a season as an intern at the Gallatin National Forest Avalanche Center, and became actively involved in their education program. He has also worked as an instructor for the American Avalanche Institute, teaching everything from Rec 1 courses to National Avalanche School Pro field sessions. He is still very active in the research community, and is currently working on a project developing large-scale, GIS-based automated avalanche terrain maps with an international research team, as well as several projects relating atmospheric patterns to avalanche cycles in the western U.S.

Andrew must have brought the snow north with him this fall as Alaska is enjoying one of the best early seasons for many years. Thanks Andrew! We look forward to working with him, taking advantage of his countless skill sets and of course, keeping the white stuff coming—no pressure!



WYDOT UPDATES



The Wyoming Department of Transportation Avalanche Program has recently expanded its operations.

We added a new Temp Avalanche Tech position for the winter of 2019-2020 and added a second temp position this year.

Returning for a second season is **Grant Henarie**. Grant came to WYDOT from the Mt Hood Meadows ski patrol. Grant worked nine seasons at Mt Hood. He was a member of the snow safety team as well as a Howitzer Gunner. Outside of avalanche season Grant works as a firefighter, and enjoys mountain biking and trout fishing.

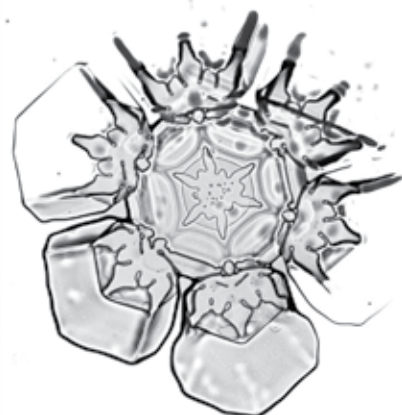
New to the program this year is **Adam Davis**. Adam comes to WYDOT from Park City Mt Resort. Adam was a patroller there as well as an avalanche educator and cat skiing guide at Snowbird. Adam recently helped to install Wyssen towers in Colorado. Prior to moving to the Wasatch and Tetons Adam earned a degree in Engineering from the University of Maryland.

In addition to increasing our staff we have installed two new weather stations. A precipitation station now sits in the Hoback River Canyon and a wind station records data on the summit of Mt Glory above Teton Pass. These stations have already helped to improve the efficiency of our operations. As a bonus we have made data from our stations available to the public through the Mesowest network. ●



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The Viking

I looked for a Viking poem for you...
One that spoke of Valhalla
And Valkyrie maidens as
Powder goddesses
leading you to their private stash...

Yet war and blood stained swords
Awaited me
and none of that was you...
The tall gentle Viking,
The goofy optimist
The gracious one
The beaming larger than life
Booming laughter Viking
The glass is always full Viking
The silly old ugly wool ski pants Viking

Viking,
~ the legend ~
Who made us all smile,
~ your slow happy drawl ~
infecting us all

And I wouldn't even dare,
actually,
To apply such metaphors
To this poem...
ones that would
Try to evoke
the "rape and pillage" of powder,

For that wasn't you,
~ **Viking** ~
the gentleman,
Extending your hand, asking gravity
'May I have this dance?'

You, our friendly
neighborhood Viking
~ The lone eagle ~
above us even now
Keeping watch...

Powder invited you,
mountains lured you ,
fluidity and oneness,
Summits and first descents...

~ No conquest nor battleground ~

Just neat tidy little turns,
joining skis to slopes,
Smiles to lines,
Friends to shared memories
Riding beside avalanches...
dancing with dragons
In sheer delight...

No, you weren't the Viking
of lands of yore,
You were OUR Viking,
The Viking of the Chugach
Spreading bliss and camaraderie like wildfire,
Burning brightly still
In the villages left mourning in your wake...

—Brooke Elizabeth Edwards
11/29/20

ALASKA MOURNS THE LOSS OF A LEGEND: ERIC "VIKING" OPLAND

BY BROOKE EDWARDS

photo Charlie Renfro



We all thought the mountains would serve as point last seen when our Viking made his first ascent of Valhalla. Perhaps it's because Eric "The Viking" Opland spent more time dancing with Ullr's dragons than anyone in Alaska. In the end, it was Poseidon who came calling, and the Viking followed his beloved salmon down into their mysterious depths.

A striking behemoth of a man, with his long locks, broad shoulders, rugged jawline and giant personality, Eric "The Viking" Opland was a pillar of the Alaskan backcountry community. At 6'4", 220 lbs. he also gained the nickname "The Rock" for skiing breakable wind crust like it was a groomer, without hesitation.

When the news of his death reached us, Wendy Wagner, Director of the Chugach National Forest Avalanche Information Center, wrote: "Sadly, the Alaska backcountry ski community has lost a legend. Eric 'Viking' Opland was a larger-than-life figure that we, the forecasters, grew to know, appreciate and respect. Running into Eric with his

big smile and warm nature on the skin track was always a treat and a sign that the powder was top notch."

Alaska born and raised, Eric grew into the ski community under the wing of his father, a lifelong ski patroller at Arctic Valley and Alyeska Resort. Eric loved going to work with his dad and must have inherited his fascination for avalanches, snow, and the intricacies of mountain terrain from his dad and the long line of Norwegians before them. He entered the Junior Patrol program with buddies Mark Norquist and Jim Cardwell and began his journey of understanding avalanches. At the time, Chuck O'Leary was leading up the forecasting for the Chugach

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National Forest and spearheading many patrol trainings at Alyeska Resort and Arctic Valley. At 15, Jim, Mark and Eric were the junior patrollers who got invited to Cordova alongside Eric's dad to help train the new patrol there.

Before long, Eric, Mark, Jim, Jerry Steuer, Dave "Poacher" Pettry, and Paul Lindemuth were venturing beyond the confines of the resort into the Chugach and Talkeetna Mountain Ranges. Before Independence Mine became a state park, it was a mining claim run by Andy's Holly's mining group and they hired Jerry Steuer to be the winter watchman of the mine, giving him a cabin for those long winter months up at Hatcher Pass. The boys would stock up on groceries and go crash at Jerry's cabin for as many days as they could, venturing out to explore the neighboring peaks and pioneering lines on what is now one of the most popular backcountry zones in Alaska. Long time skier and pioneer of many Chugach lines himself, Jerry laughed when he remarked: "Once the Viking came into his own, there was no choice but to step down and let him take the throne." Jerry tells me through muffled laughter that at first it hurt his ego to let Eric be the star. "But," shares Steuer, "it soon became clear as Eric racked up more extreme lines and first descents of iconic peaks that there was no choice but to step aside."

"He had pretty good judgment, even though he pushed it harder than anyone! "He really loved playing with the dragons," giggles Jerry, "...like a true Viking, he caused a lot of avalanches, but somehow the dragons never ate him for breakfast..."

Indeed, this was the theme that surfaced consistently through my interviews of many of his beloved ski partners and even in conversation with his life partner, Kathy Still. Everyone shared stories about Eric's intimate working knowledge of the mountains. How he understood snow, he often knew when it was going to avalanche. He trusted and believed with his eternal optimism that if he went first, he would be able to handle whatever followed. And truly, the unbelievable thing was that is exactly what happened. He kicked off more avalanches than most ski patrollers do in a lifetime.

And he still survived. His partners still survived. He worked through it better than most people. Though most were chosen to ski with him for their own prowess in the mountains and stoke for big lines, there wasn't a single person I spoke to who didn't mention how cognizant they were of the risks when they were with him and yet how safe he made them feel. Kathy noted that he wasn't a risk taker at all costs. He knew when to back off and did, quite often. She remarked that some people don't quite realize when you are used to skiing these big lines, just how far you have to back off once conditions change dramatically. "When the storm cycle moves through with a lot of wind or snow, it's not enough to pull back a little... you have to be willing to go to low consequence terrain and begin your snow stability assessment all over again. Eric was really good at that." When Eric turned around because he wasn't trusting it, everyone listened.

Kathy describes how the Viking was notorious for wanting to go first...he wanted to open the line. But she's quick to point out that he always offered it to her in his slow smiling drawl: "If you waaant it, you can take it," he'd smile slyly and say.

Kellie Okonek, an exploring ski adventurer herself, observed that: "That was Eric's offering really, the offering to go first. I mean, these were big lines we were skiing with committing consequences should something go wrong. Most of us were excited to be skiing them, but nervous enough to completely appreciate the Viking's offering to open the line." Anyone who's ever ski guided knows that opening a line isn't always as glamorous as it sounds and it's often the first skier who triggers the avalanche.

"He was quite the explorer, recalls Steuer, "he never had the attitude that he wanted to be bigger and better than anyone. He was just born with that skill and honed it over years working the nuances of exposure and micro terrain features."

When I think of the Viking and hear all the stories of all the avalanches, I can't help but wonder how he did it. How did he manage to balance that optimistic stoke with the inherent dangers of our snowpack?

When I asked Kathy about his intimate knowledge of snowpack and nuanced terrain, she said "You know, Eric used to laugh at the whole movement for 'know before you go,' not because he didn't believe in avalanche education, because he did...but because he would like to say "go, and find out." Which is so true when you think about it. You need the forecast, but you also definitely need to learn how to create your own "nowcast." Perhaps it was akin to Malcolm Gladwell's theory that he put forth in his best seller, *Blink*; that to truly become a master of something, one has to spend at least 10,000 hours of focused practice on that skill. Only masters then, should let themselves be guided by their instinct, since their years of experience have shaped their gut feelings. In the snow industry, perhaps old ski patrollers are the only others with this type of *Blink* mastery. In the backcountry skiing world it is super rare to find anyone with that many hours touring, climbing, ascending, descending in all snow conditions, all weather patterns, all snow climates. But the Viking was such a Master. Early on, he worked nights at a cold storage warehouse so he could ski all day. Later he developed his own construction business where he worked long hours in the summer so winter would be for skiing.

Don't get me wrong, I think our whole community would also agree that he was also just plain stinkin' lucky. He would be the first to admit that he got away with so much. When Kathy was sharing with me what an optimist he was, she spoke about his "Lone Eagle Omen." "We would be driving down to Turnagain, hoping that the weather and powder would be good when Eric would see a lone eagle taking flight over the Arm and he'd smile his contagiously large grin and say, 'See Kathy? It's the Lone Eagle Omen! That means it's going to be a really good day!' "And you know what?" recalls Kathy, with her own beautiful shining grin, "he was right, it always was."



Kellie adds, "There was something about having the Viking there that made those moments in the mountains all very calming. Somehow you felt safe with Eric. Even though it wasn't like avalanches didn't happen around him," she laughs. "But something about him felt safe. And that is the mystery and the legend of the Viking. He should have been someone you NEVER went skiing with because he was such a loose cannon, but his friendly, larger-than-life passion, his quotes, drew us all to him." One of his famous lines many recalled was: "you don't need to see, you just need to ski!" He'd laugh and turn his skis down the fall line, straight into the inside of a ping pong ball. "There isn't a classic line in the Chugach that there's not a Viking variation on," shares Okonek. "He was the most motivated ski bum any of us had ever known."

Eric skiing Big League. Photo Kathy Still

He and Kathy were icons in the backcountry ski world, appearing on the skin track with their dog Loki and their welcoming personalities, brightening all of our days. Indeed, these two, even more than pioneering the peaks of the Chugach and the steepest lines in Alaska, pioneered what it means to be a true ambassador of light and love, shining their passion, sharing their knowledge, and feeding the exploration of our backyard playground.

So raise a glass of scotch and join me in a toast to our friendly Viking! May the powder steep descents in Valhalla keep you laughing for all eternity! We will miss you, yet I have no doubt that this winter we will all be seeing a lot more lone eagles. Thanks for watching over us all. Skohl!

Disclaimer: This article barely scratches the surface of stories about the Viking. To read more stories and contribute your own, check out: <http://skiviking.com/> ●

Eric would request any memorial donations be made to the Chugach National Forest Avalanche Information Center or the Hatcher Pass Avalanche Center.

Brooke Edwards works as an avalanche educator, ski guide, and ski instructor. Her passions for all things wild have led her on many adventures worldwide, but she's happy to call Girdwood, Alaska her home. She will be guiding for Valdez Heli-ski Guides this season.



2020 INTERNATIONAL COMMISSION FOR ALPINE RESCUE

BY MICHAEL FINGER

The 2020 Virtual ICAR Avalanche Commission kicked off at 9 AM Mountain Time on Sunday Oct 11, 2020. Vice President Stephanie Thomas kicked it off with opening remarks.

Michael Finger from the MRA gave a presentation on the summary of avalanche accidents for the 2019-2020 winter season. As expected, due to Covid closures and lockdowns, accidents were at lows not seen in years. There was also a feeling that close calls were underreported due to the social stigma of recreating during lockdowns.

Cody Lockhart and Jen Reddy from Teton SAR had an excellent presentation on Psychological First Aid, a Case Study of the 2020 Taylor Mountain avalanche. They discussed an avalanche fatality they responded to on Taylor Mountain, and how they help patients that are involved in accidents in the backcountry deal with the traumatic stress they are exposed to. They talked about both the on-scene care they administer and the follow up steps they do in the following days and months with the 3-3-3 protocol. Teton SAR also applies the 3-3-3 protocol to their first responders as well.

Dr. Malin Zachau presented a summary of New Zealand avalanche deaths and their implications for the country's mountain rescue teams. She reviewed the fatalities over the years and statistics around these deaths. Some interesting facts were that the deaths were almost evenly distributed between the summer and winter seasons, and 65% of the fatalities were climbers. She then discussed some the work that is being done to reduce avalanche fatalities in New Zealand.

Peter Paal, Darryl Macias, Dr. Scott McIntosh, and Manuel Genswein gave a presentation on Avalife, A Survival Chance Optimized Decision Support Tool & Avalanche Patient Protocol. Avalife is a framework for efficient search, excavation, and medical treatment of an avalanche patient. It is available in a digital and hardcopy version and in several versions for free at mountainsafety.info. The video from ICAR and download is worth your time.

Martin Gurdet gave a presentation on an avalanche rescue in Austria that resulted in the deaths of six mountaineers and the coordinated rescue effort that involved over 100 rescuers and nine helicopters. The victims had no avalanche rescue gear and the accident was witnessed by a hut keeper. Stephanie had some closing remarks, and then a video of Icar Sponsors. 🎧

Michael Finger is the Assistant Commander for Salt Lake County Sheriff's Search and Rescue team. He has been an active MRA member for over 15 years and serves as alternative US ICAR delegate on the avalanche committee. Michael is also an active ultra-trail runner, climber, and backcountry skier.



See TAR 39.4 for an upcoming story on Psychological First Aid.



AVALANCHE PODCAST

Did you know that the Utah Avalanche Center hosts a podcast? Hosted by UAC forecaster Drew Hardesty and produced by KUER's Benjamin Bombard, the podcast is all things avalanche: accident reports, the art of forecasting, decision-making, and more. You'll find lively and spirited conversations with mountain guides, ski patrollers, avalanche educators, meteorologists, economists, even marketing experts. This is a great way to get more avalanche-related content to supplement your life-long avalanche education. For fun, you'll also find a few blog-casts thrown in for additional content. These are readings of short essays on risk and the avalanche phenomenon. We think you'll enjoy them all.

The UAC podcast is now in its fourth season with over 30 episodes and 250,000 downloads. We kick off Season 4 with a conversation with American Avalanche Institute owner Sarah Carpenter. She talks about the gift of education and why a systematic approach can help us navigate through the complex and sometimes chaotic landscape of the backcountry. The second episode is a conversation on risk, public safety messaging, and resilience with not an avy pro, but with Utah state epidemiologist Dr. Angela Dunn. Dr. Dunn has been at the forefront with the fight against Covid-19 in Utah and knows a bit about the bottom line, vulnerability, and exposure. Tune in!

You can find the Utah Avalanche Center podcast on Stitcher, iTunes, or wherever you get your favorite podcasts.

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2020 SOUTHCENTRAL ALASKA AVALANCHE WORKSHOP

BY JOE STOCK

In remote Alaska, it's nice when things work out better than expected. For example, it's easier to adjust to perfect weather than a blizzard. Likewise, a stable snowpack makes life easier than a dodgy one. Even so, we go into remote Alaska prepared for something to go haywire.

Same with a Zoom avalanche workshop. The 1G network could've fizzled out. Or a naked husband could've started making coffee in the background. But instead, this year's eighth annual Southcentral Alaska Avalanche Workshop was just a crazy success!

This year's theme was remote Alaska. No matter your skill level, it's easy to get off the beaten path in Alaska. We had record attendance as over 175 attendees and 20 panelists crammed the Zoom. The Southcentral Avalanche community is strong and tight-knit, between the recreational users, guides, ski patrol, and forecasters. The event facilitator was Melis Coady, executive director of the Alaska Avalanche School, who came in from Yosemite. Event co-host was Chugach National Forest avalanche forecaster Aleph Johnston-Bloom. The proceedings are here: akavalancheworkshop.org/archives.

The first talk was by Mike Janes who is an avalanche forecaster for the Snettisham Hydro Project in Juneau, Alaska. Mike manages power transmission lines and an access road that run through snow-plastered mountains above the ocean. Since most of Mike's area is without roads, Mike talked about partnering with various entities to Apply Tech to Remote Avalanche Forecasting. Mike uses a Swiss program to model snowpack and RAMMS to model avalanche powder blasts hitting a vast powerline span and a small but dangerous path above an access road. Mike reminds us that models like RAMMS are only as good as the data they're based on, so he collected detailed snow distribution maps using LiDAR and photogrammetry to feed into the models. While these models are useful, he notes that humans are still important for decision-making.

The feature presentation was by Laura Maguire called Cognition in the Wild: A Closer Look at the Complexity and Challenge of Avalanche Forecasting. Laura is a climber and skier who studied expertise in high risk high

consequence environments at Ohio State University. Her presentation focused on a ski area avalanche control team and their techniques for working in avalanche terrain. Laura started off by giving some background on two ways of thinking about failures in the avalanche world: Camp 1 is the old-school side that humans are flawed, biased and error prone so they need more rules, restrictions, and to be disciplined for mistakes. Camp 2— Laura's camp— gives a more modern viewpoint that looks at the whole picture of the challenges and complexities of working in the avalanche world, using accidents as a way to learn. Laura described normal work, in which the world is always changing and we have to adapt to these changes. Most of the time we are doing this well, even if our work isn't designed to support adapting. If there is a large gap between the way work needs to get done (safety plans, etc) and the way work actually gets done (normal work), more cognitive work must be done to bridge that gap. In other words, "Avalanche forecasting is hard." So what can we do about it? Of course Laura says "more research!" particularly on real world successes and failures. Laura shared her recent cognitive work on managing risk in avalanche terrain at a ski area. She also suggests using human error as the starting point of your investigation into an error, not the end to improve learning after an accident.

Next up was Alaska National Weather Service meteorologist Kyle Van Peurse who talked about online weather resources and then gave us a winter weather outlook for 2020/21. Kyle described weather resources as a forecast funnel that went from 1-2 weeks out for large scale patterns (eg. Climate Prediction Center Outlooks), and narrowed down as the trip approaches (eg. Southcentral Alaska Mountain Recreation Forecast). Kyle's winter weather outlook for this winter is looking GOOD! It's a strong La Nina winter weather forecast. That means there is a strong correlation between La Nina and colder than normal weather, but a weak correlation for normal precipitation. Kyle's prediction of less



rain-on-snow events made all Southcentral Alaska skiers smile.

Valdez snowmachine legend Mike Buck shared stories and techniques used on his epic sled traverses. In Mike's playground the rewards are high, but the consequences of mistakes can be severe. He is a big proponent of detailed gear checklists, leaving a trip plan, and using a 16-point trailhead meeting. Particularly cool was Mike's 1-5 Ride Level for the day using the ATES scale, and his 1-5 Stoke Check for the group. Mike explains how if you prepare and plan it can all come together for expeditions like his 420-mile day tours from Valdez to Canada and back, across the biggest glaciers in the US. On these tours that cover hundreds of miles, conditions will vary drastically along the ride, often within a few miles. Mike suggests sharing observations and stopping to assess conditions using low consequence test slopes if you're entering avalanche terrain in a new zone.

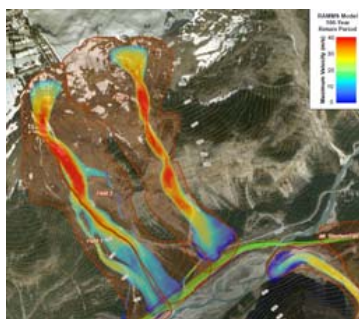
The final talk came from IFMGA Mountain Guide Joe Stock who shared a process for avoiding avalanches while ski touring in remote Alaska. His presentation can be found on page 38 of this issue of TAR. Particularly interesting were the similarities and differences between Mike and Joe's trips. Mike covers terrain in 15 minutes that Joe covers in a week. Watching for changing conditions is a priority for Mike. Luckily he has a powerful machine that lets him do loads of tests like rip saw cuts and top hops that provide valuable information on avalanche conditions. Joe's trips are much slower and localized, allowing for detailed study of the snow and avalanche conditions in that area, but without the advantage of a 165 horsepower snow sampling device. Both talks came from decades of experience and emphasized a healthy respect for the mountains.

Interspersed through the talk were updates from the avalanche community. Katreen Wikstrom Jones talked about taking snow depth measurements and submitting them to Community Snow Observations using the Mountain Hub app. The data can then be used for modeling snow distribution and runoff. American Avalanche Association director Dan Kaveney shared the goings on at A3 such as education, publishing, the new digital *Avalanche Review*, and outreach to the avalanche community. Alaska avalanche forecasters all tuned in, with updates from Wendy Wagner from the Chugach, Jed Workman from Hatcher Pass, Gareth Brown in Valdez, Hoots Witsoe on an analog computer in Cordova, Erik Stevens in Haines, and Mike Janes from Juneau. ●



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13TH ANNUAL UTAH SNOW & AVALANCHE WORKSHOP

BY CHAD BRACKLESBERG

Salt Lake City has numerous options for hosting conferences, but space for 500 people that also allows food and beverages and does not require a minimum number of hotel nights is limited. Because of this, we contract the space for USAW 14 months in advance. When we signed a contract in September 2019, none of us would have imagined we would be reading the contract fine print to find the Force Majeure clause to break the contract. We made our decision in May to move USAW to a virtual format. While Utah restrictions would have allowed us to have a large gathering, this was not the responsible thing to do.

We still wanted to maintain the in-person presentation feeling of the workshop where presenters would be presenting to a small audience (limited UAC staff and other presenters). We liked the professional aspect of a formal setting as opposed to presenters sitting in their temporary home offices with a risk of poor connectivity, video, and/or sound. We created the technical requirements necessary to host the virtual workshop. As we looked for a venue, we had three key requirements: 1) wired ethernet to ensure no streaming problems; 2) good lighting; and 3) a large enough space for 20 people with a minimum of 8' between each person. We identified a few options that met our criteria and we were able to take advantage of the generosity of Petzl North America and utilize their amazing headquarters and training facility for the workshop.

We traditionally run USAW for two full days. Two full days of webinars sounded like a horrible attendee experience so we chose to shorten our Professional Session from seven hours to five, and split the Open Session over three evenings. We hoped that the lure of coming home from work, sitting down with dinner and a beverage while being able to learn from local avalanche professionals would attract a larger audience.

We looked at several platforms and decided to deliver the workshop over Zoom Webinars since it is so widely used. As we did our technical testing and watched other online workshops, we decided that the Q&A session would run smoother if people submitted their questions over the Zoom Q&A function rather than trying to have live questions where there always seems to be audio and video issues. This allowed us to compile questions to ask live and questions that were not answered live were answered in the Q&A window by the speaker after their presentation. Through this, we were able to answer over 90% of the questions.

We had a great mix of presentations ranging from snow science to decision-making to business operations during a pandemic, with a final focus that we are in this together as a community. The dive into decision-making and especially the relationship between fatigue and decision-making presented by

Russ Costa continues to challenge people's thinking (see a link to Decision Fatigue recording below). Two local skiers gave very raw and honest talks about avalanches they were caught in and shared everything that had been going through their minds. Emotional talks like these help break down the barriers we all have about sharing potentially embarrassing avalanche involvements and hopefully encourage the entire backcountry community to continue sharing information about close calls and avalanches (see link to Is 22 my (un)lucky Number and How I Set a 77 mph KOM on Superior recordings below). We also continue to bring a focus on the concept of recreating like a pro and had various professionals discuss what recreational users can do to increase their knowledge, safety, and decision-making skills.

Over the years, USAW has generated a lot of interest from out-of-state ski patrol organizations. Our team will be discussing the concept of a professional patrol workshop for next year.

13TH ANNUAL USAW AT A GLANCE

- 294% increase in ticket sales over 2019
- 180% increase in day of attendance over 2019
- 2,260 views of the recorded session in the 4 weeks after the workshop
- 22 talks. Down from 32 talks in 2019

Each year we do a post-workshop survey. We had some interesting survey results this year.

Professional Session

- This was the first USAW for 80% of the professional session survey respondents. This was up from 40% in 2019.
- 79% of the respondents have been an avalanche professional for over six years. This was up from 63% in 2019.

Open Session

- 97% of Open Session respondents preferred the virtual format over in-person
- This was the first USAW for 61% of the respondents compared with 50% in 2019
- Similar to last year, <20% of respondents were under 30 years of age. How do we attract younger, new users to these workshops?
- Similar to last year, close to 50% of attendees have less than five years of backcountry experience. This along with the small number of new attendees that are under 30 years old is interesting.

AGENDAS

Professional Session: Recordings available at <https://bit.ly/2020USAWPro>



Photo: G. Gunderson

S. Zimmerman-Wall

Duncan Lee

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- **Proper Respect for Explosives.** Overall basic explosives safety and consequences for complacency. *Stephen Shelley, ATF Explosives Enforcement Officer/Bomb Technician*
- **NSAA Guidelines.** A working model for resort personnel deploying explosives. *Doug Catharine, Solitude*
- **Doing the DEID with a hotplate (batteries not included).** Innovative technologies to look at new snow density profiles in real-time. *Trent Meisenheimer, Utah Avalanche Center*
- **Just like they said it would.** Reflections of an epic avalanche cycle through the eyes of the snow globe. *Eric Murakami, Snowbird Snow Safety*
- **Avalanche Risk Management During a Pandemic.** A look under the hood at new strategies and procedures. *Mary Bozack and Tim Hendrickson, Mountain Guard*
- **Avalanche reduction and mountain operations framework for the 2020/21 winter.** A round table discussion.

Open Session Day 1: The Ingredients Behind the Science and Avalanches: Recordings available at <https://bit.ly/2020USAWOpen1>

- **Take me to your powder:** The importance of tracking early-season weak layers... how long do they persist? *Mark Staples, Utah Avalanche Center*
- **Leveraging Digital Mapping Tools for Planning and Communication:** Using CalTopo for winter backcountry travel and avalanche forecasting. *Meghan Twohig, CalTopo Training and Support.*
- **Stepping in or out of avalanche terrain:** What information changes my game plan. *Don Carpenter, American Avalanche Institute*
- **A Little Cottonwood Canyon Update.** Reflections on a Historic Avalanche Cycle and Summer Projects Update. *Damian Jackson, Utah Department of Transportation*
- **You Can't Always Get What You Want:** Weather anomalies and the why behind a meteorologically twisted system. *Glen Merrill, National Weather Service*
- **Can we talk?** Establishing a Dedicated Regional Backcountry Radio Channel. *Logan Cookler, Backcountry Access/Powderbird*

Open Session Day 2: Distraction and Consequences: Recordings available at <https://bit.ly/2020USAWOpen2>

- **Is 22 my (un)lucky number?** One persistent slab, twenty-one prior tracks, and a thousand distractions—the high consequences of a “low” probability situation. *John Climaco*
- **How I Set a 77 mph KOM on Superior (not in a good way):** Why do I/we choose self over others, danger over safety, death over life? And how does answering this question make me/us better? *Jared Inouye*



Craig Gordon carries on his USAW MC traditions, tux included, remotely from the Petzl North American headquarters.

- **Decision fatigue:** What is really happening in our brains? *Russ Costa PhD, Westminster College*
- **Developing competence in an ever-changing environment:** *Sarah Carpenter, American Avalanche Institute*
- **It's dark and I'm cold, shivering, and wet.** What I carry in my ski pack... what I carry in my sled tunnel bag. *Tyler St. Jeor, Canyons Village Ski Patrol/Wasatch County SAR/ Backcountry Institute*
- **“That's just, like, your opinion, man”:** Reflections on the April 2020 avalanche cycle. Tips for using a systems-based approach to avoid the subjective traps that affect our decision making. *Jenna Malone, Alta/Powderbirds*
- **Putting it all together, decision-making tools for the backcountry user.** Using the local avalanche forecast as part of an avalanche matrix in decision making. *Jim Conway, Glisse Media/TGR Safety Consultant*
- **Recess is Over.** How and why our collective, community skin-in-the-game differs from keyboard high-fives. *Craig Gordon, Utah Avalanche Center*

Open Session Day 3: We're All in This Together: Recordings available at <https://bit.ly/2020USAWOpen3>

- **Recreate Like a Pro:** What information do I look for that allows me to recreate like a pro. *Logan Cookler, Backcountry Access/Powderbirds*
- **And the Answer Is:** What our community survey results say about us. *Anna Keeling, IFMGA Mountain and Ski Guide*

We can't thank the presenters enough for all of the time and energy they put into their work and helping to deliver this continuing education workshop. Once again, we could not put on USAW without the amazing support of the A3, BCA, Clearlink, WESCO/CIL, Guides Guru, Mammut, Moab Brewery, Petzl, and Powderbird. ●

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LETTER TO THE EDITOR:

Re: Travis Feist Letter—December 2019 / Volume 38.2

Photo by
Kyle Sobek
of Tonsina,
Alaska

I wanted to write and introduce myself. My name is Jon and I am the founder of the Backcountry United Foundation. www.bcufoundation.org

Our organization is on a mission to bridge the gap between human-powered and motorized backcountry culture, focused on a spirit of inclusivity and respect between different user groups—with an objective of positively-influencing our communities through avalanche awareness and education, and sustainable access for public lands recreation for generations to come. I am also an Ortovox-sponsored ambassador, an A3 professional member, and certified (ITC & PRO1) Snowmobile-specific Level 1 AIARE instructor out of Colorado.

I'm writing in response to the very well-articulated letter that I read from your December 2019 issue #38.2, written by Travis Feist. I spent a week with Travis back in 2017 when I received my ITC credentials from AIARE. One thing that really struck me about Travis was our mutual passion AND frustration with the human-powered stereotypes which discriminate against snowmobile culture and communities across the west.

More specifically, Travis and I share a frustration with the level of corporate backing and support from the snow sports industry—which funds divisive anti-snowmobile organizations, in making multi-use public lands exclusive to the healthiest and wealthiest members of society through the unrelenting pursuit of Wilderness closures, via widespread lawsuits against National Forest managers.

The thing that attracted me to AIARE is their inclusive approach to “Saving lives through avalanche education”—which is modality-agnostic. In my view, WE are all human beings who need access to nature for the vital restorative and health benefits it provides. Motorized modalities provide dispersed recreational access for skiers and snowboarders, multi-generational families, people with disabilities, and people from diverse backgrounds, regardless of wealth and class status. “Snowmobilers” are not a different species of human being that should be stigmatized and disenfranchised from outdoor experiences. Snowmobilers tend to be hard-working, good people who are typically upstanding members of our communities. They are passionate about sharing outdoor experiences with their families and friends, and they tend to be people who donate significantly to their local clubs and communities.

Unfortunately, many in the outdoor and snow sports industry have either knowingly or unwittingly supported many environmental-focused initiatives that have created much division in our local mountain communities over the past two decades. And by proxy, the historically-mountaineering-based professional avalanche and snow science community has skewed toward human-powered culture and

industry. This is a topic that I am particularly interested in understanding, and playing a role in bridging this unnecessary divide in our mountain communities. Bridging this divide and solving these complex issues must all begin with awareness and open conversation.

Travis' letter hit a profound note for me, and I thought I should take the time to write to you and express my resounding support for the message that he was trying to get through to the professional avalanche industry community.

In this day and age where we all profess to care about ‘inclusivity’ and ‘equality of opportunity for all’ in the United States of America, how can the anti-motorized recreation crowd speak out of two sides of their mouth?—when they are all fighting for every single human being to have access to the outdoors, but at the same time fund massive amounts of dollars to groups who have been historically laser-focused on limiting blue collar and middle class folks from access to their own back yards?

Limiting motorized access overwhelmingly benefits the healthiest and wealthiest members of our society. Why can I say that? Open your mind, and walk with me on a journey of empathy for other perspectives. It is the ultra-wealthy or in the least, significantly-privileged who can live in places like Aspen, Jackson, Vail, Telluride, Sun Valley, Mammoth, Steamboat, Park City, etc. In many cases, the folks who can afford to embody ideals such as the “Aspen Idea” can buy in at an astronomical price—a price that most regular working people can never afford. While the wealthy have the luxury of financial freedom, free time, global mobility, and infinite resources, regular working class citizens rely on local access to public lands in their back yards, using the limited time and resources that they do have to enjoy some level of quality of life. While regular folks like me are struggling to afford access and opportunities for my family and families like mine, the elite flex their dollars and influence to limit my opportunities for my family in our own back yard—by supporting causes that do not take the less-privileged into consideration. Human-powered access is great for those who have the time and flexibility to travel on foot. I have all the respect for folks who can fly all over the world and enjoy whatever outdoor experience they desire. And I envy the young people without children who have the time, privilege and opportunity to explore the Wilderness on foot. Not a single motorized person is working tirelessly to take these aforementioned opportunities away from the healthiest and wealthiest members of society. Yet, it's the healthiest and wealthiest who cast their dollars and their judgment on the rest of us who have limited time and resources to get outside as often as our jobs and responsibilities allow, who rely on Forest access roads to also have the ability to enjoy the benefits of nature.

I believe we can all be better human beings, and continue to share our passion for safe travel in the winter backcountry, while also being responsible stewards of our public lands, and without reinforcing this old rich peoples' club elitism that has historically told working class people in our communities that “snowmobiles” should be excluded from their beloved back yards and backcountry sanctuaries. It's time to end the division in our society, and I believe that the professional avalanche industry has an opportunity and a duty to be leaders that promote a spirit of inclusivity, and by also discouraging partnerships, sponsorships and organizational funding mechanisms that enable human-powered exclusivity.

Motorized vehicles do not discriminate. Motorized access empowers folks of all walks of life to go deeper, to discover, and ultimately to connect with, care for, and protect the amazing treasures that are our National Forests. For me, the mountains are my temple. They are more profound than any church I've ever been to. This is a place where I have become a better human being, which not only benefits myself, but it has built a community around me, and it has enabled me to share something special with my wife and children, parents, and grandparents alike—despite physical or financial limitations. Overzealous Wilderness closures work against all of that. And I believe they have the opposite effect on a cultural desire for sustainability. When we funnel more and more people into fewer and fewer access points, what we get is greater trammeling of those remaining areas (especially as outdoor recreation demands increase exponentially in a post-COVID reality). What we also will get is ever-increasing occurrences of user conflicts at parking lots and trailheads, when multiple user groups of varying experience converge, without first understanding the immense value of one another—fellow human beings who are doing everything in their power to experience the outdoors.

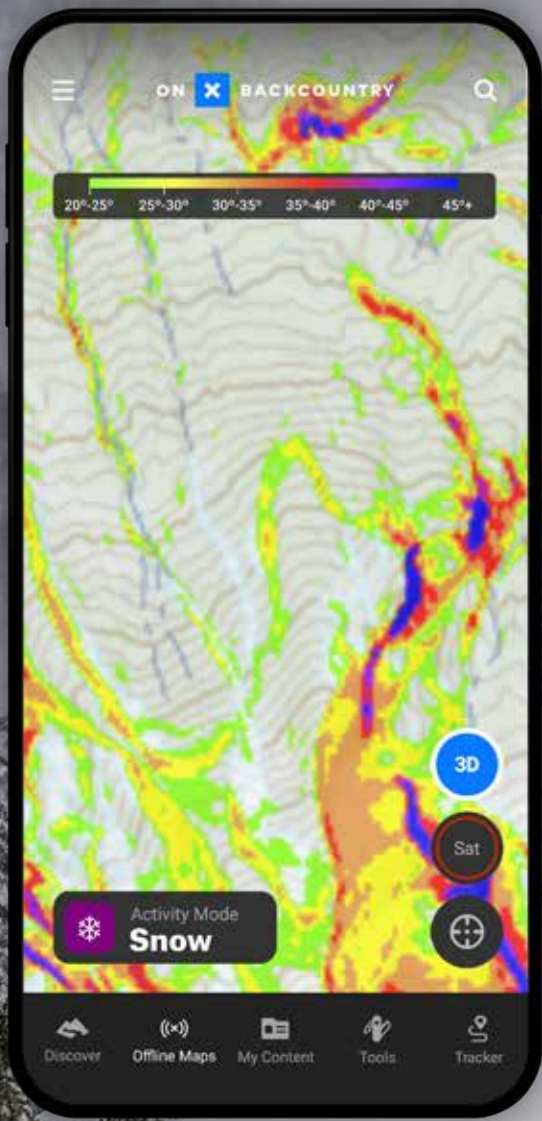
The avalanche industry should not continue to encourage or empower this division, and instead, should follow AIARE's lead of inclusivity and respect to all—who seek opportunities to get away from the pressures and dysfunction of the man-made world.

Thank you for all of the great work that you and all of your colleagues do at *The Avalanche Review!*

I greatly appreciate the opportunity to express these thoughts to you, and for the opportunity to be heard and considered by your readers.

*With great respect...
The mountains connect us all.*

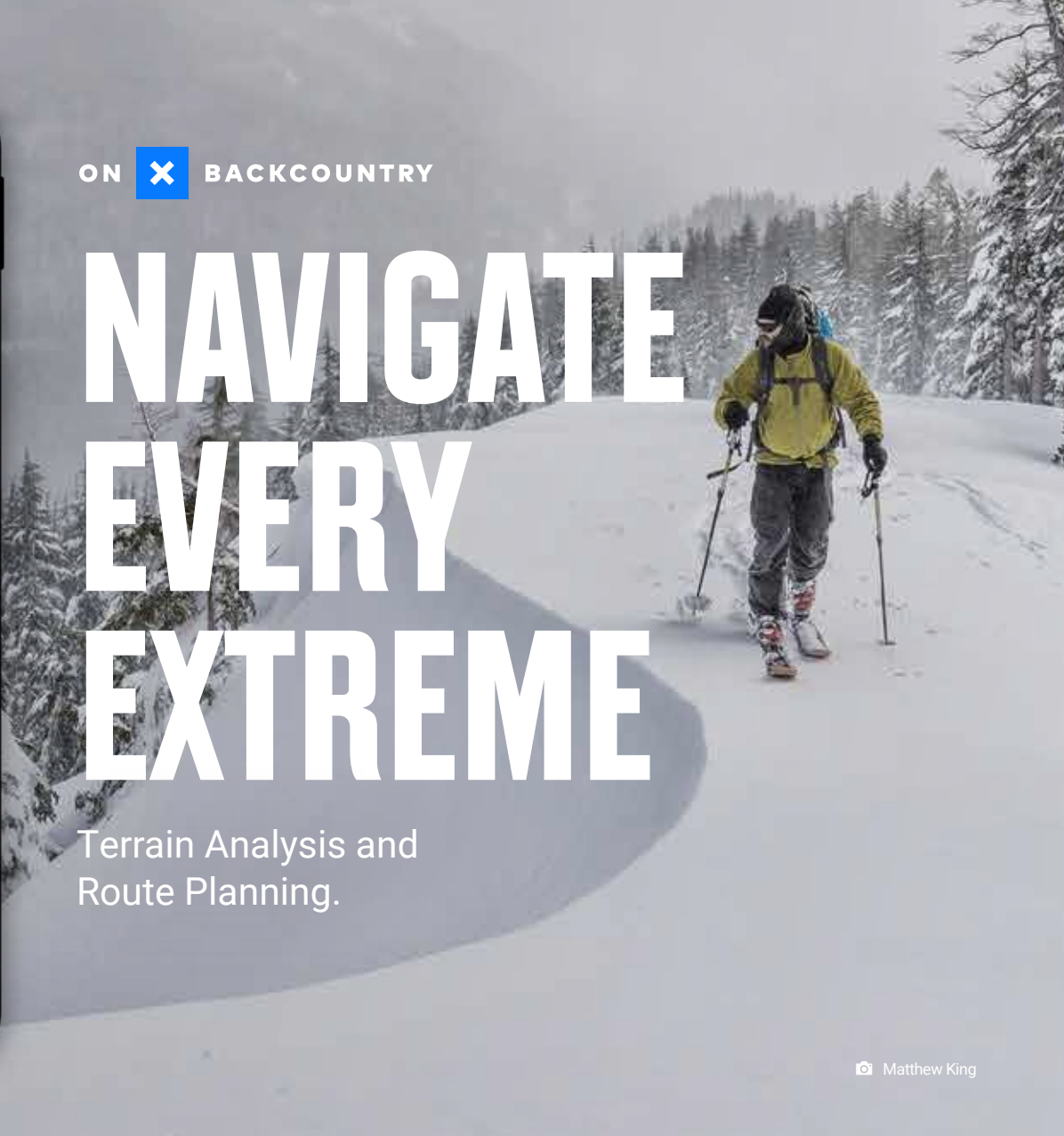
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Matthew King

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- In the practice of teaching in low depth snow or in areas without an avalanche climate.

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LEVERAGING DIGITAL MAPPING TOOLS FOR WINTER BACKCOUNTRY TRAVEL

BY MEGHAN TWOHIG

Base layers, overlays and map objects are used to create a custom ski tour plan for Vail Pass, CO.



False Color Green Sentinel imagery stacked on top of MapBuilder Topo provides current snow coverage information with topographic data to reference.



Slope angle shading uses a color scheme to highlight slope angles within certain ranges.



Access your saved maps and navigate in the field using a mobile app.



Winter backcountry travel is a complex undertaking, whether for recreational or professional purposes. It requires a wide range of skills as well as the ability to constantly evaluate and synthesize information from multiple sources.

Digital mapping tools can be extremely useful for gathering and comparing data, both before and during winter backcountry travel. They allow you to integrate multiple layers of mapping information, such as digital maps and imagery, map objects and more. You can analyze terrain and travel routes, share and collaborate on maps with other users, and then bring your map into the field with you using a mobile app.

Let's walk through some of the benefits of using digital mapping tools by planning a ski tour at Vail Pass, a popular backcountry ski area outside Vail, CO. While we will discuss ski touring specifically, the same tools can be applied to any type of backcountry travel.

However, before we dig in, it's important to keep in mind that all digital mapping tools (and maps in general) are models of reality. **While models can provide powerful insight into the terrain you will be traveling through, all models have limitations and flaws—including being outright wrong at times. It's important to verify all information once you are in the field, such as using an inclinometer to check slope angles or assessing for visual signs of wind loading.** No data is perfect—it is the user's responsibility to learn what digital mapping tools can do and understand and respect their limitations.

LEARN ABOUT TERRAIN AND CURRENT CONDITIONS

Arguably one of digital mapping tools' most powerful features is the wide range of layers available. Stacking, or combining these, into nearly unlimited combinations can provide valuable and unique insight into terrain and current conditions. The high-level view achieved through comparing different layers creates an ideal place to start planning your ski tour.

At CalTopo, we divide layers into two categories: **base layers and overlays**. Base layers are digital maps or imagery that make up the background, and they have been carefully selected to complement each other. Where one base layer may highlight official peaks and trails from a government database, another may feature crowdsourced peak and trail data with more prominent terrain shading.

Beyond classic style topographic maps, modern tools also provide **aerial and satellite imagery**. This includes near-real-time imagery, such as from the Sentinel program, which aims to image the entire earth every five days. It offers 10m horizontal resolution, allowing you to assess snow coverage and zoom in on individual snow patches. It can

also be helpful for tracking patterns, such as early season snowfall, that contribute to particular types of avalanche concerns.

To create a more customized view, you can stack and view relevant data from multiple base layers at once. **One of my favorite combinations in CalTopo is to stack the latest Sentinel imagery with a topographic base layer, such as MapBuilder Topo, and then adjust the opacity.** This lets me visualize snow coverage along with a topographic map for reference. Displaying the Sentinel imagery in false color green further enhances the snow line without obscuring the features of other maps it is stacked with.

Overlays display data with a transparent or semi-transparent background. A popular overlay for winter backcountry travel is **slope angle shading**, a visual overlay that uses a color scheme to identify slope steepness. It is an important tool for planning your ascent, identifying areas to avoid and managing avalanche danger, but is most useful when combined with observations of the physical terrain, such as measuring slope angle with an inclinometer.

Much has been written about the potential for errors in slope angle shading, usually with a focus on the technical details of how slope angle is calculated. At CalTopo, the bigger risk we see is that source elevation datasets sometimes contain gross survey errors beyond what most users would consider "micro terrain". While this is ultimately part of a much longer, in depth discussion than can be covered in this article, the takeaway point is that slope angle shading is only one piece of the bigger picture. **Don't bet your life on the accuracy of your map!**

Other overlays provide insight into weather conditions and real time data. I am a big fan of the **wind plot** overlay which displays arrows showing the current or forecasted direction of average wind speed or gusts for specific points in time up to 36 hours in the future. As part of your plan, you can use this overlay to gain an idea of where wind loading may be occurring today or tomorrow and plan to avoid those areas.

Finally, what would a ski tour plan be without consulting the **avalanche forecast**? Both the American Avalanche Association and Avalanche Canada have made their danger rating data available to third party applications, although you should still click through to your local avalanche center in order to read the full forecast including the identification and discussion of specific avalanche problems.

This overlay in particular helps drive home the power of modern mapping tools for trip planning, as you can now obtain the most up-to-date forecast from the local regional avalanche center directly from your map. Comparing data about the terrain and current conditions from many distinct sources all in one place allows you to begin to address the challenges of winter backcountry travel and build your plan effectively.

PLAN AND ANALYZE

As you learn about the terrain and current conditions, you can create your ski tour by adding additional objects, such as markers, lines and polygons, on top of your map, and saving it to the cloud.



Notice how the snow coverage shown in the Sentinel satellite imagery of Vail Pass, CO changes from 11/2/20 (left) to 12/7/20 (right).



Use the map objects you add to the map as part of your travel plan to generate estimated travel times for each leg of your trip.

Beyond indicating points of interest or your desired route, you can often get further information about each map object, such as when the sun will hit a spot on a particular slope, or the length and elevation profile of a line. For example, if you're creating your map in CalTopo you can add markers and draw lines on your map to create your ski tour plan. You can then use those objects and the Travel Plan tool to generate and display estimated travel times for each leg as well as your overall tour based on the Munter Method for Time Calculation, a popular method for calculating backcountry travel time based on the distance traveled, travel method, and elevation gain and loss.

As you draw your route and mark points on the map, you can continue to change your base layers and overlays as often as needed without affecting the position of your map objects. This allows you to build your plan dynamically, comparing and moving between different data sources fluidly.

SHARE AND COLLABORATE

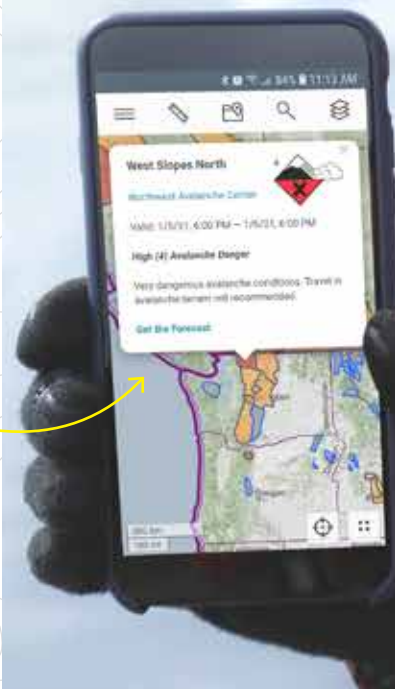
As you move through the planning process and then into the field for your actual ski tour, communication is key. Modern mapping tools make it easy to share and collaborate on your map with other users, opening up communication channels. You can easily share your map with someone else as part of your safety plan—they can even watch you on your map in CalTopo if you share your location from a mobile app or a trackable device such as a Garmin inReach.

You can also share your map with other people, granting them the ability to edit and/or add map objects. Collaborating with your partners on the same map allows you to build your plan together and be on the same page.



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BRING YOUR MAP WITH YOU

Finally, mobile apps allow you to access your saved maps from your mobile device as you travel in the backcountry, along with many of the same tools as web applications. As long as your mobile device has an internal GPS and compass, you can use a mobile app to display your GPS location on your map, record tracks and navigate the terrain, all while viewing and following the map you built during your planning process.

If you're using CalTopo, any map objects that you add to your map from the mobile app, such as a marker for a snow pit location, will sync automatically back to the cloud. This seamless communication between the mobile app and web allows you to update your map in the field and see those changes reflected the next time you view your map.

CONCLUSION

Traveling through the winter backcountry is challenging. Having one central location where you can gather and synthesize data from multiple sources as well as build and share your plan with others can greatly improve your planning process. With mobile apps, you can bring your plan into the field with you and use it to navigate the terrain. When used properly, digital mapping tools can be a powerful and versatile part of your backcountry toolkit. 📍

Super Cycle

BY MARK SAURER



February 7, 2020. It's around 0430 and I'm in my work truck on Utah State Highway 210 parked just downhill of Snowbird Entry 1. Our little convoy consisting of myself, Jake (the canyon plow supervisor) in his truck, along with one of his road graders and a plow, have all come to a stop in a "safe zone" next to a 10-foot-high debris pile where the road and a Snowbird sign used to be. The road has been closed for about 23 hours and in that time our storm total has grown to 33" of snow with over 5" of water. West winds have been ripping across the ridgetops for two days now with averages in the 30s to 50s and gusts up near 100.



Debris from the Cottonwood Draw SS-N-D4 near Snowbird Entry 1 on the morning of February 7, 2020. Photo Mark Saurer, UDOT Avy

White Pine path has run big, **very big**. We are now trapped along the one mile of road below Snowbird that is not covered in avalanche debris.



After the storm, surveying the debris piles left by multiple avalanches out of the Sleeping Giants, Little Cottonwood Canyon. Photo Laurie Delaney, UDOT Avy

We started slowly working up from the Salt Lake Valley about an hour ago and 30 minutes after a natural avalanche out of Tanner's Gulch put a couple feet of soft debris and a smattering of aspen branches and willows across the road. The grader and plow were easily able to clear a path for our trucks through that pile, but by no means does that mean this was a small avalanche. For Tanner's to hit the road it has to run 3500 vertical feet and down almost two miles of track. In a couple days when the sun finally comes out we'll find 10 acres of debris up to 20-foot-deep on the apron just above the road.

Continuing up the road under eight more avalanche paths that hadn't run overnight, the grader then the plow lead the way to clear the road ahead. We spread out and leapfrogged our way from safe zone to safe zone like patrollers on a control route, always keeping taillights and headlights of each other's vehicles in view. Before leaving the plow shed, I talked to my co-worker Laurie Delaney on the phone from her apartment at Snowbird. We agreed that there was a reasonable margin of safety for the drive up as we had a productive round of control work less than 12 hours prior with the exception of the two paths that had naturalled.

Back at Entry 1, our current roadblock of D4 debris will not be easily pushed aside by the equipment we have, so we gather up to take a look. We are not surprised to find avalanche debris here as Jake received a call from the Snowbird cat shop that an avalanche had run out of Cottonwood Draw around 0300 and crossed the road. What did surprise us was the size of the debris pile; it's been a long time since Monte Cristo Bowl or Cottonwood Ridge, both of which feed into this track, have run this big.

I almost slip and fall on my ass when I step out of my truck; the snow has transitioned to freezing





Left: Almost a week after the storm, plow crews were still working to clear the road under Mount Superior.
Photo Andrew Hennigh

Mark Saurer's and Tyson Bradley's exciting descriptions of the 27 avalanches which crossed Utah-210 during the February 2020 cycle remind us that, for over 80 years, dedicated professionals have protected an ever-increasing number of people who depend upon Utah-210 for their recreation. About 60 years ago a similar cycle closed Utah-210 for two weeks. Public pressure demands significantly shorter closures; professionals have responded.

Tyson Bradley mentions something unique about highly hazardous Utah-210. No sheds. Why? If nothing else, sheds give professionals a place to take shelter as they work to open Utah-210.

—Ron Perla

rain...in early February...at an elevation of 7,900 ft. As we're chipping ice off the highway closure gates so we can at least lift those out of our way, my phone pings with a text from Mark Staples, director of the Utah Avalanche Center. He's looking for an update on activity. I take a moment to text him a picture of the pile of snow in front of our trucks then call him back. We have an almost comical conversation about the extraordinary conditions. "I was thinking of extending the avalanche warning for the day, you think that's reasonable?" he asks. A fair question since conditions are fairly mild in the Salt Lake Valley. "Mark," I respond with a chuckle, "we've had over 5 inches of water, had to push our way through the toe of one D4 debris pile and are currently stopped below another. The wind is howling and it's raining. YES, I think continuing the warning is a great idea!"

Right around this this time an alert comes through our phones from our infrasonic avalanche detection arrays which monitor activity in the mid-canyon below our location. White Pine path has run big, very big. We are now trapped along the one mile of road below Snowbird that is not covered in avalanche debris. 2 miles up the road, the rest of the UDOT avy crew is dealing with their own issues. I hear some radio chatter as they start moving from their homes towards our office at the Alta Guard Station. Laurie later summed up the situation that morning in her storm report:

Conditions up in the Snowbird Village and Town of Alta are extreme, with over a foot of very high density snow on the roads and travel very difficult. The drive from the Hilton (Snowbird employee housing) to the Guard was nearly impossible... The Alta plow crew was luckily available to come and dig out in front of the Guard, as any truck that rammed into the almost 2' of snow there would not be moving again... Walking up to the Guard is almost hip deep, very upside down. Korps is stuck in his driveway for over an hour trying to dig out and... Dan eventually manages to wade his way out of the study plot... Mark, Jake, Sean, and Gallegos start up the canyon, staggering their movement. They run into debris at Tanners in two places but the grader manages to push through, so they carry on. Steven enters the canyon and moves in behind them. They reach entry 1 and the grader can't push through the debris there. At this point no one is feeling comfortable with the situation, both down at entry 1 and up in the town.... The decision is made to ask if (a Snowbird loader operator) can come back and start scooping from entry 1 to help push past the debris.... so that (our) crews can stay off the main road and use Snowbird entry 2 as an exit. (He) returns to help along with a Snowbird cat, Sean in the grader does what he can from the other side, the rest of those present pull back from the debris to a hopefully safer zone and watch. White Pine naturals during this time at 0458, with the highest power the infrasound has recorded for that path at 4.59. It has clearly crossed the road, so the crew at entry 1 is trapped until a path can be punched into Snowbird parking.

I must admit the decision to let the loader and grader start working the debris pile was not an easy one. Steven, Laurie and I talked about it at length before letting them into that area. Obviously a major avalanche had run already, reducing the hazard, but there are three main starting zones that feed into that path, any one of which could have produced the pile of debris in front of us. While we shot several targets throughout that area the previous afternoon (with no visible results in the raging storm), we had little idea how much snow was left up there to run again. We also could not just keep sitting there, as just down canyon from our position is the runout from the Willows paths, which had not run yet. Indeed during our afternoon firing mission several hours later, another D4 triggered out of Cottonwood Ridge jumped the sub-ridge above the Willows starting zone releasing the entire area and covering the road with several acres-worth of uprooted aspen and fir.

Our strategy for clearing a lane through the Entry 1 debris was to expose only one piece of equipment and operator at any given time and to concentrate their work on the far edge of the toe. Logic being that if the other starting zones ran, the wall of debris across the runout apron and over the road would likely (hopefully) act as a diversion dam to protect everyone. This theory panned out during our firing mission later that afternoon when we triggered another major avalanche in Monte Cristo Bowl. Again pulling from Laurie's storm report:

Monte Cristo runs class 3 with debris stopping short of the road but has an incredible powder

cloud that dusts the cat shop and has me fleeing up the snowbird parking lot away from it, also getting heavily dusted.

Any other day a size 3 avalanche like that would have easily hit the road and Entry 1, but this time it was "eaten up" by the rough track and debris field from the morning's activity and stopped just short of the road. After about an hour, a single lane is punched through the debris and we can at last sneak through. We gather up just east of the debris pile next to the relative safety of Snowbird's Creekside day lodge and discuss our next step. Working slowly and methodically with the help of both Snowbird and Alta personnel we continued to slowly shoot our way up canyon and eventually pull-off a full control mission of every path above town.

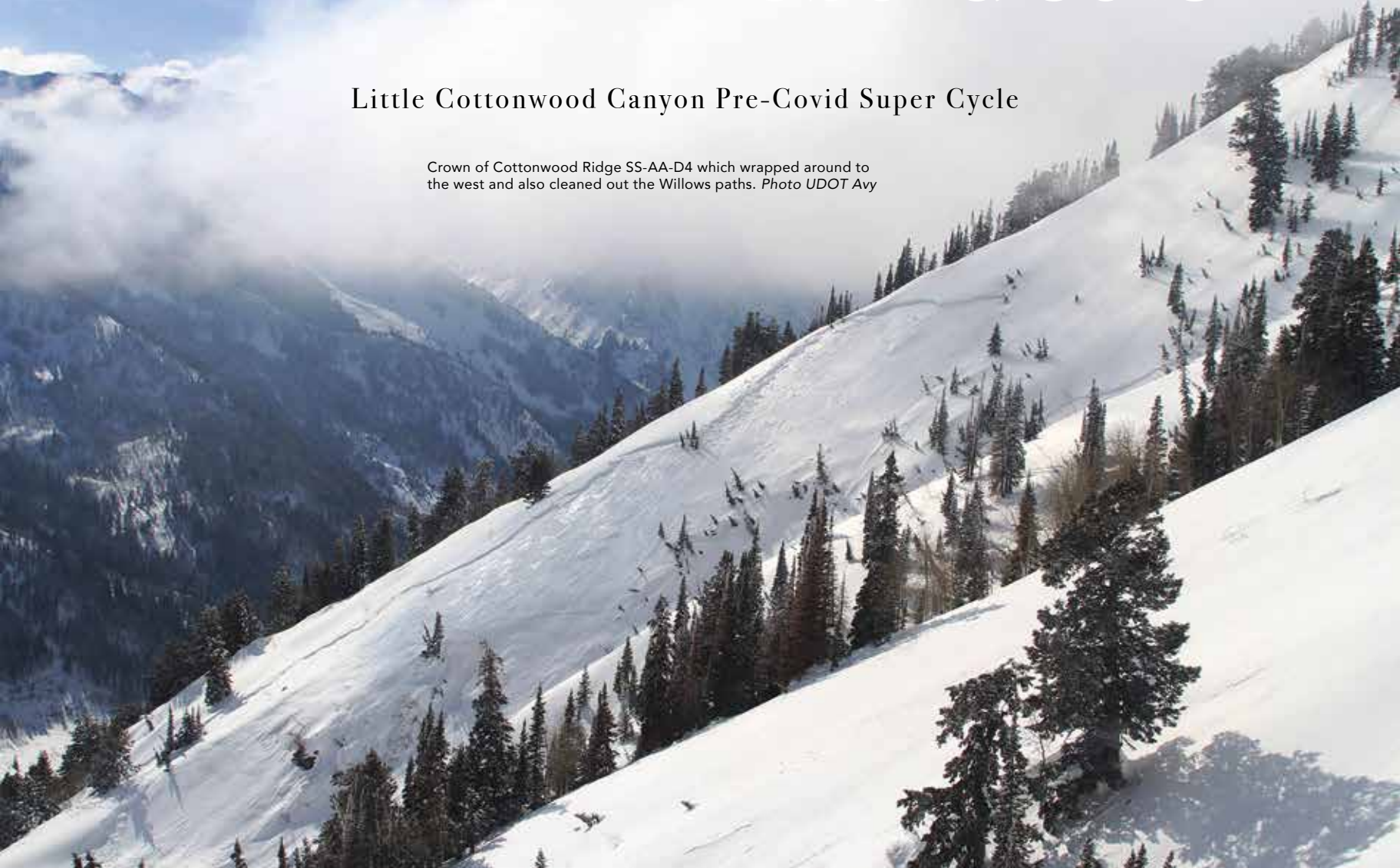
The events of the next 24 hours and indeed through the entire February 6-8, 2020 cycle are the stuff of historic avalanche hunter lore. By the time it stopped snowing Friday evening, the Guard HST was 41" with 6.79" water. Atop Alta's Mount Baldy, winds were sustained out of the due west in excess of 35 mph for 76 hours; a record for that weather station. The road was closed and town inter-logged for 54 hours. In that time we recorded 48 significant avalanches along the highway corridor, with 21 road hits and 15 avalanches D3 or larger (including the 4 D4+ naturals Friday morning). We had 13 separate firing missions between our two howitzers and 24 RACs for a total of 190 artillery rounds, 79 RAC detonations, and one 4#er on a boo bank shot which buried the road near the Forest Service garage with 15 feet of debris. That was officially the last recorded avalanche of the cycle. Despite the staggering statistics, there was minimal damage to structures and vehicles and only one minor injury. This can be attributed to the level of cooperation between all canyon partners and entities, the skills of those involved, and of course a bit of luck. Had the storm come in just a few hours later on Thursday morning there would have been thousands of resort skiers and back-country users trapped in the canyon for the duration. Had we been driving up the canyon just a little earlier or a little later Friday morning...

What I remember most about those few days is not the frightening beauty of the large avalanches we triggered and were able to watch, but a subtle audio visual snapshot of Saturday morning. As Dan and I drove up the still closed and silent canyon road before dawn under clear skies, I was struck by how stark and even more massive the debris piles and flattened forests looked in the black and white contrast of the full moonlight. It looked the same as desert canyon walls after dark on a river trip when the moon breaks the rim. Then a little later that morning as the sun rose over the ridge, I was walking around the Tanner's debris piles and heard a crystalline tinkling sound as the aspen and willows were breaking free of the ice that encased their branches due to the freezing rain 30 hours prior- a sound I never would have heard through the mechanized white noise had the resorts and road been open. ●

Organized Destruction

Little Cottonwood Canyon Pre-Covid Super Cycle

Crown of Cottonwood Ridge SS-AA-D4 which wrapped around to the west and also cleaned out the Willows paths. Photo UDOT Avy



BY TYSON BRADLEY

Wednesday February 5: I was surprised to learn that my group of eager father and son ski touring guests had shrunk by one. One dad got a flight out of Salt Lake International airport early that morning, concerned he might get stranded in Alta. A sizable storm was forecast for the coming days. Little did I realize that his foresight would prove to be laser accurate!

We skinned up into White Pine Gulch without him, after shuttling down from the Goldminers Daughter Lodge (GMD). Temps were cold, and “cold smoke” was an apt description of the layer of stellar dendrites that piled up quickly and floated around the boys like bubble bath. Smiles were ubiquitous. Utah’s finest champagne is what we all love, but this layer was destined to be the catalyst for a historic avalanche cycle in upper Little Cottonwood Canyon.

My ski guests and I toasted the sweet backcountry powder day with cold beer in the

“polar bear lounge,” aka GMD Parking Lot, as a few last flakes swirled around us. The super-stoked guests returned their beacons and went into the lodge as a much different storm worked its way into the Wasatch Mountains. They would remain there for the next 50+ hours. The bar became a popular place with stir-crazy guests. Beer kegs ran dry.

Thursday February 6: I tried to head back up the canyon, to no avail. Sheriffs turned us back at the base, no questions or exceptions considered. “The Canyon’s not opening

today,” the officer said, flatly. “No reason to sit here and wait!” Indeed, it would’ve been a LONG wait and resorts never opened either.

Returning to my office, it seemed like an overreaction to shut down LCC for the day. Down in the valley the temps were mild, there was little precipitation in Salt Lake City, and the mountain snow totals weren’t impressive. I called Mike Morris, a patroller at Alta. “What’s going on up there?” I asked. “Was it an active morning on avalanche control routes?” “Not really,” he replied. “The dense new snow wasn’t super-reactive. But the moguls are all covered and it’s great graupel skiing. We’re riding on top of it, like butter. And UDOT did have a slide cross the road.”

Better safe than sorry though, I thought, and focused my attention on guide service ramifications. Guests stuck in LCC had to be refunded since backcountry skiing there was a “no go.” And avalanche classes for the weekend would have to go somewhere else for field sessions. The Alta Library indoor lecture venue had to be replaced as well.

Friday February 7: This warm wet storm came in on a southwest flow, and immediately weighted the light fluffy layer beneath it. Then, as winds switched to the northwest,

Twenty-seven avalanches crossed the road during this storm cycle.

We got 41 inches of snow and 6.8 inches of water.



Aerial view of a very buried Highway 210 where the Mainline crosses under Mount Superior. Photo UDOT Avy



Multiple debris toes in Tanner's Gulch. Photo UDOT Avy

the cards were stacked just right for collapse. It was the “Perfect Storm,” as Utah Department of Transportation (UDOT) forecaster, Brett Korpela put it, “...to produce a 40-year avalanche cycle in LCC. We had 27 avalanches cross the road during this storm cycle. We got 104 cm (41 inches) of snow @ 173 mm (6.8 inches) of water.”

A typical Alta storm bringing 41 inches of powder would usually equate to 2-3 inches of SWE. So this one, with 6.8 inches of added SWE, weighted the slab remarkably fast. And it fell on stellar dendrites, aka “Alta powder flakes.”

Wind transports snow (and SWE) far faster than it can fall from the sky. Korpela pointed out, “The real clincher was the sustained 11,000 ft winds out of the northwest, and above 30 mph for 60 hrs. We had an upside-down setup that was easily overcome by the water amounts; wind loading coupled with graupel pooling seemed to reinvigorate the energy of the avalanches once they reached a lower elevation.”

Dense graupel, aka “popcorn snow,” is common in relatively warm storms like this one. It falls in tiny pellets that roll down off the steepest terrain and pool at the transitions to lower slope-angles.

The biggest slide of the cycle came off the Southeast Face of Sunrise Peak and barreled down Tanners Gulch, creating, as Korpela noted, “...three distinct deposition areas in the runout.” Tanners features a long, low-angle, glacier-carved gorge at the bottom that slows down avalanches. Even the D4.5 avalanche that ripped out at 0320 on February 7 didn’t make it to the highway, although it tried hard and did some forest damage as it bulldozed a deep trough toward the road.

LCC highway makes a big curve away from the canyon’s north wall to go around the long, flat, wooded (by disaster species) alluvium deposited by the ancient glacier. This intelligent routing prevents even such huge avalanches rumbling out of Tanners from reaching the road. We’ve seen debris piles 50’ high in past years. Perhaps the debris near the highway was shorter in stature this time because of the graupel pooling and multiple deposition zones upstream. One such deposit at the highest transition zone was still 30’ deep in mid-June, despite a record-warm and dry spring! I took advantage of the unusual late season snow cover to teach “snow school” en-route to the summit of Sunrise. And I got inspired to pen this piece.

Up-canyon from Tanners, Highway 210 hugs the north side of the canyon, crossing directly beneath the White Pine Finger Chutes, where there is essentially no low-angle runout. This is why more slides paste the road here than anywhere else. But these are shorter, more confined paths, and didn’t create big debris piles on Feb. 7, 2020. They never do. Avalanche sheds would be short, cheap, and effective here. No other road in the world as busy and avalanche-prone as this one lacks sheds in such locations.

White Pine proper is the next major slide path going up-canyon. It features an avalanche berm of granite blocks, aka the ‘China Wall,’ that stops medium-sized avalanches. On Friday, Feb 7, according to UDOT, “White Pine ran naturally at around 0458 as well and covered the road 20 feet deep. We had a confirmed infrasonic alert from this slide. D4.”

Bill Nalli, a previous LCC forecaster, explained to me after a series of road-smacking avalanche

cycles in 2017, “China Wall acts more like a jump than an effective avalanche berm.” The 20’ tall berm with a small trough behind it is easily overrun by D4 avalanches. It could be tripled in size, and/or another shed could be installed. The latter would need to be MUCH longer than in “The Fingers.”

Up-canyon from White Pine to the South Ridge of Superior is the zone that saw the most significant forest destruction I’ve observed since I arrived in ’85. A sizable aspen grove and many conifers were strewn across the road. “A little before the Tanners avalanche came out,” Korpela recalls, “the Cottonwood Ridge avalanche path (runs out of the Monte Cristo drainage) ‘naturalled’ and covered the road and Snowbird Entry One all the way into the creek bed. D4.”

Natural avalanches don’t require any human coaxing. No explosives. Not even a ski cut. The rate of loading simply overcomes the bonds at the weak layer interface, and the slab releases. Fortunately, this occurred in the wee hours of the morning, while the road was (deliberately) closed. Obviously, the forecasters saw it coming as they watched the wind speeds ramp up and stay strong, even as snowfall continued. They also planned ahead by sending most of the recreational public down the canyon the prior evening.

As they predicted, the precipitation intensity (PI) in the starting zones was being dramatically enhanced by wind-loading along the ridges. Northwest winds, with fresh snow available for transport, soon overloaded the upside-down snowpack. This was a basic avalanche 101 formula for slides to run. And they came out “en masse.”

Hundreds of trees met their demise as the powerful ‘white waves’ mowed them down.



Backcountry users started venturing out a few days after the storm with D3 and D4 crowns still visible off Little Superior.
Photo UDOT Avy

The debris piles below Snowbird were wide and woody. Hundreds of trees met their demise as the powerful ‘white waves’ mowed them down.

Slides came off Superior, leaving some long fracture lines visible from the road. But these were standard-size repeaters, and no major vegetation was damaged.

Cars were hit in Alta’s GMD Lot, near the Peruvian Lodge, which was also slightly impacted, as usual, by the Toledo Peak Path. A cabin near the bypass road below Alta sustained damage from a slide off East Hellgate. Fortunately, its owner, Hugh Ferguson, is a great builder. Replacing windows and cutting up firewood gave him some unexpected and low-paying summer work.

All skepticism about UDOT’s handling of the cycle was erased when the road finally opened, and motorists saw the mangled masses of trees, snapped like twigs, bent like bamboo, tangled and embedded at all angles in the dense debris piles that seemed to run continuously from White Pine to the ‘Bird. In addition to the huge naturals, avalanche front-line workers shot many slides down, with plenty of assistance from Alta and Snowbird patrollers. And the 24/7 plowing effort was highly commendable.

In summing it up, Korpela said, “We had a lot of cooperation between all the entities that work in the canyon, including the ski resorts, UPD (Unified Police Department) and the Alta Marshall’s office. Their help, coupled with good timing and a window where we were able to evac[uate] most of the recreational public out of the canyon the evening of the 6th, set us up for success.”

Most lodge guests didn’t want to get out of the

canyon at this time. They were holding out to have the ski resort to themselves after the storm. They were not so lucky. Crews had heaps of cleanup to do on the only road in and out of Alta before it could re-open, even for just one lane. Chainsaws were as important as snowplows.

After the “shit hit the fan” on Feb. 7, those incarcerated in LCC set a new record for continuous hours of being stuck inside, wishing they could ski. Interlodge travel restrictions remained in effect for 54 straight hours! Although many guests ended up going home without skiing, it was an experience they’d never forget, a quarantine they’d much prefer to the one that ended up defining 2020.

When things finally settled out, we skied the West Slabs of Mt Olympus. The wet snow had plastered itself to the 60-degree rock climbing face. Many other steep lines in the incredible shrinking Wasatch also saw tracks. High pressure set in, and it snowed little for the next month.

When it started snowing again in mid-March, Covid-19 came to America. Ski resorts shut down, and everyone went touring. Then people started fighting about whether or not to wear masks!? Avalanches became distant memories. The least of our worries. But I’d rather remember 2020 for that epic avalanche event than the divisive pandemic. Leaders in LCC handled their challenge much better. Nobody died, economic impacts were short-term, and we were back skiing again in just a few days. ●

The view up Tanner’s Gulch towards the ridgeline two linear miles and 3500 vertical feet above the road.
Photo Bret Korpela, UDOT Avy





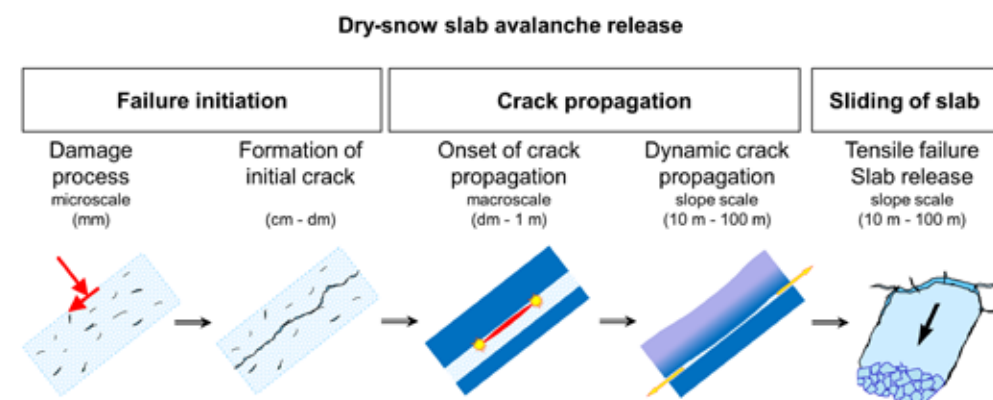
Figure 1: A snowboarder gets a real-world lesson avalanche release in the backcountry near Cooke City, Montana. Luckily, he was only partially buried and uninjured. Photo Chris Awe

BY KARL BIRKELAND

Understanding avalanche release is critically important for our work, regardless of whether we are triggering avalanches during avalanche mitigation work, avoiding avalanches while guiding clients, or just going backcountry skiing, snowboarding, or snowmobiling (Figure 1). The Colorado Snow and Avalanche Workshop's Avalanche Release session brought together top field workers and modelers virtually to discuss and present recent cutting-edge research. Presenters prepared videos of their work so workshop participants could watch presentations prior to extensive live question and answer discussion sessions. Links to the freely available video presentations are listed in the references for this article. This area of research has seen some dramatic and exciting advances in the last two decades, with a mix of innovative field research and increasingly sophisticated numerical models. The live session was moderated by Bruce Jamieson and Ben Reuter, both of whom have contributed considerably to our understanding of avalanche release and other avalanche-related topics.

Slab avalanche release is a multi-scale process covering as many as six orders of magnitude ranging from snow microstructure (millimeters or less) to slope scale avalanches (up to hundreds of meters) (Schweizer et al., 2015; Figure 2). Natural avalanche release starts with failure initiation, consisting of progressive weak layer damage leading to the formation of an initial crack. If this initial crack reaches the so-called *critical crack length*, which appears to be on the order of decimeters or possibly up to a meter, we get the onset of crack propagation.

In the case of artificial triggering, the initial damage process is not required since skiers,



snowmobilers, or explosives can create weak layer cracks large enough for crack propagation to begin. The onset of crack propagation is followed by dynamic crack propagation across the slope, which takes place at a scale of around 10 m up to 1000 m or more. The final step is the tensile failure of the slab, followed by avalanche release if the slab is on a steep enough slope to overcome friction. Of course, it may not be a perfect progression and some steps could overlap. The avalanche release session at CSAW covered all these relevant scales, and this summary will refer to the avalanche release sequence to connect the different presentations.

Basti Bergfeld, a PhD student at the WSL Institute for Snow and Avalanche Research (SLF) in Davos, kicked off the session with his presentation on multiscale field measurements of crack propagation in weak snowpack layers (Bergfeld et al., 2020). On one day Basti and colleagues measured crack speeds in a long Propagation Saw Test (PST) (5.5 m), a whumpf (up to 20 m), and an avalanche (up

Figure 2: The avalanche release process covers multiple scales, from snow microstructure (millimeters) to large slope-scale avalanche release (kilometers) (from Schweizer et al., 2015).

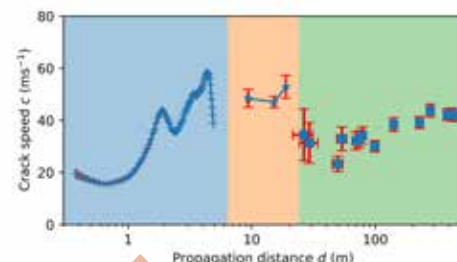


Figure 3: Crack propagation speed in a long Propagation Saw Test (in blue), a whumpf (in light orange) and in an avalanche (in green) all measured on the same day by Bergfeld et al. (2020). Crack speeds are comparable across the different scales.



Figure 4: To better understand avalanche release, Basti Bergfeld and colleagues conducted extra-long Propagation Saw Tests (up to 10 m long) on top of a concrete bunker outside of Davos, Switzerland. *Photo Alec van Herwijnen*

to 400 m). PST crack speeds were determined with digital image correlation, the whumpf crack speed was measured with a special set of accelerometers (more on these in the next presentation), while the crack speed for an avalanche was determined by analyzing the formation of surface cracks from a georeferenced video. The main question was whether crack speeds measured in PSTs are comparable to actual crack speeds in slope-scale avalanches. His measured crack speeds ranged from about 20 to 60 m/s, and were reasonably consistent between the different scales, suggesting that crack speeds of long PSTs can indeed be representative of avalanches (Figure 3). These measurements were the first to try to connect slope scale avalanche fractures to PSTs and they suggest that we can learn about avalanches by investigating PSTs.

Basti's long PST measurement was conducted on the roof of a concrete bunker just outside of Davos (Figure 4). These bunkers are near a creek and get frequent surface hoar layers, presenting an ideal research site. Part of Basti's PhD research focuses on long PSTs, some of which are up to 10 m long!

The second presentation featured Alec van Herwijnen and colleagues as they hunted for elusive whumpfs (van Herwijnen et al., 2020). Alec, a Research Scientist and leader of the Avalanche Formation research team at SLF, showed the slow progression of direct measurements of whumpf crack speeds starting with the initial measurement by Johnson et al. (2004). SLF recently developed portable wireless accelerometers that can be time-synchronized and tossed out in the snow to measure crack speeds associated with whumpfs (Figure 5). Basti and colleagues utilized these in their whumpf measurement in 2018/2019 (Bergfeld, 2020), but this past winter the conditions came together for measuring a series of multiple whumpfs in one day. The conditions also presented a unique opportunity for the researchers to wander through a creek with snowshoes on, something you'll have to tune in to the video to learn more about (van Herwijnen et al., 2020). Such "extreme snowshoeing", a common technique used by whumpf-hunting enthusiasts, may become a requirement for future avalanche researchers!

Alec summarized his results by showing that the whumpf crack speed measurements

were consistent with past measurements, and that—from the quite limited direct measurements available—it appeared that crack speeds are higher for longer crack distances (Figure 6). He also noted that one of the whumpfs created an avalanche because it propagated onto a 40-degree slope, and the crack speed for that whumpf was consistent with the other whumpfs. These are topics we will re-visit in the last two talks in this session.



Figure 5: (a) Alec van Herwijnen and Basti Bergfeld prepare custom-built accelerometers for measuring whumpf crack speeds in the field. (b) With the accelerometers thrown out in the snow in front of him, Basti triggers a whumpf. *Photos Karl Birkeland*



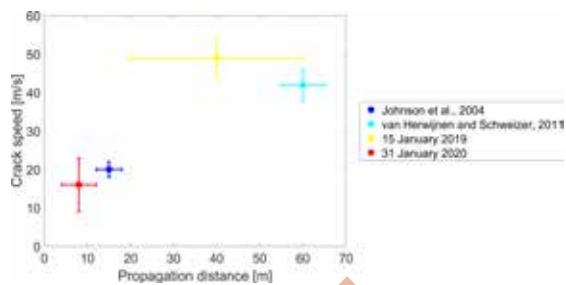


Figure 6: The limited available data of direct crack speed measurements and their propagation distances, including the measurements presented by van Herwijnen et al. (2020) in red and Bergfeld et al. (2020) in yellow.

I presented the third talk on some work I conducted with Basti and Alec while on a WSL Visiting Fellowship at SLF last winter (Birkeland et al., 2020). This work built on and refined some previous work we did with Ben Reuter (Birkeland et al., 2019). Here we added a slab by sieving 10 cm of snow into a cardboard frame on top of the existing snowpack, which had a shallowly buried surface hoar layer. We then conducted 15 PSTs (with a beam length of 120 cm) from 4 minutes to 7.5 hours after adding the slab, and we filmed our tests with a high-speed video camera capable of capturing 3000 frames per second (Figure 7). We also measured changes in slab properties directly with the SnowMicroPen (SMP). The results matched our previous work, with the PST critical crack length increasing from just 1.5 cm at 4 minutes out to 9 cm at 7.5 hours. Much of this increase in critical cut length is likely due to increasing slab stiffness (increasing effective elastic modulus), though some might also be due to increases in the weak layer specific fracture energy (which can be thought of as the resistance to crack extension) as well. In all this gives us more information about snowpack stabilization following loading. Further, our SMP measurements suggested that even artificial slabs carefully constructed with a sieve could be somewhat variable.

Ron Simenhois, a forecaster with the Colorado Avalanche Information Center, brought the conversation back to crack speed measurements in the next presentation (Simenhois, 2020). Ron is well-known for his innovative and practical approaches addressing relevant avalanche-related questions from the practitioner perspective. In this presentation he utilized a novel video magnification technique to detect subtle changes in pixel color and intensity related to slab deformation occurring prior to the opening of visible cracks in the snow surface (Figure 8). This is important because looking at videos of surface cracks in avalanche releases (such as done by Bergfeld et al. (2020) previously in this session and in more avalanches by Hamre et al. (2014)) only gives us a lower bound for crack speeds; the actual weak layer cracks may be traveling much faster. Ron assessed a video of a snowboarder triggering an avalanche, with quite interesting results. First, his analysis documented the progression of cracking in different directions. Weak layer cracks for this avalanche propagated in the downslope direction first, and then as larger sections of the weak



Figure 7: The third talk in the session investigated changes in PST critical crack lengths following loading. Karl Birkeland prepares to cut a PST while Basti Bergfeld films the test with a high-speed video camera at 3000 frames per second. Photo Alec van Herwijnen

layer broke the cracks started to propagate in the cross-slope direction (Figure 8). Second, Ron was able to document crack speeds at high spatial and temporal resolutions. Crack speeds started relatively slowly near the initiation point at 11 m/s before accelerating dramatically. Maximum cross slope crack speeds were 20 m/s, while downslope crack speeds reached about 100 m/s or 225 miles per hour! The final presentation of the session would shed additional light on Ron's findings.

Next up was Johan Gaume, Professor and the head of the SLAB Snow and Avalanche Simulation Laboratory at EPFL (École Polytechnique Fédérale de Lausanne) in Switzerland (Gaume et al., 2020). Since being hired at EPFL, Johan has gathered a strong group that works on modeling various parts of snow avalanches at all the relevant scales, from snow microstructure to slope-scale avalanche release and flow. Utilizing both Discrete Element Modeling (DEM) and the Material Point Method (MPM), Johan and his extensive team are addressing a wide array of relevant questions that aim help us to better understand snow and avalanches. These include:

- Modelling snow microstructure.
- Reproducing the crack speeds and processes of PST field experiments. These models also suggest a size for the fracture process zone, something that will be investigated further.
- Modeling slope scale avalanche release, including remote triggering from flat terrain and explosive triggering. This has allowed them to better understand failure modes and how crack speeds vary.
- Creating new models of avalanche flow, which allows them to calculate avalanche impact pressure, and avalanche flow through forested slopes and other complex terrain features (Figure 9).
- Modeling the effect of snow temperature on flowing avalanches, with a -1 degree C threshold change from granular flow to more of a plug flow (Figure 10).

Suffice to say there's enough here that I won't try to summarize it all, but rather I would encourage interested folks to watch Johan's video (Gaume et al., 2020) to better grasp the range of the work he and his group are doing.

However, some of the findings by Johan's

team regarding crack speeds bear repeating because they dovetail nicely with several other talks in the session. At the scale of a long PST, modeled crack speeds are consistent with direct measurements made by Bergfeld et al. (2020). Further, modeled crack speeds on flat terrain are consistent with whumpf crack speed measurements presented earlier in the session (Bergfeld et al., 2020; van Herwijnen et al., 2020). However, an interesting thing happens when Johan's group extends their models from flat terrain onto steep avalanche slopes. Here they note that crack speeds initially start slowly, but after reaching a certain size (or length), termed the supercritical crack size, the crack speed jumps dramatically. Under some conditions, crack speeds jump from about 30 m/s up to around 100 m/s or more, which is consistent with some of the higher slope scale crack speeds reported by Hamre et al. (2014) and Simenhois (2020), but is about twice the crack speed directly measured prior to an avalanche release by van Herwijnen and Schweizer (2011). Johan's team observed in their model that on an avalanche slope the slab starts to move downhill and the downhill movement helps to drive a change in the fracture mode from a mixed mode anticrack to an almost pure shear mode. This shear mode is well-described by the original shear model proposed by McClung (1979). The supercritical crack size varies depending on several factors, but it was around 3 to 5 m in some of their simulations. They observed this crack speed transition in both their slope-scale models and their models of long PSTs.

Johan's presentation sheds light on a question that has been asked among avalanche researchers and practitioners for at least 50 years: When thinking about avalanche release, do we need to think more about shear failure or mixed-mode anticrack (collapse) failure? His team's results suggest the answer to this question is nuanced, with both modes playing an important role. The models of Johan's team show mixed mode anticracking—and

the associated bending of the slab—is important for avalanche triggering and is also key for remote triggering from flat terrain. Then, after cracks reach a certain supercritical size in steeper terrain, pure shear may become the dominant driver for crack propagation.

To summarize the session in a few points:

- Direct measurements and models of crack speeds in PSTs and in whumpfs in relatively flat terrain are reasonably consistent, ranging from around 15 to 30 m/s.
- Models of crack speed in steep avalanche terrain jump dramatically after the initial crack reaches a so-called supercritical size, and top out near 100 m/s.
- This latter finding is remarkably consistent with the analysis by Ron Simenhois (2020), who used video magnification to measure slab deformation speeds ahead of the appearance of cracks on the snow surface. This slab deformation speed in the downhill di-



Figure 8: A technique for magnifying video frame pixel intensity and brightness demonstrates slab deformation during a snowboarder-triggered avalanche (Simenhois, 2020). Video provided by Red Bull Media House

Figure 9: The work by Gaume et al. (2020) includes modeling avalanche flow through complex terrain, including through forests.

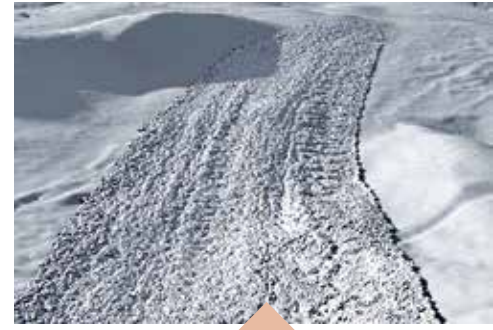
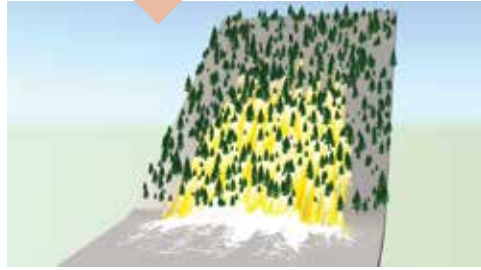


Figure 10: This debris field of a modelled avalanche looks remarkably realistic. Gaume et al.'s (2020) models showed a transition from granular flow to plug flow when the snow temperature in flowing avalanches reached -1 degree C.

rection, which is presumably associated with the extension of the crack in the weak layer, was about 100 m/s.

- These values are also consistent with both the video analyses of multiple avalanches by Hamre et al. (2014), and the video analysis of cross-slope avalanche-scale crack speed measured by Basti Bergfeld and colleagues (2020).
- Direct measurements of crack speeds on avalanche slopes are rare. So far, only one such measurement exists, and the recorded crack speed was 42 m/s (van Herwijnen and Schweizer, 2011). Hopefully more direct measurements can be made to field-truth models and video measurement techniques.
- Crack speeds are important because our limited measurements suggest that high crack speeds may be associated with larger avalanches, though this is an area that will undoubtedly be studied further in the coming years.

This session at CSAW demonstrated our steady improvements in understanding avalanche release through both field work and modeling. These advances will aid in developing ever-more complete and sophisticated models that may one day provide tools to assist avalanche forecasters. The good news for those of us that love to go outside is that avalanches are exceedingly complex. Thus, the need for being in the field and having your feet and your shovel in the snow are not going to go away anytime soon. 🍷

ACKNOWLEDGMENTS

I am grateful to the session participants, Basti Bergfeld, Alec van Herwijnen, Ron Simenhois, Johan Gaume, Ben Reuter, and Bruce Jamieson, not only for their participation in the session, but also for reviewing a draft of this article. Thanks also to Jürg Schweizer for providing Figure 1 from one of his articles. Finally, thanks to all these folks, and many others in the avalanche community, for helping me to better understand the complexity of avalanche release.

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February 2, 2020: FAC volunteer Zach Gidley demonstrates the size of a natural deep slab using his avalanche probe. This portion of the slab was 20 feet thick.

Deep Slab Forecasting

Deep in the Montana Bush

STORY BY ZACH GUY, PHOTOS COURTESY OF THE FLATHEAD AVALANCHE CENTER

“Well shit,” I muttered under my breath. “We missed that one.” It was January 15th, 2020. Cam Johnson and I were standing on a debris pile in Rescue Creek Basin of the Flathead Range, staring in awe at the carnage from the most destructive avalanche I have ever seen in person. The crown of a deep slab avalanche loomed 3,800 vertical feet above us, 10 to 12 feet thick if I had to guess. Although big avalanches into this basin aren’t uncommon, this one obliterated acres of mature timber and extended the runout down valley about a quarter mile. It had run a couple of days earlier, on a day when our forecasts were highlighting surface instabilities and concerns for mid-pack faceted crusts. Deep weak layers were an afterthought. Our forecasters had vacillated between Moderate and Considerable the last few days. It wasn’t just one slide though, the debris was covered by a deep slab release from an adjacent bowl that ran a day later, again wiping out trees that were 100 feet tall. Some trunks were wide enough that our whole forecast staff would need to link hands to circle it, in a sort of sad Kumbaya. As visibility improved later that week, we spotted several other slides of similar magnitude and severity.

Rewind to November. The start zones of the Flathead Range are, by most people’s standards, inaccessible in the early season. It’s raw wilderness, with no road access. The few low-elevation trails peter out into steep slopes matted with head-high slide alder and deadfall. Claw your way up 3,000 vertical feet of this bush and deadfall, and you’ll get to a snowpack you can drive to in Colorado.

Nonetheless, I made a couple of bushwacking forays into the Flathead Range while our staff was busy onboarding and prepping for the season. The schwacks left me licking my wounds and wishing I had watched Netflix instead. And what I found near the crest of the range was unnerving: a pronounced facet crust facet crust sandwich, the result of rain, then snow, then dry weather, then rain, then snow, then dry weather. Throughout the rest of our forecast area, this structure seemed to be embedded in undergrowth and discontinuous, or it had conglomerated into one thick crust at lower elevations. In alpine of the Flathead Range, with its higher summits and colder snowpack, the crust facet sandwich was well preserved and the snowpack was more continuous, especially in shadowed cirques and bowls.

As these layers were just starting to get buried in December, we brought up the poor

structure at FAC’s Pro Development Workshop. I posed a question to our crowd of forecasters from Montana, Idaho, and British Columbia: “Does anyone have any strategies for forecasting for this problem?” Facets on a crust are business as usual in NW Montana, where rain events followed by “backdoor cold fronts” commonly cause melt-layer recrystallization and subsequent diurnal recrystallization with the clear weather that follows. But a stout crust sandwich is another beast.

“It seems like we will be getting false unstable results for a long time. Isolating test columns changes the integrity of the crust which isn’t representative of what’s actually happening up there. How do we predict when the crust will actually have enough load to collapse?”

A few inconclusive ideas were batted around, before Ted Steiner (BNSF Avalanche Program) brought consensus to the room that watching for avalanche activity is our best tool. Blase Reardon (Flathead Avalanche Center) muttered, “It would be nice to predict it before it happens; that’s our job.”

Forecasting for the Flathead Range isn’t like forecasting in Utah or Colorado. There are no guiding operations or ski resorts or highway forecasters in the range, and there are only a smattering of users willing to fight the

long approaches to access the terrain, especially early season. The peaks remain obscured in clouds for weeks or months at a time during the winter. Plus, we didn’t have a weather station in the range at the time, something that has now changed thanks to a huge effort from the Friends of the Flathead Avalanche Center. Feedback is rare, to say the least. Nevertheless, the FAC has a decent record of tracking conditions and predicting avalanche cycles in the range that parallels Highway 2 for about 35 miles from West Glacier to Essex, MT. The shear vertical relief and intermountain snow climate lend to impressive avalanche activity on a regular basis. Historical knowledge runs deep in the region with long-time local professionals like Blase Reardon, Erich Peitzsch, and Mark Dundas all contributing to our products. Ted Steiner and Adam Clark, who forecast for the BNSF railway, are our strongest allies because their forecast tenure in John F. Stevens Canyon borders and stares into the Flathead Range. Just a few years ago, an avalanche out of the Flathead Range reached the railway for the first time in their records; they were instrumental in helping fund and install two new stations this past summer. Our operational assumptions going into the winter were based on patterns of previous deep slab

cycles. We generally see abundant avalanche activity during early loading events on faceted crusts. Feedback wanes as the layers get buried deeply or as intensity of loading diminishes. Atmospheric river events will reactivate the layers from a warm, wet, and windy loading pattern, fraught with massive cornice falls to serve as big triggers. The problem phases out again after those systems move on. We also rely on comparisons to our regional neighbors, especially Avalanche Canada, where they have a more robust network of professional operations and explosive testing to gain more information on deep instabilities.

After the workshop, the weather pattern shifted from dry to active in December. The early season crusts behaved as expected. Big loads produced a handful of naturals on basal weak layers. Avalanche activity trended downward with each subsequent storm. But the new storm track also brought unusually warm weather, washing away any chance of a low elevation snowpack due to consistent rain. The conditions thwarted forecaster efforts to get near alpine start zones. The phrase “getting night bushed” originated from Flathead Range field days that go into extra innings thanks to ferocious slide alders. Because of challenging access, we continued to operate from limited snow profiles and observations into the New Year.

The “knock-out” punch storm—3” to 4” of SWE over a two-day period, accompanied by strong winds and high freezing levels, came on January 6th and 7th. We raised the danger to High. Though the storm brought activity on mid-pack and storm snow layers, avalanche activity on basal weak layers was disappointing. We observed only one D2.5 crown that looked like it might have broken on the early season crusts above the BNSF railway in John F Stevens Canyon. We caught a rare window of good visibility of the Flathead Range and saw no deeper releases. By early January, our Avalanche Canada neighbors in Fernie had dropped Deep Slabs from the problem list. We rolled our deep slab text into a newer and more widespread persistent slab problem, rooted in a faceted crust and surface hoar layer that formed around Christmas, D2 to D3 in size. By mid-January, our most representative upper elevation SNOTEL had a 100” base and about 30” of SWE.

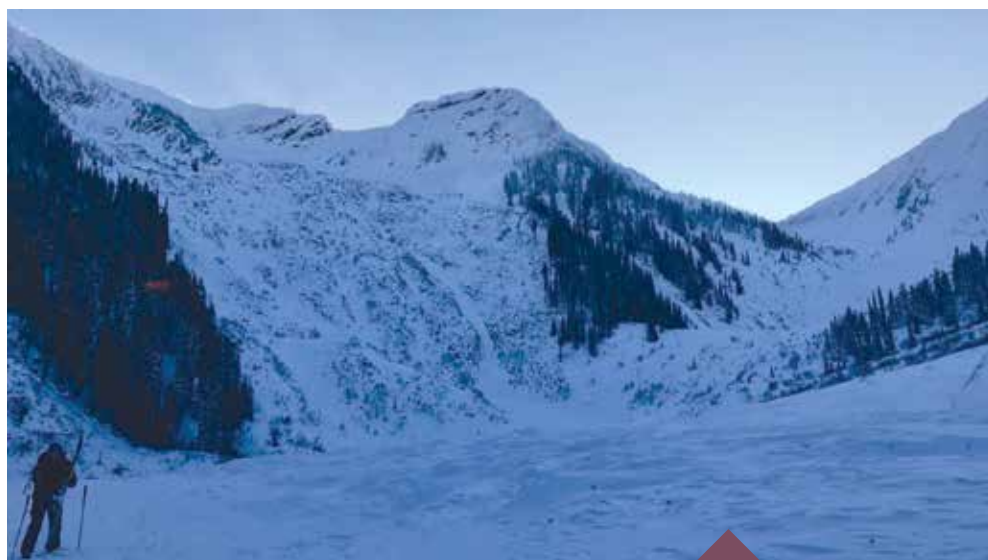
Starting on January 10th, we finally got a cold storm that opened access into the Flathead Range with low elevation snowfall. Over the course of four days, 2” to 3” of SWE from very low-density snow filled the tracks and runouts with an abundance of deep, fluffy powder. We estimate storm totals exceeded 3 to 4 feet under unusually light or calm winds. Backcountry users began pushing into the Flathead Range, which remained obscured in clouds throughout the storm. Public and staff observations during the storm highlighted that loose dry avalanches were widespread, along with a few soft slabs where a touch of wind had added just a smidge of cohesion to the new snow. Our danger ratings alternated between Moderate and Considerable throughout the storm.

With a window of visibility after the storm cleared, I was curious. So on January 15, Cam

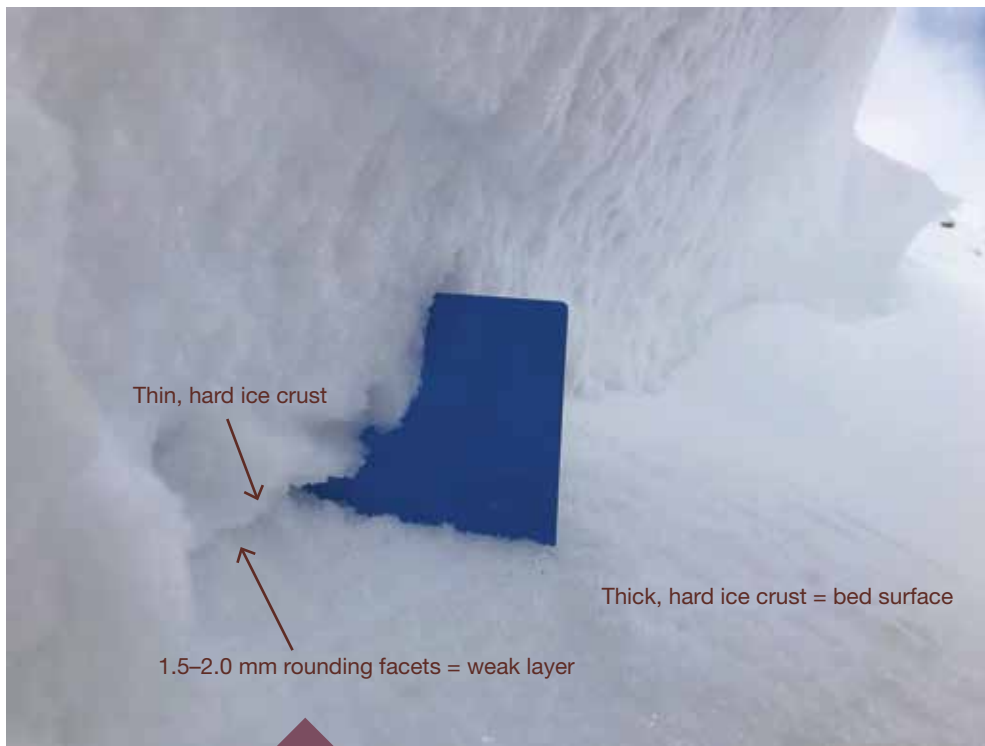


December 16, 2019: Rescue Creek before the deep slab cycle.

January 15, 2020: Our first look at the deep slab crowns above Rescue Creek that ran a few days earlier. The crowns appeared to be 10 to 12 feet thick.



January 15, 2020: Rescue Creek after the deep slab cycle.



January 25, 2020: Checking out the crust-facet-crust sandwich failure layer of a deep slab that ran the day before in the Flathead Range.

February 2, 2020: Skinning across fields of deep slab debris following the February 1 deep slab cycle. This debris pile was estimated to be 50 feet deep, D4.5 in size.



February 2, 2020: One of the monster deep slabs that ran during the February 1 cycle.

February 2, 2020: This slab broke up to 20 feet deep and ran 4,000 vertical feet, leaving acres of debris up to 50 feet deep.



and I spent the day in trail-breaking hell to get vantage of Rescue Creek Basin, one that often produces exciting avalanche results. We gawked in astonishment at two slides that had both expanded historical runouts. “Well shit,” I muttered under my breath. “We missed that one.” In subsequent days, we documented at least eight D3 to D4 hard slabs in the Flathead Range which appeared to run on our early season crust sandwich. The combination of deep, hard slabs in the start zones and plenty of loose, dry snow in the tracks and runouts conspired to make for some very impressive avalanches that obliterated swaths of mature timber. We suspect many of these ran on January 13th, a day when the danger was rated Moderate. Someone’s cryin’, Lord, Kumbaya.

A few more deep slabs ran later in January. I was able to visit one of the fresh crowns and confirmed that the failure layer, at least in this case, was facets sandwiched between the two crusts.

Any good story begins with tragedy but finishes with a heart-warming ending. Our success story came on February 1st, when we issued a Special Avalanche Advisory warning of natural deep slab releases in the Flathead Range during a warm, wet, and windy system. A week-long loading event in late January (about 4” SWE) culminated with 24-hour SWE of 1.0” as freezing levels rose to upper elevations on February 1st. With a more familiar pattern associated with previous deep slab cycles, this time we weren’t caught off guard. The results were at least three monster deep slabs from the Flathead Range up to D4.5 in size. We measured crowns up to 20 feet deep and documented acres of concrete-like debris estimated to be 50 feet deep. Despite the crowns being almost twice as large as the January slides, the debris didn’t reach historic runouts. We suspect this is because the snowpack in the tracks and runout was wet and more consolidated than the low density snow in January.

That's the end of the 2020 deep slab story. Quieter weather allowed us to pull the problem from the list and we never got evidence of it reemerging later that spring. Like everything else in 2020, there were some surprises and some learning opportunities. I've highlighted a few take home points and considerations below:

- **The importance of early season observations.** The guilty players this year formed and were buried before our forecast staff were onboarded and fieldbound for the season. I suspect many of the smaller forecast centers operate under similar timeframes. We were fortunate enough to get a few snow structure observations from high start zones early in the season; otherwise the deep slab activity would have been a real shocker.
- **Prolonged loading events.** I've been bitten by this before. Storm instabilities can wane during continuous loading events as storm interfaces and mid-storm layers settle and strengthen. That often leads to a sense of decreasing avalanche danger...until deep layers wake up. During a major storm event, it is easy get caught with a magnifying lens looking at 24 or 48 hour patterns of avalanche activity. Don't forget to zoom out and look at the bigger picture. Although our January deep slab cycle wasn't the biggest loading event of the season, it was prolonged enough that our forecast team could have been more cautious about lowering the danger due to a lack of storm instabilities. With an even broader lens, you could interpret that the mid-January loading event and deep slab cycles was simply a drawn out continuation of the more potent early January loading event.
- **Snow in the tracks and runouts.** Another common pattern I've noticed is that forecasters often get focused on the start zone characteristics (thickness and propagation widths of crowns) while losing sight of how much snow can get entrained once the avalanche starts picking up momentum. The more loose snow in the tracks, the larger the expected size should be. We've been surprised by the same issue with wet avalanches, where small point releases gouge to destructive sizes (D3s and D4s) because they entrain so much saturated, cohesionless snow in their runouts. In the case of our January deep slab cycle, we suspect that these slides reached historic runouts, not because of their exceptional start zone sizes, but because there was an unusual amount of low density snow throughout the entirety of their 4000' tracks and runouts.
- **The crust-over-facet predicament.** I think the stability tests that most of us use are best suited for common snowpack situations where we have a slab resting on a weak layer. With snowpack structures that have a collapsible crust or crust-facet-crust sandwich, interpreting the results is more challenging. The crust itself is often stiff enough to drive propagation, even before a slab forms on top of it. ECTPV or ECTPE are common results for these setups early in their existence—false alarms that will continue until at some point, they are no longer false. The question isn't just "Will the layer propagate?" but is also "how much weight can the crust hold before it collapses?" By isolating the column and sawing through the crust on all sides of the test block, this changes the integrity or "bridging" effect of the crust, and doesn't address the latter question effectively. Apart from comparing thickness and hardness of crusts to anecdotal evidence of collapses or avalanche activity, I don't have any great solutions. I'd love to see more ideas emerge.
- **ASARC's deep slab tool.** Following our surprise deep slabs in January, we started using the deep slab decision support tool developed by Conlan and Jamieson (2017) in Canada. Our staff welcomed the tool for its objectivity, consistency, and effectiveness in supporting our forecast decisions through the rest of the winter. It's a straightforward Excel sheet that you can download off of ASARC's website. One of the structural indices the tool doesn't account for is the crust sandwich. One of the influential factors in the tool is air temperature, which brings me to my last point.
- **Air temperature.** I'm well aware that there is professional disagreement on the influence of temperature swings for causing deep slab avalanches on a dry snowpack. I'll address the elephant in the room and say this: When we've had deeply buried crust/facet layers, we see a lot of loading events that don't trigger deep slabs. We see a lot of temperature swings that don't trigger deep slabs either. The deep slab cycles that we observed this season, and in seasons before, are generally associated with both large or prolonged loading events in synchrony with large temperature swings, typically rising freezing levels. In the case of the January cycle, 2" to 3" of SWE over four days with light wind wasn't a particularly alarming loading event for our region or snowpack. On the day that we traced the bulk of deep slab activity to, we saw temperatures drop from about 20°F to -20°F (or about a 21°C temperature decline). The ASARC deep slab tool gives weight to that temperature drop, which was a point of debate as our forecast staff scratched our heads about this cycle. Whether temperature influences are a primary, secondary, tertiary, or non-consideration for deep slab cycles, I hope this story inspires more research and conversation around the subject. ●

The deep slab cycles that we observed this season, and in seasons before, are generally associated with both large or prolonged loading events in synchrony with large temperature swings, typically rising freezing levels.

January 15, 2020: FAC forecaster Cam Johnson looks on in horror at the impressive destruction from a deep slab that released on a day when the avalanche danger was rated Moderate.





BY JOE STOCK

Skiing far from the road, in areas without a professional avalanche forecast, is the essence of backcountry skiing in Alaska. In these remote areas, uncertainty is high and the adventure dial is on max. Compared to the relative safety of roadside skiing, more technical knowledge, more experience, and a different mindset are needed.

Avoiding Avalanches

in Remote Alaska



I've been skiing in remote Alaska for thirty years and trying my best to avoid avalanches the entire time. So far I've been lucky, but it's not wise to depend on luck for safety. To avoid avalanches, my goal is to ditch the luck part and rely more on knowledge, experience, and a better understanding of uncertainty to manage avalanche risk. This is a work in progress. I'm perpetually questioning and rethinking the avalanche problem. So if this article resonates, please get in touch and share your ideas. I'd love to hear from you.

In this article I present a process for avoiding avalanches in remote Alaska. It's a series of steps to go through on each trip. The process starts with training in the years before your trip, and planning in the weeks before the trip. Once in the field, it's an ongoing cycle of observing conditions, forecasting avalanches, building route options, and adding margins

for safety. A mindset of embracing uncertainty ties this backcountry cycle together in the field.

THE FORECAST

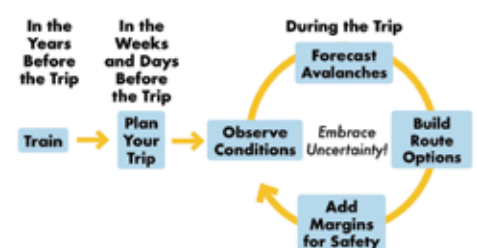
At roadside backcountry ski regions of Alaska, like Turnagain or Hatcher Pass, the professional avalanche forecast is a baseline of information before going into avalanche terrain. A team of highly skilled avalanche professionals build the forecast, like at the Chugach National Forest Avalanche Information Center or Hatcher Pass Avalanche Center. Their job is to assess avalanche conditions, consolidate observations from the community, and to present the information to the public in usable form. In regions without a professional avalanche forecast, you become the forecaster. You must do all the work of a forecasting team. Skiing in regions without a professional forecast is a different mindset and way of operating.

TRAINING

The first part of skiing in remote Alaska is training. Skiing in remote Alaska requires a lot

of training. Of course you need good fitness and riding ability to move around. Gain backcountry skills through a progression of backcountry trips, so going into remote Alaska isn't a big jump. You also need avalanche skills. The Recreational Level 2 avalanche course is geared toward being your own forecaster. It is said that without a Rec 2 you're like a one-legged man in an ass-kicking contest.

With the training you also need experience and practice. Experience adds data to your mental database allowing you to make better





Nick D'Alessio teaching Rec 2 avalanche students how to assess a weak layer in a pit. Rec 2 snowpits are more for forecasting whereas Rec 1 snowpits are more about learning. Photo by Ralph Kristofer

decisions by recognizing situations. Deliberate practice is where the learning really happens though. Deliberate practice is painful, type two fun. An example of deliberate practice is turning around before the summit because of avalanche conditions, or digging a two-meter hole in hard snow for rescue practice, or taking an avalanche course rather than going skiing. It isn't exactly fun at the moment, but it's how we learn best.

PLANNING

Planning for Remote Alaska

- Research conditions
- Forecast danger and problems
- Build trip options
- ...things will not go as planned

The second part of skiing in remote Alaska is planning your trip. This starts in the months and weeks before the trip. There is a surprising amount of information about weather and snow conditions in remote Alaska including remote weather stations, aviation cameras, trip reports, etc. Alaska adventurer Luc Mehl has a great weather resources page on his website (thingstolucat.com/ddtp-weather-resources). Pilots are another great resource as they know current conditions in remote Alaska better than anyone. I often won't decide exactly where to go until we're leaning up against a loaded plane and I'm drilling the pilot for information.

Part of planning is forecasting the avalanche danger and problems you may encounter. Make a guess based on the information you found. Was there a big recent storm that may have dumped five feet on top of a persistent weak layer? Was it a drier than normal season? Spring is the ideal time to ski in remote Alaska because the days are long, snowpack is deep, temps are warmer, and there are fewer persistent avalanche problems.

Before the trip, be armed with several entirely different trip options. Alaska adventurers know that staying flexible with trip options is fundamental to trip success in Alaska. For example, your first choice may be the central Chugach, but if it's a raging storm there be ready to shift to the central Talkeetna Mountains. Fixating on one trip option is setting yourself up for disappointment. Select places that have a range of terrain options. From simple terrain for elevated avalanche danger, to complex terrain for low danger.

Even as you head into the backcountry, things will not go as planned. My favorite is when flying into a remote area that we've been planning on for months and the pilot says, "Sorry, we can't land there." That means I get to window shop for a new place. The adventure level just went up another notch. Embracing adventure, the unknown, and uncertainty are what feed the Alaska adventure addict. If you want things to go as planned, ski somewhere besides Alaska.

IN THE BACKCOUNTRY

After training and planning, it's time to move into remote Alaska by air, boat, snow machine, or good old human muscle. To avoid avalanches while in the backcountry, use an ongoing cycle of observing conditions, forecasting avalanches, building route options, and adding margins for safety. These steps build upon the planning you did before the trip: it's a continuum of studying conditions and routes.

Embracing uncertainty is the common theme that ties this backcountry cycle together. In the snowy mountains we don't know exactly what going in the snowpack. In remote Alaska, without a professional forecast,

Remote Alaska Conditions

- NRCs Mountain Snowpack Maps: wcc.nrcs.usda.gov/cgibin/ak_snow.pl?state=alaska
- Bush Pilots: They know remote conditions the best, even if they don't ski or climb.
- NWS Alaska Snow Data: weather.gov/aprfc/Snow_Depth
- FAA Aviation Weather Cameras: avcams.faa.gov/
- AOS Real Time Sensors: data.aos.org/maps/sensors/#

we know the least. Like life in general, we rarely have a clear choice when making a decision, unless we only use data that supports our bias. Eliminating bias is impossible, even says the world authority Daniel Kahneman an, so we need to adapt ways to work with bias to minimize its negative effects.

One useful technique to embrace uncertainty in remote Alaska is to say "I'm not sure." Often. This statement from poker champion Annie Duke acknowledges uncertainty and promotes open discussion in the group.

Another useful technique for embracing uncertainty is Roger Atkins' strategic mindset for avalanche decision-making under uncertainty. Begin your trip in remote Alaska with a strategic mindset of Assessment where "There is a high degree of uncertainty about conditions, such as when...entering new terrain..." The operating strategy is to "Select conservative terrain in which to operate confidently while more information is gathered to gain confidence in the hazard assessment." This means maintaining big margins for safety and making a lot of observations.

OBSERVE CONDITIONS

Observe Conditions

- Look for red flags
- Test the snowpack
- Dig and probe for deep slab

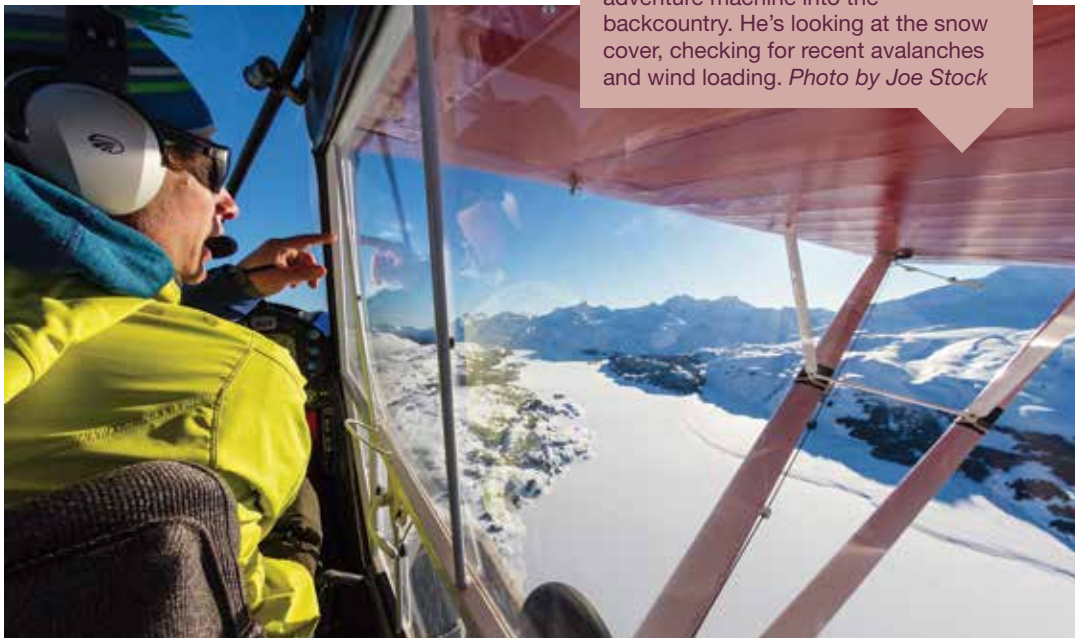
Observing conditions is the first part of the backcountry cycle. As soon as you get into the mountains you investigate the conditions you forecasted during trip planning. This is called ground truthing. Look for red flags for unstable snow. Test the snowpack with slope tests, feel underfoot, extended column tests, etc.

The probe is especially useful for learning about the new snowpack in a remote area. Get out your probe as soon as you get there. Feel for snowpack depth and layering. Is there a strong slab over a weak layer? Keep your probe out as you make your first track, probing the layers along the way.

Assessment strategic mindset with typical conditions and operating strategy

From Yin, Yang, and You by Roger Atkins, ISSW 2014

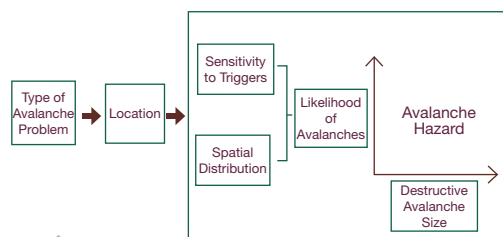
Mind-set	Typical Conditions	Typical Operating Strategy
Assessment	There is a high degree of uncertainty about conditions, such as when first encountering the terrain for the season, entering new terrain, following a lengthy period with limited observations, or after substantial weather events.	Select conservative terrain in which to operate confidently while more information is gathered to gain confidence in the hazard assessment.



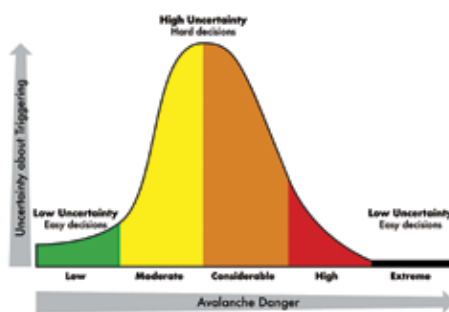
Jeff Conaway driving his personal adventure machine into the backcountry. He's looking at the snow cover, checking for recent avalanches and wind loading. *Photo by Joe Stock*



Florian Wade measuring snow depth in the Alaska Range last spring. This trip was to the normally crowded Pika Glacier, but this year it was dead: no air traffic, no planes, no other skiers, just us. *Photo by Joe Stock*



The structure of an avalanche problem is defined by its type, location, likelihood, and size. *From the Conceptual Model of Avalanche Hazard*



Triggering uncertainty compared to avalanche danger. *Graphic by Joe Stock and Kirsten Cohen with help from Keith Robine and Karl Birkeland*

One of the biggest differences about remote Alaska is I don't have professional avalanche forecasters like Wendy Wagner and Aleph Johnston-Bloom digging a bunch of pits for me. I have to dig the pits myself. In pits, as with the probe, I am especially focused on searching for a deep slab avalanche problem. These are the big and deadly avalanches that are hard to identify without an avalanche forecast. Nobody wants to get surprised by a deep slab.

FORECAST AVALANCHES

The second part of the backcountry cycle is to forecast avalanche danger and problems based on the observations you made. This process is laid out in the pithy paper entitled Conceptual Model of Avalanche Hazard.

Forecast Avalanches

- Danger
- Problems

One way to distill the Conceptual Model into a usable format, and to learn the process, is with a forecasting worksheet. This helps describe the components of each avalanche problem that are present, come up with an overall avalanche danger, and determine what observations will most reduce the uncertainty.

A useful forecasting tool for remote locations is the Dangerator developed by the Canadians. The Dangerator says your starting point when arriving in the remote backcountry is Considerable.

Considerable means "human-triggered avalanches are likely." That's the real deal. Avoid avalanche terrain when you first arrive until you make observations that may reduce uncertainty.

Another problem with a Considerable danger rating is this is where uncertainty about triggering an avalanche is often highest. At Moderate and Considerable you often don't really know what's going on in the snowpack and decisions are difficult. On the other hand, decisions are easy at Low danger where it probably won't avalanche. Decisions are also easy at High and Extreme where it probably will avalanche.

BUILD ROUTE OPTIONS

The third part of the backcountry cycle, after making observations and forecasting avalanches,

is to build route options. Notch back all of your route options during the entire trip to account for uncertainty and lack of rescue resources. Start on simple, non-avalanche terrain for the first day or two as you make observations and assess conditions. As observations reduce uncertainty, you might step out into more aggressive terrain, or your route options may stay mellow and simple the entire trip.

ADD MARGINS FOR SAFETY

The final part of the backcountry cycle is to add margins for safety. These margins are travel techniques to help assure we don't get caught in an avalanche, and to increase our odds of survival if we do get caught. In remote Alaska these margins need to be bigger than normal to account for high uncertainty and the lack of rescue resources. Rescue won't be coming any time soon.

The margins of safety we use in everyday backcountry skiing are important such as spreading out, stopping in a safe zone, and spotting our partner. In remote Alaska, other margins also become more important such as starting on small terrain, turning around if in doubt, ski testing before committing to a slope, and slowing down. Habitually using fat margins of safety will save your ass more times than you will ever know.

THERE'S A TIME AND A PLACE

Getting into big complex terrain in remote Alaska requires a unique combination of conditions and people. You need to have found Low danger after searching everywhere. And your group needs to be in agreement and feeling good about the conditions. Don't expect this perfect combination on your first trip. You're on nature's schedule.

I figure I nail conditions on one out of every five trips. The trick is to enjoy every trip. Those who go on many trips into remote Alaska enjoy the process more than the goal. Learn to enjoy terrain that is low angle and has low consequences. Enjoy camping and the simple life. One trip we flew into remote Alaska and dug for nine days straight, trying to stay afloat in a colossal snowstorm. It took us back to our simple roots of survival: dig, eat, sleep, read, talk, repeat. Boredom is precious these days.

CONCLUSION

It may seem like I've turned backcountry skiing into a laboratory research experiment. You can ignore all of this and just go skiing, and you'll probably be okay, but it is more sustainable if you have a method to the madness. Avoiding avalanches in remote Alaska is simply learning how to think like nature. We have these skills ingrained in our DNA from five billion years of programming, the trick is to slow down and apply them so that we can think like the mountains. ●

MORE READING

- Thinking in Bets: Making Smarter Decisions When You Don't Have All the Facts*, Annie Duke, 2018.
- Yin, Yang, and You*, Roger Atkins, ISSW 2014.
- A Conceptual Model of Avalanche Hazard*, Statham and Others, *Natural Hazards*, 2017.

THANK YOU

Aleph Johnston-Bloom, Cathy Flanagan, Karl Birkeland, Keith Robine, Molly Stock, and Wendy Wagner.



Iconic Palmyra Peak (elev. 13,150'), part of our inbounds terrain at Telluride. This picture was taken from my workstation on the Gold Hill Ridge on March 15, 2020, the day our "world closed down" because of the virus and a Governor's forced closure of all ski areas in the state. We had intentions and planning in place (routes, explosives, ski cut missions, etc.) to reopen Palmyra in addition to the upper Gold Hill Chutes (where I was working) on this particular day, until, well, we were told the mountain was shut down and we needed to begin cleanup for the season! The photo captures the day well: gathering dark storm clouds over the mountains of a pandemic that we know/knew very little about.

WEDEL BETWEEN COVID-19 AND HAZARD MITIGATION

BY TONY DARANYI

After all of Colorado's ski areas were abruptly shut down in March by order of Gov. Jared Polis, it became clear that COVID-19 was a reality we couldn't ignore. Like many of us, I wondered how I might assess my own risk of contracting the virus. After all, a pandemic of this magnitude is not something we'd dealt with before. At least not in modern times. For most Americans, we'd only been exposed to a concept of a pandemic through movies, science fiction, and by studying the recorded history of the Spanish Flu of 1918. Will this pandemic appear as a dark cloud on the horizon, overtaking everything in its path, I wondered, as I stood atop Gold Hill, reflecting on the moment? Does a pandemic pick us off, one at a time? Or does it take out entire communities within hours from the initial contagion of just one person? How will our lives change as we deal with this pandemic? So many questions. So much anxiety.

At the time, our direct knowledge of this particular strain of the Coronavirus was almost non-existent. All we had were a few case studies from China to go by. New York City was starting to ramp up with cases, making the virus seem threatening. And Italy was experiencing record numbers of virus cases. And deaths.

How to proceed? How to safely protect ourselves from this invisible enemy? I needed some sort of a tool, something I could go by to determine for myself what conditions might be safe and others not so safe.

Maybe it's because my brain is saturated for more than half the year with thoughts of mitigating the avalanche hazard at our avalanche-prone resort that I turned to the realm of snow science for some guidance on how to deal with the virus. It seemed intuitive to me that drawing on some parallels between the worlds of snow science and pandemic epidemiology might be appropriate. We're all familiar with the North American hazard rating scale: Green generally means safe avalanche conditions while Black means extreme hazard. In between is where things get dicey and more nuanced, from Yellow to Orange to Red. That's initially where I thought this virus might belong.

So, I began with formulating a risk assessment equation for the virus. Numerous snow geeks have defined avalanche risk assessment as: the

likelihood of an event occurring times the exposure to that occurrence times the consequence of that occurrence. Applying this risk assessment formula to the pandemic, the coronavirus, except for some real hotspots around the country, is in the low risk/high exposure/high consequence regime. That represents a classic Yellow rating, or "Moderate" hazard. Here in the San Juan Mountains we're basically in this ratings category for most of the winter. Those of us who forecast or who enjoy backcountry travel or who are responsible for mitigating hazard, are familiar with the do's and don'ts of living in this regime day-in and day-out. Essentially, we've learned that we can't let our guard down. Ever.

And so it is with the virus. We don't let our guard down, as long as we're in this constant "Moderate" hazard rating. As a mental exercise, I then began to draw parallels between the protocols for safe backcountry travel and living with COVID-19 in this "moderate" risk regime.

First off is the "go/no-go" decision. Would you leave your home to go on a tour under moderate avalanche hazard conditions? Most likely. But beforehand, you would check the Avalanche and Weather Forecasts provided by your regional Avalanche Center. You would also try to read any pertinent and recent Field Reports from backcountry enthusiasts and the local ski patrol.

What about COVID-19 under moderate hazard conditions? What criteria applies to the "go/no-go" decision? Would you venture out to the grocery store, or the hardware store or the post office? Probably. But you would check with County officials who issue the warnings and precautions to take. You would be aware of hot spots, and whether or not your locale is under something other than Yellow hazard conditions. (If you're in a Code Red, you would be sheltering in place, following lockdown protocols. The no-go decision is a no-brainer.)

Nevertheless, under a moderate hazard rating, you've decided to leave the house to go on that tour, picked a buddy to tour with, and selected a suitable touring location. Once you're ready to ascend, you turn your attention to safe route finding. You'll avoid starting zones; you'll avoid ski cutting hard slab; you'll be aware of pockets of instability and cornices; you'll be aware of wind-loading, new snowfall, rapid warming, general changing

conditions; you'll be mindful of situational awareness, the social dynamics of your party, heuristics in general; you'll be aware of other parties near your selected tour.

Your travel in the backcountry will also include spacing out adequately when crossing avalanche paths, descending one at a time while looking for islands of safety. If there are other ski groups around you, you'll be sure not to travel above these parties.

As far as that trip to the grocery store is concerned under COVID-19 conditions, you'll avoid large groups; you'll have keen situational awareness, keeping distance from non-mask wearers; you'll avoid stepping into a "High Probability, High Consequence" environment where crowds may have gathered; you'll be mindful of peer pressure.

While at the grocery store, you'll physically distance yourself from others, wash or disinfect your hands, and not touch your face.

Lastly, but perhaps most importantly, both ski touring and reducing your exposure to the virus when out in public involve having adequate Personal Protective Equipment. For touring, it's a shovel, beacon, probe and possibly an avalanche balloon system or Avalung. Navigating safely in a pandemic environment involves wearing a double cloth mask, or a surgical mask, or best, an N-95 mask. You'll have disinfectant available, you might have a face shield, or disposable gloves, or if needed as a responder, a full body gown.

One local medic who gave us our local EMTs and Fire Department a briefing on how to best protect oneself from the virus commented that an early discovery about COVID-19 was that alcohol killed the virus. He also explained that the virus initially takes hold in your throat before going into the vascular and/or respiratory systems. To counter this, he suggested gargling once a day with alcohol. His preference was tequila. Mine too.

No, we don't have a silver bullet by which to contain the virus. In avalanche terrain, the ultimate weapons are explosives, whether hand charges, automated technology, heli drops or artillery. But if we all took necessary PPE precautions, reducing our Vulnerability, maybe we can reduce the death and suffering that all of us Americans are seeing first-hand from this out of control pandemic. Let's also continue to limit exposure by avoiding the Red or, worse, Black hazard rating for Covid. That would make our travel decision a "no-go", and sheltering in place. Again.

Meanwhile, it's time to go and gargle. And to head out on that ski tour we've been dreaming about. May you all stay healthy and safe this winter. ●

Tony Daranyi is a Senior Avalanche Technician with the Telluride Ski Patrol, where he has worked for 22 years. He escapes the virus by seeking out powder stashes in the San Juan Mountains. In summer, he and his wife own and operate Indian Ridge Farm in Norwood, where they "turn snowflakes into food."



RADIO INITIATIVE: TELLURIDE

BY MATT STEEN



You're awake when the alarm goes off. The phone rings. It's Gavs, your ski buddy. The sky cleared after two days of storms. You're up and out the door. The buzz is palpable. The powder line, waiting for Chair B to spin, is classic. A long, rowdy bunch of addicted powder junkies. Coffee, burritos and who knows what is fueling their engines. You find yourself in the middle of it with Gavs. Looking around, you pick out riders scheming up a plan. Which run? Which lift? What sequence? Which line? In bounds? Out of bounds? Penalty Box? Backcountry gate? Strategic. Like readying for a battle, a game. Xs and Os with arrows.

It opens! Smiles and hoots! You are on your way up.

Riding the chairlifts to get to the top, your plan is to go out the backcountry access gate. Most everyone is only skiing the ski area it seems. There are however groups with packs loading the chairs in front and behind you.

Are these other people making their way to the top gate too? What are they skiing? What should we ski?

The powder buzz is intensifying. Gliding off the top ramp, you see dozens of people crowded around the access rope line leading to the backcountry gate. What the hell! Oh! Ski patrol's doing avalanche control along the ski area boundary. After a few moments, it opens! Good timing. Next up is the sprint-hike to gain another 300 vertical to the gate. At the top, people are everywhere. Some small groups of two, and a few larger 4-packs or more, or solo?

"Hello!" A local skier says as they walk up. "We have to talk."

Gavs knows him. "Hi Ricky! Oh geez, what did we do?"

Ricky sets his ski tails down and leans them on his arm like a ski rack. "No, really, where are you guys headed? I don't want to slide you. It might be best to let you know where I'm headed too, and when I am clear. I could end up above you. You could be above me." He shrugs his shoulders and swings his skis up on his shoulders and begins to walk away.

I say to Gavs that I wish there were some way we could communicate with their group once we all start moving. How am I going to know exactly who is where?

We crowd the parking lots, skin tracks, ridges, backcountry gates, and ski lines in our local backcountry, we are inevitably going to cross paths with other backcountry users, so we are responsible for sharing a level of backcountry etiquette and responsibility.

In Telluride we use the Bear Creek Radio Program, which was begun in the 14-15 season to address a solution to this problem. We use FRS (Family Radio Service) radios with common and known channels, and have specified channels that are dedicated to specific geographical areas and drainages. These

publicized channels are intended for inter-group communication and with other groups in the area or slope you're riding. It's not a bad idea to have an alternative frequency if you are setting up a shoot or exchanging lots of direction over the air.

In case of emergency services, 911 and local regulations remain in place. These radios aren't regulated or monitored by any organized rescue group. These are "family band" radios, and you should use them as such. Your group is your family, and this care and courtesy extend to other groups as well. When out of

cell range for a 911 call, maybe someone on your shared channel has cell coverage. They can certainly help if they're able. This system is designed for the people, and by the people.

Family band UHF radios have been around for many years. The popularity of these radios are increasing with the popularity of the backcountry. Backcountry Access Link 1.0 and 2.0 radios are intended for use with avalanche transceivers, and are a wonderful addition to your backcountry kit. Beacon, shovel, probe. Airbag? Avalung? Don't forget your RADIO!



The Bear Creek 'side-country' off the east side of the Telluride ski area with "Revelation" (w/ ski lift) on the left, the "X-couloir" in the middle, and "Temptation (Tempter)" on the right. Photo was taken by Matt Steen of Helitrax winter of 2019-2020, in association with a backcountry rescue operation in Temptation; there are a couple of fresh bomb holes visible in Temptation Bowl in addition to the dust cloud moving down the track of Temptation Gully (Tube).

Wouldn't you want to know if someone was dropping into the Tube above you?

Place yourself back on the ridge again. Your neighbor Ryan just walked up. What are your thoughts? Does my neighbor know backcountry etiquette or what's up out here? Does he have any avalanche education? Is he an active member of the backcountry community? Did he take the backcountry pledge?

It's a good thing you are prepared. Up on the ridge you pull out your spare radio and hand it to Ryan. You discuss the hazards of the day and learn that he took an avalanche training course earlier in the season. He also trained this year and read the forecast this morning!

Looking down at your radio, you change to channel B. "Radio check?"

Gavs and Ryan respond, "Copy. Loud and clear."

Later, you key your mic again. "We have three riders standing on top of the Graveyard. Anyone in or around Deep and Dangerous?"

"This is Ricky's group, clear of the D and B, thanks!" squawks the radio.

We smile and begin our descent, one at a time, radio communications and all, doing our due diligence. That is all that we can do. I'll look out for you, if you can please do the same for me.

Matt Steen is the Snow Safety Director of Telluride Helitrax, aka Chief Detonator. He volunteers for the Peter Inglis Avalanche Education Fund, a local avalanche awareness program offering scholarships for avalanche education. He also hosts Backcountry Avalanche Chats throughout the winter months. He pushes radios as an ambassador for Backcountry Access. He struggles with clear communication, and is always finding ways to work on it.



For more information about Telluride's Backcountry Radio Program visit telluridemountainclub.org.

RADIO INITIATIVE: NORTHWEST

BY JUSTIN DAVIS

This is the graphic NWAC will be using. You will notice that the layout is the same as Telluride (thanks Matt for allowing us to use your design!). We used an image donated by one of our great friends, amazing photographer, and supporter of backcountry safety, Scott Rinkenberger.



This background should be recognizable to many/most backcountry skiers in the area. The channels were chosen in consultation with the very passionate SAR/county radio folks. We avoided BCA presets and used different channels (not just privacy codes) for each channel. We removed the inbounds channel with input from the Pro Patrol, as they felt that it was not needed at this time. The graphic was put together by Kate Hourihan, a local designer who does lots of work for NWAC.

The current plan is to get the web pages up on NWAC's site shortly at <https://nwac.us/backcountry-radio-channels/>. We will be structuring the pages in such a way that we can easily add additional areas. Possible candidates could include Stevens Pass,

Crystal Mountain, Mt. Baker, Mt Hood, Paradise (Mt Rainier), if there is a need and if this project works how we hope it will. Our plan is to recycle the graphic with different area names and local background images. I could see the collection of these stickers on skis, car bumpers or ski carrier boxes becoming a fun trend, with people collecting all six (or more). I think it could be cool if we coordinate graphics and if others choose to use this design. It could really give this project a national consistency while still preserving our local character.

Once the website is live, we will start our marketing campaign, which will likely include social media, NWAC push, grass roots personal promotion, signage, stickers (of the enclosed graphic), traditional media, inclusion in Avy 1 curriculum, etc....

Justin Davis is a member of SPART (Ski Patrol Rescue Team), a unit of King County Search and Rescue. He served as a board member of the Northwest Avalanche Center board of directors for 11 years (3 as President). He values untracked snow over heavily tracked snow and solitude over crowds.



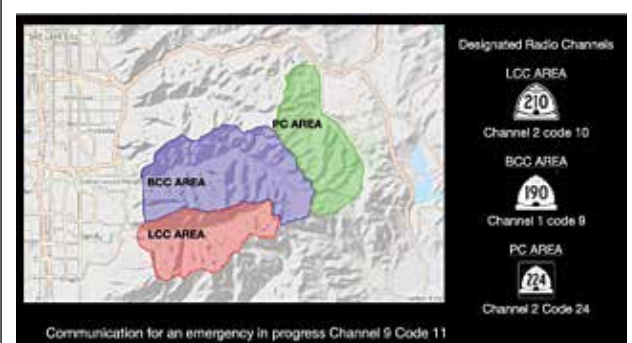
I don't want to slide you. It might be best to let you know where I'm headed too, and when I am clear. I could end up above you. You could be above me.

RADIO INITIATIVE: UTAH

This winter the Utah Avalanche Center, in partnership with Backcountry Access, will be implementing regional common-use radio channels for the Wasatch Range. These channels are designed to better facilitate group-to-group communication in the high-use backcountry areas of the Wasatch. These frequencies are in the Family Radio Service (FRS) bands and do not require a license from the FCC for use. More information on the radio program and examples for use can be found on the Utah Avalanche Center website at <https://utahavalanchecenter.org/education/group-group-radio-channel-initiative>.

Regional Group Monitoring Channels:

- Little Cottonwood Canyon/Highway 210: Channel 2 Privacy Code 10
- Big Cottonwood Canyon/Highway 190: Channel 1 Privacy Code 9
- Park City Ridgeline/Highway 224: Channel 2 Privacy Code 24
- Rescue Channel (when a rescue is underway): Channel 9 Code 11



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CRESTED BUTTE AVALANCHE CENTER

The majority of winter 2019–2020 had a very typical feel to it, even mundane, following the historic season of 2018–2019. Snow water levels for the Gunnison River Basin tracked closely with historical averages for the entire season. The normalcy of last winter quickly changed in March with the rise of the Covid-19 pandemic. March of 2020 managed to match the complexity of March 2019 but for very different reasons. There was an increase in backcountry usage as soon as the ski resort and businesses closed.

The first portion of March offered a short window to prepare and consider our options for dealing with Covid-19's impact on backcountry recreation. The ski resort remained open, and people were employment. The incredible increase in usage had yet to appear even though Covid-19 concerns were on the horizon. This grace period did not last long. The local resort closed operations for the season on March 14th. Chair lifts stopped spinning, people lost work, and backcountry usage immediately increased. The CBAC did not conduct survey work to gather data on this increase. It wasn't necessary; the increase was apparent to even the average observer. Trailheads overflowed with vehicles, and easily accessible terrain features filled with tracks. Regular snowfall and quality riding conditions enticed people to recreate. Anecdotal stories and accounts from reliable sources

spoke of chaotic encounters between groups in high-traffic areas in the first few days following the resort closure.

It quickly became apparent that the CBAC needed to make changes to our messaging to account for the public health crisis. The Crested Butte Avalanche Center deliberated at length to find the best path. Daily avalanche products are essential for backcountry safety and the CBAC's mission. We included language in the forecast discussion urging increased caution. Initial remarks focused on the increase in users. The messaging was informal for the first week, but that changed on March 26th when state and county officials released comprehensive public health orders.



These orders allowed the use of public lands and did not prohibit backcountry recreation. It was clear that people were going to continue using the backcountry. On March 27th, the CBAC added a bright red banner with a Covid-19 statement to avalanche products. This hard-to-miss messaging continued for the rest of the forecast season. The messaging encouraged people to choose less risky terrain options and to think beyond themselves. Medical and emergency services didn't need the extra burden of a backcountry accident.

Crested Butte has a long history of backcountry recreation, but the community is small and crowding has been relatively



CBAC: Cornice failures and subsequent avalanches on Whetstone Mountain from March 26th event. Photo Eric Murrow

uncommon. The CBAC travel advice often included comments on communication, spreading out, and looking out for one another. We told people to expect busy skin tracks and consider avoiding high traffic areas. Some forecast agencies operate near large population centers and regularly deal with crowded terrain, but for the CBAC, and our users, this was a new problem to combat. The goal was to help reduce the chances of an accident involving separate groups recreating in the same terrain. I can't claim, with much confidence, that our Covid-19 messaging changed our user's habits, but I like to think that it produced some positive effects.

The most memorable avalanche event of last winter coincided with Covid-19's spread. A modest stormy period deposited around two inches of SWE from the 19th through the 25th of March, roughly seven days. Tender slabs formed from wind and snowfall, but the stormy period passed without a major avalanche cycle due to the slow, prolonged loading. Winds increased after the skies cleared, so wind loading persisting for a day longer. The wind loading caused a round of cornice failures on March 26th. Many northerly and easterly slopes produced dangerous avalanches due to cornice fall. The surprise avalanche cycle required a change to products after publication that day. Social media avenues helped to push the updated information midday. A few natural avalanches ran unrelated to cornice failure, but most large avalanches on this day resulted from cornice fall. This unusual event added one last curveball to an already challenging time. The initial forecast products published that day were inaccurate, but luckily no accidents or close calls came to light.

The decision to continue daily avalanche forecast products was easy. The spread of Covid-19 led to an increase in backcountry usage, and public health orders permitted backcountry recreation. Excellent conditions for skiing, snowboarding, and snowmobiling persisted and included elevated avalanche danger. The public needed timely and accurate avalanche forecast products more than ever. The hard part was finding the balance between keeping people informed without encouraging risk-taking in light of the pandemic. It is difficult to say if the Covid-19 messaging had an impact on our user's behavior, but the CBAC gave its best to meet the challenge.

—Eric Murrow

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Photo By Brendan McCue

ORIGIN AND EARLY USE OF THE AVALAUNCHER

COMPILED BY DON BACHMAN AT THE REQUEST OF PETE PETERS

Avalanche control methods were developed at Alta by Monte Atwater and Ed LaChapelle in the early 1950s including the use of artillery. Initial trials by the Utah National Guard chronicled in Atwater's book "The Avalanche Hunters", 1969, led to the use of the 75mm recoilless rifle as a tool for avalanche control. In the meantime, the Colorado National Guard loaned a 75mm pack howitzer to the Colorado Highway Department, for use at Berthoud and Loveland Passes. Two additional 75 howitzers went down to the San Juans in 1956, as told in the book "Living and Dying in Avalanche Country" by Marshall and Roberts, 1992.

The use of these artillery weapons required agreements between the US Army and State and Federal Government (US Forest Service) agencies, plus rigorous training for operating personnel and stringent ammunition storage requirements to support the operations. Close range fragmentation also limited use to distant target areas. While artillery weaponry is still in use today, primarily the 105 mm howitzer, the air cannon concept is utilized where appropriate.

My father, Earl Bachman, was a winter sports administrator for Region 5 of the Forest Service during the 1950s, and retired in 1964, after 40 years with the agency. His assignments included public land ski area development at Dodge Ridge, Heavenly Valley and Alpine Meadows. He was not involved with the Squaw Valley development and had expressed dislike for the process which brought state control to the venue.

He recognized the need for an explosives delivery system that could be used for avalanche control that did not involve artillery weapons. He had seen baseball pitching machines in use by the San Francisco Seals minor league team and thought this device could be adapted for control purposes. He presented that idea to Slim Davis, his boss, and participant in the Squaw Valley Olympics Forest Service liaison team. Slim felt the idea worth of merit and passed the idea along, as Monte relates in his book on page 177. My father told me this story when he learned that I was involved with Avalauncher testing at Berthoud Pass in 1964.

That Avalauncher had been purchased by Den Davidson, the Amax Mining Company's avalanche technician, at the urging of Forest Service avalanche researchers Art Judson and Dick Stillman. They recognized the avalanche problem on the road into and above the Urad mine facility near the east side of Berthoud Pass. We set up the device at the mine and the Berthoud Pass ski area where I was on the Ski Patrol. I recall emptying #303 dog food cans (to the benefit of my dog Sam) and refilling them with Sacrete as dummy rounds for sighting in the device. This application extended to control of the pit walls at the Climax Mine, near Leadville. The Henderson Mine was developed in the late 60s, as the adjacent Urad Mine was phased out. Avalanche mitigation continues utilizing the original air cannon concept of explosive delivery and has been continuous since that testing phase over 45 years ago. ●



Here is a photo of the 1960 winter Olympics USFS avalanche crew. Back row, far left: Monty Atwater. Front Row third from left: Dick Stillman. Photo courtesy Don Bachman



Next! Using the avalauncher to protect the Silverton speed skiing venue in 1983. Photo Don Bachman

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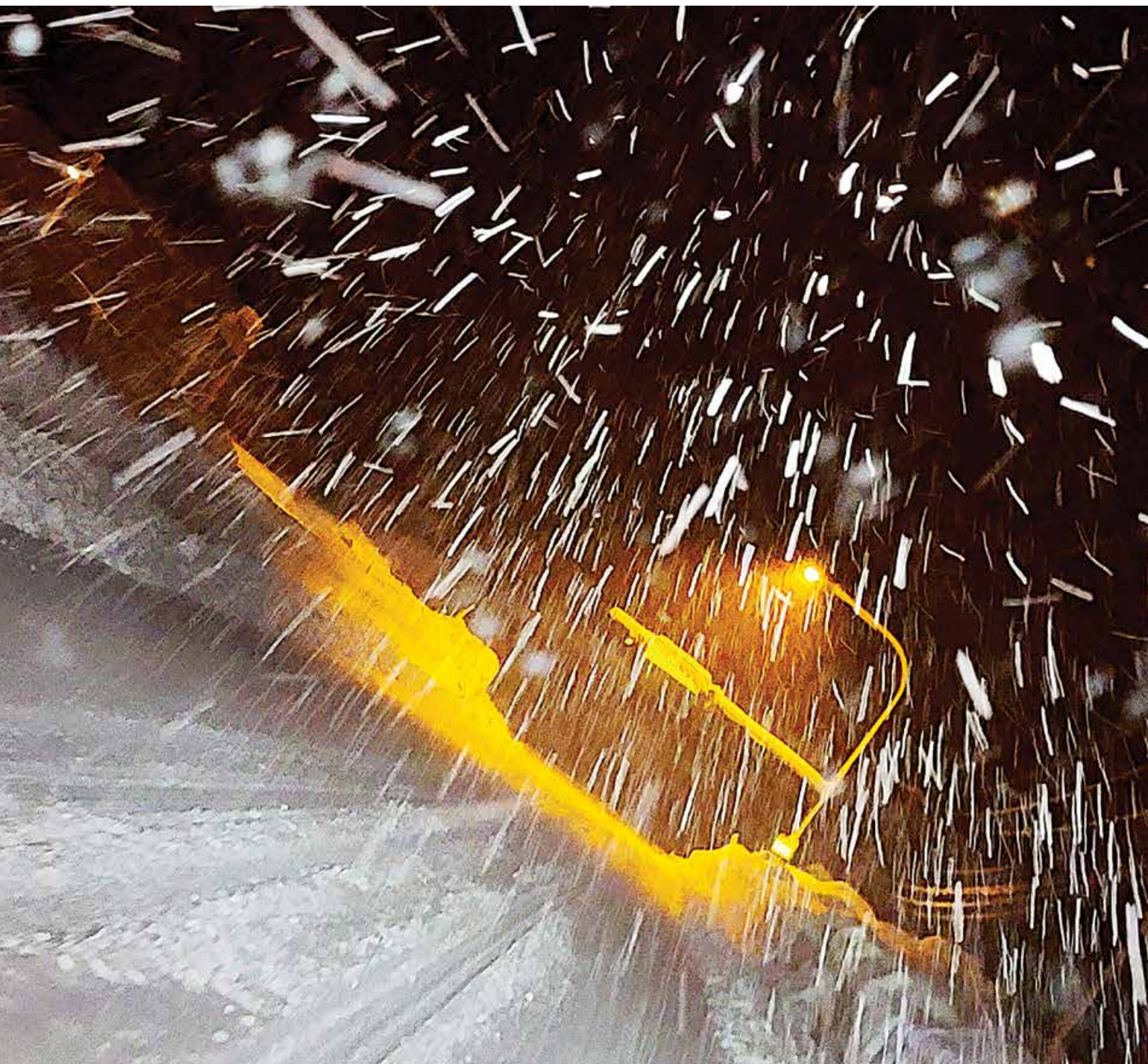
ACL - Dan Dobrowolski - dan@avconlog.com Cell: 434-960-0558



Don Bachman has been an avalanche professional since 1960. He includes TAR in his historical musings from his home in Bozeman Montana. In this photo from ISSW 2012 in Banff, Don shares dinner and stories with Ron and Gretchen Perla.

LAST LAP

Up early and en route to a highway avalanche mission. No traffic, but lots of flakes! Photo John Stimberis

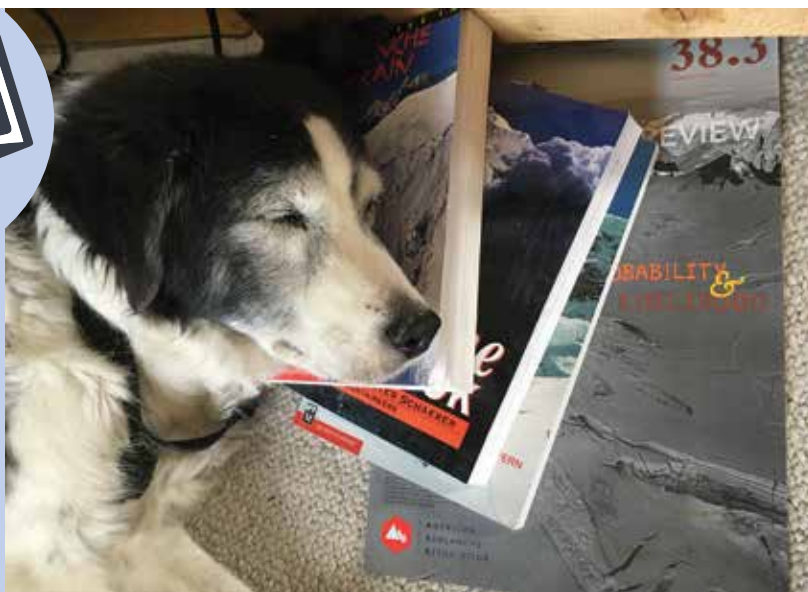


Embracing adventure,
the unknown, and
uncertainty are what feed
the adventure addict.

—Joe Stock, pg. 38



Sterbie's dog
Allie refreshing
her avalanche
skills by osmosis.
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