

# THE AVALANCHE REVIEW

Debris flow outside the boundaries of Mammoth Mountain, April 2018.

Photo Mike Phillips

# MIX & MATCH

**RAIN  
SNOW**

**WET SLAB  
DRY SLAB**

**WET AND DRY SNOW AND AVALANCHES OCCUR AS A CONTINUUM, AND REAL-LIFE SCENARIOS ARE NOT EASILY SORTED INTO DISCRETE CATEGORIES.**

**STORY PAGE 30**

These avalanches east of Ketchum occurred at the tail end of a March 22<sup>nd</sup> mixed rain and snow event. Clearly visible in the photos are wide, thin crowns involving only the new snow as well as deeper, slightly narrower crowns failing on faceted grains adjacent to a melt-freeze crust that was buried on February 14<sup>th</sup>.

Photo Ben VandenBos.

# THE AVALANCHE REVIEW

The *Avalanche Review* is published each fall through spring by the American Avalanche Association, Inc., a nonprofit corporation. The *Avalanche Review* welcomes the submission of articles, photographs, and illustrations.

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## A3 STATEMENT OF PURPOSE

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

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

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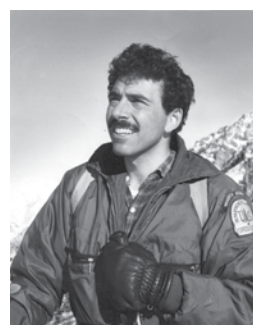
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## CONTRIBUTORS



**Peter Lev** has a long history as a mountaineer, beginning back in the day when rock climbing was considered 'training' for mountaineering, and that would be the late 1950s. He was a mountain guide, initially employed by Exum Mountain Guides in the Tetons in 1960, and became a partner in the company in 1978. He retired from Exum in 2006 and guided another 4 years, until age 70, for Sylvan Rocks in the South Dakota Needles. Though pretending to be retired (some have said he always has been) Lev currently works with a private long-range weather forecasting company.



**Ron Perla** survived two major avalanches on the Alta ski patrol and as a USFS snow ranger. He co-authored an avalanche handbook, and helped design the USFS National Avalanche Schools. He established snow labs at Canmore, Sunshine, and Whistler where he studied strength, metamorphism, and microstructure of dry and wet snow. He developed two avalanche dynamic models, and is currently working on a third. See: [www.snowavalanchearchive.com](http://www.snowavalanchearchive.com).



**Liam Fitzgerald** has been an avalanche professional since 1968. He started on Squaw's patrol for 3 seasons, then was Snowbird's snow safety director for 27 years, then he ran UDOT's program in Little Cottonwood Canyon for another 16 years. Now he lives on Lake Pend Oreille in North Idaho where the winters are "not for everyone."



**Scott Savage** is the Director of the USFS Sawtooth Avalanche Center in Ketchum, Idaho. He considers each day that he learns more than he forgets to be a success.



**Dan Veenhuizen** is an avalanche forecaster and dog handler at Stevens Pass Mountain Resort in Washington. He doesn't really have any hobbies besides skiing and rock climbing, but enjoys those things as well as long walks in the woods with his wife and working dog, Scout.

# FROM THE EDITOR

BY LYNNE WOLFE



Photo Sue Miller

**This issue is full.** I don't think we could fit another photo or sidebar. You'll find a wide array of material to engage you. I learned a lot from the wet snow-themed material, especially as warm temperatures and rain-on-snow become more commonplace. In Scott Savage et al's investigation into an avalanche cycle in the Sawtooth Avalanche Center's tenure last spring, he reminds us that our real-life avalanche problems are rarely simple in their classification; the reality is much more nuanced and fluid. This case study became the seed for a wet snow conversation up in Alaska; you'll find Wendy Wagner's notes on page 34. In addition, Dan Veenhuizen uses an avalanche cycle at his home area of Stevens Pass to explore how theory translates to the realities of wet snow, and Mike Phillips of Mammoth Mountain showcases an odd wet debris flow outside their area boundaries last spring.

The TAR time machine takes us back to 1973, where a bevy of venerable contributors bring vivid memories of an avalanche cycle in Little Cottonwood Canyon. I am deeply entertained by stories from Peter Lev, Onno Wieringa, Ron Perla, Tom Kimbrough, and honored that Liam Fitzgerald would send us an excerpt from his yet-to-be published memoir. Plus it makes me laugh that these guys are still debating the sequence of events within a 15-minute span 45 years ago. Thanks also to Mark Saurer for the Little Cottonwood avalanche atlas, and we used a gorgeous photo of an avalanche on Superior to honor Adam Naisbitt's talent and passion posthumously.

You'll find many other important contributions in this issue: John Sykes' material from Saddle Peak, Jason Blevins' piece from the Colorado Sun on Colorado avalanche statistics, more material for our sledder constituency, education notes about BCA's Send and Return campaign from Bruce Edgerly, and an insightful short essay from recreation attorney Leah Corrigan about the role of empathy in accidents.

We've had a rash of avalanche fatalities so far in 2019, but the accident on January 5 outside Silverton hits me hard. On an avalanche class. That's my worst nightmare. I teach classes and get feedback saying, "we need to see more avalanche terrain." And I have to balance that with maintaining appropriate margin, bringing us all back alive, just like Wild Kingdom. *The Avalanche Review* extends our deepest condolences to everyone involved in all these accidents, but especially to our compatriots at the Silverton Avalanche School.

As you can see in this issue, we have many new faces on the A3 board. I want to thank the outgoing members for their dedication, and especially my friend and mentor Blase Reardon, who gave me a chance to edit a few stories back in 2002. I deeply appreciate his intelligence and skill as an editor, and his unwavering commitment to honesty in communication and work. Your years on the board made a difference.

On other topics, personally I am very thankful to all of you who reached out to me in 2108 as I underwent breast cancer treatment. I wouldn't want to repeat that year, but I am skiing and feeling strong now, thanks to modern medicine, to your support, and to my own stubbornness and willingness to work hard. Thanks friends.

Finally, *The Avalanche Review* apologizes to John Stimeris for misidentifying his gorgeous photo of Chamonix and Mont Blanc as Innsbruck in TAR 37.2. Whoops, sorry John. ▲

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\*Go with us on this one. We're Canadian and we know pancakes.

# METAMORPHISM



## Flathead Avalanche Center News

**Blase Reardon** and **Clancy Nelson** will be trading in their sunscreen bottles for bear spray canisters this winter to join the Flathead Avalanche Center's forecasting staff. Blase is returning to the Flathead Valley as our lead forecaster, after diversifying his forecasting experience in Idaho's Sawtooths and the Central Mountains of Colorado. Clancy is joining the forecasting team from the Eastern Sierra. The mountains welcomed Clancy and Blase on their first field day this season with pea-soup fog, surface hoar layers, and even a little rain. Welcome to NW Montana!

## Gallatin National Forest Avalanche Center News

The Gallatin National Forest Avalanche Center (GNFAC) is excited to welcome **Ian Hoyer** as the fourth member of our forecasting team. Ian cut his teeth in forecasting at the Colorado Avalanche Information Center where he spent three seasons as a backcountry forecaster based out of Leadville.

Prior to his time at the CAIC, Ian developed his digging skills with a thesis requiring far too many Extended Column Tests while earning his Master's degree at Montana State University. His other avalanche experience includes a season interning with the GNFAC, ski patrolling at the Yellowstone Club, and teaching a range of avalanche courses.

## What's new at the Northwest Avalanche Center:

There's a lot going on in the PNW. We have added or refined several positions in order to expand our forecasting and outreach. Here are a few highlights:

- We will be hiring a new Director this spring. Please reach out if you're interested!
- **Kenny Kramer** is working part time this winter and is set to retire in the spring of 2019. In the meantime, **Simon Trautman** (on loan from the NAC) is filling Kenny's shoes as the Interim Director.
- We added four field-based Avalanche Specialists. **Dallas Glass**, **Josh Hirshberg**, **Andrew Kiefer**, and **Matt Primomo** are based out of key Washington locales.
- **Cheri Higman** is our new Education and Outreach Manager; **Anna Meehan** is our new Media Coordinator; and **Jonathan Christ** is our new Trailhead Outreach Coordinator.

We have a great team developing, but the news is not all good. We lost our friend and colleague **Laura Green** in a river accident in early December. We will miss you Laura.

—Simon Trautman



2018-2019 Northwest Avalanche Center staff. Photo courtesy of NWAC

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## FROM THE EXECUTIVE DIRECTOR

BY DAN KAVENEY

**Thanks to those of you who voted** in the board elections this past October. Even though all the candidates were running unopposed I was glad to see strong participation in the election as members lent their imprimatur to the new board. In addition to the newly *elected* board members, the New Year will mark the *appointment* of a new Publications Chair.

Writing this is bittersweet for me; I'll miss the departing board members. They've been generous with their wisdom, experience, friendship, and support as I've begun this position, and for that I'll be forever grateful. They've also helped the A3 accomplish a lot, and it's clear to me they've substantially improved our situation with their leadership. On the other hand, I'm excited to welcome our new board members to the team and am very much looking forward to working with them and benefiting from their new perspectives, skills, and energies. With that, I'll invite you to join me in thanking the outgoing members of the board for their service, and in welcoming the new members to the team.

**John Stimberis** has decided to step down after a long and successful tenure as President and Vice President. John has presided over some seminal moments in A3 history, and I'm sure he'll always be remembered as a key figure in the organization. John began his tenure on the board as Vice President. As VP he played a key role in recruiting and hiring Jaime Musnicki as Executive Director, and I'm sure we can all agree that proved to be an excellent choice (following in Jaime's footsteps still freaks me out a little). He later rose to the role of President upon Dale Atkins' resignation, subsequently won re-election to the position, and has been A3 President ever since. I've long thought that hiring the right people is one of the most important things a "boss" does, and John's role in hiring Jaime continues to resonate in positive ways every day.

John also led us both through the creation of the Pro Training Program and through the re-organization of the board. Both of these endeavors were very challenging, and both have proven to be critically important both to the A3 and to the avalanche industry. I believe John's success as board president is grounded in several key virtues. First, he has broad experience as an avalanche professional; he has worked as a Ski Patroller, Educator, and High-

way Forecaster. Second, he always considers the big picture and what would be best for the organization. Lastly, he carries a certain calm, collected demeanor with him that always serves those around him well. Thank you, John, for all your contributions to the American Avalanche Association.

**Aleph Johnston-Bloom** will also be leaving the board after serving as Secretary since 2016. She began her tenure on the A3 board as Ethics Co-Chair, where she always worked to elevate industry practice. The fact that Aleph started as Ethics Co-Chair doesn't surprise me a bit because I've come to know her as someone committed to doing things *right*. Aleph was instrumental in the re-organization of the board and in the creation of A3's Pro Training Program. She brings vision, a willingness to do the heavy moving and lifting needed to get things done, and superior organizational skills to the board. I see the positive results of her work every day.

In addition to her many other contributions, Aleph has been a tireless advocate for inclusiveness in the avalanche profession, particularly for women avalanche professionals. Perhaps her most visible contribution to this goal has been her strong role in helping to organize the Avalanche Divas, a group with which she has been active for many years. More broadly, Aleph always encourages people to think "outside the box" in order to be more inclusive of others. Thank you, Aleph, for your many contributions to A3 and the avalanche field in general.

**Blase Reardon** has elected to leave his position as Publications Chair. Blase has been involved with A3 for over two decades, and has served in many roles, among them editor of *The Avalanche Review*, Publications Chair, and as an instrumental figure in the creation of the Pro Training Program. Perhaps his most important accomplishment for A3 was to help with the transition of *The Avalanche Review* from the compact, one-color publication it was when he arrived to the journal as it stands today—a full-color, large-format, glossy publication that features the best in avalanche writing. In addition to his accomplishments as editor of *The Avalanche Review* he helped recruit the stupendous Lynne Wolfe to the job when it was time for him to move on from that position. As Publications Chair Blase has also been instrumental with *The Snowy Torrents* (and serves as one of the authors of the upcoming volume covering 1986—1996), and with *Snow, Weather, and Avalanches: Observation Guidelines for Avalanche Programs in the United States*. I believe A3's publishing program is the glue that holds the A3 community together. If that's true then Blase's efforts have a lot to do with the good health our association enjoys today. Thank you, Blase, for your service to A3 and the avalanche profession. I know you'll be making substantial continued contributions for many years to come.

Our departing board members have left some big shoes to fill, and I know the new board is up to the job. I'm very much looking forward to working with them. Please join me in welcoming our new board to their posts.

**PRESIDENT: Halsted "Hacksaw" Morris.**

Halsted has been active in the A3 for over 2 decades. He first served on the Board as a Member Affiliate Rep beginning in 1996 and has served as the Awards and Memorial List Chair for the last 11 years. In 2015 Halsted was elected Vice President and, last October, was elected President, succeeding outgoing President John Stimberis in the role.

Hacksaw has had a long and diverse career as an avalanche professional. He began his career as a ski patroller at Loveland Ski Area. After 14 years at Loveland Halsted joined the Colorado Avalanche Information Center and spent the next 7 years there as its first Education Director and as a Field Observer and Accident Investigator. He later went on to work as a Tech Representative for Ortovox and as an independent avalanche safety instructor. Hacksaw's diverse interests have also inspired him to start and run Hacksaw Publishing and the website [HeliskiHistory.com](http://HeliskiHistory.com). Halsted is a strong believer in A3's mission, and plans to work to advance our various activities, particularly those oriented toward Pro Training, Publication, Scholarships, and Research Grants.

**VICE PRESIDENT:****Erich Peitzsch.**

Erich most recently served the A3 board as Governance Chair until being elected Vice President this past October, succeeding outgoing Vice President Halsted

Morris. Erich is a Physical Scientist with the US Geological Survey in Glacier Park, Montana and also a PhD student at Montana State University in Bozeman, Montana. In addition to his scientific and academic backgrounds, Erich brings a diverse employment history to his post as Vice President. He has served as an avalanche educator, a professional ski patroller, and as the Director/Avalanche Forecaster for the Flathead Avalanche Center in Hungry Horse, Montana.

Erich sees the A3 as progressing through a time of exciting change and plans to play a role in representing our members from all sectors. Erich will bring his broad perspective as a researcher, forecaster, instructor, and former patroller to help represent the membership and help lead the organization toward our goals of solidifying our educational, publishing, and outreach objectives.

**SECRETARY: Katie Johnston.**

Katie is new to the governing board, elected to her first term as Secretary this past October, succeeding outgoing Secretary Aleph Johnston-Bloom. Katie currently



works as a Pro Patroller at Stevens Pass Ski Area, as an Avalanche Forecast and Control Specialist for the Washington Department of Transportation, and with Cascade Powder Guides. She holds a graduate degree in Snow Science from Central Washington University.

Katie brings the perspective of a hard working female practitioner who also understands the nuances of avalanche education and ski guiding. She is interested in working towards increasing the numbers of practitioners, specifically professional ski patrollers, who become members of A3 and in strengthening their role in our industry.



**TREASURER: Pete Woodring.**

Pete has been serving as Treasurer since 2017 and will continue in the role going forward. Pete is focused on helping improve our

fundraising activities and financial oversight. He is a founding partner of Cypress Partners, a wealth management firm devoted to helping individuals and families with comprehensive planning and capital preservation and growth strategies. He started in the business in the late 90s with U.S. Trust Company after playing soccer at the top level in Germany, Denmark, and the U.S. Pete is an avid skier and mountain climber—activities that make it easy for him to appreciate the importance of the work A3 does.



**MEMBERSHIP: Jake Hutchinson.**

Jake has been elected to a second term as Membership Trustee. He brings a long and diverse avalanche career

to the position. Jake started ski patrolling at The Canyons in 1992 and worked there until 2011. During that period he served in a variety of roles, including Lead Patroller, Snow Safety Director, Dog Handler, and Ski Patrol Director. He is a lead instructor at the American Avalanche Institute, where he has been employed since 2000, and has worked as an avalanche specialist for the spring opening of Going to the Sun Road in Glacier National Park since 2015. Jake has long been involved with Wasatch Backcountry Rescue, and works part time in avalanche mitigation with the Alta Ski Patrol.

Jake brings a strong interest in expanding A3 membership, and in working to find ways we can better represent and support our members. He has been deeply involved in the recent board restructuring, the creation of the Pro Training Program, and in A3's certified instructor program. Jake is excited about solidifying A3's role as the umbrella organization for all avalanche professionals in the United States.

**EDUCATION: Eeva Latosuo.** Eeva will continue as Education Trustee and Chair of the Education Committee. Eeva is an Associate Professor of Outdoor Studies at Alaska Pacific University, a Senior Avalanche Educator at the Alaska Avalanche



School, and an Avalanche Specialist and Avalanche Dog Handler with Alaska Search and Rescue Dogs and Alaska Mountain Rescue Group.

Eeva began her avalanche career in 1999 while working at both Vail Resorts and the National Outdoor Leadership School. She has gone on to teach many courses in Outdoor Studies at Alaska Pacific University.

Eeva brings to the board a strong expertise and interest in education and in diversity of membership. She is very involved in the Pro Training Program, the Education Committee, and the Industry Advisory Group, all of which benefit significantly from her leadership. Eeva hopes to help A3 evolve the Pro Training Program to make it stronger, and to increase A3 membership, especially among the motorized community.



**GOVERNANCE: Tom Mattice.**

Tom is new to the Governing Board, elected this past October to succeed outgoing Governance Chair Erich Peitzsch. Tom began his avalanche career in 1990 at the Montana Snow-

bowl, where he worked as a ski patroller. He later served as Lead Guide and Operations Manager for Cascade Powder Cats from 1997—2008. Since 2008 he has served as the City of Juneau, Alaska's Avalanche Forecaster and Emergency Programs Manager and as the Director of the SE Alaska Avalanche Center.

Tom hopes to contribute by helping A3 in its continued mission of supporting the avalanche professional by increasing industry safety and increasing access to education and educational resources at all levels. He also hopes to work to augment A3 membership, especially among avalanche professionals, and to use his demonstrated grant-writing skills to help solidify the organization's funding.



**PUBLICATIONS CHAIR: Drew Pogge.**

The Governing Board recently appointed Drew as the new Publications Chair, succeeding outgoing chair Blaise Reardon. Drew is an avalanche professional as well as an award winning

freelance writer and photographer: two sets of skills that will hold him in good stead as A3 Publications Chair. Drew founded Big Sky Backcountry Guides, where he is Owner and Lead Guide, and is also an instructor for the American Avalanche Institute. On the publishing side, Drew is former editor-in-chief of Backcountry Magazine, contributing editor at Skiing Magazine, and contributing editor to Outside Bozeman magazine. Ski mountaineering has led him around the world—to the Torngat Mountains in Labrador, the Yukon's Tombstone Range, Arctic Norway, the

volcanoes of Ecuador and Chilean Andes, Iceland, Alaska (Denali, the Boundary Range, and elsewhere), and all over the continental U.S.

Drew plans to use his avalanche and publishing skills to continue A3's strong support of The Avalanche Review and to help make sure we're maximizing the potential of our publishing ventures by working on creating a stronger digital presence for A3's publications, supporting existing publications such as The Snowy Torrents, and considering new publishing ventures A3 might wish to pursue.



**MEMBER AFFILIATE REP: Jonathan Shefftz.**

Jonathan patrols at both Northfield Mountain (a groomed Nordic ski area) and Thunderbolt on Mt. Greylock (a backcountry ski trail). Since 2006 he has been an avalanche instructor for both the National Ski

Patrol and AIARE, as well as a Mountain Travel and Rescue instructor for the National Ski Patrol.

Jonathan believes he is especially well-suited to serve as the Member Affiliate Representative since he essentially straddles two worlds: most of the time he spends in avalanche terrain is for personal recreation, yet he has also earned many professional-level qualifications. He hopes that by serving on the Board of Trustees he'll be able to give something back to the professional avalanche community that has been so supportive of him. Jonathan, who resides in Amherst, MA, is the sole east coast representative on the Board.



**AT-LARGE PRO: Sean Zimmerman-Wall.**

Sean has been a Ski Patroller at Snowbird since 2009, and has also been employed by Snowbird Backcountry Guides since 2013. He

is the co-owner and Lead Guide at Patagonia Ski Tours, and, since 2018, is an Instructor for AIARE. In addition to his avalanche skills Sean is an accomplished writer and photographer with many publication credits in magazines such as Powder Magazine, Ascent Magazine, and the Utah Adventure Journal. Sean has been active in the A3 since 2014. He serves on the Education Committee and was involved with the Pro Training Program since its inception. He is a regular contributor to The Avalanche Review.

Sean sees the A3 as a vehicle for the advancement of education and advocacy within the avalanche industry, and hopes to involve a wider range of the professional community (particularly ski patrollers) with the American Avalanche Association through improved communication and targeted engagement. He hopes to help A3 capture the wealth of knowledge that exists within our community, and to focus on fostering mentorship opportunities within A3 and the organizations it represents.

Board membership represents a significant investment of time and energy, and each individual board member plays a critical role in A3's success and development. I'll take this opportunity to thank all board members—past and present—for their service to the avalanche community. ▲

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# ICAR 2018—UPDATES FROM CHAMONIX, OCTOBER 2018

BY ANTHONY STEVENS

ICAR has four Technical Commissions, covering all aspects of mountain rescue and prevention for rescuers:

- Air Rescue Commission AIR
  - Avalanche Rescue Commission AVA
  - Alpine Emergency Medicine Commission MED
  - Terrestrial Rescue Commission TER
- with one Technical Sub-Commission:  
—Dog-Handlers DOG



protocol takes approximately 15 minutes to deliver and was shown to be sufficient for clients to perform a companion rescue in scenarios performed on the same day as training. At Glenmore Lodge our courses last up to six days, therefore we needed to determine the effectiveness of our protocol towards the end of a course.

To do this we measured the performance of novice clients in a single burial field scenario. Clients received the minimal TSP training on day one of their courses and were unaware that they would participate in a field test at a later stage. Thirteen separate groups with a total of 74 clients were tested. The search area was standardized, the start point for the students was 100 meters downhill from a single 1-meter burial. All students had their equipment packed for a normal day's training and were unaware that they were about to be tested. The instructors timed the companion rescue and recorded milestones as described below.

The average time taken for the groups to expose the "casualty's face" was 6 min 10 secs. The slowest time taken was 9 min 45 secs. The proportion of time spent on each phase of the companion rescue was: Time to start signal search: 13%, Time to find signal: 12%, Time from first signal to crawl: 7%, Time for fine search to first probe: 16%, Time from first probe to strike: 9%, Time from strike to casualty exposure: 43%.

Glenmore Lodge has validated a minimal train-

introductory avalanche education have emerged. While usage has clearly increased over the last decade, avalanche fatalities have not tracked at the same rate, suggesting that avalanche education, forecasting, and communication are clearly helping. However, the analysis of accident reports in previous studies has correlated increased risk exposure with the attainment of avalanche training (McCammon, 2000, 2004), and while research exploring the outcomes of educational interventions exists in other fields (e.g. driver education), the practical impact and underlying theoretical roots of current and popular avalanche educational methods remain relatively unexplored. In order to better understand the relationship between theory and practice within introductory avalanche education, this study examines students' interpretation of their experience. Using an inductive, qualitative approach, 20 participants were interviewed before and after taking an AIARE Level 1 avalanche course; interview transcripts were coded for concepts relating to motivation, learning objectives, perceived outcomes, and relationship to risk, addressing the following questions: what motivated students to take the course, what did they gain from the course, and what did they value? How do students describe their experience? How do students talk about decision-making, risk, and learning before and after the course?

Results reveal that participants approach the AIARE Level 1 as a gateway through which they can establish their social and technical legitimacy

## Updates from each area:

### AIRCOM

- The FAA has prohibited all longline work in private use in the US due to hook failure in powerline areas
- All doors-off work is prohibited as well due to harness attachments; there is currently only one approved release system.
- Not applicable to public use (like the government or sheriff).
- Charley Shimanski from the USA is now ICAR aviation commission president.
- The RECCO helicopter search tool for large area searching winter and summer (all seasons) will be available in the US this early winter, with ranges for detection up to 1 kilometer. Drones continue to be a huge problem for helicopter rescue teams with some collisions and many near misses this past year.

### MEDCOM

- The Medical Commission published Mountain MCI guidelines in the last year and is continuing to work on hypothermia research. They are working on developing Quality Improvement Indicators for avalanche rescue programs as well.

### AVACOM

- We stress that all of the papers looked at and discussed at ISSW and ICAR talked about how shoveling takes the most time and is the space where "beginners" differ the most from professionals. Two papers from ISSW talked about this; it was also a topic discussed in the avalanche commission at ICAR.

*Paper 1: The Effectiveness and Retention of Minimal Transceiver, Shovel and Probe Companion Rescue Training By Derek Bain.*

The deployment of Transceiver, Shovel and Probe (TSP) in guided groups often requires client training in order to have confidence that the equipment can be used effectively in an avalanche burial. Glenmore Lodge is the Scottish National Outdoor Training Centre where mountaineering instructors and recreationalists are taught winter mountaineering and climbing. In order to equip their clients with the skills to perform a companion rescue, they adapted a minimal TSP training protocol developed previously by Genswein. This

**Overall, participants describe the course in a positive light, but they also report a breakdown between their ability to grasp information and their ability to transform information into actionable knowledge.**

ing protocol similar to and developed from previous research. The effectiveness of the training after five days was unknown.

We considered 10 minutes as a benchmark time for a potentially effective companion rescue. In our field tests we achieved an average of 6 min 10 secs therefore can conclude that our minimal training is effective up to five days. Unsurprisingly the slowest part of our scenario performances was during the digging phase. This suggests that quality time spent on this part of the training may have the biggest impact on performance.

*Paper 2: Theory and Practice in Introductory Avalanche Education By Cassandra Balent<sup>1,2</sup>, Jerry Johnson<sup>1,2</sup>, Jordy Hendrikx<sup>1</sup>, Elizabeth A. Shanahan<sup>2</sup>*

As backcountry recreation continues to grow in popularity, critical questions regarding the role of

as well as gain access to more terrain. Participants report that the course imparts confidence with regard to planning and executing skills, especially for those who do not tour after the course. Overall, participants describe the course in a positive light, but they also report a breakdown between their ability to grasp information and their ability to transform information into actionable knowledge.

Through a comparative lens juxtaposing behavioral economics and experiential learning theory, this study locates participant experience within a normative dilemma: participants desire a pragmatic learning experience that enables independent and collaborative decision-making, but they instead receive largely instrumental training. When describing their subsequent touring experiences, this dilemma is highlighted in participants' reported inability to apply course lessons to their tours, especially with regard to social and group dynamics.

<sup>1</sup>Department of Political Science, Montana State University, Bozeman, United States

<sup>2</sup>Snow and Avalanche Laboratory, Department of Earth Sciences, Montana State University, Bozeman, United States



# Can you see **the avalanche?**

**LARA®**, **SARA®**, **IDA®** and **GINA®** are **remote avalanche detection systems** that work **24/7**, independent of weather conditions and automatically inform operators about avalanche activity.

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Understanding the theoretical and practical implications of introductory avalanche education is a critical step in understanding how education shapes subsequent behavior and decision-making in the backcountry. This study identifies important signposts for future study and reveals a critical connection and breakdown between theory and practice, indicating that further inquiry into introductory avalanche education is warranted.

## Psychosocial Health Conversation at ICAR Stress Injury

Stress injuries occur when:

- Resources are overwhelmed
- Rescuers feel a loss of control
- Subjects are kids, friends, co-workers
- Repetitive exposure
- Responders are in danger
- Responders are physically tired and emotionally drained

Stress injuries are difficult to measure. Not just PTSD anymore. Stress injuries include:

- Anxiety and depression
- Substance abuse
- Strained social relationships
- PTSD
- Suicide

Using the term Stress Injury normalizes mental health discussions. Suicide is now recognized as the leading occupational killer of emergency responders.

**A lot of times we are very reluctant to bring mental health issues forward until it's too late or we get ourselves in trouble—emotionally, legally, or physically.**

## Recent Study by Responder Strong (National Mental Health Innovation Center in Colorado) Findings:

- Mental health should be incorporated into prevention and training and move away from Post-Hoc crisis intervention
- First responder culture still stigmatizes mental health problems
- Wide support to improve recognition and resiliency training across agencies

Quote from that study: *“A lot of times we are very reluctant to bring mental health issues forward until it's too late or we get ourselves in trouble—emotionally, legally, or physically.”*

AVACOM should have all its info for sale around November 15th. Professionals can buy a subscription and then have access to all the information for teaching.

<https://www.mountainsafety.info/> ▲

Anthony Stevens was born and raised in the great state of Wyoming and is a life-long resident of Jackson Hole. He grew up climbing, backcountry skiing, backpacking, fly-fishing and working on the family ranch. He is currently an instructor for Jackson Hole Outdoor Leadership Institute (JHOLI), a Field Instructor for NOLS (teaching backpacking, winter backcountry, and light-weight backpacking courses), a Wilderness Emergency Medical Technician (WEMT), Training Advisor and team member on Teton County Search and Rescue (TCSAR). Passions include drinking large amounts of coffee, trail running, mountain biking, backcountry skiing or anything else that keeps him in motion. When not in the mountains he is working on passing his passion for all things Wyoming on to his kids.



# Passing Notes during class

## USAW

For the last two years, the Utah Snow and Avalanche Workshop (USAW) has offered separate sessions for professionals, recreationalists, and motorized users. This year's 11th annual USAW was a two-day workshop allowing in-depth discussions for each group. Presentations followed the ISSW style of 15 minutes with 5 minutes for questions. A new feature this year was the "speakers corner" where people could visit with speakers to ask additional questions. We returned to the Mountain American Exposition Center in Sandy this year so we had ample space for the workshop attendees and sponsors in the hall. As always, the wonderful sponsorship of the Utah ski resorts and outdoor industry helped us put on a great workshop.

The professional session on Friday was dedicated to topics around explosive issues and workplace risk management. The recreation session on Saturday offered topics around lessons learned from recent accidents and decision-making. Sharing these stories provides a powerful learning opportunity and also helps build a community in which there is no shame in recounting an avalanche accident. One especially well received portion of the recreation session was a women's panel that discussed female decision-making in the backcountry. The motorized session went for two hours and occurred just before the doors opened in the adjacent room where the Intermountain Snowmobile Show was occurring. Some of the topics focused on human factors, decision-making, and personal stories from people who have been involved in or impacted by accidents. Grouping our talks into themes has helped our attendees better understand the goal of the messaging.

### Professional Workshop Agenda:

#### Closed Door Explosive Handler Workshop

- NSAA Guidelines—Jonathan Morgan—Alta
- Explosive Storage and Management Policies at PCMR—Andy VanHouten—PCMR
- Basic Explosives Safety—Steve Shelley—ATF
- Avalauncher Safety Protocols—Frank Waikart—Snowbasin
- Cornice Management and Ridgeline Safety—Doug Catharine—Solitude
- Implementing RACS and Other Alternatives to Artillery—UDOT's Summer Vacation—Bill Nalli—UDOT

#### Damp Snow Challenges in an Intermountain Snowpack

- Utah Winter Review: A look back at the winter of 2017-18
- Winter Weather Forecasting—The Fate of Utah's Snow, Now and Then—Glen will look at the fate of Utah's snowpack out to

## Regional Snow and Avalanche Workshops

2100 AD in a warming climate, and will attempt a feeble winter forecast for the 2019 water year—Glen Merrill—National Weather Service

- Wet Snow Issues in Provo Canyon—Forecast challenges on the southern end of the Wasatch—John Woodruff—UDOT
- Testing a Persistent Weak Layer in Mary Ellen Gulch on 3-8-18—Nat Grainger—Snowbird

### Open Workshop Agenda:

#### Human Factors and the Stability Perception Conundrum

- Winter Weather Forecasting—The Fate of Utah's Snow, Now and Then—Glen will look at the fate of Utah's snowpack out to 2100 AD in a warming climate, and will attempt a feeble winter forecast for the 2019 water year—Glen Merrill—National Weather Service



Emilie Drinkwater discusses her perspective on decision-making in the backcountry. Photo Chad Brackelsberg

### Managing Risk

- Cockpit Resource Management (CRM)—Group decision making... how is the power to make decisions shared across a group/between group members—Russ Costa, Associate Professor of Honors & Neuroscience—Westminster College
- Managing Your Risk Management Team—A panel discussion focusing on communication and decision-making in high-stress environments—Tina Biddle-Snowbird, Andy Van Houten—PCMR, Dave Kikkert—Park City Powder Cats, Mark Saurer—UDOT
- Risk, Uncertainty and Operational Barriers—Sources of risk, uncertainty and setting operational alarm barriers within a safety culture—Bruce Triemper
- The Element of Surprise: SEALS, Known and Unknown Risk—How we evaluate and manage risk based on past lessons learned—through planning, checklists, mission focus and assigning accountability—Chris Lindsay

- ISSW Recap—A review of few key presentations from the 2018 ISSW in Innsbruck with a focus on human factors and decision-making—Greg Gagne—Utah Avalanche Center
  - Subjective Risk Perception in Objectively Dangerous Spaces—How partners, knowledge, experience, and familiarity with terrain all factor into our perceptions of risk—Russ Costa—Associate Professor of Honors & Neuroscience, Westminster College
  - Say What?—Words of Estimative Probability and the Language of the North American Public Avalanche Danger Scale. Are We All Communicating the Same Risk—Jimmy Tart
- #### Challenges With an Unconventional Snowpack

- eLearning Module Update: A new online avalanche education platform—Paul Diegel—UAC
- Utah Winter Review: A look back at the winter of 2017-18
- Provo Area Mountains—Who is the sleeping maiden in your own backyard—John Woodruff—UDOT

- I'm Alive—Surviving an Avalanche in the Meadow Chutes—A presentation on the factors leading up to being caught in and surviving an avalanche from a first-person perspective—*Peter Ingle—PhD, Westminster College*
- Weak, Layered and Structured... a Snow Stability Enigma—How a perceived lack of strength in a shallow snowpack can conspire against us whilst suggesting green light conditions—*Craig Gordon*

### Decision Making/Affecting Other

#### People's Days

- Decisions... Decisions—An early morning tour begs the question “Where are we going?”—*Devin Loertscher*
- Female Decision Making From a Rec Standpoint—*Shaun Raskin, Ashley Patterson, Emilee Drinkwater, Cindi Lou Grant, Quinn Graves*
- Avalanche Accidents and the Impact on Their Families—A personal viewpoint addressing long-term effects avalanches have on our lives once the dust has settled—*Austin Balls, Levi Johnson*

#### Know Your Posse

- Big Red Cats—An avalanche survivor discusses the importance of having solid partners—*Rich Nydegger*
- Knowing the “I” in Risk—A changing paradigm of decision making through the years—*Noah Howell*

### Motorized Workshop Agenda

#### How We Move in the Mountains

- Looking at Terrain Through Different Lenses—A pro rider and a hi-end recreationist discuss terrain options and a close call—*Brett Rasmussen and Tony Jenkins*
- From Sand to Snow—Examining the travel habits and terrain choices of the snowbike community—*JT—South Valley Yamaha*
- Avy Ed for Sleds... An Overview—Putting it all together—*Tyler St. Jeor*
- Essentially Solo—Rescue as a sledder—*Mark Staples*

**Chad Brackelsberg** is the Executive Director of the nonprofit Utah Avalanche Center. He is responsible for communications, marketing, fundraising, strategy, and UAC business operations. Chad spent the prior 20 years in the corporate world working for large consulting companies in technology consulting, program/project management, and data center operations. Chad is active in the Utah outdoor community and is an avid backcountry skier, ski mountaineering racer, ultrarunner, and mountain biker.



CAW

Let's skip over the presentations for now and start with the après. After a day of snow and avalanche nerdery, California Avalanche Workshop participants walked outside the Kings Beach venue to a sunny social session overlooking Lake Tahoe. Sierra Nevada Brewery donated cold beverages. Attendees mingled with presenters. Plans were made for the upcoming season. Sweet raffle prizes were won. It's hard to imagine a nicer way to wrap up the fifth annual California Avalanche Workshop.

Heading back inside, the day began with a recap of the 2017–2018 season by yours truly. Dr. Eric Stendell, Director of Tahoe Wilderness Medicine, shared medical insight about avalanche resuscitation. One takeaway is that icy beards pose challenges to traditional CPR masks.

Making the trip down from Mt. Shasta, Nick Meyers and Dr. Sean Malee presented about Mt. Shasta Avalanche Center's operations and the center's outreach to the motorized crowd. Mt. Shasta



Doug Workman of Mammut trading tall tales with Todd Offenbacher. Todd is a ski guide, SAC Board member, and presented at the CAW this year about triggering an avalanche on Mt. Tallac. Photo Matt Bombino

has quick access to serious high alpine terrain and the ambassador program has increased MSAC's reach and hopefully reduced accidents.

Happy Gilmore err Sierra Avalanche Center Pro Observer and Education Coordinator Travis Feist showed as many Adam Sandler clips as copyright law allows while discussing differences in how snowmobiles travel in avalanche terrain versus how backcountry skiers travel. Travis also discussed how the Sierra Avalanche Center Daily Flow stickers guide decision-making during dynamic field days.

Michael Ferrari, Patrol Director at Mt. Rose Ski Tahoe, addressed the often confusing Alphabet Soup of the various avalanche-related organizations. Michael provided a short entertaining stab at organizing the acronyms and bringing some clarity to the confusion.

Forecaster Andy Anderson tackled the impossible task of reporting back from ISSW and condensing a week-long conference into a single presentation. His talk covered a half dozen presentations that struck him as noteworthy. Andy energetically shared the latest developments in av-

alanche modeling, research on storm snow, surface hoar, and climate change.

Forecaster Steve Reynaud discussed tools and techniques to manage risk in the backcountry. Steve discussed the Avalanche Terrain Exposure Scale (ATES) and the importance of choosing appropriate partners.

Erin Laine discussed leadership and conveyed how significant early ski patrol mentors were for her professional development. Erin explored the relationship between authority and leadership, using her experiences as an international ski guide.

Longtime Tahoe local, globetrotting ski guide, SAC Board member, and famously upbeat Todd Offenbacher wrapped up the day with a reflective talk about his own avalanche accident on Mt. Tallac. Titled “Shame and Embarrassment,” Todd toned down his normal humor and shared the raw emotional journey he experienced after triggering a potentially fatal avalanche near the top of the highest peak ringing Lake Tahoe. His mix of revisiting the clues he missed before he dropped and his own pain in processing these mistakes afterwards was well received by the audience.



Andy Anderson of the Sierra Avalanche Center shares his insights from ISSW. Photo Matt Bombino

The 2018 California Avalanche Workshop was again supported by a grant from A3. Throughout the history of the CAW, A3's support has been the most significant and truly allows this event to occur. The Sierra Avalanche Center has already locked in October 19th as the 2019 California Avalanche Workshop date. We look forward to more interesting presentations, community, and hopefully another sunny après session on the beach.

As soon as **David Reichel** graduated from college he ran to the mountains. He has been working and playing in the Sierra ever since with occasional work trips to Mt. Shasta, Argentina, and Japan. While he guides all aspects of mountain travel, making powder turns is his favorite way to spend a day. David is a Professional Observer for the Sierra Avalanche Center and he founded the California Avalanche Workshop in 2014.



# Bend SAW

Central Oregon held its inaugural Bend Snow and Avalanche Workshop on November 10th at Central Oregon Community

College. Central Oregon Avalanche Center (COAC) hosted the sold-out event at Wille Hall with around 280 attendees. The stoke was palpable with a dusting of snow on the Three Sister Volcanoes in the distance. Over 95% in attendance were from Bend with the remainder coming from outside the area. There were thirteen outstanding speakers both from Central Oregon as well as from outside the area. Roger Atkins gave a very interesting keynote talk on decision-making and strategic mindset to the benefit of both professionals and recreationists in the audience. Erich Peitzsch discussed his research in the Glacier Park region using tree destruction as a proxy to reconstruct a historical avalanche record as well as some cool drone work to map seasonal avalanche cycles in remote regions. Simon Trautman gave the audience an interesting high level look at the operation of avalanche forecast centers across the country. Lastly, Pete Keane charged the Central Oregon backcountry community to create a culture of near-miss incident reporting as a tool to help prevent major accidents. A loose theme for the day was decision making in the high risk, low frequency space where we so frequently operate. Other highlights from the event included a Diva breakfast with 35 female attendees meeting up in the morning before the event to help create and bolster the female backcountry community in our region. We would like to thank Mt. Bachelor and A3 for stepping up with major sponsorship dollars for the event.

Kevin Grove is a COAC board member and director of the COAC forecaster/observer team. He teaches engineering, physics, and avalanche courses at Central Oregon Community College. Kevin is currently VERY busy helping raise an energetic two-year-old toddler and a three-month-old butterball (baby, not a turkey). He has spoken at NSAW, WYSAW, and TedxBend.



# CSAW

The Colorado Snow and Avalanche Workshop, CSAW, is an

A3 supported professional development seminar put on by CAIC. A great and diverse speaker lineup kicked off with the always entertaining Ray Mumford and Jamie Yount covering the past and future of Colorado DOT avalanche mitigation.

The most talked of and terrifying presentation was Dr. Cameron Wobus's outlook on the impact of climate change on our future snowpack. Specifically, he presented several scenarios based on different models that forecast later openings and shorter seasons for most ski areas ranging from the least impact in northern Colorado to a worst case of the end of skiing in the East by century's end. The projections made nobody happy with one audience member asking Dr. Wobus: why not

make this a topic of avalanche education? While there were murmurs of approval, others wondered where to find the magic tree that would grow the extra class time.

Examination of accident trends by Mark Staples of USFS provided a better understanding of what many professionals have observed: that one can be effectively solo despite having a partner in avalanche terrain. A group discussion from four veteran avalanche professionals on how an event affected their avalanche career was an opportunity to see valuable perspectives, plus I appreciate hearing from those who instructed me: Denny Hogan and Craig Sternbenz. The "Ridiculously Resilient Ridge" by Jimmy Fowler of NWS recapped the processes underlying the subpar snow year last season. Paul Schlattet covered new weather forecast tools available to avalanche professionals for Colorado. The 2018 CSAW marked 17 years that have seen so much growth in attendance that it is in its fourth venue to accommodate the hundreds of attendees.

Aaron Parmet, BSN, has attended the last 16 CSAWs and was a past presenter. He is an avalanche instructor for Colorado Mountain College, an avalanche technician with Colorado Rapid Avalanche Deployment, a critical care nurse, and medical officer for Summit County Rescue Group. He wrote this on a bus in Patagonia.



# NRSAW

The 2018 Northern Rockies Snow and Avalanche Workshop (NRSAW) drew another large and enthusiastic crowd to Whitefish, MT on November 3rd. Some might call this a regional workshop, but I'm touting NRSAW as an international event. We draw crowds all the way from Canada.

Some common feedback from this year's speakers was how engaged the audience was. This year we had about 250 recreational and professional users in attendance, yet the setting felt local and intimate enough to promote a lot of healthy discussion following each presentation.

This year's event highlighted six presentations covering a variety of avalanche-related topics. John Sykes, a recent MSU graduate student, shared his research findings on the travel habits of lift-access backcountry skiers. Evelyn Lees, a long-time forecaster for the Utah Avalanche Center, discussed the alarming trends in solo and uphill travel avalanche fatalities. Both of these talks were especially relevant to our community that is still processing a solo, lift-accessed avalanche fatality last winter. Dave Hamre, a veteran in the industry who is the Avalanche Program Director for the Alaska Railway spoke about applying the Avalanche Hazard Index to backcountry travel and talked about the wildcard in the deck. Caleb Merrill, a ski guide working in Nevada and the Pacific Northwest, discussed the obstacles and positive outcomes behind sharing near-misses to the community. Caleb finished with a great highlight reel of quotes from some of the veterans in the avalanche industry, clipped from his Avalanche Hour podcast. Dr. Sara Boilen, a local psychologist, ex-

plored the psychological and economic theories to enrich our understanding as to why we behave predictably and irrationally in the backcountry. She ended with some great take-home points to help combat our human selves. Last but not least, Dan Kaveney, the new Executive Director of the American Avalanche Association, gave a quick progress update on the AAA.

It takes a village to host an event like this. Many thanks to all of the hardworking volunteers from our Friends group (FOFAC), the many sponsors and donors, the speakers, and everyone who came to event. Cheers to a big winter!

Zach Guy recently migrated his deep-slab problems from Crested Butte to NW Montana, where he is the director of the Flathead Avalanche Center. He also bought a rain jacket this winter.



# SAAW

I have to admit I am really bad at saying no, which is a big reason I am sitting in front of my computer writing this at the eleventh hour with powder and holiday gatherings tempting me away. I tend to take on a little too much a little too often. This year the Southcentral Alaska Avalanche Workshop (SAAW) was a prime example of that. I was on the organizing committee, was the MC, gave a talk on ISSW highlights and was responsible for staffing the A3 table at the event. In retrospect I didn't really get to "enjoy" the day, but I had a pretty good vantage point to observe what was going on. I also had some time to reflect on the fact that this was the 6th annual SAAW and this was the start to my 6th season as an avalanche professional in Alaska.

Thinking back on about how new and shy I felt six years ago when I first attended; I remembered the awkwardness of not really having anyone to talk to, and not really understanding the AK avalanche scene at all. It felt so different this year being part of the avalanche community, having an easy rapport with other avalanche professionals, and name recognition with the public.

Sitting at the A3 table, I thought a lot about the value of having this event in a place like Alaska. Geographically we are pretty dang removed from the rest of the US avalanche industry. We can't just hop in the car and drive to another state for an avalanche workshop. Traveling to ISSW (especially this year) takes some serious \$\$\$ and time. Receiving the generous workshop grant from the A3 (and TAS) is really what allows the SAAW to happen and the Southcentral pros to get annual continuing education, a networking opportunity and a chance to interact with guest speakers from the lower 48 and other parts of Alaska.

The organizing committee has evolved with the event and is now an eclectic mix of pros from Southcentral that includes the forecasting staff from the CNFAIC, the Alaska Avalanche School executive director, an APU snow science professor, an AK DOT forecaster, Chugach Powder Guides' lead guide, and an Alaska Avalanche Information Center founder/Valdez forecaster. We work hard to come up with an engaging lineup of local and guest speakers. It was fun to watch

throughout the day and see avalanche professionals listening intently as they watched the presentations, asking thoughtful questions, and having animated conversations with each other at breaks. Last year we opened the event up to the public (for free) after lunch, which has been very well received. This allows for another level of interaction amongst the local winter backcountry community and avalanche professionals, expanding the value of the workshop.

Every year we use the A3 workshop grant to bring up a guest speaker from the lower 48. This year it was Scott Savage, Director of the Sawtooth Avalanche Center. He gave two talks that were definite highlights of the day, Memory 101 for Avalanche Connoisseurs in the morning pro session, and Lessons Learned from the 2014 Frenchman Creek Idaho Snowmachine Accident during the public afternoon session. I overheard some local snowmachiners remarking on how much they learned and appreciated the talk. We also used workshop grant funding to bring up Pat Dyer from

Juneau Mountain Rescue to discuss Use of the Long Range Receiver in 2017/18 SAR efforts.

Multiple professionals said Helping Rescuers Perform Under Pressure was their favorite talk of the day. Presented by Deb Ajango, owner of SafetyED and Alaska Pacific University assistant professor, this talk addressed how we prepare for and perform in stressful situations i.e. avalanche rescue.

Alaska Pacific University was well represented throughout the program. Recent graduate Rachel Newell presented her analysis, Energy, Air and Snow sharing her findings from radiation research done at Turnagain Pass. Fresh from his oral presentation at ISSW Innsbruck, graduating senior Cristian Ortega (1st in his family to graduate from college) delivered his Senior project, Presence of Social Media Use and Smart Phone Technology Among Backcountry Skiers and Snowboarders, Hatcher Pass. Associate Professor Eeva Latosuo presented our collaborative project, Wise Ones—Conversations with the Prominent Mentors of the US Avalanche Industry. It also important to

note that this event would not be possible without the very helpful and well organized Alaska Pacific University student volunteers.

Kyle Van Peursem from National Weather Service – Anchorage Forecast Office gave the much anticipated 2018/19 Winter Weather Outlook, and Tim Glassett from AK DOT talked about avalanche considerations, Managing the Bird to Gird Bike Path and Musings from the Road.

While still relatively small compared to other workshops like CSAW, USAW, and NSAW, SAAW has continued to grow during the last six years. Three years ago we needed to find a larger venue at Alaska Pacific University to accommodate the growing number of participants, and this year's afternoon session had over 140 people in attendance. We have loyal food sponsors that have consistently provided break goodies and lunch every year. In my opinion SAAW is a pretty good deal. Twenty bucks gets you in for the whole day of avalanche education, snacks at breaks, lunch and two tasty beverages at the after-party. This year the Girdwood Brewing Company custom brewed a double IPA, Avy Savvy, just in time for the event. They continued pouring this for the entire month of November at the brewery, in celebration of Alaska Avalanche Education Awareness Month (as declared by Governor Walker). For the first time on our YouTube Channel [ChugachAvalanche](#), we live-streamed video and recorded the event. All the talks are available if you are interested in checking out SAAW 2018.

Thanks again to A3 and TAS for supporting the regional workshops especially in this far northern corner of the country! I am looking forward being part of the 7th annual SAAW, but will hopefully get a little better at saying no... or working on my delegating skills!

**Aleph Johnston-Bloom** is an avalanche specialist for the Chugach National Forest Avalanche Information Center in Girdwood Alaska. Over the past 19 years she has garnered experience as a highway avalanche forecaster, a backcountry avalanche forecaster, a patroller, an educator, and a ski guide. She is the former director of both the Silverton Avalanche School and the Alaska Avalanche School. As she starts her sixth winter in Alaska, she is looking forward to riding snowmachines and really hopes there is snow to sea level.



Top: Pat Dyer discusses the long range receiver that they've started using at Juneau Mountain Rescue.

Bottom: Calm before the storm: tables of organizations that support the Southeast Alaska Avalanche Workshop (SAAW). Photos Aleph Johnston-Bloom

## ESAW

The eighth annual Eastern Snow & Avalanche Workshop (ESAW) on November 3 attracted approximately 175 attendees to Fryeburg Academy in Maine, just across the state border from New Hampshire's Mount Washington in the White Mountains' Presidential Range.

This year's ESAW was, as always, a collaborative effort. The organizing partners included the USFS Mount Washington Avalanche Center (MWAC) and the White Mountain Avalanche Education Foundation (WMAEF), with support from the Mount Washington Volunteer Ski Patrol (MWVSP) and other volunteers. ESAW once again relied on a grant from our lead sponsor the American Avalanche Association (A3), with your

faithful correspondent as A3 Member Representative the sole East Coast A3 board member. Additional support came from our title sponsors DPS and Outdoor Research. Registration fee proceeds over and above hosting costs benefited the WMAEF, which provides avalanche education to youth of the Northeast.

Frank Carus, the WMAC Director, repeated his performance from last year as our MC for the day. First up was Dr. Sam Colbeck, retired from the U.S. Army's Cold Region Research and Engineering Laboratory (in Hanover, NH) after three decades of groundbreaking cold lab and field research in snow crystal bonding and wet grain relationships. In his sixth year of ESAW presentations, this time Sam explained Snow Metamorphism and Structure. As always, Sam's material was fascinating, although most participants were no doubt relieved that we were not tested afterwards on our comprehension.

Mount Washington's avalanche climate does not fit neatly into the typical three-part Maritime-Intermountain-Continental classification: lots of bitter cold, yet also lots of rain. (Which means lots of masochistic skiers and climbers!) In that vein, Francis Meloche, a graduate student at the Département de Biologie, Chimie et Géographie at the Univ. du Québec à Rimouski in Canada, spoke on The Northeastern Rainy Continental Snow Climate Classification ... while rain steadily fell outside the ESAW venue. The focus was on Quebec's Gaspé Peninsula, adopting the "rainy continental" classification originally used to describe the central Japanese alps. His research indicated that Mount Washington's snow climate falls in line with other rainy continental snow climates described by Karl Birkeland, Pascal Haegeli, and others. The Canadians in our midst theme continued with a presentation from Julie Leblanc, a forecaster for Avalanche Québec, on the newly introduced Dangerator. This decision tree allows recreationalists to determining a danger rating in regions with no public avalanche forecast.

Frank then spoke on The Evolution of Avalanche Forecasting on Mount Washington with an introductory picture of a WMAC bulletin from January 21, 1994: pretty much just a single sentence, vaguely anticipated to be in effect throughout the weekend, and recommending a hiking trail to the summit, thereby avoiding the two glacial cirques of Tuckerman Ravine (frequently mainly by skiers) and Huntington Ravine (frequented mainly by climbers). Since then, those two glacial cirques have stuck with micro-scale forecasting due to intensive use of Tuckerman Ravine. For this coming season, the MWAC has a new full-time forecaster, which puts it at four full-time forecasters for the first time in three years. And winter recreationalists are increasingly traveling throughout areas outside the two micro-scale forecasted glacial cirques. In response to this trend and a desire to use the North American Avalanche Danger Scale consistently with other U.S. forecast centers, the MWAC will now start providing snow and avalanche observations throughout the entire Northern Presidential range. The two most popular glacial cirques will still have a micro-scale forecast, but the number of separate ratings will drop from 18 total across to the two cirques to three in Huntington and four in Tuckerman. Frank provided mock-ups of how the new bulletins will appear, and described the challenges that forecasters will face in implementing this start of a new era in the MWAC.

This was followed by an update from Jake Risch, President of the Friends of Tuckerman Ravine. Next was DIY Snowpack Sensing, from Elizabeth Murkowski, who holds a graduate degree in meteorology and works in the Watershed Sensing Lab at Plymouth State University. With technological advances, remote sensing devices can now be far less expensive and hence more feasible for more extensive geographical coverage.

Then, for better or for worse, we relived the prior winter, via Season Summary, Incidents on Mount Washington 2017/18 by Ryan Matz from the WMAC. The snowpack had started to develop by November 30, and already on December 1 we had our first human-triggered avalanche. December went on to record 81" of snow, almost one-third of the average 254" annual tally, which also hampered observation efforts, even with a telescope trained on Tuckerman Ravine from the ranger station at treeline below. By January 11, more than 144" had fallen on the summit, over half the annual average. Then on January 13, a storm delivered two inches in 24 hours, and three inches cumulatively for the entire storm. Of rain.

The resulting avalanche reduced a large section of the Tuckerman headwall down to bare rock, with a crown height up to 20 feet. A gradual snowpack rebuilding process then started, albeit with our usual fits and starts. This included some of the best skiing of the year in late February—spring skiing. Fortunately, March came in like a lion, and kept roaring throughout almost the entire month. April delivered in a big way for spring

skiing, but then early May shut down the late-season skiing very quickly.

After all this serious and technical information, we sorely needed some fun, and Naomi Risch delivered in the form of a tribute to her grandfather, Al Risch. Although Al passed away the prior month at age 85, his achievement and exploits continue to live on: founder of the Professional Ski Patrol Association, founder of the Friends of Tuckerman Ravine, and adventures that earned him the moniker the "Cowboy of the Mountains"! (Search on his name and Conway Daily Sun to learn more.)

Thanks to our A3 grant, we were able to bring in a Western presenter, Brian Lazar, Deputy Director of the Colorado Avalanche Information Center. Brian's first presentation was Avalanche History: An (incomplete) History, which started all the way back in 1518 with a chart showing 60 fatalities in a European incident that year. The first publication on avalanches dates back to 1706 and provides advice on protecting houses from these "large snowballs" as they were apparently called at the time. The first avalanche-related publications aimed at recreationalists appeared in the late 19th century in Europe. North American awareness began around that same time in North America, prompted by railroad incidents. In 1916, Mathias Zdarsky (aka the "Father of Alpine Skiing") published Elements of Avalanche Awareness which recognized most of the fundamental factors that still drive our understanding today. In a follow-on publication in 1926, Zdarsky coined the phrase "wind is the architect of most avalanches" which should be familiar among avalanche instructors.

# REDUCED TO PROTECTION



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**ORTOVOX**

After lunch, Julie Leblanc returned to present on the prior season's summary in the Chic Chocs of Quebec's Gaspé Peninsula. Frank Carus then moderated a panel discussion on Climate Change & Avalanches, Danger Rating Effectiveness, and Backcountry Ethics, with many of the prior presenters. This was followed by an update on the WMAEF by board member Bethann Swartz.

Brian Lazar then returned for Avalanche Forecast Ratings and Avalanche Problem Types, complete with dramatic photographs and video of when such problems manifest themselves in spectacular avalanches. Brian presented some intriguing survey results where forecasters from different centers were asked to rate hypothetical scenarios. Although the vast majority of ratings were tightly clustered, some surprising outliers still occurred. Brian also asked the question of where a forecast region can experience a Size 3 avalanche yet still merit a Low rating. (Answer = yes!) Brian concluded in response to a participant question, "I don't want to be all doom-and-gloom: we're doing a good job!"

Ryan Matz also returned, this time with Probability, Consequence, and Fatal Avalanches, starting off with the pointed question of, "Why do good people make bad decisions?" Ryan emphasized a positive feedback loop in which after each tour we ask ourselves whether we were good or merely lucky, and if we were "rewarded" (with fun skiing) for bad decisions? He advised us that if these are not yet the thoughts we have after each tour, then we should start having them! Ryan also quoted the guide Larry Goldie to the effect that after some "successful" tours you should first pat yourself on the back ... and then punch yourself in the stomach.

ESAW concluded with Regional Winter Climate Change Impacts and Citizen Science Snow by Dr. Elizabeth Burakowski, Research Assistant Professor with the Earth Systems Research Center & Institute for the Study of Earth, Oceans, and Space at the University of New Hampshire. After so many pictures of dramatic alpine terrain, she started off her presentation with a picture of herself and her twin sister as snowsuit-bundled little girls in 1984 back in Waukesha, Wisconsin. Her point was to illustrate how she still feels about winter, i.e., happy, as do presumably all ESAW attendees. Unfortunately, her information on winter climate change assessed recent historical trends that are decidedly unhappy for any winter recreation enthusiast. And the projected future trends are ... worse.

We concluded with our annual expo, including rep displays for A3, AIARE, Acadia Mountain Guides, Arc'Teryx, Backcountry Access, Backcountry Babes, Black Diamond / Pieps, Catamount Trail Association, DPS Skis, Granite Backcountry Alliance, Mammut / Barryvox, MWVSP, Mount Washington Weather Observatory, Ortovox, Ragged Mountain Equipment, Ski the Whites, Sterling Rope, and Synnott Mountain Guides. Throughout the day we had raffled off and auctioned donations from these sponsors plus Equinox Guiding Service, La Sportiva, Patagonia, Revo, and Skimo Co.

Jonathan Shefftz patrols at Northfield Mountain and Mount Greylock in Western Massachusetts, where he lives with his wife and daughter. He is an AIARE-qualified instructor, NSP avalanche instructor, and A3 board member. When he is not searching out elusive freshies

in Southern New England or explaining to his daughter that to go sledding instead of skiing we have to ski to the sledding hill first, he works as a financial economics consultant and has been qualified as an expert witness in state and federal courts. He can be reached at [JShefftz@post.harvard.edu](mailto:JShefftz@post.harvard.edu) or just look for the lycra-clad skinner training for his NE Rando Race Series.



## WYSAW

As with each WYSAW event (this was the fourth one)

Lynne Wolfe challenged us to take home 2-3 things from each speaker that we would incorporate into our own practices. While each speaker may resonate differently with each person here are some of our take-homes:

### The Illusion of Control and The Perils of Positive Outcomes—Dale Atkins

(Editor's note: Dale will have a story in the April TAR expanding on many of these points)

The keynote address challenged us all to think ... Here is a quote to ponder:

"We took off in really sketchy weather conditions, but we made it through fine."—Pilot

How do you feel about that pilot?

"We skied in really sketchy avalanche conditions, but we made it through fine"—Skier

How do you feel about that skier?

For most of us, we would prefer not to fly with that pilot, yet most of us have probably been that skier. Why is that OK?

Dale continued with a smorgasbord of references and concepts that challenged HOW we look at accidents. Most accident reporting is modeled after a law enforcement report—what happened—just the facts with little to no interpretation. Lawyers support that and say that all documentation should contain just the facts with no opinions.

What Dale suggested was a new paradigm of looking at accidents for WHY they happened. He said that "hindsight bias" prejudices our judgment about the process because we know the outcome. It is important to evaluate the process of the decision-making, but not the outcome. We need to learn why it made sense to them to do what they did. This will highlight the vulnerabilities of the parties involved and perhaps add to our ability to avoid similar mistakes in the future. Honestly, that seems difficult in light of how the legal system wants us to record data and analysis, but perhaps there is a way to do this without exposing ourselves and our employers to liability. It does seem like a quicker way to effect change.

His take-home points for the audience were:

1. **Be humble**—acknowledge when you make mistakes
2. **Practice sensemaking**—Why does it make sense to us to do what we intend to do?
3. **Use some imagination**—picture your plan going awry—pre-mortem test
4. **Add some devil**—have someone (not always the same person) play the counterpoint.
5. **Interrupt**—Similar to a pause step in a checklist. Interrupt the process, so you can

possibly break the chain of small errors and/or gain situational awareness. This is a process to brake the dysfunctional momentum that can affect backcountry travel groups.

The mantra that he had the audience repeat twice is an eye opener:

"Safety should be born in the belief that everything I do can lead to a potential disaster!"

**Thoughts for Rescuers**—Dale Atkins (Pro session, morning of Nov 27)

Among many messages for SAR team members the one that stuck with me was this table that Dale showed from Edward Russo and Paul Shoemaker's 2002 book *Winning Decisions: Getting It Right the First Time*:

GOOD	Deserves Success	Bad Break
BAD	Dumb Luck	Poetic Justice
	GOOD	BAD

### OUTCOME

The point being that developing a good plan or having a good process is the most consistent way to achieve good outcomes. For avalanche professionals this often amounts to doing your homework (Following the season history, preparing a daily forecast, deciding on appropriate mitigation measures/terrain treatments, reflecting on the day...).

A corollary of this was a Dwight D Eisenhower quote that Don Carpenter referenced in his talk about the DDL:

"Planning is everything, the plan is nothing."

**A Feel for Snow**—Dr. Terry O'Connor

Terry wears many hats and has a good perspective to philosophize from. Here are some of his opening words which speak to his message:

"I've been on the receiving end of many of these 'what were they thinking?' incidents over the years. But as I've thought and learned more about the decision-making process, through personal experience, my review of the literature and conversations with friends and mentors I've begun to think perhaps a better question is 'what were they feeling?'"

And before their first turns "were they capable of feeling the consequence of their actions?"

Terry went on to look at fast decision-making (typically driven by Recognition Primed Events or prior experiences) vs slow decision-making (analytical, checklist driven...). His contention is that regardless of the process, our "feel" for the snow/situation and emotions are the real drivers for what choices we make. His very compelling stories showed how prior experiences and the emotions associated with them skewed his decision-making in what became critical situations.

What implications does this have for us as backcountry travelers and as educators? Again in Terry's words:

"For skiers and their partners out there: if you are less experienced know that it is easy to get caught up in the vast expanse of opportunity out there and indeed, if you have a somatic sense of danger in your situation, what's the harm of sharing your concerns? Don't want to rock the boat? Perhaps there is more consequence if you don't."

For the experienced partner, if your partner has concerns, address them. Is there something there you don't see? Are you trying to outfox the uncertainty of your environment?

## You don't have to be right, you just can't be wrong.

*For educators out there: Can we really teach a feel for snow? Can we really make our students feel the consequence of their actions if it hasn't happened to them?*

As educators we attempt to teach everything about avalanches from how they form, to where they live, to how to manage ourselves... But what can we do to convey consequence if someone has never seen the aftermath of avalanches with bad outcomes?

### The Avalanche Gamble—How Do You Play Your Hand—Lori Zacaruk

Lori is an experienced, capable, and CREATIVE avalanche educator who focuses on snowmachiners. She invented a card game with seven decks (avalanche danger, weather, group, terrain choice...) and all players (i.e.—students) got to pick one card from each deck and then had a minute to either replace their cards from those remaining in the deck or from the hands of the other players. The goal is to have a hand that is least likely to cause harm.

The take-homes for me were:

- The 'players' were engaged and were critically thinking how they could lessen their exposure and vulnerability.
- You can't often change the snowpack or weather, so your group and your terrain are your most controllable 'cards.'
- This game was for AST2 students in Canada, but could easily be used at the end of a Level 1 or Level 2.
- Creativity can really fire up people and there can be new approaches to scenarios for decision-making.

### Gothic Couloir—Connor Nolan and Jim Ryan

These two former ski racers were pursuing challenging lines around JHMR for two years before they were involved in a serious avalanche accident. Their account of the accident AND the ensuing rescue really illustrated two points well:

1. Good skiers can travel into serious avalanche terrain, but may have the sense that it is very benign. The 40° terrain where the incident occurred was viewed as an easy way to get back in-bounds.
2. After the slope released, the skier was caught in the trees near the top of the debris field under considerable hangfire. TCSAR responded and were on site despite the overhanging hazard. That seemed to be the greatest guilt that they had about the accident and the message that they wanted to share with the audience.

### Debriefing—Did We Make Good Decisions or Just Get Away with it—Lynne Wolfe

This talk started with a good look at a close call Lynne had in 2012. The incident involved a large D3.5 avalanche that was started by a ski cut and could have impacted Lynne and other skiers for the 2800' below the crown line. She wrote about this incident in TAR 30 #4 (April 2012)—available in TAR archives.

One quote that stood out from her debrief was from Karl Birkeland:

*"Sounds like you guys ended up on the right side of the line. However, it also sounds like you ended up pretty close to the line. My experience is that if you are too*

*close to that line too often, sooner or later you'll end up on the wrong side of the fracture. The older I get—and the more I learn what I don't know—the further I like to be away from that line!"*

Kudos to Lynne for her pursuit of effective reflection. Many articles within *The Avalanche Review* (which she edits) address reflection and decision-making.

### Are you Alone? And Uphill Fatalities.—Evelyn Lees

Evelyn Lees and Mark Staples took a look back through recent avalanche fatalities in Utah.

The concept that stuck with me is the category of "effectively solo." This means that there may have been more than one in the party, but the others were more than 15 minutes away from responding (due to uphill travel time or not observing the avalanche). That seems like an important reason for emphasizing safe travel protocols and keeping eyes on your partners.

You can find their article in the TAR archives from April 2018, 36.4.

### Backcountry SOS app—Stephanie Thomas

You have a backcountry emergency, you are exhausted from the search, the patient care, the stress of being lost—now try to figure out your coordinates and get them to 911 without missing a digit or screwing up. Backcountry SOS will send your GPS coordinates in Lat/Long by text message to 911. This is more accurate than 911 trying to triangulate your location off of cell towers and is especially effective for areas with poor coverage. You can add one of three simple fields (Lost/Trapped, Injured, Life-threatening).

Currently this works if you're in Teton County Wyoming and Idaho, but with promise to expand to other counties soon. Currently works on iPhones, but will be on the Android Platform soon.

Download (free) from the app store (Its icon says BC SOS, but type in the full name to find it).

### Trends of Persistent Slabs Following Loading Events—Jason Konigsberg

Jason is a forecaster for the Colorado Avalanche Information Center (CAIC) and as such faces the challenge of when to lower the danger to LOW from time to time. Many forecasters agree that Low Avalanche Danger is probably the hardest level to go to and is particularly difficult in the land of persistent and deep slabs. Jason's curiosity drove him to put some numbers to the number of days out from storms, so he looked at avalanche activity based on storm loads of 10cm in one day and sustained strong winds. Seeing that avalanches continued more than 7 days after these loading events, he looked at the subset of avalanches that occurred more than 7 days following loading. He found that even small loading events with as little as 1-2" of snow would be potential triggers for these persistent slabs. During periods of high pressure with no loading whatsoever there were very few avalanches more than seven days out. Now forecasters have some data to work with when they are looking at going to Low.

More details can be found in *The Avalanche Review* 36 #3, February 2018, page 21. OR

[https://arc.lib.montana.edu/snow-science/objects/ISSW2018\\_P10.1.pdf](https://arc.lib.montana.edu/snow-science/objects/ISSW2018_P10.1.pdf)

### Teton DDL—A Science Perspective—Patrick Wright

Patrick explored why the December Drought Layer may have been so persistent, as well as a good overview of the different periods of Activity and Re-Activity. The interesting thing that I gleaned was that the overall warmth of the snowpack may have contributed to the prolonged faceting of the early December snow over the Thanksgiving Crust. It was not a melt-layer recrystallization process as the crust was thoroughly frozen, but in many areas the snowpack had been isothermal on Thanksgiving so that there was a lot of residual heat that remained in the lower snowpack (below the crust). He hypothesized that heat may have prolonged heat transfer through the crust while diurnal faceting was occurring in the upper snowpack. That mechanism may have turbo charged the faceting process so that the facet layer was quite thick in many areas and the facets were well developed.

### Teton DDL—A Practitioner Perspective—Don Carpenter and Don Sharaf

Don and I explored the DDL layer further by looking at its evolution (formation, burial, activity, dormancy, reactivation, extinction/removal) and then how we managed groups in the field given its persistence and frequent reactivation. Don C illustrated the challenges of opening terrain when there is still uncertainty for a low likelihood/high consequence avalanche. The best quote came from Brian Gorsage (WYDOT) who said *"You don't have to be right, you just can't be wrong."*

Take-home points were:

1. Facet crust combos suck, but thick layers of facets over crust really suck
2. Loading cycles may influence weak layer longevity. Storms with 2" of water seemed to reactivate the DDL, but not 'crush and flush' it out of existence.
3. Varying up evaluation techniques gave us some more information to work with. PSTs became more valuable as the layer moved beyond the depth of ECTs
4. Sharing of ideas within operations through a Facebook group and actual face to face meetings was much more useful than just considering your own observations.
5. Obvious instability is clear... lack of instability doesn't mean you're out of the woods...





## Forecasting for an Untouchable Snowpack—

Kevin Hammonds

Kevin is now a professor at MSU and runs the cold lab for the university. In the past few years he has given us much to ponder regarding faceting around crusts, but in this talk he looked back at an accident (2010) that occurred while he was a climbing ranger on Mt. Rainier and a meteorology student at the University of Utah. The thrust of his talk was that many areas are too remote or too high to be easily forecasted for (either by conventional weather data or for avalanche hazard). Kevin went through the weather data available at the time of the accident to see if he could have made a fair estimate of the amount of loading in the start zone of the avalanche. In 2010, with some expert analysis, he was able to create a fair estimate of precip amount (SWE) and wind speed and direction for 12,000' (600 mbar). The meteorology products have become even better since then and with today's commonly available products and familiarity with your forecast zone, some estimates could be made for areas that lack instrumentation.

## The Dangerator: A Tool for Estimating Avalanche Danger—James Floyer

James Floyer is one of the lead forecasters for the Canadian Avalanche Centre and helped develop a tool for estimating avalanche hazard in areas without forecast centers. It's an interesting tool that when 'verified' to predicted danger levels in current forecast zones typically was hitting the assessed level ~70% of the time and within one level almost all of the time. If anything it would tend to assess a higher hazard than underpredicting it. It tended to overpredict more often in the spring when the snow moved into an isothermal state. This was not a novice tool, but any AST1 grad (CA) or level one grad (US) would be able to apply it. Simple enough that I won't go into explaining it:

Questions put forth for the decision steps:

- Critical Loading—"Do you expect roughly 30cm or more of new snow, or significant wind, or rain during the period of 24 hours prior to and up to the end of your day?"
- Critical Warming—"Do you expect a rapid rise in temperature to near or above 0°C or the upper snowpack to become wet due to strong sun, above freezing temperatures or rain?"
- Recent Loading—"Has there been loading within the past 48 hours, including roughly 30cm or more of new snow, or significant wind, or rain?"
- Slab Avalanches—"Are there signs of slab avalanches in the area from today or yesterday?"
- Persistent Slab Problem—"Is there a persistent or deep persistent slab problem in the snowpack?"

More details on these decision questions can be found in Table 1 of James' ISSW paper.

[http://arc.lib.montana.edu/snow-science/objects/ISSW2018\\_O15.2.pdf](http://arc.lib.montana.edu/snow-science/objects/ISSW2018_O15.2.pdf) ▲

Don Sharaf is a co-owner of the American Avalanche Institute and one of the prominent mentors mentioned in Aleph Johnston-Bloom and Eeva Latosuo's ISSW 2018 poster, *Wise ones—case study on prominent mentors of the US avalanche industry.*



# VALUE ADDED

How the Association of Professional Patrollers is helping small resorts elevate snow science skills

BY CATHLEEN CALKINS



Since 1969 the Association of Professional Patrollers (APP), a 501(c)(3) organization, has worked to promote the profession of ski patrolling by offering continuing education and standardized testing and certification in a number of disciplines, including snow science and avalanche mitigation. Originally conceived by patrol directors and risk management professionals in the Tahoe region of California, APP curricula, testing standards, and certification were designed to help ski areas evolve and implement programs for patrollers whose job duties included in-bounds avalanche mitigation.

While APP membership (currently at 2,500 with over 10,000 total members since its start fifty years ago) represents larger ski areas (operations with more than 3,000 skiable acres), the organization is finding that its focus for continuing education and standardized certification for patrollers at smaller ski areas is paying off. On-site delivery of programs as well as regional events ensure that professionals at these smaller resorts, including paid patrol staff, risk management, and snow safety experts, have affordable access to avalanche mitigation and snow science education as well as standardized testing, which results in APP certification.

In terms of avalanche study, APP's programs cover snowpack evaluation, terrain travel, snow pit analysis, weather observation, and rescue as well as explosives. The curriculum was created to follow and meet (at a minimum) the new Professional Avalanche 1 standards.

"Professional patrol staff, regardless of size of the ski area operation, are tasked with avalanche mitigation," says CJ Sveta, vice president of APP, and an 18-year professional who patrols at both Timberline Ski Area, a 1,415 acre resort on Oregon's Mount Hood, and Mt. Ashland, a 220 acre resort near the California-Oregon border. "Larger areas are more likely to have the resources to pay for training and education in terms of snow science, but for smaller mountains this kind of industry immersion for patrollers is out of reach." In other words, small ski areas don't always have the resources each year to send members of their staff to sanctioned testing.

Shannon Maguire, APP board member and senior lead patroller at Sierra-at-Tahoe, a 2,000 acre resort on Lake Tahoe's west shore, explains it this way. "We are in a unique position at Sierra," says Maguire. "Because our pay scale is tied to APP certification, our (patrol) staff is motivated to complete APP's snow science and avalanche mitigation testing before taking their Pro level 1 and 2 coursework, which ensures they have spent time studying the snowpack and are set up to pass." Sveta echoes this sentiment. "By completing APP's avalanche mitigation and snow science certification, patrollers are able to demonstrate to resort management they are a good candidate to be sent to complete their pro-level training," says Sveta.

Devin Heimstra, snow safety supervisor for Mount Rose, a 1,200 acre area 22 miles southwest of Reno, Nevada, believes APP's education and certification benefits the individual patroller, too. "Taking part in APP's education clinics and certification testing is more manageable for patrollers," Heimstra says; "and offers a good measure to see how ready they are to take the Pro Level 1 course or its bridge."

Another benefit for ski areas is that APP certification meets or exceeds a defined criterion. "By providing formalized testing, I know that an applicant for a patrol position who has an APP snow science certification is guaranteed to have demonstrated a certain level of knowledge," adds Heimstra. He also finds value in introducing patrollers to avalanche science in a forum that is made up of ski patrol professionals.

APP offers resorts options for delivery of programs. Patrol directors are able to host on-hill APP education and certification testing, which means ski areas don't incur costs to send staff off-site. This type of delivery opens it up to all staff interested in developing their skills. Alternatively, APP holds several regional clinics each season where members of various patrols come together to learn, test, and network.

What's next for APP? Sveta sees APP continuing to build relationships with global avalanche professionals and agencies and explore how a partnership with APP can fill gaps in delivery of education. "APP is continuing to evolve and elevate its standards to help support professional patrollers in their quest to gain advanced accreditation," Sveta adds.

To learn more about APP and its testing curriculum, visit [www.propatrollers.org](http://www.propatrollers.org). ▲

Cathleen Calkins is a writer, editor, and professional ski patroller. When not storytelling or telling stories, you can find her using every self-powered method available to ascend the slopes and trails near her home in Sisters, OR.



# DECISION FOOTPRINTS:

Understanding travel behavior in backcountry skiers with GPS tracking and surveys

BY JOHN SYKES

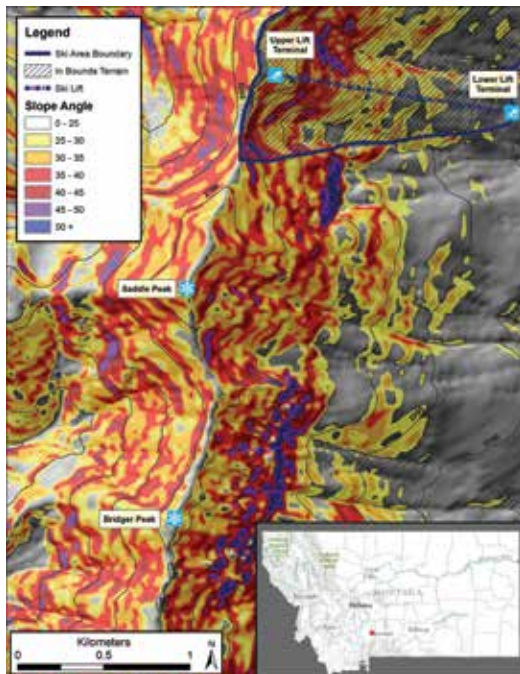


Figure 1: Slope angle map of Saddle Peak showing the ski resort boundary. The vast majority of skiers travel on the eastern aspect (right side of the ridgeline) due to predominant wind direction and snow cover.

**Decision-making in avalanche terrain is a tricky thing to study.** We can't carry out discrete experiments because of the risks involved, so researchers are forced to rely on observational data or hypothetical decision-making scenarios. Our research uses GPS tracks and surveys, both observational data, to connect two pieces of the decision-making puzzle. The GPS tracks give us a detailed look into the travel behavior of our participants and allow us to use a geographic information system (GIS) to analyze terrain. The survey data reveals who our participants are by asking questions about demographics, preparedness, and some potential decision-making biases of the participants.

To give you a sense of what we do, recall a tour you went on recently. Try to remember the group you were with, the terrain you traveled through, and the decision points along your route. Picture your entire route from a bird's eye view, as you would in Google Earth, and break it up into a series of points collected every three seconds or so. With the GPS point locations, we can extract the slope angle, curvature, aspect, landcover, and avalanche terrain exposure scale (ATES) rating for each point along the route. The time stamps associated with the GPS points allow us to calculate the time between points, the distance between points, and the speed of travel. These data provide the foundation for our method of analyzing travel behavior in backcountry skiers. In this summary of our work, we focused on the percent of the GPS track that traveled through complex terrain, as defined by ATES, to summarize the travel behavior of our participants.

After our participants complete their ski run, we ask them to fill out a 20-question survey focused on their experience, knowledge of the avalanche danger, rescue preparedness, instability tests, group dynamics, and a bunch of questions about their susceptibility to decision-making biases. The survey questions give us a sense of who the participants are. When we combine their GPS tracks and surveys it provides a rich dataset for analyzing what individual traits are correlated with specific travel behaviors. For this research our focus is to identify traits of participants that exposed themselves to large terrain traps.

The population we targeted for this study was lift access backcountry skiers (LABC), aka sidecountry, out-of-bounds, or off-piste, on Saddle Peak in the Bridger Mountains of Southwest Montana, USA. We chose Saddle Peak because of its proximity to Bridger Bowl Ski Area and the orientation of the terrain, which lends itself to only one access point and one return point, making it easier to hand out and collect GPS units from participants. The terrain on Saddle Peak is complex, with steep wind loaded slopes above cliff bands in many areas. **A variety of ski runs is accessible by hiking from the ski lift, but they all involve traveling in avalanche terrain, on slopes with slope angles of 35° or higher (Figure 1).** The ski run with the easiest access, directly adjacent to the ski area boundary, is also the most exposed to large cliff bands below. There are no truly safe options on Saddle Peak, but there are options with less exposure to terrain traps. Numerous avalanche events have occurred on Saddle Peak, with notable events in 2010 and 2018 (see Gallatin National Forest Avalanche Center website for details).

From February 2017 to February 2018 we collected 136 GPS tracks and surveys from volunteer participants on Saddle Peak. Our sample has a median age of 36 and median number of years skiing of 28 years. Compared to prior research on backcountry skiers, our sample was older and contained a lower proportion of female skiers (9%). Group size ranged from 40% solo skiers, 39% groups of two, and 21% groups of three or more. The large percentage of solo skiers is an alarming result of our research, but it is consistent with an emerging trend from research on backcountry skiers in North America and Europe. Our sample is composed of 79% self-rated expert backcountry skiers, defined as having more than five years of backcountry skiing experience. In contrast, only 49% of our sample has taken a level one or higher avalanche course. This discrepancy is likely a reflection of the age of our sample, but also shows that there is room for improvement in communicating the importance of prioritizing field-based avalanche education as part of developing backcountry skills for LABC skiers.

To visualize changes in travel behavior **we created heat maps for survey questions** that had significant results from our statistical models: gender, backcountry experience, and avalanche mitigation (Figure 2). Males, experts, and participants who did not assume avalanche mitigation in the Saddle Peak area all show similar widespread travel with a concentration along the central ridge. These are interpreted as positive attributes, because the central ridge is the safest descent option in terms of slope angle and terrain traps. Females show a very high concentration of tracks along the central ridge, indicating a conservative terrain selection. However, the sample size of female skiers is small (n=13) and it is unknown whether they were traveling in mixed gender groups. Non-experts and participants who incorrectly assume that there has been avalanche control in the Saddle Peak area show a high concentration of travel adjacent to the ski area boundary. This line choice exposes skiers to large cliff bands and is generally considered a high risk option, albeit convenient due to the proximity to the ski area.

In summary, we have expanded the existing knowledge of travel behavior and decision-making in avalanche terrain by targeting a unique subset of the population, LABC skiers. Our surveys show that there is a high incidence of solo skiers on Saddle Peak, and that the self-rated backcountry experience does not match up with the level of avalanche education for this population. On April 15, 2018 a solo skier was killed on Saddle Peak after triggering a wind slab part way down the popular central ridge run. He was shallowly buried with a hand exposed, but it took 75 minutes for volunteer rescuers from Gallatin County Search and Rescue to dig him up. Doug Chabot, the director of Gallatin National Forest Avalanche Center, commented:

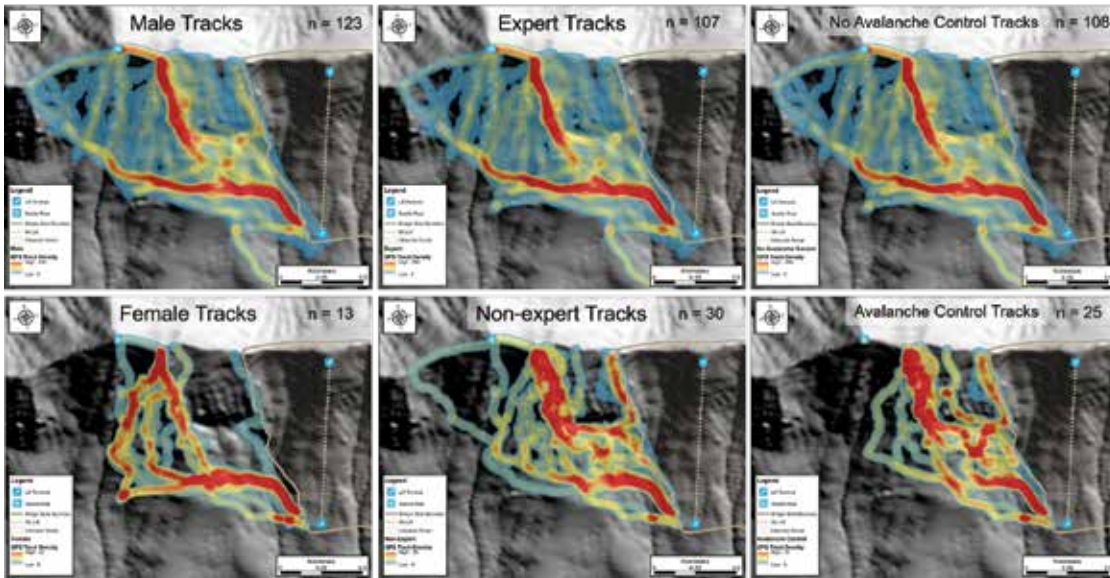


Figure 2: Heat maps showing the GPS track density for six subsets of our participants. The upper row of maps all show similar travel behavior, while the lower row shows that females, non-experts, and participants who misunderstood avalanche control practices travel have different patterns of travel behavior.

“There’s just no room for error when skiing alone...it’s the game he played and I respect that. But the consequences are also real, and I respect those too. Skiing solo means there is no one to do a rescue, ever. It’s all on you. Face down with an airbag showing? Dead. Hand sticking out of the snow? Dead. It’s pretty binary, which is likely part of the appeal.”

This avalanche fatality was a poignant reminder of the consequences of traveling solo in the backcountry.

We also found that less experienced participants and those who do not understand the ski area’s avalanche mitigation policy are more likely to expose themselves to large terrain traps along the resort boundary. Whether these terrain choices are due solely to an incorrect understanding of the avalanche issues, or to a combination of misunderstanding and convenience due to location near the boundary line is difficult to disentangle from our observational data, but we can see this cohort uses this more exposed terrain.

Our overall goal is to minimize avalanche fatalities by understanding the travel behavior and decision-making of all backcountry recreationists. By learning how people are traveling in the backcountry we can help improve education outreach and avalanche hazard communication to targeted populations. This research is only a start to understanding the travel behavior of LABC skiers and would be greatly improved by collecting data from other LABC areas. Thanks to the American Avalanche Association for providing a graduate research grant to defray the costs of this project and to my graduate committee members: Jordy Hendrikx, Jerry Johnson, and Karl Birkeland. ▲

**John Sykes** is an avalanche educator, researcher, and mountaineering guide. He cut his teeth in Alaska, working for the Alaska Avalanche School and Alaska Mountaineering School since 2011. In 2016 John moved to Bozeman, MT to pursue a graduate degree in Earth Science with Jordy Hendrikx at the Snow and Avalanche Laboratory. He was lucky enough to receive the Young Snow Professionals award at ISSW 2018, enabling him to travel to Innsbruck and present his research.



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Photo: B. Pritchett

# A DECLINING NUMBER OF AVALANCHE DEATHS IN COLORADO, THE WEST IN THE PAST FOUR SEASONS

BY JASON BLEVINS

**They tried to kick blocks of snow from the cornice,** hoping a tumbling chunk might trigger an avalanche.

“All we were getting were crumbles. We just couldn’t get a big enough block to go,” said Bryan Wickenhauser, a champion ski mountaineering racer from Gunnison. “So yeah, there was some hesitancy. But we were all committed. No one was going the other way.”

The five skiers at the top of Red Lady Bowl on Mount Emmons above Crested Butte that morning in late November rank among the most accomplished ski mountaineers in Colorado, if not the West. The crew of uber-athletes has carved tracks on Red Lady every week for more than 20 winters and they were keen to kick off the season after a storm during Thanksgiving week dropped 22 inches of snow.

After the first skier laid down about 15 turns, the avalanche released.

Wickenhauser and his three partners on top started hollering.

“We yelled left and ... he went left and the snow went big. We knew the islands of safety in that bowl, as long as the entire bowl didn’t go,” said Wickenhauser, a three-time winner of the grueling Grand Traverse ski-mountaineer race between Crested Butte and Aspen. “The skier was never caught in any moving snow.”

The group was familiar with the terrain, well equipped and aware of the risks. And there was some luck—as well as skill—in their dodging of disaster.

*This story first appeared in the Colorado Sun on December 17, 2018:*

<https://coloradosun.com/2018/12/17/colorado-west-avalanche-deaths-falling/>

*Reprinted by permission of the author.*

Red Lady Bowl at sunrise December 19, 2016, in an incident similar to the one detailed here. This slide was skier triggered by a still unidentified lucky individual.  
*Photo Ben Pritchett*



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# WE WANT NOBODY DYING IN AVALANCHES.

**Ethan Greene and Dale Atkins are the type of guys who are always scanning the horizon for risks.**

The two veteran avalanche researchers may be enjoying a beautiful stretch of weather—with avalanche fatalities at a record low over the last four seasons—but they see a storm brewing.

As they study their avalanche incident reports, they see more skiers, snowboarders and snowmobilers involved in dangerous events that could have been avoided if they had followed the basic principles outlined in rudimentary safety clinics.

"These are people that have some avalanche experience. But you know how that goes. Whether it's boating, climbing, skiing or snowmobiling, the better you get the bigger your goals get. You try to accomplish more things and you end up cutting it a bit closer," said Greene, the executive director of the Colorado Avalanche Information Center. "They are getting tripped up by events that could have been avoided by following the principles outlined in the 'Know Before You Go' program."

After only a month of skiing in Colorado, Green has fielded four reports detailing close-call avalanche incidents that caught or buried people in the backcountry.

As more accidents involve experienced backcountry skiers, safety educators emphasize a closer look at human behavior—specifically group decision-making—as a path to safer travel in avalanche terrain. More safety courses include aids to facilitate decision-making, identifying how expert skiers, machismo, powder fever, familiarity and other factors in a group can raise risks. That's a big shift from when safety focused mostly on terrain, weather and how to identify sketchy snowpack.

In many ways, that focus on so-called heuristics has worked, with decision-making now a primary concern when traveling in avalanche terrain.

"I think we have done a really good job of giving people knowledge and skills to push their limits, which is fun and part of the experience of the backcountry," Atkins said. "But it puts you on the edge more often, right on the cusp of an accident. My challenge to avalanche educators right now is to develop a way to better instruct people on not just when to turn around, but how to turn around."

Backing off is not easy, said Bryan Wickenhauser, whose crew of skiers in late November kicked off an avalanche in Red Lady Bowl in Crested Butte, where they have skied every week of winter for the past two decades. He knows the dangers of adventuring with elite athletes. Especially when they are in familiar terrain and feeling confident.

"You find ways to justify your decisions. You say, 'Well it's early season and the snowpack isn't that deep. And we can see the whole run, the whole way down.' There's just so many factors we can use to justify our approach," Wickenhauser said. "But yeah, the group dynamic is huge in the mental game."

And bailing on a line when you are in a crew often takes more courage than charging, Wickenhauser said.

"All the sudden you can be this isolated dude who doesn't want to ski a proposed route and that's hard," he said. "To make the commitment to opt out is huge."

Even with the struggle to control human behavior in avalanche terrain, the recent decline in avalanche deaths indicates that skilled backcountry adventurers are making better decisions. They seem to be more ready for an emergency, as seen in a recent avalanche on the back side of Aspen Mountain that buried a ski guide, who was quickly located and dug from the snow, uninjured, by his ski-guide partner, using a beacon, probe and shovel.

There are more stories like that every season. Airbags floating skiers above moving snow. Rescue skills on display. Better decisions yielding fewer accidents. The frequency does not lessen the pain avalanches reap.

"Sure, what we are seeing is encouraging. But when you have that front-row seat to accidents, it's hard to get excited," Greene said. "We have to go see where people died and talk to their friends and families. It's hard to take a victory lap when you are still having those conversations. What we want to see is nobody dying in avalanches. That's when we celebrate."



Ethan Greene



Dale Atkins

"One member of the group chalked up the close call to 'powder fever,'" according to a report on the incident in the Colorado Avalanche Information Center database. "They recognized they were rolling the dice."

Wickenhauser and his crew are part of a surging number of backcountry travelers pushing deeper into avalanche terrain, testing limits and plundering powder in the snowiest corners of the state. And more and more often, those avy-savvy backcountry explorers are returning home unscathed.

The last four years in Colorado has seen only 11 avalanche fatalities. That's the fewest in any four-year stretch since the late 1970s. (Knock wood, right now.) The number of backcountry users killed in U.S. avalanches over the last 10 years—a sobering 261—is down more than 8 percent from the previous 10-year span. The 2008-18 decade also marked a drop in avalanche deaths from the 1998-2008 decade in Alaska, Montana, Utah, Idaho and California.

That decline comes as populations across the West are growing rapidly. So are the number of skiers, snowboarders, snowmobilers, climbers and tourers venturing into the backcountry.

"It's actually pretty remarkable, given the growth, in Colorado that our fatalities have stayed stable," said veteran avalanche researcher, educator and forecaster Dale Atkins.

The recent decline in fatalities comes as avalanche forecasting is significantly improved, with local avalanche centers providing daily regional assessments all winter. Of course, the last several seasons have included long stretches without much snowfall across the West, reducing the risk of huge slides. But even in the low-snow years, backcountry travelers are filling avalanche-education classes and clinics. Media and backcountry-gear makers are more involved in avalanche awareness and education campaigns.

At first blush, it would appear that a renewed push for avalanche safety across every aspect of the snowsports industry is working. But avalanche educators are hardly raising their ski poles in victory.

"There's also luck involved. In some years, there's more luck than in other years," Atkins said. "And remember, we are always one or two accidents away from going from heroes or zeroes in our efforts."

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In the last 15 years, Colorado has seen highpoints, like the 11 deaths logged in the 2012-13 season, with 11 deaths, and low points like 2016-17, with only one death. The drop in avalanche fatalities over the last four seasons is so steep that it triggered a slight downward trend for the last quarter century, the first sustained decline. But a large avalanche—especially a devastating slide like Sheep Creek that killed five skiers on Loveland Pass in 2013, or Liberty Ridge that killed six climbers on Washington's Rainier in 2014—can reverse a hopeful trend in an ugly minute.

"You don't have to look back very far, just before the lull, when we were above average," said Ethan Greene, director of the Colorado Avalanche Information Center since 2005. "When you are dealing with relatively small numbers, it all can change in an instant."

The state-funded Colorado Avalanche Information Center maintains the national database on avalanche incidents and fatalities, so Greene, an expert skier with a Ph.D. in snow science, is fluent in avalanche statistics and trends.

Greene is quick to dispel any notion that there are fewer avalanches now than before. There is no requirement for skiers or snowmobilers to report a slide and, really, there are many reasons to not reveal involvement in a slide, most involving criticism and accusations lobbed from the internet. So there is no accurate tally of how many people are involved in slides.

"We do more and more to gain confidence in our number of incidents, but the only thing we know for sure is that the number of incidents we record is not right," Greene said.

He's equally reticent to cite numbers showing increased use of the backcountry. Sure, there are more backcountry travelers today than a decade ago. How many is impossible to know.

Backcountry gear sales provide a glimpse of the growth. SnowSports Industries America, a trade group, estimates that as many as 6 million skiers and snowboarders venture outside resort ropes annually. But that's based on sales of equipment—like technical bindings, skins and walk-mode boots—that works fine inside resort boundaries.

"There's a whole group of people who buy and use backcountry equipment to go up and down the ski area. Most manufacturers are hesitant to share their numbers on beacons. Basically, there hasn't been a great retail number we could use," Greene said.

Even without firm backcountry use numbers, the lure of untrammelled powder is obvious by the number of cars lining the highways over Berthoud and Loveland passes, or the parade of skiers hiking to East Vail from the Vail ski area after a big storm. The morning crowd of climbing skiers at uphill-friendly resorts, like Buttermilk, Eldora, Arapahoe Basin and

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Breckenridge, can number in the hundreds. Snowmobile sales in western states have been climbing since 2015, with 34,200 registered snowmobiles in Colorado. There are more than 250,000 registered in the most avalanche-prone states: Colorado, Alaska, Washington, California, Montana, Idaho, Utah and Wyoming.

Avalanche fatalities in the U.S. really started climbing in the mid-1990s, when snowmobile technology — longer tracks with larger paddles to grab snow — enabled thumb-throttling explorers to venture off trails and deeper into the snowy hills. Those machines allow users to access dangerous terrain all day long, versus climbing skiers who maybe get a lap or two on the steep stuff.

Once the new machines came around, avalanches started claiming the lives of about 10 snowmobilers a year, according to Greene’s analysis. Snowmobilers now top the U.S. avalanche fatality list, with 88 deaths since 2008. From 1951 to 1990, a mere 14 snowmobilers died in avalanches.

The ski technology followed. In the early 2000s wider skis, lighter boots and better bindings made it even easier to ski up and float down remote powder stashes. And more recently, track-mounted motorcycles have created new backcountry users who can probe steeps that even snowmobilers can’t reach. The go-anywhere snow bikes have been involved in three fatal avalanches in recent years, including two in Colorado in 2016 and 2017 that account for half of the state’s avalanche deaths in the last two seasons.

“I think we are at the tipping point for those snow bikes,” said Atkins, echoing a common refrain heard in avalanche discussions.

Fatalities do not reflect the growth in use of the technology speeding users deeper into avalanche terrain. Last December Greene co-authored a journal article critical of a previous analysis that noted an increase in avalanche deaths since 1950. Greene looked at fatalities since 1995—when snowmobiles began boosting the annual death tally—and showed a stable or even declining trend.

“While we might not know exactly the slope of that use line, we feel the number of deaths is not going up at the same rate. It’s staying much more flat and even has indication that it is going down,” Greene said. “So we are seeing a success story. But the source of that success is very complicated.”

\*\*\*\*

About five years ago, several high-profile slides involving experienced skiers prodded a revamped focus on avalanche awareness. Educators started emphasizing decision-making. Avalanche-safety gear makers took a larger role in promoting avalanche education. The producers behind adrenaline-charged ski movies began urging awareness of the often avoidable risks hiding in avalanche terrain, as did popular ski magazines, like Powder. The industry and media realized they had done a phenomenal job marketing the inspirational aspects of backcountry skiing and maybe it was time to turn their efforts toward sparking a deeper appreciation of the sport’s perils.

“We need to give people a little better view of the real world they are getting into,” Kim Miller, the president of backcountry ski boot maker Scarpa North America, said during a “The Business of the Backcountry” panel discussion at Denver’s SnowSports Industries America

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trade show in 2014. “We want people to understand the risks. This is about self-regulation and self-responsibility. Just like we ski in the backcountry, that’s the attitude we need to adopt in our businesses too.”

Today, thousands of skiers are skinning up groomed slopes at ski resorts, prodding first-ever resort uphill travel policies and proving newbie skidders a chance to hone techniques before venturing into avalanche terrain.

Local ski shops, grappling with the growth in online retail, are hosting avalanche clinics, as a way to establish themselves as community assets. Education programs, like the wildly successful Know Before You Go campaign corralled the U.S. Forest Service and all 22 U.S. avalanche forecasting centers in crafting an hour-long presentation promoting avalanche awareness. The program—with a video or slideshow from an avalanche professional—preaches the need for safety gear, like an avalanche beacon, probe and shovel, attention to weather and avalanche forecasts, and the ability to recognize and travel through avalanche terrain. It’s a chance to reach skiers who might not be lining up for a more intensive course but are still heading into the backcountry.

The motorized community also has embraced avalanche education. Brian Lundstedt lost his brother Tyler in an avalanche six years ago on Buffalo Pass, east of Steamboat Springs, and launched an avalanche education effort geared toward motorized users. Hundreds of Colorado snowmobilers have passed through the Tyler’s Backcountry Awareness program, which offers free clinics and more intensive training through the American Institute for Avalanche Research and Education.

“Brian’s work has made a huge difference,” said Scott Jones, the president of the Colorado Snowmobile Association.

Snowmobile giants like Ski-Doo and Polaris offer free clinics and classes through dealers across the state. And at about 30 snowmobile trailheads across the state, solar-powered beacon stations flash green or red when snowmobilers pass, indicating whether the rider’s beacon is working.

“Those are an in-your-face reminder that the risk is out there,” Jones said. “We are seeing just a lot more interest in safety in the last few years. We did have a couple really bad years a while back and that’s a horrible way to become aware that you need training, but it’s raised the questions we need to be asking. It feels like all this is making a difference.”

Today, Miller, with Scarpa, sees the cultural shift toward safety in the backcountry as something akin to the widespread recognition of the dangers from smoking or the increased use of seatbelts decades ago. It takes years of subtle changes to change a mentality, and maybe that’s what happening in the West, Miller said. Those changes include a growing recognition of not just dangerous terrain and conditions, but how poor decisions made in the backcountry can lead to devastating consequences.

“The thing that really rises to the top for me is that all these different groups and all these different actions, we are all on the same page and that’s pretty unusual,” Miller said. “It’s been a grassroots rising of awareness and we have all stayed focused on how we wanted to change in a cultural and societal sense.” ▲



More views of the crown and debris above Crested Butte in the Red Lady Bowl, December 20, 2016. Photos Ben Pritchett



Jason Blevins is a co-founder and writer at The Colorado Sun, a news start-up owned by journalists and directed by readers. He spent more than two decades as a reporter at The Denver Post, roaming the Colorado high country covering Rocky Mountain business and sports. He lives in Eagle, Colorado with his wife, two daughters and a dog named Gravy. Follow him @JasonBlevins.





## LOCALIZED DYNAMIC LOADING IN ADVANCED SNOWMOBILE MANOEUVERS

BY IAIN STEWART-PATTERSON

**With the constantly evolving snowmobile and snow bike technology,** more riders are able to execute more advanced manoeuvres (sic for Canadian usage) in increasingly challenging terrain. The learning curve is not as steep as it was ten years ago. The avalanche fatality statistics speak loudly. Motorized mountain users are dying in greater numbers than any other the user group. Over the last ten years, 88 US riders and 60 Canadian riders have died in avalanches.

This begs the question—are motorized users at greater relative risk than skiers and climbers? If so, is it related to a lower level of training and related decision-making skills, or to a style of riding that might place an increased level of stress on the snowpack? With a lack of definitive user day data for recreational motorized users and a limited set of motorized near miss reports,

it is hard to calculate. Contributing factors may include: an increased number of users, rider technical skill sets that exceed avalanche knowledge and risk management skills, machines that allow easier access to start zones and hazardous terrain features, or perhaps the stress that a sled can place on the snowpack. Haworth, Hendrikx, Johnson and Sykes (2018) found that snowmobilers spent less time in avalanche terrain compared to skiers. However, the snowmobilers had to make decisions on how to manage a greater number of avalanche terrain challenges.

The motivation for this study developed from discussions over the last five years, during the annual delivery of a Canadian Avalanche Association Industry Training Program Level 1 professional course for snowmobilers.





# MAY THE FORCE BE WITH YOU

Rider Jeremy Hanke sending it big in the mountains above Revelstoke.  
Photo Alain Sleighter

The demographic of the students in this course each year include numerous professional riders, guides, and operation owners. Scott Thumlert's video based on the results of his 2014 research has been shown as part of the curriculum. His conclusions were that snowmobiles produced a stress bulb that was three to five times the localized dynamic loading of a skier. The anecdotal evidence from discussions with the students was that many of the accidentally triggered avalanches experienced or witnessed by the students occurred during more "extreme" manoeuvres than those tested by Thumlert, Jamieson, and Exner (2012). The research team working with me on this study included Thomas Exner, a mountain guide who worked on the initial pressure bulb study and Jeremy Hanke, a professional snowmobile rider and avalanche educator.

The static mass of a rider and sled are roughly 3.5 times more than a skier, but the sled also has a footprint that is roughly 2.7 times more than a skier, so the weight is distributed over a larger surface area. Dynamic loading is

more complex as there are a number of ways to increase (or decrease) the load. Skiers and snowmobilers both vary the load through weighting and unweighting, jumping, and falling. Snowmobilers also increase the load through application of the throttle. This often results in track spin, trenching, and the load being applied closer to a potential weak layer.

## METHODOLOGY

The goal of this study was to investigate the effects of more advanced manoeuvres that would likely exert greater forces on the snowpack. The starting point for the study was the measurement of track penetration in a variety of conditions. It was recorded for full throttle uphill climbs, downhill carving turns, and sidehilling. The climb and downhill turn generated the greatest track penetration and bracketed foot penetration.

Full snow profiles were completed including density, compression tests, and extended column tests. We also experimented with one of the suggestions from

## RESULTS

### Full throttle uphill climb with trenching

Snow Depth	Effective Depth	Uphill trench Track pen 65 cm	Uphill (no trench) (Thumlert et al, 2014)
100 cm	35 cm	0.1–0.7 kPa	0.2–0.3 kPa
130 cm	65 cm	0.1–0.4 kPa	0.1–0.2 kPa
160 cm	95 cm	0.05–0.4 kPa	

### Downhill carving turn

Snow Depth	Effective Depth	Downhill Turn Track pen 45 cm
100 cm	55 cm	0.15–0.2 kPa
130 cm	85 cm	0.05 kPa
160 cm	115 cm	0.05–0.15 kPa

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Dr. Iain Stewart-Patterson, PhD, IFMGA, is a Senior Lecturer and one of the founding members of the Adventure Studies Department at Thompson Rivers University. Blending theory and practice, he is a certified IFMGA Mountain Guide and completed a PhD, in which he investigated the decision process used by expert heli and snowcat guides. He has been instructing and guiding ski, rock, and alpine adventures for over 40 years. He is an active avalanche educator with the Canadian Avalanche Association Industry Training Program. He is also an enthusiastic climber with many first ascents on both ice and rock and has been on expeditions to Nepal, Peru, and Alaska.



### Note about the Polaris manual

One small thing that most skiers (or even sledders) wouldn't be aware of has been avalanche info in Polaris owner's manuals. It's been a long process with them but we have built a great working relationship. They didn't want much info when it was a paper version because every page had an additional cost. With a digital version now, it's a different situation. Not necessarily newsworthy (this isn't the first year for this), but it's a pretty seismic shift.

Check out pages 16–21:

[https://prdvehiclepubsdata001.blob.core.windows.net/public/OwnerManuals/SNO/9928945r01\\_standard.pdf](https://prdvehiclepubsdata001.blob.core.windows.net/public/OwnerManuals/SNO/9928945r01_standard.pdf)

—Mark Staples

the Thumlert and Jamieson (2014) study. We removed snow from the top of the compression test column equal to the measured penetration of the track on the full throttle climb.

## LIMITATIONS

This was a pilot study. We have a very small data set that is not conclusive. In addition, there are significant challenges in capturing high speed dynamic movements. Precision handling of the snowmobile and careful placement of the sensors are required.

## DISCUSSION

The uphill full throttle climb and downhill carving turn are representative of normal snowmobile terrain use. Snowmobilers are typically using these manoeuvres in everyday terrain management. So if these regularly used manoeuvres place additional stress on the snowpack, why are we not seeing more snowmobile avalanche involvements?

What are the implications for persistent weak layer forecasting and management? As generating a hazard forecast includes an assessment of the likelihood of triggering, how should riders adjust their terrain selection based on their mode of transport? Should snowmobilers manage their use of terrain differently when there is a persistent weak layer?

Sidehilling and the turnout at the apex of a highmark will potentially create even greater penetration of the stress bulb into the snowpack. These two manoeuvres were not tested due to the complexity of measurement. Trenching cuts through stiffer layers that provide bridging. The weight of the snowmobile and rider may not be enough to break the bridge, but the cutting action of the rotating track has the potential to saw through. A rider who initiates a slope test by sidehilling across a convex roll can increase track spin and the resulting trenching to increase the likelihood of triggering a deeper weak layer. On the uphill climb, when the rider begins to lose momentum, a turnout back down the slope is needed to avoid getting stuck. If the turnout is not completed in time, the rider will power out and sink the snowmobile with the potential to create a five to six-foot-deep trench.

## SUMMARY

Advanced snowmobile manoeuvres such as the uphill trench likely add more stress to the snowpack than the manoeuvres assessed by Thumlert and Jamieson (2014). This track penetration brings the dynamic load closer to buried weak layers, potentially increasing the likelihood of slab failure initiation. The outlook for winter 2018–2019 is to increase the data set of the uphill trench and the downhill carving turn manoeuvres. In addition, modified compression tests and extended column tests will be conducted. In these tests, the surface layer of snow equal to track penetration will be removed. The intent is to find a snowpack test that more closely approximates the forces applied to the snowpack by snowmobilers and provides a better indicator of the likelihood of snowmobile triggered avalanches. ▲



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# BUILDING A STRONG RIDING TEAM STARTS WITH TRAINING TOGETHER

Your team's strength may save someone's life

BY MIKE BUCK

I am sure that I may slip a time or two while writing this and spell out the word snowmobile. In Alaska there are no snowmobiles unless it's an official police report or maybe a newscast. In Alaska, if you work on the North Slope and have a nice jacked up diesel 4x4 you ride a sled on your off weeks, if you live in a village and ride with your cousin you ride a snogo, and if you live somewhere on the road system you ride a snowmachine. The diversity of the name and the terrain that we enjoy up here on these great toys is as vast as this great state. Snowmachines in Alaska are a way of life. In rural Alaska, the per capita of snowmachines to people is unmatched in the world. It is the only way to explore much of the state that is otherwise too remote to access. Winter opens unlimited possibilities to those with adventure in their blood.

My years as a snowmachine guide in Valdez provided me with the experience of leading groups of riders in avalanche terrain with a systematic approach to keep them safe. As a guide I built competent teams on a daily basis and taught clients in short order how to be a competent rescuer, how to use hand signals to communicate dangers and how to travel in a group while playing and having a great time along the way. Even though I almost always had a tail guide, it was essential to build a strong riding team in case I was the guy in the avalanche or the one to fall into a crevasse on a glacier.

As an avalanche educator, I teach similar skills and focus on skills needed to build a competent riding team in avalanche terrain. An instrumental part of the success in achieving these elements is to get riders to train as a team. I help them identify true islands of safety, recognize hazards, and use appropriate travel protocols to manage their team in following those three simple safety practices. The safety of the riding team in avalanche terrain relies heavily on the group leader. A role that should be filled by riders who've completed a snowmachine specific avalanche class. Encouraging this type of training provides a better path toward group preservation and a long fruitful life in the mountains. When you are riding with a group of snowmachiners in the backcountry it often resembles herding cats. Everyone wants to get powder shots, play, rip around, jump, carve, climb and in general experiencing that feeling of power and freedom. This often, or maybe almost always resembles pure chaos. Giving students the tricks and skills needed to safely manage an active dynamic flow of machines in the mountains is essential to their success. If a riding team trains together, that expectation of "this is how we are riding and this is what's expected" is clear.

The following is an example of how a safe riding team travels in the mountains: Identify a hazard zone ahead, locate a safe zone for stopping, signaling the rider group to rally at the safe zone and stop for a discussion of how the hazard area will be handled. Maybe you move to another safe zone so the group can play and rip around where there is no danger of avalanches. Next, maybe you move through a hazard zone one at a time with eyes on each person as they traverse through. This is a methodic movement through the mountains using gathered information at each stop along the route as a team effort. Team communication and dialog is shared along the way to prevent hazards from being overlooked or misjudged.

I have been blessed to have explored many corners of this amazing state by snowmachine. With our long days in the springtime and endless snow, it is easy to travel hundreds of miles deep into the mountains. The gratitude that I feel for having such great experiences here has inspired me to give back to the sport through helping with educational efforts to reduce the number of deaths in backcountry snowmachine accidents. Alaska loses an average of 12 people per year to snowmobile accidents. The statistics show two of those will be avalanche related. Not a pandemic by any means but in hindsight, these deaths that rock our tight knight mountain riding community are preventable.

I would love for an expert in avalanche statistics to put some numbers to the following question. What percentage drop in snowmobile avalanche deaths would result if riders would religiously follow these three safety practices? 1. One at a time in Avalanche terrain. 2. Recognize/utilize true islands of safety. 3. Everyone Rescue ready. I am sure the numbers would be dramatic.

Avalanche training for snowmachiners is best as a team process. Travel protocol should be well understood by all the team members and an established leader should be designated for each ride. In Alaska, a good riding team has members that have a variety of skills to contribute to the team such as avalanche training, emergency first aid, mechanic, survival, glacier travel, rope rescue and others. Team members may also be members that provide special equipment for the group, such as satellite phone, rescue gear etc. Build a strong and diverse group. "Your life may depend on the strength of your team." ▲

Mike Buck is an Instructor for the Alaska Avalanche Information Center and the Alaska Avalanche School as well as being a BCA ambassador. He has guided whitewater and snowmobile trips and explored extensively in Alaska for nearly 40 years. He provides backcountry snowmobile safety classes to communities across Alaska.



## SAFE 907 RIDERS

1. Survival and safety equipment.
  2. Food and Water
  3. First aid
  4. Who has communication equipment and gps (sat phone, inreach, spot, cell phone, rhino, two way, channels, etc.) Radio check
  5. Hand signal review (if you have new riders in your group) - slow down, speed up, stop, stay there, danger, come on, point positive, I'm OK, 1 at a time, gather up, let's go, etc. etc.
  6. Route plan and rally locations- review map for any new people or all if riding a new area
  7. Trip plan filed
  8. Ride level and terrain for the day agreed on by the group—1 to 5
    - \*Easy day simple terrain 1
    - \*Average day simple to challenging terrain 2 to 3
    - \*High output ride challenging to complex terrain 4
    - \*Big Day 5 challenging riding and complex terrain
  9. Stoke Check (give an explanation to new riders)—1 to 5 \* this is a great ride 5
    - \* this is a good ride 4
    - \* I am good to go 3
    - \* this is starting to be not good for me 2
    - \* low stoke I don't like this 1
  10. Time plan breakdown - (return time, lunch, breaks, etc.)
  11. Travel & Avalanche terrain protocol—lead rider, spacing, sweep, responsible for the guy behind you, one on a slope at a time with eyes on.
  12. Avalanche and weather forecast review
  13. Emergency Plan
  14. Avalanche gear- Pack, Probe, Beacon and Shovel
  15. Beacon check ( battery power, transmit and receive verification)
  16. Any additional gear or topics for special rides
- Build a good equipment checklist for your team and adjust for specific rides as needed
  - Rotate leadership roles through your team on occasion
  - Take advanced training to enhance your team (avalanche, medical, survival, rescue etc.)
  - Come up with a TEAM name and build team pride
  - Do avalanche rescue early season and several times throughout the season
  - Stop and share observations often, re-assess prior to high marking or entering challenging or complex terrain
  - Practice terrain selection and discuss it with a team member or your entire group
  - Pre ride meetings should be held several days prior when possible and always for advanced rides -planning and preparation is often needed.

# SAVING LIVES THROUGH SNOWMOBILER AVALANCHE EDUCATION

BY DOUG CHABOT



Sledder training in Cooke City. Photos courtesy of the Gallatin National Forest Avalanche Center

**The forecast area of the Gallatin National Forest Avalanche Center (GNFAC)** includes Cooke City, a snowmobiler Mecca. The terrain is big, open, accessible, within view of Yellowstone National Park and deadly. Cooke City's first snowmobile avalanche fatality occurred in 1992 and since then there have been 19 snowmobiler fatalities, making it the deadliest real estate in USFS land for motorized recreationists. The GNFAC's education efforts started in the early 90s by teaching riders that rescue gear was essential. As sleds got more powerful and multiple avalanche fatalities became the norm, we hammered the message to ride one-at-a-time. In 1999 I created a 1-hour avalanche awareness lecture for snowmobilers using cutting edge technology, PowerPoint. This was distributed on CDs to every avalanche center and dozens of snowmobile clubs across the west, but sledders kept dying in avalanches.

On December 18, 2015, a party of five was riding outside Cooke City during a High danger when they triggered a slide that caught three, buried two, and killed one. We interviewed the four survivors and were immediately impressed with their avalanche acumen. They had taken avalanche classes, had the latest gear, including airbags. They visited Cooke City frequently, one coming for 15 years, almost a local. They knew the avalanche danger was High and were riding low-angled slopes. When the avalanche occurred they sprang into action and quickly dug out their friend, but it was too late. It appeared to be bad luck as they had done everything correctly, including having the proper gear, getting the forecast, going one-at-a-time and knowing how to perform a rescue.

Boy, was I misled. What they told me was not what happened.

**We interviewed the four survivors and were immediately impressed with their avalanche acumen. Boy, was I misled. What they told me was not what happened.**

Just before saying goodbye to them I discovered they had a Go Pro camera that captured the entire accident. Could I get a copy? Sure, they said. What was on that camera forever changed my thinking regarding avalanche accidents. The interview with the four survivors did not even slightly match the unbiased footage I watched. They were all on the slope together and far up the avalanche path. After the slide occurred it took 17 minutes before they began a beacon search for their friend. Seventeen minutes! And then they used hands and a shovel blade to dig, too frenzied to even snap on the handle. It was eye-opening and I left knowing that our education efforts had to change. If I had not seen the footage on the Go Pro camera I would still believe that this tragedy was simply a matter of bad luck, which it was not.

The next year we implemented an aggressive education program with the help of Cooke City businesses and Montana State Parks. Every Friday evening from Thanksgiving through mid-March, the Friends of the Avalanche Center hires snowmobiler instructors to lecture for an hour on current avalanche conditions and rescue protocols. On Saturday from 10 a.m. to 2 p.m. they set up a portable BCA Beacon Park near a warming hut and teach people how to use a beacon and do a rescue. There is no signup or waivers. It is a free clinic to get people thinking about avalanches. Since implementation in November 2016 there have been no fatalities near Cooke City. We are changing a mind-set by highlighting avalanche danger, the specifics of avalanche terrain and how a proper rescue unfolds. GNFAC cannot take all the credit for zero fatalities during these two years. There were many close calls and we cannot predict what will happen this winter. What is evident is that the community is behind our efforts and the attitude and conversation around avalanches is changing for the better.

Last winter there were two snowmobiler fatalities from two separate incidents in the Centennial Mountains of Idaho. These mountains are next to our forecast area near West Yellowstone, where in both instances we had issued an avalanche warning. One rider had no rescue gear and the other was in a terrain trap. These accidents occurred in an avalanche forecast no-mans-land. GNFAC, the Sawtooth Avalanche Center, the Bridger-Teton Avalanche Center, and the Utah Avalanche Center are working together to educate riders outside our forecast area. An avalanche specialist from each center (Mark Staples, Scott Savage, Chris McCollister and me) met at the Klim Winter Kick-Off in Rigby, ID to garner community support and business interest. A long-time snowmobile guide and educator for our Friends group joined in, and since he lives nearby the avalanche centers, we'll contract him to teach awareness classes. There is a lot of work to be done and education is the first step. Although the Centennial Mountains are outside our forecast area, its snowpack is remarkably similar to West Yellowstone.

The GNFAC is adding a page to our website to give folks headed into the Centennial Mountains a one-stop-shop of weather, snowpack and rider observations. <https://www.mtavalanche.com/forecast/centennials>. We hope our low-cost solution of education and information will seep into the riding community, much like it did in Cooke City, and save lives. ▲

**Doug Chabot** has been the Director of the Gallatin National Forest Avalanche Center in Bozeman, MT, since 2000. Doug spends most of his off-season in Central Asia avalanche consulting, working on his nonprofit Iqra Fund, and climbing.



# THE ADAM ANDERSEN AVALANCHE PROJECT

BY SUMMER ANDERSEN

On January 10, 2018, my fun-loving, charismatic husband of eight years walked out the door for an afternoon snowmobile ride with friends in the Mount Jefferson area of Island Park, Idaho. After a few hours of fun, the group of three was headed back for the evening when Adam cut up a steep gully and triggered an avalanche. He was caught and fully buried. Adam's friends and volunteers searched for hours in the snow that was described as thick and as heavy as "wet cement", but with no beacon and no airbag, their search was in vain. As tears and prayers poured out on Mount Jefferson, I was at home with our three young children, oblivious to how my life was about to change entirely.

The aftermath of Adam's death was a dark and painful time. However, even through my grief, I began to realize how woefully ignorant both Adam and I had been about the dangers of backcountry recreation. I was dismayed to hear story after story of the loss of others: "My dad died in an avalanche..." "My brother died on that same mountain." "I was with my best friend when he was buried."

It was their loss, as well as my own, that inspired the Adam Andersen Avalanche Project. A plan to possibly provide a couple of beacons, possibly one airbag for rent quickly evolved into much more. In 2018, the Project was able to participate in two avalanche awareness events and raise funds for six packs that included airbag, shovel, probe, and a beacon to be rented for free in Island Park and Idaho Falls. We now have status as a non-profit and, with the assistance of the Forest Service, the Project purchased and designed avalanche warning signs that were posted up at every trailhead in Island Park, including the trail that my husband rode up January 10th. And this is only the beginning. It is the mission of the Adam Andersen Avalanche Project to change the conversation across the sport, to help bring awareness for all riders, not just the enthusiasts, on how to enjoy the backcountry, but also to return home safely.

Packs can be rented for free at High Mountain Adventures in Island Park as well as Action Motor Sports in Idaho Falls.

Donations can be made at [adamandersen.org](http://adamandersen.org)

Follow us on Facebook at:

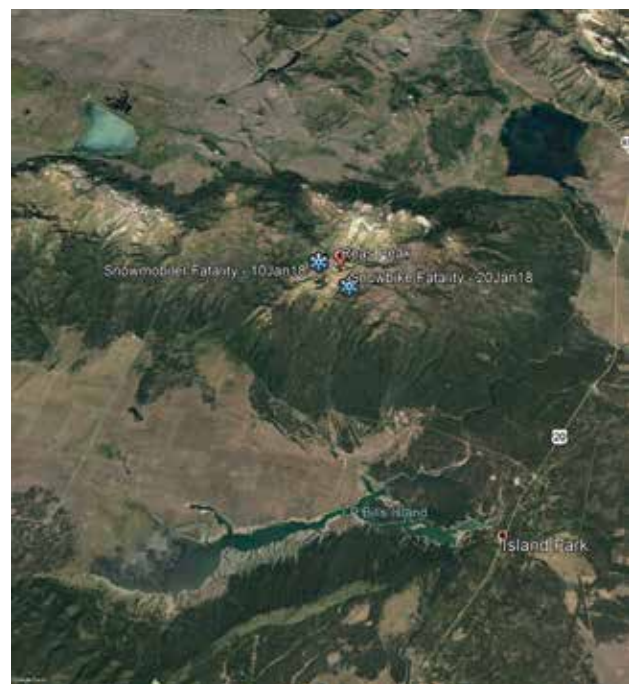
<https://www.facebook.com/AdamAvalancheProject/> ▲



Left: Summer Andersen with one of the new signs that's been posted at popular Island Park trailheads for this winter. Top: Adam Andersen. Photos courtesy Summer Andersen

Center: The terrain trap where Adam Andersen was caught on January 10, 2018. Photo Jason O'Neill

Below: Reas Peak Google Map capture. Both Centennial fatalities in 2017-18 were within a mile or so of each other.



## DeltaLancer Avalauncher Ammunition

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



### Key Design Characteristics:

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



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



Slab avalanche in the Baker Creek drainage that released during the March 22-23 storm. The crown was above the rain-snow line, but most of the debris, snow in the track, and the smaller avalanche to the right were wet.

# MIX

## FORECASTING FOR DRY AND **WET** AVALANCHES DURING MIXED **RAIN** AND SNOW STORM EVENTS

SCOTT SAVAGE<sup>1</sup>, ERICH PEITZSCH<sup>2,3</sup>, SIMON TRAUTMAN<sup>4</sup>, BEN VANDENBOS<sup>1</sup>

**Professionals in coastal and some inland mountain ranges** regularly face mixed rain-snow events. Professionals in inland ranges frequently deal with persistent slab avalanches failing on old faceted layers buried deep within the snowpack. What happens when you combine these snowpack and weather events? Widespread avalanching involving faceted layers during mixed rain-snow events is rarely observed and is not as well-understood. Last March, USFS Sawtooth Avalanche Center (SAC) staff observed this scenario.

### Snowpack History

The SAC's Wood River Valley (WRV) zone harbored a shallow, weak, snowpack with faceted snow crystals from December (December weak layer) through early January 2018. Below 7500 ft., many slopes were devoid of snow. Upper elevation and alpine starting zones contained snow, but several strong wind events scoured many exposed slopes. From early January through mid-February, light to moderate snowfall interspersed with dry, cool, sunny periods formed a layer of near-surface faceted crystals associated with crusts on some aspects (*Figure 1*). This layer was subsequently buried on 14 February. A storm on 1-2 March deposited approximately 50 mm (2 in.) of snow water equivalent (SWE), producing an extensive natural avalanche cycle on the December and 14 February weak layers. Additional snowfall from 14-17 March caused another round of natural avalanche activity on the 14 February layer.

### Storm Event

A southwest flow delivered a warm, wet storm system beginning early on 22 March. In the 24 hours following the onset of precipitation, remote weather stations near Ketchum-Sun Valley recorded 45-65 mm (1.75-2.5 in.) of precipitation. Direct observations of surface crusts in the following days indicated rain-snow levels ranged from 7700-8700 ft. during the storm accompanied by moderate to strong south/southeast winds.

### Avalanche Activity

Avalanche mitigation at a nearby ski area resulted in multiple intentionally-triggered, D1 loose wet avalanches failing on near-surface crusts on steep slopes between 7550-9000 ft. However, no substantial debris was observed or reported in any large runout zones near the valley floors by sunset on 22 March. Good visibility in the following days allowed for better observations. As expected, widespread D2-D4 natural dry slab avalanches occurred throughout the advisory area at upper elevations above 9000 ft. Crown depths ranged from one to over three meters. The upper elevation events were clustered on west, north, and east aspects. This natural activity was present in much of the advisory area and was most pronounced in the Pioneer Mountains of the WRV zone. Here, widespread 60-105 cm deep, D2-D3 natural slab avalanches also released in middle elevation starting zones between 7500-8900 ft. (*Figures 2,3*). This middle elevation activity occurred on west, north, and east aspects but was more narrowly focused on northwest aspects. Many slides occurred in paths where activity has not been observed in the previous 30 years (personal communication: Abromeit, Bachman, Bingham, Gardiner, Kellam). The widespread, natural middle elevation activity was confined to a relatively small area—a few drainages—in the WRV zone.

The observed avalanches at middle elevations failed on large (2-3 mm) faceted crystals above an ice crust about 20-40 cm above the ground (*14 February layer, Figure 4*). The uppermost regions of the starting zones held dry surface snow and did not appear to receive any rain. However, based on field observations, rain fell in substantial portions of many of the starting zones for at least part of the precipitation event. In the lower parts of the starting

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<sup>4</sup> U.S.D.A. Forest Service National Avalanche Center, Bozeman, Montana, USA



**WIDESPREAD AVALANCHING INVOLVING FACETED LAYERS DURING MIXED RAIN-SNOW EVENTS IS RARELY OBSERVED AND IS NOT WELL-UNDERSTOOD.**

Crown/flank face below the rain-snow line in one of the March 22-23 avalanches in the Pioneer Mountains shown in Figure 2. The upper reaches of this crown were entirely dry.

**MATCH**  
**WET SLAB RAIN**  
**DRY SLAB SNOW**

zones and in the avalanche tracks, the snowpack above the failure layer was much thinner; free water from rainfall had percolated through the slab to the failure layer and bed surface. At one observed avalanche site, the slab changed from a completely dry, 80 cm thick snow mass at the top of the crown to a thoroughly wet, 20 cm thick slab 100 vertical meters downslope.

**Cause of Elevation Dependency within the WRV Zone**

In exposed upper elevation terrain, the combination of existing snowpack structure, heavy snowfall, and extensive wind-transported snow caused the observed dry slab avalanche activity. At elevations that received only rain during the precipitation event, isolated wet loose avalanches released. The snowpack at these lower elevations was quite thin, and water from previous warm weather and rain events had eroded the snowpack or previously wet all layers. Given the temperature and precipitation conditions, we present three possible mechanisms that may explain the widespread middle elevation avalanche activity (Figure 5):

1. Loading the snowpack: Snowfall and wind-transported snow overloaded the upper reaches of the starting zone and caused fracture, independent of the water percolating down to the weak layer lower in the starting zones.
2. Free water weakening: Rainfall percolating through the snowpack in lower portions of the starting zones stressed or weakened the slopes, promoting fracture and subsequent slope failure.
3. Changing slab properties: Snowfall accumulated in portions of the starting zones before rain fell on top of and wet the dry snow, changing the slab properties enough to induce fracture.

Given the uncertainty associated with rain-on-snow induced slab avalanches failing on persistent weak layers, we see a need for synthesizing observations and insight from this case study into a hypothesis. We suggest that a combination of the three stated mechanisms—and possibly other mechanisms not yet observed or characterized—caused the fractures. This hypothesis is consistent with the observed elevation dependency of the low frequency, middle elevation activity during this storm (see sidebar for additional discussion).

**Aspect, Spatial, and Elevation Patterns**

The frequency of middle elevation slab releases on northwest aspects in a relatively small area in the Pioneer Mountains was notably different than crowns observed above the rain line. Several factors may help explain the observed patterns:

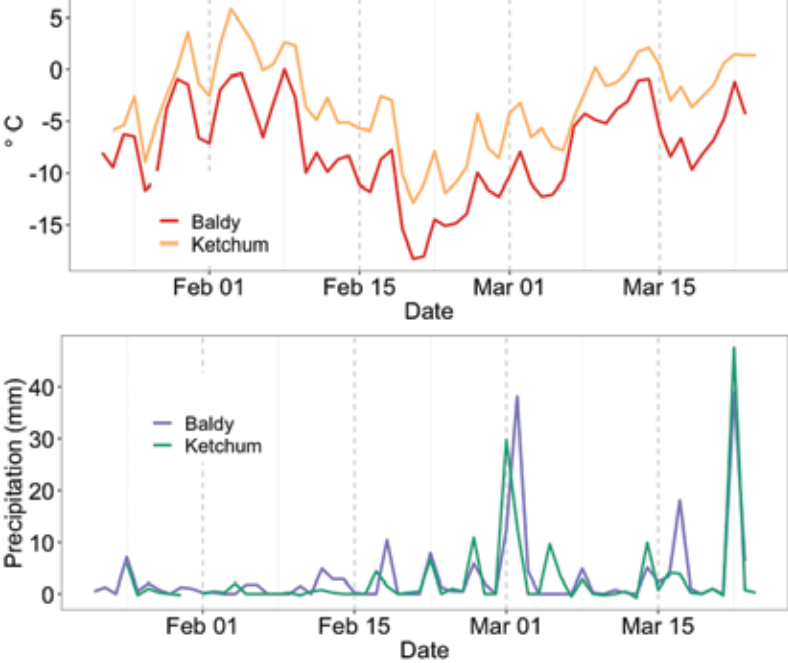


Figure 1: Top panel: daily temperature for Bald Mountain (blue, 9000') and Ketchum Ranger Station (green, 5900') automated weather stations (AWS) from 22 January to 24 March. Bottom panel: daily precipitation for the same AWSs and time period (Savage et al. 2018).

1. Differences in snowpack depth and structure dependent on aspect and elevation: Strong northwest wind events in December and January scoured snow from many exposed northwest-facing slopes, resulting in a thinner overall snowpack and enhanced faceting in early February on those aspects.
2. Drainage orientation: The affected drainages are oriented generally southwest to northeast, resulting in a higher proportion of northwest and southeast-facing slopes in the impacted area.
3. Solar effects: The snowpack had dramatically thinned or melted on aspects more directly-oriented to the sun.
4. Wind transported snow: South to southeast winds blew during much of the storm event, focusing wind-loading on west, northwest, north, and northeast aspects.



Figure 2: Natural slab avalanche activity on 22-23 March in the Pioneer Mountains. On site observations indicated the crown faces were just above the rain-snow line. Photo Sawtooth Avalanche Center



Figure 3: Widespread natural activity on 22-23 March in the Timber and Federal Creek drainages, Pioneer Mountains. Observations from adjacent ridges indicated all but one (the upper left avalanche) of the highlighted avalanches released near or just above the rain-snow line. Photo Sawtooth Avalanche Center



Figure 4: Crown profile at location within the fluctuating rain-snow boundary. Photo Sawtooth Avalanche Center

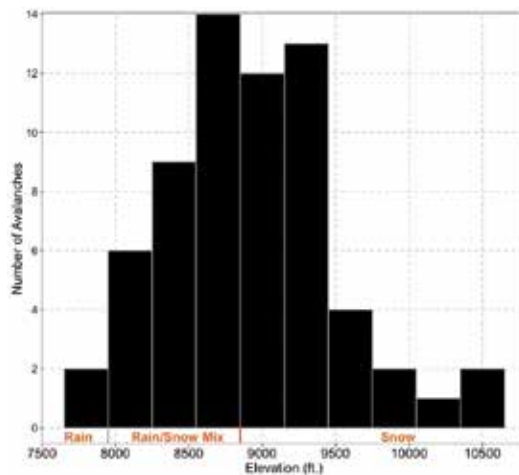


Figure 5: Avalanche occurrences versus elevation. Note the cluster of observed activity at and just above the rain-snow line (Savage et al. 2018).

5. Previous avalanche activity: The 2 March storm event produced widespread natural activity, eliminating the 14 February weak layer on some slopes.

Substantial uncertainty exists as to why more middle elevation, north and northeast-facing slopes in the WRV zone did not release.

### Forecasting Implications

Extensive slab avalanching occurred in a single mountain range near the rain-snow line in a narrow elevation band, on a narrow range of aspects, over a relatively short time period. Precipitation type, amounts, and pre-existing snowpack structure produced the rarely-observed avalanche activity in this area. Several factors contributed to the difficulty of forecasting this avalanche cycle:

1. Precipitation models under-predicted precipitation by a factor of 2.
2. Detailed snowpack structure observations were limited by the regional operational scale.
3. A precipitation threshold appeared to be exceeded in a limited geographic area; widespread natural activity was confined to the end of the precipitation event and only where over ~2 in. of precipitation fell.
4. Staff had little to no experience observing or forecasting previous, similar events.

### Communication Implications

In North America, many operations use a conceptual model of avalanche hazard (CMAH) (Statham et al., 2017) as a general framework for assessing and forecasting avalanche hazard. The regional forecasting community and individual operations develop decision trees and communication platforms based on the CMAH. These tools work well in the vast majority of scenarios when transitions between avalanche problems are clear; graphics and text describing avalanche location, likelihood, and size sequentially follow the avalanche problem type. However, wet and dry snow and avalanches occur as a continuum, and scenarios not easily sorted into discrete categories (e.g. problems) occur (Figure 6). The effects of dramatic spatial and temporal changes associated with events like the one presented in this article will stress any discrete sorting platform, despite the number of avalanche problem types employed.

The discrete boxes (avalanche problems) are adequate for sorting or categorizing snow and avalanches the vast majority of the time, but how should we communicate when a discrete sorting approach doesn't work perfectly? One option is to address the uncertainty. Although considering and addressing uncertainty is paramount in avalanche hazard forecasting and public communication (LaChapelle, 1980; Jamieson et al. 2015), public avalanche forecasts do not graphically display it. One way to mitigate this issue is to describe the uncertainty associated with the avalanche problem illustration in the product text. The caveat is that some consumers may view textual admissions of uncertainty as "indicators of ignorance" instead of actionable information (Lewandowski et al. 2015).

We suggest developing communication tools, techniques, and procedures that better handle a continuum of avalanche problems—especially wet-dry—and can facilitate communicating uncertainty in selecting the primary avalanche problem type. While current communication products work well for "typical" avalanche conditions, improvements may help to communicate dangerous, infrequent events in a consistent manner.

### Continuum vs. Discrete?



Figure 6: Wet and dry snow or avalanches exist in a continuum, but choosing an avalanche problem type sorts the same phenomena into discrete boxes (Savage et al. 2018).



# MAMMOTH MOUNTAIN



STORY AND PHOTOS BY MIKE PHILLIPS

**What stands out most about this event** is the lack of institutional knowledge of this path. Patrollers who have been at Mammoth since the late-70s have no recollection of any slide of consequence in Fresno Bowl. Rarely do the windswept and sun-exposed SW slopes of the Sierra see avalanche activity beyond loose wet problems, but this was an exceptional rain event. I guess the old adage rings true that given the right conditions any slope that can slide, will slide.

Between April 6 and April 8 2018 Mammoth Mountain Ski Area received 2.9 inches of rain up to the summit of the mountain (11,053'). This soaking rain drenched the snowpack and raised alarm bells for wet snow avalanche problems. Avalanche control work within the ski area during the storm yielded small and isolated results, and structure protection was needed solely due to the flooding that ensued at the ski area's base lodges. When the skies cleared, large debris flows of pumice and mud were found on the stripped windward slopes on the backside of the ski area. The flowing water and debris eventually met snow a couple hundred feet from the summit ridge, and where the terrain steepened, two large wet slab avalanches were naturally triggered (R4D3.5).

Crown heights of the distinct lobes ranged from 30" to 40+". These slides ran approximately 3000' and were at their widest points 500' across. The slides and associated debris flows were highly erosive in the soft, loose terrain beneath the snow. Our historic knowledge of Fresno Bowl is limited to small size 1 avalanches on the steepest crossloaded sidewalls, but now we question what the future holds for other paths which seldom perform, given warmer temperatures and rising snow levels. ▲

**Mike Phillips** is a ski patroller at Mammoth Mountain. In 9 seasons he's seen the biggest snowfall season, the wettest season, one of the driest seasons and the snowiest month on record in the High Sierra. What he likes most about ski patrolling and avalanche work is that you can expect to see something new every day. To take a break on weekends Mike instructs AIARE courses and pursues the elusive Sierra cement in the backcountry near his home in Mammoth Lakes.



## Future Work

Professionals in coastal and some inland mountain ranges regularly face mixed rain-snow events. Southern and central Idaho have not experienced these events frequently, but climate models suggest a higher frequency in the future due to a changing climate (Lazar and Williams, 2008; McCabe et al., 2007; Musselman et al., 2018). We encourage future work investigating wet snow avalanches and developing professional and public communication tools and platforms to handle scenarios as we have described in this article. ▲

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**Scott Savage** is the Director of the USFS Sawtooth Avalanche Center in Ketchum, Idaho. He considers each day that he learns more than he forgets to be a success.



**Erich Pietzsch** currently studies avalanches with chainsaws and drones.



**Simon Trautman** works for the USFS National Avalanche Center and is the acting Director of NWAC for the 2018-2019 season.



**Ben VandenBos** is a Forecaster at the USFS Sawtooth Avalanche Center. He has come to realize that his skiing compulsion is a feature, not a bug.



Left: Debris flowing into the Placer Valley with a view of the alpine terrain above and starting zones. Photo Henry Munter

Right: Interesting track from a wet loose avalanche above Bear Creek in the S Fork of the Boise River drainage, Idaho. Photo Jen Stevens

## THE WHOLE THING HIT THE PEANUT BUTTER, TURNED INTO A WORM, AND DIED.

- HENRY MUNTER

## MUSINGS ON WET SNOW

SUMMARIZED BY WENDY WAGNER

**This past November**, the Chugach NF Avalanche Center hosted a gathering of about 25 avalanche professionals to discuss wet snow. Chugach Powder Guides GM Henry Munter's quote tying peanut butter, worms, and avalanches together highlights a common theme from the event; **wet snow and avalanches are different beasts.**

Scott Savage kicked off the morning's discussion by presenting a case study on **a mixed rain-snow avalanche cycle that occurred in Idaho last spring**. We used this study as our framework. The slab avalanche activity in question occurred at the tail end of a warm precipitation event, producing avalanches involving an old faceted layer about a meter deep. Savage noted a high concentration of observed crowns located both within the fluctuating rain-snow elevation band and just above the highest extent of the rain line; many of the crowns were predominantly still dry snow. Savage presented a few factors that may have contributed to failure in these events (see Savage et al. article on page 30).

At the recent Innsbruck ISSW, he spoke with Alec van Herwijnen (WSL Institute for Snow and Avalanche Research SLF—Davos) about a similar event Alec had observed in Switzerland. Savage said Alec also observed releases just above the rain line. Alec hypothesized that the high deformation rates from the dense new snow load may play a significant role in this type of avalanche activity (personal conversation, October 2018). You could sense the wheels turning in people's minds as they recalled similar events from their pasts. Mike Janes (Alaska Electric Light & Power, Juneau) noted the major slides that damaged the Snettisham power facilities in 2008 also failed just above the rain line. Dave Hamre (Alaska Railroad) recalled 3 specific events during his 37-year career where he had seen similar activity and had been in the field (standing in the rain for hours) monitoring water infiltration lower on the slope during the precipitation event. Interestingly, Hamre observed the onset of avalanche activity almost exactly when the water percolating through the snowpack reached a well-developed faceted layer. His experience showed that free water weakening faceted layers in the lower portions of the starting zone may play a significant role in these events.

This was interesting to our crew at the avalanche center as, when we see warm storm events at Turnagain causing failures in buried faceted layers, we often see crowns just above the rain-snow line. We frequently struggle with categorizing these dry-at-the-top/wet-at-the-bottom avalanches. Jed Workman from the Hatcher Pass Avalanche Center brought up an interesting side note in the discussion; what should we label them, 'dry' or 'wet'? At our avalanche center, the rule of thumb is to label them 'wet,' based on the character of the debris. This is opposed to the mechanism of release, which may be a three-way mixed-mode, for lack of a better term. Savage et al. describe these modes clearly in their TAR article: wet slab mechanics near the stau wall, dry slab mechanics at the top, and changing slab properties in the middle. The dangling carrot and million-dollar questions of course are:

1. What mechanism(s) drive these mixed wet-dry releases?
2. Do the relative importance of the various mechanisms change for different, but similar, events?

Unfortunately, these questions remain unanswered.

We'd like to thank all the great minds that joined us for this morning of information sharing. As luck would have it, the very next day a rain-snow event hit Hatcher Pass and voilà, Workman was dealing with peanut butter and worms. ▲

Gathering inspired by Aleph Johnston-Bloom, article by Wendy Wagner and others.

# PERSPECTIVES ON **WET** SNOW AVALANCHE PROBLEMS: FORECASTING AND MITIGATION STRATEGIES

BY DAN VEENHUIZEN

**“So, what do you think will happen?”** It seems like this question starts bouncing around the Pacific Northwest at some point every winter. It’s usually when we’re staring down the barrel of an atmospheric river event after several weeks of heavy snow. Our region is well known for prodigious moisture. Proximity to the Pacific Ocean ensures that the water will come and oscillating upper level air patterns bring freezing levels that can vary from sea level to over 8,000 feet any month of the winter. What this means is that we can and often do face wet snow problems any month of the year. Avalanche forecasters from all snow climates agree that wet slabs in particular are difficult to forecast for. When I began work on this article, I tracked down some very experienced (25+ years) avalanche workers in the region and asked them what their thoughts were on managing these particular problems. The basic response was, “I don’t like ‘em.”

In the past few years I have been contacted by folks from other snow climates wanting to discuss managing wet snow problems mid-winter. As I read through the seasonal summaries from the forecast centers in the October 2018 issue of TAR, I noticed that almost everyone mentioned dealing with more wet snow problems mid-winter than they were used to seeing. As inglorious as it is, we in the PNW are used to seeing a little bit of rain in between our long spells of amazing powder skiing. I thought it could be useful to synthesize a bit of existing research with a few case studies and share some strategies that we employ. The perspective that I’m coming from is that of an operational forecaster at a ski area that sees heavy rain events on a winter snowpack. I fully acknowledge that folks in other regions face wet slab forecasting problems involving periods of intense radiation, different stratigraphy, and their own unique topography. I learned a lot reading about those scenarios while researching this article.

## What does existing work say?

The mechanism for avalanche release in wet snow is well understood. McClung and Schaerer lay out the basics nicely<sup>1</sup>. In a loose wet scenario, free water (either from rain or melting of surface snow due to temperature) reduces cohesion in the surface snow and point release avalanches occur.

In a wet slab or glide scenario, free water (either surface snow melted by radiation or a rain on snow event) percolates through the snowpack. The rate of percolation depends on stratigraphy and often preferential flow channels will form. Capillary barriers like crusts and layers of small grains can cause pooling on those layers and allow the water to flow downslope over great distances.<sup>2</sup> Once water reaches the weak layer it affects bonds in those grains and a wet slab avalanche might occur.

Blase Reardon and Chris Lundy’s conceptual model for wet slab forecasting, known as the water factory–slab–funny business model<sup>3</sup>, is an excellent description of the elements present for wet slab events. The water factory is either meltwater from the near surface layers as a result of radiation (sunny places), or rain on snow events (the Cascades). The slab is the bulk of the snowpack that comprises the avalanche and is often relatively dry (or less wet) snow compared to the other two elements. Reardon points out this is likely due to preferential flow channels allowing the water to drain through the slab without fully wetting it. The funny business is the weak layer, in Reardon’s case studies this is often a layer of coarse grained, wet facets. Reardon and Lundy were able to use this model to explain nearly all wet slab occurrences, and just as importantly non-occurrences, while they were forecasting for the Going To The Sun Road in Glacier National Park.

Sometimes the weather throws curveballs and the line between wet and dry avalanches is blurred. Savage, et al. describe an interesting mixed rain and snow event in the Sawtooths last winter<sup>4</sup>. The storm involved over 2” of SWE, with freezing levels being roughly in the middle elevations of their terrain. Observations following the weather event included slab avalanches both above and below the rain line, with those below the rain line being mostly confined to a particular aspect. Savage describes factors leading to a different snow stratigraphy on that aspect at the middle elevation band.

Bruce Tremper puts some numerical parameters around wet snow instability<sup>5</sup>. His “red light” observations include: foot penetration past your shins in wet snow; rain on cold, dry, new snow;



Destructive wet slab debris with full size trees in it. March 2017 event.



Nearly meter-deep crowns in relatively low angle terrain that sees light skier traffic. March 2017 event.



Freezing rain crust and saturated facet layer made up the structure at the bed surface/weak layer interface in March 2017.

three nights without a freeze on a recently isothermal snowpack, and widespread rollerballs. Tremper suggests that the same stability tests we like to use for dry slab problems can be applied to wet slab problems, but that due to the transient nature of stability with wet slab problems, the tests are less reliable as a predictor of stability.

While these forecasting considerations and relevant observations have been in our collective consciousness for quite some time, avalanche workers still struggle with the timing and extent of wet slab events. Baugher and Birkeland's paper about the wet slab cycle at Crystal Mountain (WA) in March of 2014<sup>6</sup> is an excellent case study that highlights typical meteorological considerations, albeit with atypical results. In this case study, the critical weather event involved over 3" of rain and four days of above freezing temperatures. Baugher points out that these meteorological factors are not unusual in the Northwest, but that the snowpack structure at the time was quite unusual. Reardon's "funny business" was in play, in this case a layer of rounded depth hoar.

### Stevens Pass case studies

In March of 2017 we were enjoying a nice round of late winter storms. Between March 1 and 10 we received over 70" of snow. An atmospheric river event loomed on the horizon. During the previous days we had performed mitigation work in all of our avalanche terrain using explosives and ski cutting. We were managing for the current storm and wind slab problems as well as trying to keep our starting zones as cleaned out as we could before the rain arrived. When the rain began, we noted the typical onset of D1-2 wet loose natural avalanches; these were generally releasing in our steeper terrain. As the weather event carried on, we became increasingly concerned about larger, more destructive wet slabs releasing. Our management strategy shifted from active mitigation involving explosives and ski cutting to passive terrain closures. On the third day of the rain event, after 4" of precipitation and three days of temperatures above freezing, we witnessed a natural cycle of R4-D3 wet slabs.

The interesting thing about these avalanches is that they released much lower in the slide paths than we're used to seeing, actually in terrain that is typically the lower part of the track/runout for the paths. These terrain features were aprons below steeper terrain that is full of cliffs and chutes. The average slope angles at the crowns were in the low 30s. These pockets of terrain see some skier traffic, but nothing I would call "compaction." Of note was our snowpack structure during this event. In the first week of February we had endured a freezing rain event. This left an IFrc that was about 2cm thick. In the middle of February we received small amounts of low density snow and then an extended dry period when near surface facets formed (funny business). The 70" of snow in the first 10 days of March fell on top of these facets and had settled to about a meter by the time the rain event started.

In February of 2018, we endured another robust round of old-growth forest-producing rain. It was again the third day of the event, February 4th. The usual round of smaller, widespread loose wet avalanches had occurred the first day with the onset of rain. The high temperature for the previous 72 hours was 39 degrees F and occurred at 10am that day. At 3pm an R3/D2.5 released high in a chute, entraining wet snow and leaving a gouge in the track, running beyond its average deposition zone. It was not observed whether this released as a wet slab or wet loose.

### Musings on numbers

- Tremper's three-day rule seems like a pretty good one. With the onset of rain on dry snow you will almost always see loose wet avalanches, but the more destructive wet slabs seem to need a few days for the weak layer to be affected.
- At what we in the Northwest consider minor amounts of precipitation, .25-.75" of rain, our main concern is loose wet problems. We rarely see wet slab cycles within that range of precipitation. Once we see amounts over 1", and more likely between 2-3+" of precipitation, we begin to expect natural wet slabs.
- Above freezing temperatures are obviously important. Not only with regard to the structural integrity of the snow surface, but because of the addition of water from melting of the snowpack itself. The "water factory" really ramps up with warm rain. Our most

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notable avalanches seem to occur during events where the temperature at the start zones reaches 38-40 degrees F.

- As Reardon and Baugher point out, snow-pack structure is important. Paying careful attention to the distribution and properties of those crusts will inform your strategy. How slick is it? Did new snow stick to it immediately or did it take a few storms? Is it permeable? Is the overlying slab homogeneous and will it allow rapid percolation of water? Paying attention to any preserved facet layers, especially large grained facets near capillary barriers, also seems useful.
- The most notable results I've seen are in terrain that sees little skier compaction (our hike-to terrain and outside ski area boundary paths). Not to say wet slabs won't release in mogul fields, they certainly do, but in our terrain the heavily skied runs rarely seem to produce the way the less traveled terrain does.



### Management strategies

When we expect a snow-turning-to-rain event we generally approach our control routes the same way we do as when we have dry snow problems. We try to aggressively get all available snow out of start zones, and even pick on some little pockets that are normally not producers, including cornices. Once the entire landscape turns moist, it's surprising where a rollerball will come from that entrains available snow and becomes something big.

Once we have wet snow, we rely mainly on ski cutting to manage the loose wet problems. Ski cutting is very effective for these so long as you can keep that downhill ski from getting caught in the mush. It's hard to get these avalanches moving in lower angle terrain.

If we know we're in it for the long haul and have an extended rain event brewing, we lean on terrain closures heavily. We've had mixed success using explosives for wet slabs. Larger explosives work better, but they are not nearly as reliable as they are when the snowpack is dry. If you are going to try to mitigate with explosives, timing your efforts with the heaviest precipitation, and warmest temperatures seems to be the best bet. Sounds fun huh? Due to the uncertainty of stability based on explosives results in wet snow, we generally error on the side of caution. If we are getting into day 2-3+ of an event, we will probably just start the day with a lot of avalanche terrain closed. Setting up your closures to include terrain beyond your normal dry snow runout zones is probably a good idea.

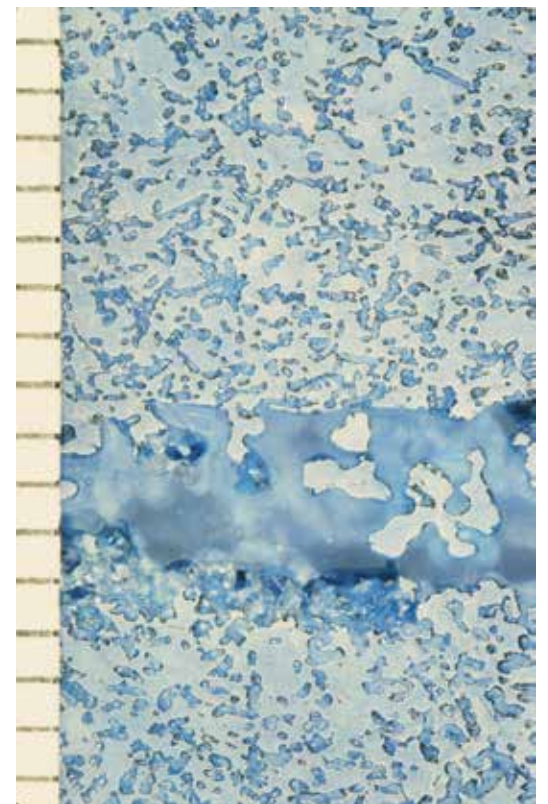
We try to get out and around the ski area during these rain events. It is valuable, as always, to see what has released, how big, and when. I dig a lot of quick test pits to see how far the water has penetrated into the snowpack. Know what your indicator slopes are for these problems as there are definitely certain terrain features that will be producers. Rock slabs and smooth ground cover are obvious candidates.

### Implications for other snow climates

I'd be curious to hear from operations in other regions about their experiences. In my personal travels to other snow climates I've generally used avoidance strategies to manage wet slab problems. Hearing what folks are doing for active mitigation would be interesting. I'd also like to hear other people's thoughts on meteorological thresholds that they find important. My assumption would be that a lower density snowpack would produce slab avalanches with a lesser amount of liquid water during a rain event. I wonder how much snowpack temperature would hinder the process of percolation...

Brandon Levy (who spent eight years as a DOT forecaster in North Central Washington and is now with CDOT/CAIC) is one of the folks I had some correspondence with on this topic. He pointed out another process to consider in high temperature gradient regimes; melt layer recrystallization. This occurring in a rain turning to snow scenario could be an equally important process to pay attention to as the more obvious rain after snow situation.

Well, in December as I write this, Stevens Pass has an IFrc about a meter down with facets on top of it and an atmospheric river event in the long-range forecast. I wonder what'll happen? ▲



RON PERLA: FROM THE ARCHIVES

Top: Ugly rain crusts ruin pretty layers. This is an example of melt water working its way down (piping,) and re-freezing.

Bottom: Rain crust section 1mm grid.

1: McClung, David; Schaerer, Peter (1976, 2006) *The Avalanche Handbook*, p. 100-103

2: Peitzsch, Erich; TAR April 2008

3: Reardon, B.A. and C.C. Lundy. 2004. *Forecasting for natural avalanches during spring opening of the Going-to-the-Sun Road, Glacier National Park, USA. Proc. Int'l. Snow Science Wksp. Jackson, WY. Sept, 2004: 565-581.*

4: Savage, Scott; Peitzsch, Erich; Trautman, Simon; VandenBos, Ben (2018 ISSW Proceedings) *Forecasting for dry and wet avalanches during mixed rain and snow storm events*

5: Tremper, Bruce (2008) *Staying Alive in Avalanche Terrain*, p. 183

6: Baugher, Paul; Birkeland, Karl (2014 ISSW Proceedings) *Decision-Making and Avalanche Mitigation During a Rapid Onset Wet Slab Avalanche Cycle*

# ALTA

## 1973

BY PETER LEV



Stu Thompson setting the indirect sight, with Peter barely visible behind the 105, reading the coordinates.

I believe I took this photo on the morning of the shoot with black and white film during poor visibility

—Ron Perla

**BY DECEMBER 30, 1973**, a little over 60 inches of snow, equaling 7+ inches water, had fallen on Alta, Utah. This serious storm was preceded by a thin early winter snowpack which re-crystallized into loose ‘cup crystals’, otherwise known as Depth Hoar, a common situation in the Colorado Rockies, but less common in the Wasatch. Though not unheard of; it is one of the worst possible ‘set-ups’ for winter.

Five feet of new snow resting on such a significant weak layer was not lost on Head Snow Ranger Binx Sandahl, the Lead Forecaster and his crew, of which I was a member. I was the gunner on the primary avalanche control weapon for the Highway and the Town of Alta. The gun was a 105mm (4 inch diameter) recoilless rifle, located on a bunker on top of the north end of Peruvian Ridge. Each round delivered about five pounds of high explosive, and lots of metal shrapnel. This is a military weapon with a huge counterblast out the rear of the chamber to balance out the potential huge recoil. Operating this weapon were myself, Stu Thompson, and ‘Ham Bone’, both from the Alta Ski Patrol, whereas I was USFS. Only Ham Bone was strong enough to lift over his head from storage down in the tower the 10 or so rounds we needed for a full shoot, which was what we were looking at. For us, it was common to blind fire with pre-set sightings on all the targets.

The weather was cold and snowing, but the winds had relaxed, and after three days we were finally able to get to the gun. The old Wildcat chairlift was still in place and could not be operated in high wind, so we waited for this day. Binx felt that a full shoot was needed because the NWS was uncertain how much longer the storm would continue. The idea was to bring down what was up there before the avalanche potential increased even more. We all were very aware of the potential threat to the lodges. For this situation a complete town closure is initiated, no interlodge travel, and during the actual shoot, all guest and employees are to be in the basements. We were ready, so we thought.

As per our gun procedure, after the initial test shot on Hellgate Cliffs, and an ‘all clear’ from Alta Central Radio, we planned to fire all the remaining shots as quickly as possible. This was partly because the gun is up in the weather, the storm, ie, miserable. The targets included Superior, Hellgate, Cardiff, Flagstaff, on through the Emma slide paths eastward to Grizzly Gulch. These are major avalanche paths and in their runouts are the lodges of Snowbird (Mt. Superior only) and Alta. Had Alta Central reported ‘activity’, or worse the Hellgate Lodge has been hit by an avalanche, then procedure required we fire the shots one

at a time and call in after each shot to confirm ‘activity.’ Also, before each shot Sara, the central radio operator, would check each lodge to make sure all are in the basements.

Sighting on the blind-fire target 20 feet away, dialing-in for first shot for Hellgate Cliffs, I check in with Sara. She and the radio are located in the basement of the Deep Powderhouse, a ski shop owned by the town marshal. The Hellgate Lodge, directly below the Hellgate Cliffs, is also partly owned by the Alta town marshal. Sara gives the ‘go ahead.’ Fire! Then, as per procedure, I call Sara for a report as to any ‘results’ observed by the Hellgate Lodge. She says “All OK.” So, we proceed to crank the rounds off. We are now dialed-in on Flagstaff Shoulder, a low shot which we always shoot first, before the high main Flagstaff starting zone, thinking to bring down that major Flagstaff path in smaller pieces. The Alta Lodge is directly below the Shoulder. The 105 has a turn handle for a trigger. My hand is turning the handle, and suddenly my mind says “This can’t be right,” but cannot stop my hand from turning that trigger.

We halt the shoot and I call Sara. Silence....and silence. Then the radio explodes with voices, first from Alta Ski Lifts; “We are being covered in a huge dust cloud.” Then finally, Sara; ‘the Alta Lodge has been hit, bad.’ Thus came the all-time record avalanche damage to the Town of Alta in the modern day. The big dust cloud at Alta Ski Lifts came from Cardiff. Prior to that Mt. Superior came down, the largest slide path of all, filling in the Cliff Lodge parking lot. A nearby smaller path, subsequently named ‘Valerie’s’, hit the Plaza area in Snowbird where there was a work trailer where Valerie and her boyfriend had retreated for some excitement, but not the kind they eventually got. But the most amazing avalanche was brought down by that one shot into Flagstaff Shoulder. The fracture, which turned out to be a five-foot crown, traveled up to the summit of Flagstaff, and on through all the Emma gullies and rounded separating ridges eastward about a quarter mile into Grizzly Gulch. Over 50 automobiles were destroyed with that one shot; some carried from the Alta and Rustler Lodge’s parking lot down and across the Transfer Tow to be deposited in the trees east of Lower Rustler.

We quickly cleaned the gun and headed down to see if we could help. Sara had indicated there were people buried/hurt in the Alta Lodge. There was also a propane leak. I went straight to the Lodge. One young woman apparently did not go into the basement, rather stayed in her room, which had large windows on the uphill, avalanche side of the Lodge. She was looking at a large picture book. When the snow poured in, the book and the window drapes were pressed over her face, allowing breathing

As I recall I was on the weapon as well as the rookie and only my second year on the weapon.

We went to the Alta Lodge as that was the hot spot.

When the helicopter arrived to take Bill Carghill...I think his name was...Rob Hoskins the pilot said someone had to go with him...being the most junior patroller standing there, I was conscripted...much to my dismay.

We had a slow flight following the highway out of the canyon and then got lost trying to find the hospital. After we dropped Bill off I eagerly prepared for the ride back up the canyon only to be told by Rob that there was no way he was going back up there. It took me a couple of days to get back and as you might expect the bulk of the slide activity happened the morning of the Flagstaff slide.

—Onno Wieringa



After the dust settled. Photos Ron Perla



room, and saved her. Her room was filled to the ceiling with snow, as was the hallway outside her collapsed door. A Lodge employee also failed to go into the basement, rather stayed in the employees room/kitchen (where the food was) and was slammed against the big cook stove, rupturing his spleen. This of course was critical. Our local brilliant helicopter pilot, Bob Hoskins, came up to get him flying the tree-tops. Unfortunately, a certain self-privileged 'guest' demanded to be flown out first, and—hard to believe—a minor fist fight broke out between two guests, both demanding to be flown out first. The injured person was flown out.

This fist-fight was not the only hard-to-believe thing that happened. Now the hard part. Verified by USFS Snow Ranger Binx Sandahl, and also told to me by Sara, the main radio operator, is this: The Town Marshal was standing over her shoulder when I called down to ask for a report from the Hellgate Lodge if any avalanche activity had been observed. She said; "All OK." Which I took to mean, 'nothing observed', so proceeded with the firing sequence. We don't know why the Marshal did this. There has been speculation he did not want to spread panic, or perhaps since he was an investor in that Lodge there were other priorities. As it happened, the Hellgate Lodge was hit in their parking garage hard enough to cause some damage and shake the main part of the Lodge.

Had Sara been allowed to report accurately, we cannot be certain things would have turned out differently, other than the two Alta Lodge folks, who should have been in the basement, would have been in the basement. That one Lower Flagstaff shot would still likely have brought everything down, and the damage would still be there. But the chaos would have been minimized and managed.

Two notable events occurred when the skies finally cleared. The first was when the ski lifts got their big D-9 cat out to start clearing a path to the lifts building. Alta Ski Lifts has a large parking lot for all the visiting skiers, and the D-9 drove over the acres of smooth snow and parked near the Goldminers Daughter Lodge, perhaps to go in for a coffee. A radio call alerts him that he is parked on top of a car, now very squashed under the snow.

The other one is less amusing, at least to me. On the first blue-sky day we at Alta were visited by two men from the USFS Headquarters in Washington DC. They are standing in their patent leather shoes, long trench coats, golfer hats and sun glasses on the highway just above the Alta Lodge, looking at the Alta Lodge scene depicted in the photo above. We were soon to learn the USFS would no longer be doing avalanche forecasting and control work for Alta, or any ski area. Instead they would provide us with an observer, a so-called 'Snow Ranger', to make sure the highway and ski area avalanche control personnel were 'doing things correctly.'

Binx and I transferred to the Utah Dept of Transportation, which was going from the frying pan into the fire, but that is another story. ▲

## THE FIRST TIME

BY RON PERLA

**DO YOU REMEMBER WHEN YOU FIRST CAME FACE** to face with the destructive forces of an avalanche? My wife Gretchen and her parents most certainly could not forget their first exposure to avalanches. Gretchen's parents had flown from Michigan to Colorado to meet me for the first time. It was Christmas holiday 1973. A few years earlier, the USFS transferred me from Alta to Fort Collins to work for Pete Martinelli on the avalanche handbook and national avalanche schools, impossible projects if one didn't visit avalanche threatened areas. There was a big storm in progress at Alta. I didn't want to miss this one. Here was the perfect chance to show Gretchen's parents my field of research.

So the four of us drove from Fort Collins to Salt Lake City and waited for permission from Binx Sandahl to drive up Little Cottonwood Canyon which was closed to the public because of the avalanche hazard. We barely made it up the road and I jammed our car into one of the last safe parking places beneath the Alta bunkhouse where we would spend the next three days.

After New Year's Eve supper, Binx and Peter Lev joined us for a drink. They were deeply concerned about the large amount of

new snow hanging over Alta. The forecast was for much more snow before morning. Binx was wondering if he should ask Alta manager, Chick Morton, to start up the Wildcat lift that evening to allow a gun crew to reach the Peruvian 105mm recoilless, and blindfire on the slopes which threatened the village of Alta where people were already confined to lodges. Spirits of snow rangers Engen, Atwater, LaChapelle, Baldsiefen, Lindquist...who had seen the devastation caused by similar Alta storms in the 1940s, 1950s, and 1960s said: "Yes, Binx and Peter, that's exactly what you must do, bring down the avalanches tonight before they get too big." My advice was: "Have another drink."

Avalanche control began morning of 30 December 1973. Even for those of us who worked many years at Alta, the extent of the damage which greeted us when we skied down from the Peruvian gun was staggering.

Safely in the Bunkhouse, Gretchen and her parents were awakened by war zone artillery. Later, they emerged to walk around debris and wreckage. Truly remarkable that my new relatives were introduced to my life's work via this once in a decade event. ▲

Ron,  
Great story, especially, 'have another drink.'

Were you on the gun with me that day? You said you 'skied down' from the gun.....?

I remember Stu and Hambone.  
—Peter Lev



# UNDER SIEGE

## 1973

BY LIAM FITZGERALD

**NOVEMBER 1973:** When living it day to day, a couple of years can seem like a long time; looking back on it from the end of a forty-six-year career, not so much. As season two was drawing to a close, I started to feel as though I was gaining my “sea-legs” and becoming fairly adept at facing what Mother Nature could throw at me. The stories we had all heard of the historic storms of the past, and the havoc they wrought, evoked a strange desire to actually experience them in person, if for nothing else, but to see how we might measure up. All that rather naive bravado might well be expected from a young and still fairly inexperienced avalanche worker, but it was also a perfect example of what people mean when they say: “Be careful what you wish for.” For those of us who lived and worked in Little Cottonwood Canyon, things were going to get very interesting in the not-too-distant future.

November 1973 saw nearly average snowfall (73”), but lower than average snow water equivalent (SWE) (3.88”), and after starting out fairly cold, temperatures warmed considerably towards the end of the month, and it even rained up to 11,000’! Prior to the warm-up, the snowpack on the upper mountain was quite weak in many areas; faceted crystals formed a pronounced weak layer near the ground, while on lower elevation slopes, conditions were much different; the thick layer of depth hoar found up higher was absent, and the snowpack appeared to be fairly strong. There were also areas with a combination of what could be found at both the top and the bottom of the mountain – weak snow lower in the pack, and stronger snow near the surface. All in all, the probability of making accurate predictions as to what might happen in the future, based on snowpack conditions, seemed rather low.

The first three weeks of December 1973 passed by without any significant weather or avalanche events. There were a few small storms, which as expected, required some attention, but nothing truly noteworthy. This “ho-hum” weather pattern resulted in only slight changes in the snowpack during that period, and in general, things remained more or less the same as they had been when the month began. Weak snow could still be found near the ground, and in some cases faceted grains still comprised a major portion of the snowpack. But in other cases the overlying layers of snow seemed to have gained a little strength during the previous few weeks, and conditions didn’t look quite as threatening.

Would these types of conditions decrease the likelihood of the deep-slab avalanches that seemed to be normal for the area during December and early January, or would the snowpack structure allow for a considerably larger build-up of snow before the “weak link” would eventually fail?

By the third week of December, the National Weather Service Office in Salt Lake City began to suggest that a large, well-developed storm was headed our way, and that it was a “slow-mover,” that could, if things fell into place, produce a lot of snow.

*The following excerpts are taken from the journal of daily weather, snowpack, and avalanche events that I kept from December 1972 until June 2014.*

**12/22/73:** Began to snow mid-morning, 5” (Snow) .53” (SWE) by 1600 hrs. Winds shifting to south, 30–35 mph, with stronger gusts.

**12/23/73:** 7” (snow).65” (SWE) overnight, winds still south-westerly, but speeds have decreased to the 20–30 mph range. Much of mountain well skied during the day, but several areas on upper mountain left closed due to the weather, and limited visibility. Snow continuing during day, another 6”/.55” by p.m. observation.

**12/24/73:** Snow continued overnight, another 5”/.45” by 0530 hrs. Wind decreasing and shifting to the west. Very little avalanche activity from control work. Skiing good, although portions of upper mountain remained closed due to inability to see upper elevation starting zones and uncertainty of what might be going on there. Light snow during the day, tapering off around sunset, 1.5”/.08” measured at 1600 hrs.

**12/25/73:** Wind increasing overnight, 35–40 mph from southwest. Temperatures also rose during night to just above freezing. Began to snow again after midnight, heavily rimed crystals, 5”/.66” measured at morning observation. Firing Village howitzer onto Mt. Baldy and a few other upper elevation targets in am, no visible results. Highway targets east of Snowbird fired with limited results on Superior and Hellgate. Very thin rain crust observed below the new snow all the way to the top of the ski area. Snow continuing during the day along with strong westerly winds, and decreasing temperatures. 6”/.53” measured 1600 hrs.

**12/26/73:** Light snow overnight, 3”/.25”. Winds decreasing to 15–20 mph from west. Thin cloud cover in am (could almost see the moon). Once again, control work produced little in the way of avalanche activity. Some visibility up high, looks like a lot of snow most everywhere, but no significant avalanches(?). A couple of inches of very light snow fell during the day, without much wind. Much of mountain open, and pretty well skied.

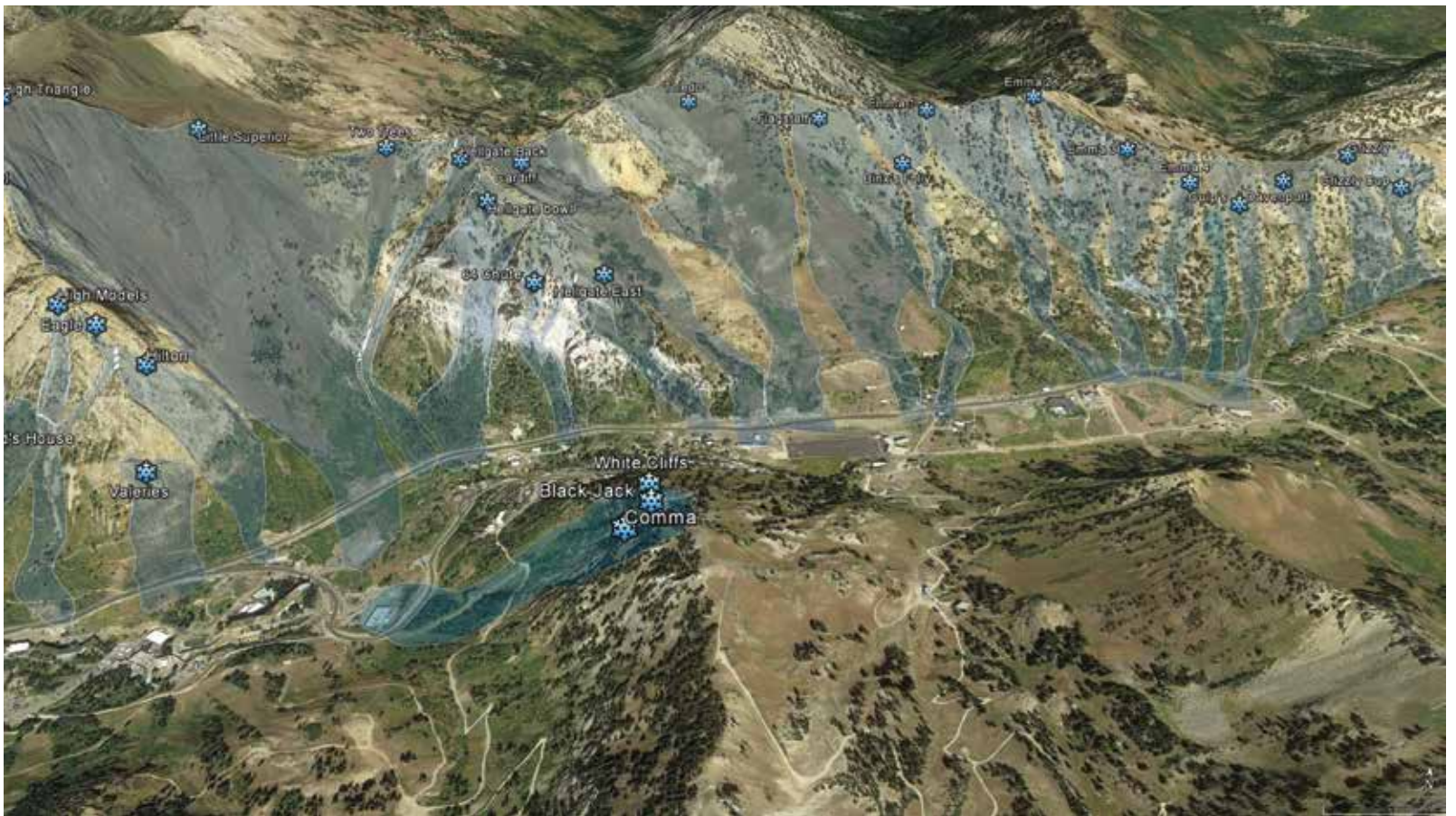
An excerpt from Liam Fitzgerald’s unpublished book of stories from his life in avalanche country.

Many years later when I was with the UAC, Peter (Lev) and I became interested in the weather data from October 1973 to see just what events lead up to the layering that produced this avalanche. As you know, the UAC is housed along with the National Weather Service, so of course I was able to locate data from this October for the Salt Lake valley but, surprisingly, nothing from the mountains. Back in ‘73 the Alta folks, lifts, and highway personnel, didn’t get hired on until 1 November and no one was recording mountain weather data during October.

During one of my Alta Patrol winters, I did witness a big day with the artillery bringing down very large avalanches off Flagstaff, the Emmas, and Grizzly Gulch. These slides demolished several cars that were in the various parking areas. Occasionally when I have been skinning up Grizzly Gulch in a storm, I think about watching that monster come barreling out of the Gulch to take out cars in the Albion parking lot.

—Tom Kimbrough





Little Cottonwood Canyon, Utah, avalanche map courtesy of Mark Saurer, Utah Department of Transportation

All in all, the probability of making accurate predictions as to what might happen in the future, based on snowpack conditions, seemed rather low.

Tom Kimbrough likes to wear tutus and drink Bulleit on his birthdays.



**12/27/73:** Storm returned during the night, 3" / .40" new by morning. Wind shifting back to the south and increasing. Snowing hard. Lots of new snow avalanches from control work, both in the ski area and above the canyon road. Little Pine (slidepath name) across road from shooting, 5' deep, 150' wide, not sure of activity above Town of Alta. Snow throughout day, 13" / 1.70" by evening. Canyon road to close around midnight, Interlodge Travel Restrictions to go into effect.

**12/28/73:** Snow continued overnight with strong westerly winds. 12" / 1.38" measured at 0500 hrs. Lots of wind in study plot, so not sure if measurements are accurate. Much blowing and drifting of snow, even at lower elevation. Alta and Snowbird both closed due to severity of storm and avalanche hazard. Shooting road targets closest to the Snowbird Village and above the Town of Alta in am, no plans to open road at this time. Running a few hand charge routes to protect snowcat roads, in order to maintain access to the Valley Howitzer, and some of the chairlifts. Two patrollers caught and carried several hundred feet in Wilbur Bowl, no injuries! Re-shot highway at 1530 hrs. Only one large avalanche observed. Wind blowing very hard, with lots of drifting snow, hard to see.

**12/29/73:** Snowfall and wind decreased somewhat during the night. Decided to try to get road open, to allow for lodge guests to leave, and a few supplies to be brought up to the resorts. Firing all highway targets from Snowbird down. Alta gun crew could not get to their weapon to do control work as the Wildcat chairlift could not run due to too much wind. Alta remained on Interlodge Travel Restrictions. Road below Snowbird opened around 1300 hrs. At 1330, large Natural (avalanche) observed from Cottonwood Draw. Road immediately shut down, and we re-shot several highway targets. Several more releases from firing, but none reached road. Re-opened road for a few hours to bring in supplies, all closed again at 1700 hrs.

**12/30/73:** Storm still raging. Very high avalanche hazard everywhere, Interlodge Travel still closed. Over 60" of snow, and over 7" of water since storm began, most of it in the past two days. Decided not to try to open anything! Threw shots into Dalton's Draw from the tram car, with no results. Took snowcat to Valley Howitzer, firing most all highway targets. Only result observed was large avalanche from #10 Springs Gully (slidepath name), assuming many other paths ran also,

but did not try to travel down the road to check things out. Reports of devastation at Alta! Alta Lodge and several other buildings damaged, many cars hit, and at least one serious injury. Brought "road-gun" to Snowbird Plaza to fire avalanche paths above the Village. Lodge evacuated, and guests brought to Snowbird Center. One slide ran all the way to the Plaza, damaging several trailer houses used for employee housing, with one minor injury. Much relief to have those paths shot.

**12/31/73:** Clearing during night. Using helicopter to bomb highway targets, resulting in several large avalanches. VERY large avalanches from Superior and Hellgate, Superior crossed the creek, and ran uphill a considerable distance on the other side of the Canyon, depositing snow and tree branches on Bypass Road! The road under Superior and Hellgate (~2,500' in length) must be covered with at least 20' of avalanche debris. Most all avalanche paths on the north side of the canyon slid to the road, and several ran to the creek! Alta looked like a war-zone, with the walls of buildings caved in, windows blown-out, vehicles tossed every which way, and a VW Bug deposited on the roof of the Alta Lodge!

Although this storm only ranks tenth on the list of Alta's biggest storms of the past seventy-years (snow and water equivalent wise), it was very destructive. In fact, it was the most destructive storm to hit the town of Alta since the mining era, and to my knowledge, no storm since then has caused as much damage. I never heard what the total cost of the damage actually was, but it would have had to be in the hundreds of thousands of dollars. Viewing all that destruction was a little depressing at first, but as with most natural disasters, the effort by the local population to work together to clean up the mess and get back on their feet was inspiring.

In long duration storms such as this one, carrying out avalanche control work at carefully planned intervals can be critical, especially when inhabited buildings are at risk. The inability of the Alta gun crew to reach the P-Ridge Rifle on December 29th due to high winds preventing the chairlift from operating may have played an important role in bringing about the devastating avalanches that occurred on the 30th. As it turned out, there was a period of more than twenty-four hours when the slopes above the Town of Alta had not been controlled, all the while the storm continued to rage. There is no guarantee that if they had made it to the gun mount on the 29th, and been able to fire at the targets above town that the outcome would have

been any different, but it might have helped. By shooting one day earlier, it's possible that they may have brought down slightly smaller avalanches than the ones that eventually occurred. By the time the gun crew did reach the weapon, midmorning of December 30th, there would likely have been several additional feet of snow blown into the starting zones that hadn't been there the last time they had been shot. Realizing this, and the potential for occupied buildings to be hit, they had developed a plan to try and minimize the risk.

The slide paths that threaten the Town of Alta are spread out for more than a mile along the east-west running ridge that separates Big and Little Cottonwood Canyon. The plan was to fire one of the western-most targets, Hellgate Bowl, first, and wait for a report from the Hellgate Condominiums, which are located within the runout zone of that path. The resident manager of the Hellgate would try to observe the results from the basement of the building, where he and the other residents were sheltered. If a large avalanche was observed, he would relay the information by phone to Alta Central (the Alta Marshal's dispatch office) and the dispatcher would then relay the information by radio to the gun crew. Then, knowing that large avalanches were occurring, they would fire the rest of their targets, moving from west to east, in slow secession, waiting after each shot to hear what the results were. If any of the lodges reported being hit, firing would be suspended until the safety of the building's occupants could be confirmed.

The first shot in Hellgate Bowl did produce a large avalanche, which hit the northwest corner of the building. Thankfully, that portion of the building had been evacuated, and there were no injuries. But for some reason, the confirmation that avalanches were running, and running big, was never received by the gun crew, and without that input, they assumed all was OK. They started firing subsequent targets in rapid succession, not waiting for a response from the dispatcher as to what the results might be. As they moved eastward to the targets on Flagstaff Mountain, a sudden, frantic call from the dispatcher, "We've been hit, Alta Central has been hit!" burst forth from the radios we all carried, followed by an ominous silence. No one said a word. We collectively held our breath, waiting for the next transmission, which came several seconds later, "Our whole building was just engulfed in a huge dust cloud, and I can see that the Alta Lodge has been hit!" That set things in motion. A few individuals who had been at the bottom of the mountain got there first; struggling through waist-deep snow, broken and uprooted trees, upside-down cars, and shattered glass, in order to reach the building.

A group of Alta ski patrollers arrived a few minutes later, and began to search the rooms where they thought people might be trapped. Thankfully, on the side of the building that faced the mountain, the guests had been evacuated in advance, which was a good thing because those rooms were the most seriously damaged. But a room at the end of the now demolished east wing was thought to have possibly been occupied by a female employee, and that's where the rescue party headed. As they pulled open the door, they found the inside packed with snow to the top of the doorframe. They began to dig their way inside while frantically calling the young woman's name, but not hearing any response. After what must have seemed like an eternity, they found where her bed was located, and as they continued to dig, they discovered her shoe, and then a leg, and finally they reached her upper body. She was alive! Amazingly, as the avalanche had blown through the room's only window, the air-blast ripped off the curtain and sent it sailing across the room, and then defying the laws of probability, it landed on her head and shoulders, covering her face. Then came the snow, which buried her where she lay. But the window curtain had created an air-pocket over her nose and mouth, which kept her alive until the patrol dug her out.

There was another Alta Lodge employee, however, who wasn't quite so lucky. The same avalanche that had buried the young woman in her bed had struck other parts of the lodge as well. Two young men were in the Alta Lodge kitchen when the wave of snow broke through the north wall, traveled down a long stairway, and slammed one of them against the stove at the far

end of the room. He was only partially buried, but had suffered serious injuries, one of which was thought to be life threatening. Now we had a real problem on our hands.

Three of us had been driven by snowcat to the Valley Howitzer about the same time as the P-Ridge gun crew made it to their weapon. Our plan was to shoot only those paths above the highway that threatened the western edge of the resort. Prior to the storm of December 1973, the slopes directly above the Snowbird Village were not considered to be much of a threat, and because of that perception, during the first few years of operation, there was no plan in place as to how to control them. But in the spring of 1973, there had been several wet-snow avalanches, initiated by warm daytime temperatures, observed running from this area, which had come fairly close to the road. When we realized the level of destruction being wrought upon Alta, we felt that those slopes that we had never been concerned with before might actually pose a threat to the Village.

The 75mm Pack Howitzer, located at the Valley Gun tower, was a great little weapon, but it had a few limitations, for one, you could only lower the tube or barrel so far in order to hit lower-elevation targets. The slopes above Snowbird Village that we had suddenly become concerned with were likely to be below the level that the weapon could reach, but we decided to give it a try anyway. Hoopie, armed with a radio, climbed onto the roof of the Lodge at Snowbird and acted as a forward observer while we made several attempts to get shots into the general area. All the other targets above the canyon road and the Town of Alta could be fired in the dark, or during periods of poor visibility by use of Blind-Fire target data. We had no BlindFire data for the slopes above Snowbird Village, so even if we could have lowered the barrel far enough to reach them, we would have had no idea where the shots were landing. His reports from the rooftop confirmed our suspicions that we were not able to hit the right areas, even though we had lowered the weapon so much that each time we fired a round, it tried to jump out of its wheel chocks and careen off the mount. There was also some concern that with each round we fired, due to his close proximity to the detonation, Hoopie would hear the whine of shrapnel whizzing over his head. When we finally realized that this approach wasn't working and that we needed to try something different, he agreed, and willingly abandoned his post.

There are times when it seems that fate just takes over, and directs you to do things for reasons you don't fully understand at the time. Case in point: we had another 75mm Howitzer, that on rare occasions we would haul down the canyon road to fire slide paths that could not be shot from any of the permanently mounted weapons at the resorts. For some unknown reason, a day-or-so earlier, during the first part of the storm, I had gotten ahold of that weapon and had it moved to the garage on the bottom floor of the Snowbird Center. When we realized that we couldn't hit the starting zones above the Snowbird Village with the Valley Howitzer, the idea of using this other weapon seemed like a possible alternative. We got a snowcat to haul it up onto the Plaza (the large, open-air deck that serves as both "Village Square" and roof of the Snowbird Center, surrounded by shops and restaurants, and adjacent to the loading area of the Aerial Tram) and there it waited, for what, we weren't exactly sure.

A doctor who had been trapped at the Alta Lodge for the past week determined that the young man injured by the avalanche had a ruptured spleen, and needed to get to a hospital, quickly; but how to do it? Much of the canyon road was no doubt buried under avalanche debris, and before the plows could start removing snow, we would need to control the rest of the paths that affected the road. All that would take a day or maybe longer. A call was made to the helicopter operator who provided the aircraft for the fledgling helicopter-skiing operation in the canyon, asking him what the chances might be of using a helicopter for the evacuation. He was briefed on the situation and thought that in spite of the storm and poor visibility, he might be able to fly up the canyon from the Salt Lake Valley, grab the victim, and fly him back down to the hospital, in time perhaps to save the young man's life. I don't think anyone but the pilot really thought that this was possible; it was still snowing, and still very windy, with the cloud deck only about two or three hundred

I know a story about Adam's great picture of Superior. It was April 2011, that's the reason why the light is so great, it was later in the season. We had been plagued by a film production crew from a "Reality TV" story called "Snowmen," focusing on the work UDOT did in Little Cottonwood Canyon, both avalanche control and snow removal. It was very difficult to accommodate the film crew as they were continually in our faces while we were trying to work, and they repeatedly wanted to set up "realistic" scenes of whatever storyline they were following. Most all the time they were with us it was snowing, and visibility was pretty limited, so they could never get any actual avalanche footage. The first clear morning after the storm(s) had ended, we were doing control work above the canyon road. As you can see from the photo, it was a bluebird day, and just what they had been hoping for. They had all their camera and sound equipment set up on the Bypass Road, and pointed towards Superior, When the slide Adam took the picture of (with his \$200.00 camera) was released, the cameraman was changing film, or doing something other than filming, and missed much of this beautiful example of avalanche as art.

—Liam Fitzgerald



April 27, 2011; Superior shot #9 up and running thanks to a bullet from the UDOT howitzer on P-Ridge after a 3-day, 24" storm. **Photo Adam Naisbitt**

feet above the road. But in spite of all that, he was willing to give it a try. He took off from the airport and started his climb up to Alta. As he entered the canyon, we stopped firing the Valley Howitzer to allow him to get past Snowbird, and we watched as he traveled, not more than a hundred feet above the road, from treetop to treetop (his only visual reference), on his way to the Alta parking lot where the victim was waiting. He picked up his patient and repeated the same flight plan, this time going down canyon. No one who witnessed that event had any doubts about the skill and heroism he displayed that day.

After finishing our rather ineffective mission at the Valley Howitzer, we returned to the Snowbird Village for the next episode in the unfolding drama. We had decided that the Lodge at Snowbird needed to be evacuated, and in the time it took for us to get back down from the weapon, all the guests had been removed and were brought to the Snowbird Center. Several members of the patrol took a snowcat to the ammo storage magazine near the bottom of the mountain, picked up the appropriate number of rounds, drove onto the plaza-deck, and deposited them near the gun. The storm seemed to have lessened some in intensity by the time we had set the weapon up on its makeshift firing platform, and we were ready to start firing. Also during that period, a number of the guests we had moved from the Lodge - several dozen at least - had discovered what was going on, and had gathered behind us on the Plaza, in what seemed to be a reasonably safe location, to watch the show. Through the in and-out visibility, we could see several large wind rolls on the fairly broad, open, but not particularly long slope that rose up from the road, across the canyon from the Village. We aimed the weapon at one of them, and just before the clouds completely obscured our view again, pulled the trigger.

Along with removing everyone from the Lodge over concerns for their safety, there were three doublewide house trailers parked adjacent to the Plaza which were being used for temporary employee housing; we evacuated them as well. The holidays had been more hectic than usual, with hundreds of lodge guests stranded at the resort; the scores of employees stuck in the canyon also needed to be sheltered during the storm. Some of these individuals who had nowhere else to stay, "crashed" in the trailers along with the regular occupants. All in all, there was little privacy during the past several days and nights, and little or no chance for recreation of any kind. Not wanting to pass up an opportunity to have a little time alone-together, a young lady named Valerie who lived in one

of the trailers and her boyfriend snuck back inside once everyone else had left.

As I peered into the clouds, trying to see the results from our first shot, I suddenly saw what appeared to be aspen trees, popping out of the snow, and being hurled towards the Plaza at a high rate of speed, along with a billowing dust cloud. As I turned around with the idea of escaping, the first thing I saw was a wall of people, the same people we had moved out of the Lodge, standing there, heads tilted back, and mouths open wide, transfixed by the same image that I had just seen; a large avalanche headed directly towards them. I threw my arms up into the air and yelled, very loudly, "RUN!" They looked at me for about half-a-second, and then all scattered, trying to find anything they could to hide behind.

As the dust settled, one-by-one, we all, slowly and quietly at first, made our way back into the open to assess the damage. The avalanche had deposited about a foot of snow on the Plaza deck, along with an abundance of aspen branches. We had been spared even worse damage thanks to a large hole that had been dug a little uphill of the Snowbird Center. The hole, or excavation, was for the foundation of a new lodge (scheduled for construction the following summer), but it was currently empty. Due to its considerable depth and width, it slowed the avalanche down and contained much of the snow that, had it not been there, would have hit the Plaza.

As people continued to come out of the woodwork and look around, we heard someone yell up to us that they thought they heard voices calling out from one of the trailers. The avalanche had damaged all three of them, but one had remained upright, in spite of being hit. Further inspection confirmed the original report that people were trapped inside. Several patrollers quickly located picks, axes, and shovels and began to frantically break through the partially collapsed wall of the trailer to reach whoever was trapped inside. This took a while, during which time many of the people from the Plaza who had witnessed the avalanche, gathered on the edge of the deck to watch the drama unfold below them. After several minutes of beating and shoveling, they got inside; a short time later one of the rescuers popped his head back outside and said, "There's two people in here, they're alive, but they're naked!" We happily gathered up some blankets to provide them with a degree of modesty, and the now celebrated couple made their way out of the trailer, to the applause of several dozen strangers. As one might expect, we named the avalanche path that caused all the damage *Valerie's*. ▲



Goertzen measures slope angle while filming "Send and Return: the BCA Safe Shredding Series."

# PEER AMBASSADORS AT WORK:

Modeling good decision-making in "aggro" freeride films

BY BRUCE EDGERLY

**Aggressive freeride films from Teton Gravity Research, Matchstick Productions, and many others influence hundreds of thousands of young skiers and snowboarders every year. Rowdy big mountain athletes charge big lines, send big airs, and are sometimes shown outrunning avalanches. Does this "aggro" behavior send the right message to young, impressionable riders?**

Backcountry Access (BCA) performed a survey through its social media channels in 2018 to determine how freeride films affect the behavior of skiers, snowboarders, and snowmobilers. The results indicate that 51 percent of recreationists and 93 percent of professionals (that we sampled) believe that freeride films affect the behavior of skiers, snowboarders, and snowmobilers in the backcountry. In fact, 31 percent of professionals confirmed that they have rescued individuals that said they were trying to imitate something they saw in a freeride film. And 94 percent of professionals agree that including avalanche safety content in freeride films would likely cause riders to modify their backcountry behavior.

Based on these trends, BCA shifted its sponsorship budget in 2018 toward developing a series of videos that show the "other side" of freeride films, including the avalanche safety and decision-making process behind these aggressive segments. Entitled "Send and Return," the BCA three-part video series not only shows well-respected athletes riding aggressively, but also shows them evaluating avalanche conditions and planning their tours according to the avalanche conditions. In these films, the athletes demonstrate how to execute safe travel protocols including trailhead tests, traveling one at a time, performing snow stability tests, and communicating clearly about the trip plan. And after they are filmed "sending" radical lines in big mountain terrain, they are always shown safely returning at the end of the day.

The "Send and Return" project enabled BCA to deploy its newly recruited roster of athletes and peer ambassadors to influence the target audience. This communication strategy grew out of BCA's involvement with The Avalanche Project and a study commissioned by that organization that concluded that "peer to peer" communication is the most effective way to modify the behavior of young, aggressive riders.

## BACKGROUND

As a company founded by freeskiers, BCA has always been a supporter of freeride films and competitions, usually with an educational component to its partnerships. BCA representatives have helped train and equip the athletes and production teams. In the early years, BCA even sponsored safety segments on the "DVD extras" that came with each DVD. With the advent of social media channels including YouTube, Vimeo, Instagram and Facebook, it has become easier for BCA to distribute video content outside conventional means such as DVDs and film tours. This widespread access to social media audiences has created opportunities for manufacturers to create their own content instead of relying on film producers and their own distribution networks. Since avalanche safety doesn't quite "sell" as readily as aggressive freeriding, producers rarely include avalanche safety content in their films. This prompted BCA to create its own series of short videos in 2018 that could be distributed through today's well-developed social media channels.

To test these ideas, BCA distributed a survey to the backcountry community through e-mail and social media channels, to determine if freeride films affect the behavior of skiers, snowboarders, and snowmobilers—and whether including safety content could have a positive effect on their behavior. This BCA survey, entitled "Are You Under the Influence (of Ski & Sled Films)?" can be found in the Appendix.

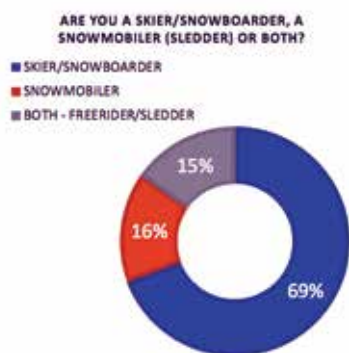
The video project was partially influenced by research commissioned by The Avalanche Project, a former consortium of ski industry stakeholders with a mission to develop consistent snow safety messaging across North America. Focus groups hosted by Kruse Consulting concluded that "peer-to-peer"—rather than "top-down"—communication is the most effective way to influence young, aggressive off-piste riders (Kruse et.al. 2014).

## SURVEY PARTICIPANTS

A total of 1,370 people completed the BCA survey. The makeup of the survey participant group is characterized as follows.

- 10 percent of survey participants were 25 years old or younger, 41 percent of survey participants were 26-40 years old, and 49 percent of survey participants were 41 years or older.
- 31 percent of participants typically spend ten days or less in the backcountry, 24 percent spend 11-20 days in the backcountry, and 45 percent spend over 20 days each season in the backcountry.
- 69 percent of participants identified as a skier or snowboarder, and 31 percent identified as a snowmobiler (or both snowmobiler and skier/snowboarder).
- 75 percent of the survey participants self-identified as a recreationist (recreational backcountry skier, snowboarder or snowmobiler) and 25 percent of survey participants self-identified as a professional (professional guide, ski patrol or educator).

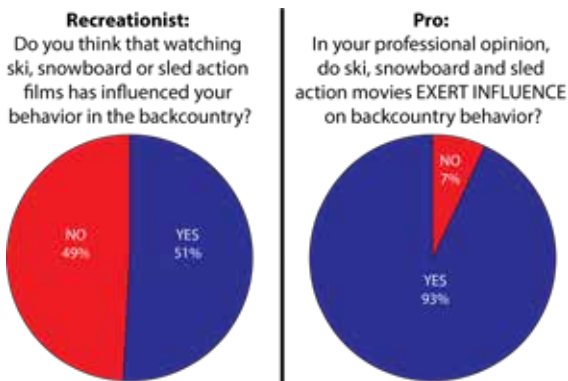
## SURVEY RESULTS



Distribution of survey participants, by activity.



Level of avalanche training among survey participants.



Recreationist versus professional perspectives on the influence of freeride films.

**SURVEY RESULTS**

There were several key findings in the survey:

- Of the recreationists surveyed, 51 percent said that watching freeride films influences their behavior in the backcountry. 49 percent said freeride films don't affect their backcountry behavior—close to an even split.
- While 62 percent of recreational riders stated that they have entered into backcountry terrain similar to what they'd seen in a freeride film, 11.5 percent reported that they had entered into such terrain during “questionable” avalanche conditions specifically to ride in terrain and conditions similar to what they'd seen in these films.
- Of the snow professionals surveyed, 55 percent said they'd had guests ask them to teach them tricks or take them to terrain similar to what they'd seen in a freeride film. 31 percent said they've had to rescue someone who said they'd tried a trick or entered into terrain to imitate something they saw in a freeride film.
- Among these pros, 93 percent said they thought freeride films affect the behavior of recreationists; 7 percent said they didn't think so. Consistent with these results, 96 percent of professionals said they thought recreationists are “somewhat” or “extremely” more likely to take additional risks in the backcountry than if they had not seen freeride films. Six percent said they didn't think this was the case.
- Of the professionals surveyed, 94 percent said they thought recreationists were “somewhat” or “extremely” likely to modify their behavior if avalanche safety segments were shown within freeride films. Six percent said it was unlikely.



Goertzen, a former freeride competitor, tosses a front flip for the camera.

**SEND AND RETURN VIDEO SERIES**

Over the winter and spring of 2018, BCA commissioned several of its athletes and ambassadors to create the three-part BCA “Send and Return” video series that includes avalanche safety messaging in addition to aggressive skiing, snowboarding, and snowmobiling footage. The series consists of one video featuring backcountry skiers and snowboarders, one video featuring hybrid skiers/snowmobilers, and one video featuring only snowmobilers. The videos were filmed and edited by Ben Goertzen of RedYeti Productions, Riley Leboe of Seeking Nirvana, and Jim Phelan of Thunderstruck Films, respectively. Each video includes segments showing athletes checking the avalanche bulletin, planning their tour, performing a transceiver trailhead test, riding one at a time, performing appropriate stability tests, and returning to the trailhead at the end of the day. And, of course, they all include aggressive riding footage, including eye-catching aerial maneuvers.

“Send and Return” debuted in the autumn of 2018 and is being distributed via social media and is downloadable at [www.backcountryaccess.com](http://www.backcountryaccess.com). ▲



Thunderstruck rider Cody Hunt jumps a wind lip outside Alpine, WY in episode 3, “Riding Revy with Team Thunderstruck.”

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**Bruce Edgerly** is co-founder and VP of Backcountry Access, Inc. (BCA), a leading manufacturer of avalanche safety equipment, including Tracker transceivers, Float air-bags, and BC Link radios. Edge is totally stoked on skiing, and his son Stu, sidelined with a blown ACL, is now living vicariously through his dad.






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# A Lawyer's Perspective on Incident Response

BY LEAH CORRIGAN

Outdoor professionals tend to be very adept at managing risk in the outdoors, and there is an ever-increasing focus on technical training for on-the-ground risk mitigation, wilderness medical training, and rescue training. However, there tends to be much less focus on the fundamentally human aspects of how we respond to a serious incident in the backcountry. The human response to a serious accident or fatality is a major factor in whether a lawsuit occurs, and how effectively the lawsuit can be defended. It also has a major impact on the reputations of both the organization and the involved professionals. Understanding and training on this human response is a critical component of professionalism for guides.

This article is designed to give an overview of those on-scene incident response considerations that are most often overlooked by outdoor professionals.

## 1. Competence.

When a person or their loved one is involved in a serious incident, your apparent level of competence in managing the response to the incident is critical to how they will feel about the outcome. The best way to appear competent is to be competent. It is difficult to display a level of professionalism during a stressful incident if you have not trained with your co-workers on how an incident is managed. Your incident response plan should contain an "incident command" structure that is appropriate to the size of your company. Disciplined deference to that structure is an important baseline standard of incident response. Also important, however, is a recognition that a dynamic environment requires flexibility in your response to an incident. Perhaps the individual with the highest level of medical training is needed for a technical rescue? Perhaps your lead guide was involved in the incident and is physically or mentally compromised? In such cases, having the flexibility to adjust the command structure is important. In order to develop the skills and communication required for your team to function efficiently and effectively when the inevitable occurs, scenario-based training is necessary. Managing an incident in a professional manner is like all skill-sets in the outdoors—it takes practice.

## 2. Managing Human Emotion

An obvious, but often overlooked consideration in incident response is the recognition that human emotions can and should impact the manner in which you conduct yourself as a professional. Whether dealing with a person who has suffered a serious injury, or with a person who has witnessed an injury or fatality (perhaps of their loved one or a close friend), having a fundamental awareness of how they are responding emotionally is a necessity. It is easy to get caught up in dealing with the nuts and bolts of managing all other aspects of an incident, and overlooking the emotional trauma of the involved person or their companions. You ignore this emotional response at your peril.

It is fundamental to being human that we show empathy and kindness to someone who has suffered a life-altering loss. It is also natural and expected to express sorrow to a person who has suffered a loss. As professionals, you should not suspend your natural response to show kindness and empathy to someone in that situation, and to express sorrow. It is a false assumption that if

an outdoor professional says "sorry" in the event of an incident resulting in death or injury, they have admitted liability. There is a fundamental difference between expressing your sorrow that something devastating occurred, and admitting fault for the occurrence. As outdoor professionals, you know that bad things can happen in the backcountry as a result of inherent risk. That is a risk that all participants in an

outdoor activity must accept. However, that reality does not change the fact that you can still feel genuine empathy and sorrow that an incident occurred, and it is entirely appropriate, and perhaps necessary, to express that emotion.

A related consideration is developing an understanding of the strengths and weaknesses of those with whom you work. Some individuals are better caretakers than others. Some individuals are more experienced and disciplined in their communications than others. Some individuals are better equipped to withstand their own emotional reaction to a traumatic incident than others. Analyzing and discussing your team's individual strengths and weaknesses is an important aspect to ensuring an emotionally-appropriate response to a serious incident.

Like all skills necessary to being a true outdoor professional, an emotionally competent response to an emergency takes practice. Scenario based-training is important, and is particularly critical for younger professionals who may have less experience dealing with human loss.

## 3. Scene Management and Investigation

The third area where critical errors in incident management are most often made is in a failure to control the scene of an incident, and to competently gather facts and information that form the basis for a thorough investigation. Many outdoor incidents occur not due to the negligence of professionals, but as a result of an inherent risk of recreating in a dynamic environment. Documenting exactly what happened can illuminate that distinction, and may dissuade injured people and their families from filing a lawsuit. In the worst-case scenario of a lawsuit, an effective and thorough investigation can provide a lawyer the tools to mount an effective defense against claims of negligence.

In an age where cell-phone and other bystander-gathered videos often provide the dominant narrative for what occurred and how the incident was handled, control of the scene is important. Cell-phone or "Go-Pro" videos are generally incomplete, and tend to show a scene that appears more chaotic than it is. Oftentimes, individuals who are filming a scene should or could be assisting in managing the incident. It is appropriate to ask them to stop filming and help, or to stop filming out of respect for the involved person or their family. Redirecting their energy to assisting with a task is appropriate, if done respectfully and calmly.

When an incident occurs, effort should be made to gather a witness statement and/or any photographs or videos from bystanders or group members, and each professional who was involved in the incident or response. Witnesses and professionals should be instructed that the purpose of a witness statement is simply to set forth their observation of objective facts. A witness statement should never contain subjective guesses as to facts, should never contain speculation, and should never contain opinion. It is the job of the person who conducts the investigation of the incident to stitch together each witness statement, photographs, weather and snowpack data, and any other relevant factual data to put together a narrative of the incident—the story of what happened. Therefore, witnesses do not need to speculate or guess at facts in order to create a complete narrative. Understanding this can help witnesses provide a helpful and complete statement, and avoid writing down inadvertently damaging or incorrect information or opinions.

These three areas of incident response are the areas where many outdoor professionals have the most room for improvement toward the ultimate goal of professional competence in all relevant disciplines. Competence in incident management is a necessary skill for outdoor professionals, particularly in an age of ever-increasing litigation resulting from recreational injuries. ▲

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Andy traps his eye on the terrain from his perspective in film.  
Photo: Freddie Marzinger



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Kim, Heidi, Andy, Wendell and Sam Schmitt enjoy a cold one after a snowy day in the backcountry.  
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