THE Avalanche REVIEW

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INCIDENT on CHINOOK PASS

Story and photos by John Stimberis

Every ski cut set off a wet point release that kept moving.

The radio transmission was loud and clear, but the reality of the call was so surreal: "**I'm in an avalanche!**" I looked up the road and there it was, an avalanche pounding the highway. Snow shot off the road and down to the valley floor. I called back to check that he was still there and the equipment operator confirmed that he and the John Deere 850 bulldozer were in fact still on the road.

Article continued on page 17.

The Avalanche Review
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in this issue

"People do not die from nuances. They die from an ignorance of what lies under their feet and an adamancy about that ignorance."

– Doug Chabot
Human Factors and Digging, page 12

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american avalanche association

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from the executive director

Hello AAA Members & TAR Subscribers,

I hope this issue of TAR finds you in the midst of another great winter season. I'm coming to realize that, in my role as Executive Director of the AAA, all times of the year are busy! There is always a project (or two or three or more) on the table and plenty of work to be done. This issue of TAR highlights a number of things the AAA has been working on or involved with recently, and helps to paint a more complete picture of how the AAA is actively supporting and engaging with the industry in myriad ways.

I am frequently asked about what value the AAA brings to the industry and to individual members. TAR itself is one of the most obvious answers to this question, sharing information across the industry and around the world, and yet the AAA is also working on so much more! One of the bigger projects on our plate right now is the work being done by the AAA Education Committee, under the leadership of Committee Chair and Project Manager Kirk Bachman, on revising the avalanche education paradigm in the U.S. As you'll learn in Kirk's article, this is a multi-phased project with the goal of re-envisioning an avalanche education system that better meets the needs of both recreationists and professionals in our country. The project is in collaboration with stakeholders across the industry, and we welcome feedback and input as we craft the details of the new system.

In addition to the Pro/Rec project mentioned above, there is still more! We recently awarded research grants to two different individuals and their projects (Scott Savage and Katrin Wikstrom Jones). Our AVPRO coordinator, Dallas Glass, has been busy tying up details of this year's AVPRO course taking place in Summit County, CO, at the end of February. The AAA has stepped up to collaborate with and support the efforts of Project Zero. Our new SAR Committee Chairs, Maura Longden and Nick Armitage, are working to prioritize action items in that segment of the industry. Earlier this fall we relaunched a more user-friendly avalanche.org website to provide the general public with easy access to important avalanche information.

Perhaps most importantly, we continue to work on solidifying ways to sustainably support more programming that aligns with our mission (i.e. we're developing strategies to consistently generate more revenue for the AAA). This is just a sampling of how the AAA is actively working to add value to your membership and to support the industry as a whole.

So, take a moment or two to enjoy this issue of TAR, and please be in touch with your avalanche industry-related questions, thoughts, or concerns. We're here to "**promote and support professionalism and excellence in avalanche safety, education, and research in the U.S.**", and we, of course, need your help and engagement to do that most effectively. I hope your winter has been and continues to be safe and successful!

—Jaime Musnicki, AAA Executive Director

Sisters Jaime (right) and Megan Musnicki visit over the holidays.
Photo by Mom, Gail Musnicki

from the editor

As I put this TAR together, there's a wide distribution of 2cm surface hoar almost half a meter down in the Tetons; my early-season optimism about our snowpack is tempered by a long-term mistrust in this tricky PWL. Luckily I have counsel from previous TARs to fall back on. I can find a PWL essay from Karl Klassen from TAR 26.4 by using the Google search feature on the TAR archives page, plus six more pages of articles that refer to surface hoar. I'll continue to extract and file these articles individually by topic in the TAR library section of the AAA website; let me know which articles/ folders you'd like to see please. http://www.avalanche.org/moonstone.php.

Here's a stuffed issue of TAR. We began simply with a rescue theme; that theme then expanded to include the AAA Education Committee's proposal to institute distinct Professional/ Recreation education progressions, along with explanation of the process. The plan is still malleable; now is the time to read carefully and express your opinion to the organizing team.

Then I received a wave of articles that revolve around another theme, that of using the avalanche problems to refine forecasting and decision-making. And THEN I did my word counts- we were FULL. So you'll find 36 pages rather than 32 to this TAR; it should give you food for thought on some front, and plenty to chew on until the April TAR, whose broad theme blankets human factors, decision-making, and accident case studies. Deadline for submissions is February 15.

I'd also like to extend an apology: the December TAR omitted the graphs and figures from Karl Birkeland's important article about the science behind digging compression tests on low-angle slopes. You'll find it in this issue in its entirety on page 10.

Your editor and your ED share some laughs and some powder turns in Grand Teton Park, on the editor's birthday.
Photo by Georgie Stanley

Pride of place on the cover goes to our AAA President, John Stimberis, who sent TAR a riveting story, accompanied by his trademark high quality photos, of a bulldozer buried in an avalanche on Chinook Pass. Centerfold photo honors go to Josh Cooley, whose gorgeous shots of last year's Damalanche in Valdez deserve to be seen on a high resolution screen, but our paper format must suffice for now.

The rescue theme opens with news from the AAA SAR co-chairs Nick Armitage and Maura Longden as they revitalize their committee. You'll find articles on systems and statistics updates from Dale Atkins, a report from IKAR, a beacon primer from Bruce Edgerly, a look at ski patrol accidents from Alex Bergeron, and a thoughtful analysis of a fatal avalanche accident in the Sawtooths from Terry O'Connor that builds on Scott Savage's ISSW material.

The bulk of US forecast centers have adopted the avalanche problems in their forecasts; avalanche schools are teaching the problems at the core of lessons; a lot of big brains are coming up with tips and tricks for teaching and interpreting the problems, then writing articles for TAR. In this issue, you will find further definitions and clarifications from Brian Lazar et al. You will also find additions to the avalanche problem toolbox via new travel advice graphics from Wendy Wagner and Drew Hardesty; unfortunately, we don't have room to print more than a couple. Alex Marienthal put some thought into the deep slab problem; he shares his insights on page 33. Then Doug Chabot and Mark Staples bring a pair of linked articles on the value of digging pits to add data to your understanding of the problems.

Drew Hardesty presents a strong argument towards a Backcountry Code of Conduct on page 9; would this be helpful in your home area? Unnecessary? What do you think?

And if you've ever battled a broken weather station on a windy day, tried to interpret French Gazex directions, or wanted to throw your phone out the window and return to a simpler millennium, don't miss Dave Hamre's essay, "Technology Trap," on the back page.

—Lynne Wolfe, Editor

aaa news

AvPro 2014: A Report from Michael Phillips

Tim Farrar demonstrates craftsmanship in a classroom-sized snow pit at Alpine Meadows during the 2014 AvPro course in the Lake Tahoe area.
Photo by Mike Phillips

Sometime around the middle of January I started wondering whether or not 2014 was going to be the best winter for attending an extended professional avalanche course. A massive dry spell struck the Sierra Nevada from early December until the end of January with only trace amounts of precipitation measured at Mammoth Mountain. The winter of 2013-2014 will likely go down in the record books for low snow, and continuing drought conditions in the state of California. The persistent "Ridiculously Resilient Ridge" put much of California well out of reach of the Pacific storms that typically bring heavy mountain snow and quench the thirst of my fellow ski patrollers who crave dynamic weather and early morning control work. The meager mid-season snowpack in the Sierra was plagued by depth hoar, crust/facet combinations, and poor skiing conditions uncommon this late in the winter. Then it started snowing and my confidence grew as to the value of a field-based avalanche course this season. February brought periodic snowfall that peaked at the end of the month, just in time.

This year's AvPro course was held in North Lake Tahoe, California/Nevada February 25-March 4, 2014. Alpine Meadows, Squaw Valley, Mt. Rose and the beautiful Donner Pass backcountry hosted a diverse group of ski patrollers, avalanche forecasters and search and rescue specialists for an excellent eight-day course. Each year the AvPro course attracts a variety of avalanche professionals from different backgrounds and mountain regions of the U.S. This year's class of 12 was comprised of a talented group of pros from the Sierra Nevada, Mt. Shasta, the High Cascades of Central Oregon, and Colorado's Front Range.

A significant amount of time was spent at Alpine Meadows ski area. The ski patrol there welcomed us and shared much about their weather program, operational avalanche plan, and avalanche control. We participated in an avalanche rescue scenario with their patrol and were fortunate to shadow experienced route leaders for a morning of control work thanks to a small storm that brought enough "Sierra Cement" to warrant at least a few hand charges.

The weather during the course was a mixed bag of beautiful California sunshine, wet snow, and rain at the lower elevations. I sensed amazement from some of my Rocky Mountain classmates who don't usually deal with soaking rain events mid-winter or digging snow pits to the ground only to find saturated snow and mud instead of depth hoar. I can only assume that that alone was a unique learning opportunity for them.

Prior to enrolling in this course, students are expected to be proficient in particular skills such as companion rescue and snow pits, and should also have a broad knowledge base of operational avalanche programs, and snow and avalanche science. Coming prepared with strong background knowledge and practical skills will enable students to get more out of the educative experience and feedback process of this course. Benchmarks and evaluation criteria to pass the course are to demonstrate comprehension of classroom material through a written exam, successfully locate and probe-strike three buried beacons in a 50 m x 50 m area in under seven minutes, and demonstrate a high quality snowpit documented to SWAG standards in one hour or less.

The AvPro curriculum is designed to address practical skills, present emerging research, and identify trends in the professional avalanche worker trade. The 2014 course balanced classroom time with field time including backcountry travel. Hands-on learning and guided practice helped students take their practical skills to the next level. Above all, professionalism and craftsmanship were common themes amongst all of the topics presented and practiced throughout the course. Students were held to a higher standard in their communication, documentation and practical skills. This course was one of the best professional development opportunities I have ever been a part of.

Many thanks go out to the people who made this valuable course a success. AvPro 2014 was organized and facilitated by AAA education coordinator Dallas Glass. Instructors Ned Bair (CRREL, UCSB), Tim Farrar (Snowbird, Utah Mountain Adventures, Rhino Access) and Patty Morrison (Stevens Pass, WASDOT) each brought unique energy, experience and perspectives to the table, and provided excellent instruction across a broad spectrum of topics. Guest speakers and gracious hosts included Jeff Goldstone, Evan Salke, Gene Urie and the Alpine Meadows Ski Patrol; Andy Anderson and Brandon Schwartz of the Sierra Avalanche Center; Mike Ferrari, Tom Carter and the Mt. Rose Ski Patrol, Larry Heywood of Squaw Valley, and Zach Tolby of the NWSFO in Reno, NV.

Mike Phillips is a 5th year patroller at Mammoth Mountain Ski Area in California's beautiful High Sierra. He was a recipient of a generous scholarship from the AAA to attend the 2014 AvPro course.

Research Grant Updates

Congratulations to Scott Savage and Ella Darham, who were recently awarded grants from the Theo Meiners research fund.

Scott Savage: The Effects of Artificial Warming of Surface Layers on Propagation.
Warming-induced dry snow avalanches are not well understood, appear to involve changing slab properties, and are very difficult to accurately forecast. Savage plans to test the effect of surface manipulation on fracture in an initially stable snowpack. He will start with snowpacks that initially lack surface slabs and produce ECTN/ECTX and PST>50/100 results. To mimic the effect of rapid warming, he will artificially warm low density surface snow and then perform ECT and PST tests on both control and artificially-warmed samples - both with and without pre-existing weak layers beneath the storm snow – following deposition of cold, low density storm snow. Stability test results, temperatures (air, within the new snow, and in the weak layer), densities (near surface and lower in the new snow), hand hardness, and new snow depth above the substratum will be recorded before and after treatment.

Ella Darham: Avalanche Explosive Mitigation Analysis & Implications on the Anti-Crack Model
The goal of the ongoing research is to provide quantitative evidence of various avalanche explosive delivery methods comparing their effectiveness for triggering larger avalanches in an operational setting. Additionally, the research will test practical implications of the anti-crack model with respect to slab 'communication' in explosive induced avalanches. The following research is being conducted within the operational boundary of the Bridger Bowl Ski Area located in southwest Montana.

The first aspect of the research is to compare effectiveness of different avalanche mitigation methods (air blasts, surface blasts, cornice drops…) on two major slide paths within the Bridger Bowl Ski Area boundary. Once this first aspect is addressed, then the second, more important part of the research can be implemented. Since the research is conducted in an operating ski area, measures need to be taken outside of the research parameters to ensure avalanche safety for the skiing public. Subsequently, if the surface blast is ineffective to the degree to which we determine risk to be satisfactory, a second charge (air blast) will be detonated in the respected slide path. The purpose is to determine (A) if air blasts can trigger additional avalanches after a surface blast detonation in the same location and (B) if the 'communication' of force from an air blast is disrupted due to vertical cracks inflicted in the slab layer from the previous surface blast; thus, affecting the subsequent avalanche size.

A stationary time-lapse camera is mounted on tower 17 at the top of the Alpine lift facing Hidden Gulley and Northwest Passage. The camera is be programmed to capture a photograph every few minutes during avalanche control (7:30am-9:30am) to ensure photographic documentation before and after each shot is detonated. From the photographs that capture the avalanche activity, the percent of slide path area involved in the resulting avalanche are calculated; thus, determining the relative size of the avalanches (R Scale). From the triggering locations the approximate depths of the avalanches are recorded to assist with calculating the approximate volume, destructive size (D Scale), of the avalanches.

During the winter of 2013-14 minimal tests occurred due to administrative and technical logistics. From these few results it was found that the aerial shots were more effective than the surface blasts. So far, there is no conclusive evidence as to whether the shots are continually producing larger avalanches on the same slab/weak layer interface. Testing will carry on during the 2014-15 winter, and potentially 2015-16 depending on results. The hope is that the future findings will be useful for all avalanche control operations utilizing explosives (heli-skiing, ski areas, departments of transportation, mines etc.), as they will now have in-depth, practical, and comprehensive evidence to support their avalanche mitigation programs.

****This research is in its early stages and is a work in progress. Comments, suggestions, and critiques are gladly welcomed and encouraged. Please feel free to contact me at any time at* ***ekdarham@gmail.com****.*

ACKNOWLEDGMENTS:
This research has been made possible by the American Avalanche Association's Theo Meiners Grant. Special thanks to Jordy Hendrikx, Karl Birkeland, Randy Elliott, Doug Richmond, and Pete Maleski for their continued help and support.

Ella Darham grew up skiing at Bridger Bowl and has patrolled there for 7 years. Like many Bridger folks, Ella is looking forward to being another "lifer" on the patrol.

In Memory of Terry Onslow

Gifts from the Debris

By Bruce Gough

As I looked at the satellite imagery, a massive low pressure was moving up the Gulf of Alaska. March 25, 2009, forecasts were calling for gale force winds and generous amounts of snow that evening. It seemed so surreal, as it was partly cloudy and calm that afternoon, yet in the distance an angry monster was on the loose, bearing down on the Kenai Mountains, south of Girdwood, Alaska.

The storm arrived that night with a fury. High winds accompanied over a meter of snow in this monster event. The next day we knew it would be wise to pack a big lunch; a very long day lay ahead.

I drove to Portage early to help organize the gun crew for avalanche control work. A nasty slide path called F7, just outside the north railroad tunnel portal on the Whittier subdivision, was to be our first control mission. The main starting zone is 1,000 meters up and feeds into a tight narrow gully that slowly fans out near the bottom. Unfortunately, our railroad tracks lay only meters away from its base. Transported snow is usually a factor for this slide path, due to its geographical location and the terrain features.

Years earlier, Dave Hamre and I shot this slide path in late spring, during a wet and windy storm cycle. We triggered a large wet slide that produced a powerful punch as it hit our tracks and Portage Creek. High energy impact hurled the thick river ice out with ease. Once the avalanche had stopped flowing, 20 meters of snow lay on our track with a width of 200 meters. Learning from this past experience, I positioned my truck on Portage Road, a safe 300 meters distance from the slide path, but not too far for good visibility. Several ravens flew overhead then would swoop down to pick up something out of the snow, only a meter or two from my truck, then fly away. After several revisits by these birds, I decided to check it out. It surprised me to find small salmon fry scattered about on top of the snow, apparently the slide had the energy to blast out water, ice and fish. Avalanches will never cease to amaze me. Now, back to the story.

That morning (back to March 2009), our chief train dispatcher has advised both Dave and me that a Whittier freight was scheduled for that evening, and to check back later on its progress. We organized our gun crew and set the 105 Howitzer in position. Our gun crew had done all the pre-fire weapons checks, all was in order, now was the time to awake this sleeping beast.

Since the storm had passed the day before, weather was not a real issue, even though low hanging clouds did not allow us to see the starting zones for visual firing; we had good blind fire data to hit all the sweet spots.

"Ready to Load" was announced. Our weapon was loaded and all data was correct and repeated. "Clear to the Front," "Clear to the Rear," "All clear," "Ready to fire,"…"FIRE!" The shot rang out with a thunderous roar, the projectile raced through the dense cloud cover, and within a few seconds, we heard the explosion. We waited in silence, silence, then we heard the distinct rumbling sound of an avalanche, yet we could not see it. The sound was getting much louder now, intensifying with every second, the sound of 100 locomotives roaring down the mountain. The thunderous sound continued, and after what seemed like an eternity, the rumble slowly faded away. Silence fell on our crew. Dave and I looked at each other and knew what the other was thinking: "That was a big one." Our crew continued shooting the remaining shots at known starting zones and depleted our ammo.

At this moment, chatter came over our railroad radio. "Dispatcher calling the Gun Crew, over!" "Gun Crew, Over!" "Whittier recently lost all electricity and was just wondering if you know anything about that situation?" "Negative dispatcher, we are unsure why they lost power, over." "Ok, thanks, Dispatcher Out," "Roger, gun crew out." Once again, without saying a word, Dave and I looked at each other. We sprinted to our railroad truck and drove in the direction of the slide path. We rounded the next curve in the road and then we entered a surreal landscape,

This slide path, "Kern," is roughly 15 miles from F7, on the Alaska Railroad as it parallels the Seward highway. It can potentially hit both railroad and the Seward highway. Generally, if these avalanche paths are active, so is F7. *Photo by Bruce Gough*

a twilight zone, a bad dream you want to wake up from, this cannot be, but it is. This beast left its mark.

Initially, our attention was on a jeep that had driven into the flanks of the avalanche debris, the front wheels embedded in the slide while the rest of the vehicle was not affected. A young man was exiting the jeep as we stopped our vehicle. "Are you ok?" "Yes, fine." Dave and I then retrieved our probes, checking for any other vehicles that may be buried. Luckily, we did not find any. We then revisited the young man again to check on him, and once again he said he was ok, but he was going to be late for work. The slide on the road was roughly three meters high and 20 meters wide. Looking back towards F7, we quickly realized why Whittier had no power. Overhead high voltage transmission lines were strewn about like spaghetti. Treated wooden power poles were snapped at the bases like toothpicks. Large trees and limbs were scattered along this path of destruction. The smell of spruce and hemlock permeated the air, as if holding a cheap air freshener under your nose.

It was now that we turned to see our friend Terry Onslow driving up in his State of Alaska DOT truck. Perfect timing. Dave and I approached Terry to brief him on the current situation. Terry asked if everyone was ok, and we acknowledged yes. Terry surveyed the situation, and said "Looks like you got your work cut out." Terry radioed up a state loader that was nearby and we called upon our loader in Whittier to assist as well. Traffic control was set up, and with the help of Terry, we then used the loader to pull the jeep back out of the slide. The fender wells were packed with solidified snow and had to be hand picked out so the wheels could turn. Otherwise ok. The loaders cleared the road and the traffic was released. Terry informed us that he had never seen this slide hit the road before nor had any history of it either. A first for all of us.

I forgot who made the call back to the dispatcher to explain that we now knew why Whittier did not have any power.

A few days later I revisited this slide and measured the runout distance from the toe of the slope as 500 meters in length.

Terry's handmade avalanche debris bowl.

Several weeks later I received a phone call from Terry. "Hi Terry, what's up?" "Are you coming by Girdwood today?" I told him I would be passing through a little later. Terry told me to stop by, and I agreed. When I met Terry later, I knew immediately something was up. Terry had this wry grin on his face. He said, "You know that slide you and Hamre knocked down at F7?" "Umm yea," "well, I got something for you and Hamre." Not knowing what lay in store, I stayed quiet. Terry reached in his truck and pulled out a beautiful wooden bowl and gave it to me. Shocked and surprised at the craftsmanship of this bowl, I asked Terry, "Did you craft this bowl?" Terry said, "Yep, out of that damn wood you and Hamre put on my road from F7!"

In reflecting back on this event, I realized: NEVER underestimate the power of an avalanche, expect the unexpected, and cherish the gift of friends, community and talents of those we hold dear.

Terry, may you Rest in Peace, and know that you are loved and missed by many.

Bruce Gough
General Road Master South End
Master Gunner
Alaska Railroad ❄

Terrence Raymond "Terry" Onslow
February 20, 1945 – November 25, 2014

By Dave Hamre

Longtime Girdwood, Alaska resident Terry Onslow, age 69, passed away on Tuesday, November 25, 2014 at Providence Alaska Medical Center following a short, unexpected illness.

"Terry touched many people's lives and was loved by many for his strength of character, loyalty to friends, sense of humor, and willingness to stand up for what he believed was the right thing. The world shares our loss of a really good man. Terry was always larger than life and lived a very full and busy life… we miss him greatly," says his family.

Terry was born February 20, 1945 in Missoula, Montana to Donald Raymond and Kathryn Smith Onslow. He studied Anthropology at the University of Montana Missoula prior to beginning a varied and interesting career that included working as a logger, volunteer firefighter, skilled carpenter, ski patrolman (Stowe, VT, Bridger Bowl, MT, and Big Sky, MT) and ending his Montana career as Big Sky Resort mountain manager. While at Bridger Bowl, he met the love of his life, Judith Jean Robertson, who he married in 1976 in a joint Catholic/Protestant ceremony at the Gallatin Canyon Soldier's Chapel.

"I was on the Bridger Bowl Junior National ski patrol in the early 70s. Duane Bowles was the pro patrol leader, Terry the assistant, Beep Dixon, Jim Kanzler, Onno Wieringa were core members. Parties seemed wilder back then. One of them at Terry's house had drinking and feasting on Rocky Mountain Oysters, procured by Onno, one of which was the size of a big Idaho russet potato. That night after winning an athletic drinking game, it was later proclaimed the winner must eat the biggest oyster. I didn't like them. Terry and Beep insisted. It was also proclaimed that I had to chew it. I was held by both arms, my jaw was pinched open, and one hand held my chin, the other had a firm grasp on my hair and chew I did.

Terry's personality permeated the Bridger Bowl ski patrol, and later the Big Sky patrol. His career continued in the industry with both winter ski and snow safety programs. He was a consummate professional who did his job with flair, personality, humor and wit. He touched many people."

—Doug McCarty

After moving over to Big Sky when it opened in 1972, Terry became Patrol Leader and later the Mountain Manager. Some of his focus was paid to patrol morale, which was fairly low following some unfortunate events in 1974 or so. Terry wanted to improve this so designated a couple of people to come up with an event that would boost morale, which was subsequently named the Dirtbag Ball. This event, sponsored by the ski patrol, has been a Big Sky institution ever since. Folks in the valley vie for the distinguished prize of being named the Dirtbag King or Queen, partially thanks to Terry.

"I arrived at Bridger Bowl in '69 and when I met the group it looked something like Doug McCarty describes plus Peter Lev, John Montagne, and Jim Kanzler. Most of us went on to long avalanche careers. After Terry's Figure 8 partner didn't show up for a competition and I filled in, Terry took me under his wing. He and Don Mitchell taught me how to shoot the 75 R.R. which got me started on artillery. We all stayed and enjoyed everything Bridger Bowl had to offer for several years until Big Sky was opening, then there was a mass migration south to the new place. I wish I had owned a camera or at least written a diary in those days because it was a lot of fun."

—Onno Wieringa

Ultimately the skills from his early professions led to becoming an Avalanche Forecaster for the State of Alaska, based in Girdwood, where he moved his family – wife Judy and daughter Erin (born 1982) – in September 1983. He served the State of Alaska for 27+ years, retiring in 2011, working countless hours including holidays and weekends to ensure that Alaska's highways remained safe from avalanches for travelers. His many achievements included his work on RWIS (Road Weather Information System), which allows for improved public safety and road condition information, and ongoing improvements to avalanche safety along the Seward Highway avalanche corridors. He was also instrumental in both the creation and ongoing operations of the Avalanche Artillery Users of North America Committee in which he helped lead the organization to establish high standards for training and operation of military artillery in avalanche work.

"Terry faced one of the most notorious and dangerous pieces of roadway called Bird Hill before the road was relocated down to tidewater. The road ran around the hillside at the 300-400 foot level with the peaks up around 3,500 feet average. Every once in awhile this place would just go off. There was 3.5 miles of roadway that was almost continuously threatened with virtually no safe spots. The starting zones were a series of uniform gullies in the 37-40 degree range. The transition zone, which is quite steep all the way to the ocean, would usually have some damp snow on it that would impede avalanche flow. Every once in awhile it would have a cold layer with buried surface hoar or some other structure that would cause avalanches to accelerate all the way down the hill to tidewater below the road. It would all go critical at the same time with the first avalanche stopping traffic flow and another one within 20 minutes or so. It was very scary to me, and I had seen a lot of scary avalanches by then. Back then Alaska DOT managers higher than Terry didn't want to close the road on the basis of a forecast, which left Terry out there numerous nights sorting out traffic in the middle of raging storms after naturals started hitting the road.

After a few times of doing this he started developing some new procedures in his get-around- the problems kind of way. The State also had a policy of not cleaning up avalanche debris after night fell. Every once in awhile Terry would wait to shoot until about 2 or 3 PM in the afternoon knowing that if he knocked anything down on the road, they would not be able to clean it up by nightfall. This gave him and by extension the managers above him cover for keeping the road closed all night."

—David Hamre

Following his retirement from the State of Alaska in 2011, Terry devoted much of his time to his favorite pastimes: spending time with his family and boating in Prince William Sound aboard the Elena – shrimping, fishing, exploring, and enjoying the company of fellow boaters. He also spent much of his time woodworking - a lifelong enjoyment, and creating wooden masterpieces on his lathe. He was active in the Alaska Woodturning Association and enjoyed introducing others to woodturning. Terry was active in the Girdwood community, and enjoyed spending time with friends he made over his 30+ years of living in the area; he enjoyed cooking for community events and for his family. He also loved traveling, and in addition to his worldwide snow science-related travels, Terry enjoyed his visits to Tahiti, France, Russia, Hawaii, Argentina and more.

Terry was active in the Catholic Church in Girdwood and instrumental in the building of the Our Lady of the Snows Chapel including The Meadows Community Center, which was completed in 2005. Terry was also active in the avalanche community made up of international snow scientists and the Avalanche Artillery Users of North America community where he was an instructor.

Terry is preceded in death by his mother and father. He is survived by his beloved wife of 38 years, Judy Onslow, of Girdwood, AK; daughter Erin Pennings (Klark) and grandson Emmett Pennings of Anchorage, AK; brother Tim Onslow of Missoula, MT; son from a previous marriage Erik Dix of Nieafu, Tonga; cousins in Alaska, Montana and Texas, as well as many, many friends whom he considered family. His ashes will be scattered in Prince William Sound during the summer 2015 boating season.

After stints working on snow safety at Alta, Alyeska Resort, and more recently at the Alaska Railroad, Dave Hamre is looking forward to being phased out of full time employment in the avalanche field soon. For more from Dave Hamre, please see his story on Technology Traps on page 36 of this TAR.

Six Weeks with Terry

By Matt Murphy

Terry Onslow decided to retire from Alaska DOT in January of 2011 after 27 years of supervising the avalanche program for the Seward Highway. The plan for his exit was to double-fill his position with the new incumbent for the last six weeks of his career. I started work on December 10, 2010, and spent the next month and a half trying to absorb as much info from a legendary avalanche forecaster as I could.

As we got started, Terry handed me a handwritten letter from Don Bachman which was addressed to Art Judson and Knox Williams. The short version of this letter is that it described mass destruction accompanied with a little bit of chaos and some humor from an avalanche cycle that overwhelmed the Seward Highway area in January 1980. Terry told me it was one of the first things he read when he took the job in 1983. I got the impression that the letter made an impact on Terry, but it probably did not freak him out as much as it did me. What was I getting myself into?

Other stories followed while I sat shotgun in Terry's work truck as we drove hundreds of miles looking at countless avalanche paths along the highway between Seward and Hatcher Pass. I heard Terry's details about: the Spring of 1988, February 2000, loading a 105mm Recoilless on a Twin Otter and flying out to the remote town of Chignik on the coast of the Aleutian Range, driving six hours north with artillery on Christmas Day to an avalanche path in the Alaska Range. The stories about complex events just kept coming.

Terry kept meticulous records of weather and avalanche occurrences over the years. One day he went into great detail about some weather event that occurred on February 20th of one particular year. He went on and on about it, and I thought it was odd the he could remember so much from that one day. He mentioned that it was common to have avalanche problems around February 20th. By this time I had to interrupt him to let him know that by strange coincidence my birthday was February 20th. He just chuckled and paused while he drove down the road and told me a couple minutes later that this same day was also his birthday and Dave Hamre's as well.

One might speculate that there could be some sort of Mike Wiegele cosmic connection here, but there is not. This is a serious job that Terry was handing over to me; so, after stories and history lessons of the Seward Highway, we got down business. Terry told me numerous times, "…there's no cookbook for how to do this job." Despite this statement, we spent a considerable amount of time discussing strategies that had worked for him. I could tell it was a challenge for him to try to communicate some of the intuition that he had gained over the years, but he also seemed genuinely happy to make this effort.

I quickly realized the importance of this time in our both of our lives. Here was an old-timer handing over the reins to the new guy. I was honored to be the one sitting there in Terry's truck. It was an experience that can't be duplicated, and I hope I make him proud of how I handle this responsibility. Not having Terry a phone call away anymore will impact my life. I wish I had asked him more questions.

Matt Murphy is the program director for Alaska DOT&PF's Seward Highway Avalanche Program. He has also been a ski bum for 17 years. His new favorite type of skiing is with his five and two-year-old sons at Alyeska. ❄

metamorphism

New Hires in the Avalanche Industry

New Positions and Faces at UDOT

By Mark Saurer

This last year has brought several changes to the Utah Department of Transportation (UDOT) Highway Avalanche Safety Program. As Randy Trover so eloquently expressed at USAW this year, with the retirement of Liam Fitzgerald and Paul "Lord Vader" Garski, there truly has been a "changing of the Guard." Paul started his career in Little Cottonwood canyon with Liam at the fledgling Snowbird Resort in 1971. Rumor has it his first job was cutting steaks in the kitchens of the Snowbird Plaza. He joined the Ski Patrol in 1974 and worked his way up to Patrol Director. He left Snowbird in 2003 when his friend Liam offered him a job as a UDOT forecaster, a position he held for 10 years until his retirement last spring. Those of us who were fortunate enough to work with Liam and Paul are honored to call them mentors and friends.

As the "Old Guard" has headed down the canyon for the last time, the remaining staff of forecasters have been assigned to new roles and few new faces have been added to the UDOT crew.

Bill Nalli, Program Manager

This fall Bill was named to replace Liam as the UDOT Highway Avalanche Safety Program Manager. Bill began his avalanche career in 1996 as a ski patroller at Solitude, Utah where most days were spent honing his "avalanche hunting" skills. He has worked as a snowcat and heli-ski guide in the Uinta Mountains and human powered backcountry guide in the Central Wasatch. Bill has also been an avalanche educator for over 15 years and continues to teach with the American Avalanche Institute. In 2004 Bill began working as an avalanche forecaster with UDOT in Provo Canyon and was the supervisor for that area until 2013. Last year he moved back to the Central Wasatch as a forecaster in Big Cottonwood. While much of his time in this new position will be spent in Little Cottonwood Canyon, he has been given the directive of managing the avalanche issues for all of Utah's state highways. Look for him from Logan Canyon to Powder Mountain, Big and Little Cottonwood canyons, American Fork and Provo canyons, and south to Huntington and Cedar canyons.

Chris Covington, Provo Canyon Supervisor

Chris started his career as a Snowbird ski patroller and was hired in 2001 by UDOT as an avalanche forecaster for Provo Canyon. He worked there until 2003 then was transferred to Little Cottonwood Canyon where he worked until the start of last winter. In December 2013 he returned to Provo Canyon as the Canyon Supervisor. When Chris isn't ski touring, he enjoys reading stories with his kids.

Working with Chris are Matt Primomo and John (Woody) Woodruff. This is Matt's third season as a UDOT forecaster in Provo Canyon. Prior to that he worked locally as a guide and avalanche educator and has spent five seasons in Chile as a forecaster for mining operations. Woody started working with UDOT part-time last season. He's been a ski patroller at Sundance Resort for 12 seasons, the last nine as Snow Safety Supervisor, and is the Wasatch Backcountry Rescue (WBR) coordinator for Sundance.

Greg Dollhausen, Big Cottonwood Canyon Supervisor

While Greg has been a UDOT highway forecaster in Big Cottonwood Canyon for 22 years, he was formally named Canyon Supervisor last winter. In his words, "I've always believed that timing is everything…I was in the right place at the right time and was offered a job in 1992 with the UDOT Highway Avalanche Safety Program. Sure, there have been plenty of ups and downs over the years, however I still maintain that (this) is the best job in the world."

Working with Greg in Big Cottonwood Canyon starting this season will be Steven Clark. Steven has been a key part of the UDOT program for 4 years now, first as an intern and more recently as a seasonal forecaster in Little Cottonwood Canyon. Congratulations to Steven on his new position. We'll miss him over here (in LCC) and will call on his skills and laughter often.

Matt McKee, Little Cottonwood Canyon Supervisor

Matt McKee became Canyon supervisor for Little Cottonwood Canyon last year. He began working on his snow craft as an Alta Ski Patroller in 1996. Matt was lucky enough to learn all there is to know about highway avalanche forecasting from Greg Dollhausen in Big Cottonwood Canyon back in 2005. Later that summer he "survived" a winter forecasting for a gold mining operation in Chile. Matt feels honored to have spent the last few years learning from the legends Liam Fitzgerald and Paul Garske. Now (in his words) he "gets to work with the best crew in the field." In short, Matt likes snow and misses his ski time as a lifty at Alta.

Matt's team of forecasters working out of the Alta Guard Station includes Damian Jackson, Mark Saurer, Laurie Delaney and Brett (Korps) Korpela. Damian was an Alta Patroller for 13 years and spent 10 seasons in New Zealand working as Snow Safety Officer for three ski areas and a forecaster the New Zealand Avalanche Center. He is also the Intermountain South representative to the AAA board. Damian started working on the "other side of Highway 210" with UDOT in November 2013. Mark also started working for UDOT in Little Cottonwood last winter. Most of his 20-year snow career has been with the Park City Ski Patrol including seven seasons as a Snow Safety Supervisor. Laurie has been a Snowbird Ski Patroller for seven years and started working part-time with UDOT last season. She was just promoted to a full-time position with us. Korps joined us just before Christmas as a full-time seasonal forecaster; he's been an Alta ski patroller for six seasons. Congratulations also go out to Korps and Laurie. Please see a future issue of TAR for tribute to Liam FitzGerald. ❄

CNFAIC

Heather Thamm is the newest member of the Chugach National Forest Avalanche Center staff. Heather grew up in Northern Idaho and determined to go to college in a place with big mountains, she moved to Alaska in 1998. Heather has 10 winters working as a ski patroller for Alyeska Ski Resort and served three of those years as the Assistant Ski Patrol Director. She enjoys the occasional month long expedition course working with college students at Alaska Pacific University teaching wilderness skills. She has also worked as a sea-kayaking guide, mountain guide and trail builder. Today she spends her summers juggling part time glacier guiding and running her own photography business. Heather calls Girdwood her home and feels incredibly blessed to be able to work and ski tour in her back yard.

In other CNFAIC news, congratulations to **Wendy Wagner,** who is no longer the temporary director of the avalanche center, but has been awarded permanent status.

News from Andy Dietrick

I had an exciting move this fall. Your Alaska Section Representative has changed jobs and relocated to Juneau, Alaska. Although we love Girdwood with all our hearts and cherish our dear friends, there was an opportunity to stay in the avalanche profession and move back to the hometown near family. I left my post at Alyeska Snowsafety and in mid-December I started work as an Avalanche Tech for the Southcoast Region of the Alaska Department of Transportation in Juneau and Skagway. For AAA business, I can still be reached at aaa_ak_rep@yahoo.com. Attached a pic me getting that jaw stretched out for daily double brat-burgers at my new DOT post. Hope you're well. Been tropical up here. Happy Holidays!

—Andy ❄

what's new

Memorial Fund Boosts Wallowa Avalanche Center

By Dave Waag and Keith Stebbings

On the heels of a the 2013-14 season which included two skier fatalities, the Wallowa Avalanche Center (WAC) in Joseph, Oregon, is expanding and updating their avalanche safety offerings thanks in large part to a generous donation from the Shane Coulter Memorial Fund, a resource established by Laurel Coulter in the name of her husband, Shane, 30, who lost his life in an avalanche on February 11, 2014 while backcountry skiing in the Wallowa Mountains. The same incident also claimed the life of Jake Merrill, 23.

Coulter and Merrill's deaths signaled the critical need for a more robust system of evaluating the threat of avalanches, increasing safety awareness and for preventing future accidents. Coulter's widow, Laurel Coulter, opened the online memorial fund in Shane's name to generate a source of monetary support for WAC's mission. A total donation of $21,500 will help WAC expand avalanche hazard forecasting and safety courses within the Wallowa Mountains and surrounding region.

Laurel Coulter visits with Julian Pridmore-Brown, Deputy Director of the Wallowa Avalanche Center.

According to Keith Stebbings, Director of WAC, "Based on the gifted monies from Laurel, we came up with a business plan to have the money sustain us for at least two years in the expansion of our operation. We will use ongoing donations from our sponsors and individual supporters to sustain our normal administrative costs. We are now able to provide vastly improved resources, which were not possible before. We believe we are helping others avoid accidents."

Laurel Coulter added: "I am deeply gratified by the generosity of those who donated to Shane's memorial fund. I firmly believe he would have wanted us all to channel our grief from this unfortunate accident into something positive – and we did!"

Newly expanded services include two paid forecasters and four pro observers for a total of six field personnel this season and in addition, thanks to the memorial fund, WAC can now offer a small observer stipend. The memorial fund allowed WAC to purchase liability insurance and the additional funding was crucial in developing a rich new website design, incorporating our new forecast product and other advanced features.

For the past five seasons, WAC offered weekly condition bulletins describing the state of the snowpack and observed concerns. Beginning this season, WAC now includes the North American danger scale ratings and nationally accepted problem icons used by avalanche centers nationwide. Advisories are issued Thursdays with an outlook rating for Friday. Future plans call for daily advisories; however, for now the forecaster is on watch for the entire week to monitor weather continually, should an avalanche warning be needed and to update the Friday advisory.

Best of all is a recently executed MOU with the local Wallowa-Whitman National Forest. As an official partner with the USFS, WAC now enjoys recognition of our increased services including issuing advisories, warnings and expanded education outreach including new trailhead signage.

In the bigger regional picture, WAC continues to build relationships with the Northwest Weather and Avalanche Center as well as with the Central Oregon Avalanche Association. Stebbings adds, "The intent here is to continue to work together and share ideas. We are in preliminary discussions to create some sort of regional avalanche center sharing network. But it's too early to know what it could look like."

The Wallowa Avalanche Center is a 501(c)(3) non-profit organization. Learn more or donate at wallowaavalanchecenter.org.

This update first appeared in a slightly different form in Off Piste. Thanks to Dave Waag for sharing the material. ❄

Gasman Industries Ltd. Announces Snowpro Plus+ Release 32

Victoria, B.C. Canada -- Dec 15, 2014 – Gasman Industries Ltd. is pleased to announce Release 32 of Snowpro Plus+, the premier Windows-based Snow Cover Profile graphing software.

The new software release has a number of new features for the snow community including a new save format, a brand new Latitude and Longitude form with 4 map types, and numerous improvements to make Snowpro even better and quicker to use to create your professional snow profile graphs.

Gasman also announced their new Online Help and Support Centre at **gasman1.zendesk.com/hc** a new Snowpro Plus+ web site at snowproplus.com, and the addition of a second free license for all subscriptions. A free full featured Trial can be downloaded from the web site. ❄

For more information see the announcement at ***gasman1.zendesk.com/hc/en-us/articles/203060005*** *or contact Gary Sims.*

Heli-Ski US Presents Mechanized Guide School

Heli-Ski US (HSUS), a Utah nonprofit corporation whose members represent the best helicopter skiing operators in the country, announces its first ever mechanized guide school. Dates and venues for the 2015 HSUS guide school are: Ruby Mountain Heli Ski, Nevada, January 21-26, 2015, and Points North Heli-Adventures Inc., Alaska, February 28-March 7, 2015.

"As helicopter skiing continues to grow in popularity it is important to provide the highest level of standardized operating and safety guidelines to ensure the highest quality experience for our consumers," explains Tait Wardlaw, HSUS board member and general manager of Chugach Powder Guides. "The HSUS mission is to ensure and protect the future of helicopter skiing in the United States through a professional organization dedicated to safety, ongoing education and training, marketing and positive credibility and political influence."

What's cool or significant about this?
This is the first ever certified course specifically for helicopter ski guides. Certification is through Heli-ski US.

For more information, contact John Dicuollo ***john.dicuollo@backbonemedia.net*** ❄

Update from the Forest Service National Avalanche Center

We want to let everyone know that the updated NAC website is now live at **www.fsavalanche.org**. A huge thanks to Simon Trautman for being the big driver behind the update, and to Jennifer Self for her work on the site! Check it out and feel free to share it through your avalanche centers.

As with all websites, it is a work in progress, so feel free to share any comments or suggestions with Simon and myself. The site is set up so we can edit things fairly easily, so if you run into anything that seems wrong, be sure to let us know.

—Karl Birkeland and Simon Trautman ❄

ABS RECALL ACTION

ABS recalls European steel cartridges and ABS Twinbag Systems for checking

Here you can find all the important information concerning the immediate recall of the European steel cartridges and ABS Twinbag systems, with explanations what you need do to have your ABS products checked. We apologize for the inconveniences caused.

The producer and filler of ABS steel cartridges has detected problems in the filling process, and it is possible that steel cartridges that have already been delivered may have been contaminated during filling. The contamination residues could block the airbag system during subsequent activation. So far three instances of this problem, caused by the supplier, have occurred during training activations.

For more information, please go to: **http://www.abs-airbag.com/en/recall**

Extended service hotline:
We have set up a service hotline that will be open from 08:00 to 18:00 from Monday to Sunday until further notice in order to answer your questions regarding the recall action: **+49-89-898789-66**

Of course you can also e-mail us at s**ervice@abs-airbag.com**: we will answer as soon as possible.

The following products are affected by the recall:

- all European ABS activation units in steel (steel + handle) with a filling date till 02.12.2014
- ABS backpacks with integrated Twinbag system (double airbag) on the market since 1996, including ABS Inside Partner models (Bergans, Dakine, Deuter, Haglöfs, Ortovox, Salewa, The North Face, Vaude)

Products not affected by the recall:

- Carbon cartridges
- Steel cartridges with a filling date from 03.12.2014
- ABS Monoairbags
- Yellow steel cartridges from North America

what's new

Verde Presents Free, Online "Business of the Backcountry" Programming for Outdoor and Snowsports Retailers and Sales Reps

DURANGO, CO (Dec.2, 2014) – The snow's falling and the stoke is rising among backcountry enthusiasts as they ready for the 2014-15 winter season.

As the backcountry category continues to post huge gains in both participation and sales in the winter outdoor and snowsports markets, retailers and sales reps face growing challenges as well. Outdoor and snowsports sales reps and retailers are often the first point of contact for novice and experienced backcountry enthusiasts, alike, in both selling backcountry gear and safety equipment, and offering resources to this customer base.

In short, it's a giant responsibility to serve this end consumer, one that reps and retailers take very seriously.

This is the 'why' behind the live events that Verde Brand Communications has hosted in its Business of the Backcountry panels, which have been extremely well attended for two winters in a row at both the SIA Snow Show and Outdoor Retailer Winter Market. Verde's panels have consistently delivered best practices, discussion, direction and community for backcountry reps and retailers.

Today, the next era of this popular industry resource debuts in a first-of-its kind, absolutely free, six-week, learning and training opportunity: The Business of the Backcountry 2.0, powered by Verde Brand Communications (http://bit.ly/bizofthebackcountry).

"Verde is incredibly proud to announce this free, online, interactive program that addresses the many challenges and responsibility of selling winter backcountry gear," said Kristin Carpenter-Ogden, Founder and CEO of Verde, and the moderator of the Business of the Backcountry panels. "In a brand new, online format, our 2.0 programming delivers the most current best practices and most targeted trainings - directly from world-renowned snow safety and industry-respected experts, straight to a retailer or a rep's computer or mobile device."

In the new online format, Verde has extended the reach and the valuable insights of each expert panelist, enabling the trainings to reach many, many more people. What's more, the audience is able to go deeper with each expert in the virtual, multi-week panel format. Participants are encouraged to engage, share and network directly with one another, and to ask questions of our panelists in a built-in forum.

The Business of the Backcountry 2.0 is a completely free resource that enables retailers and reps to join the world's most respected snow-safety and industry experts as they share five weeks of free content tailored just for those who are engaged on the front lines of getting their customers ready to enjoy the backcountry safely and responsibly.

Verde's five-part programming will cover topics ranging from gear to education to broader considerations that feed into solid stewardship of the backcountry experience, and attention to safety and personal responsibility of those who love it.

The programming includes one-on-one interviews and question-and-answer opportunities with well-respected experts including:

- Bruce Tremper, author and director the U.S. Forest Service Utah Avalanche Center
- Doug Chabot, renowned climber and director of the Gallatin National Forest Avalanche Center
- Sarah Carpenter, co-owner of the American Avalanche Institute and certified AMGA ski guide
- Bruce Edgerly, co-founder of BCA
- Ben Pritchett, program director of AIARE
- Ethan Greene, of the Colorado Avalanche Information Center
- Kim Miller, CEO of SCARPA
- Jen Brill, co-owner/founder of Silverton Mountain Ski Area
- Dr. Iain Stewart-Patterson, IFMGA guide, academic, and renowned researcher in the field of decision-making in avalanche terrain
- Rebecca Selig, professional skier
- Tom Murphy, a founding member of AIARE, AAA avalanche educator
- And more

Panel topics include:

- **Innovations in Gear (safety, hard goods and soft goods) and Packing for Preparation, Safety, Comfort, and Fun**: A preview of the latest innovations, and an opportunity to train your staff on what customers need to complete their kits, how frequently they need to replace their safety gear, the finer points of layering, where to find training to properly use their gear, and more.

- **Guiding Your Customers to Forecasting and Avalanche Education:** With a panel of the most respected and influential names in snow science, forecasting and education, this expansive topic will: update you on the latest initiatives from the forecasting and education side, take your staff through the "best practices" of encouraging your customers to seek out forecasts and further education, identify the basics of avalanche terrain and instability, learn how avalanche education has evolved over the past few years and decide if it's time to recertify, and more. This topic in no way is a replacement for a certified avalanche education course; it is designed to help you and your staff enhance your leadership and understanding in how to build a strong, more savvy, backcountry community.

- **How to Sell Responsibly Within a Risk-intensive Category:** With lessons from other sports, like climbing and mountaineering, we will discuss how to balance enthusiasm (for the sport and making sales) with responsibility. Plus, we will explore the value in further developing your retail store as a community resource.

- **The Human Factor: The Psychology of Decision-Making and Risk:** We'll speak with researchers, academicians and guides who study and witness how individuals and groups of all levels communicate, find consensus, and ultimately make decisions. What can we do to strengthen a safety-culture mindset?

- **Women in the Backcountry:** Gain insight into how 50-percent of your customers may (or may not) approach backcountry adventures differently than the other 50-percent. We'll summarize the physiological differences that can help guide what gear you recommend to your female customers, and present tips for selling to women in the store and empowering women in the field.

Each of the above modules is anchored by podcast interviews with our experts. Additional, downloadable resources – some designed for training enhancement and others to share with consumers via your own online properties and social media – will be provided.

Programming begins on December 2, 2014, with a new topic going live every 1-2 weeks through January 13, 2015. To accommodate busy schedules during the holiday season, the format allows for anytime access to the podcasts and additional content. Once a topic goes live, it will be downloadable and available for the remainder of the winter.

This free programming and training is intended for outdoor and snowsports retail staff and sales reps, and there is no limit to how many people per organization may have access. To sign up, please visit: **http://bit.ly/bizofthebackcountry**.

Verde Brand Communications
Kristin Carpenter-Ogden
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From Bruce Edgerly of BCA:

With alpine touring going 'mainstream,' there's been lots of industry concern recently about how to get alpine retailers and reps up to speed on snow safety. Kristin at Verde PR has really stepped up by providing this program—and by doing it on her own time. And it dovetails perfectly with the Backcountry Starts Here program we're working on at Project Zero. There's a lot of energy in our industry right now that's going into education. Hopefully by working together like this we can move the needle on reducing avalanche fatalities.

decision-making

Time for a Backcountry Code of Conduct?

By Drew Hardesty

A couple winters ago, I was asked to be the keynote for the annual Avalanche Awareness night in the Tetons. It's a fantastic community event, sponsored by Skinny Skis and held at Snow King. Attendance routinely exceeds 700 folks. Their initial pitch was for me to talk about terrain – but knowing that half the room had already lapped the Ford/Chevy/Stettner on the Grand Teton, I sought out a more compelling topic – *Has the Freedom of the Hills Become Anarchy in the Backcountry?*

The idea began with the near miss off Teton Pass from the winter before. A very experienced local ski party "ski cut" a deep slab avalanche, triggering what Rod Newcomb called a '100-year event' down into the often bumper-to-bumper Coal Creek drainage. Miraculously, no one was caught or buried in the size 4 avalanche. It shook the Teton backcountry community. Surely this experience would be a '100-year event' too…or would it? But after numerous conversations and after digging into the archives, I found event after event, case study after case study of similar "If not but for the grace of God" near-misses like these: Saddle Peak in the sidecountry of Bridger Bowl; Dutch Draw in the sidecountry of the Canyons; Galena Pass in the Sawtooths; Hell's Canyon sidecountry of Snowbasin; DOT avalanche teams seeing headlamps in the starting zones of their artillery targets for the morning; backcountry riders triggering avalanches onto the open roads. The list goes on and on. I even relayed my own experience as an offending party – as years ago Bruce and I remotely triggered a size 3 avalanche on the north side of Cardiff Peak which then sympathetic'd another slab on the south side – catching two. Fortunately for the two on the south side of Cardiff Peak, it was only a 'catch and release' experience.

My conclusion is that, with a population explosion in the backcountry – we need a Backcountry Social Contract, philosophically modeled on Thomas Hobbes's 17th century political treatise Leviathan. Hobbes argued in favor of a social contract among men as a way to avoid the "war of all against all", "where life in the state of nature (or in our case, the backcountry) is nasty, brutish, and short". I feel strongly that now is the time to shape and define the culture of our growing backcountry communities so it becomes one of stewardship, awareness, and responsibility. Ultimately we must acknowledge that risk assumed by the individual is shared by all. Just ask the party below. Ask your friends and family. Ask the DOT avalanche teams. Ask the school kids in the bus on the road in the runout zone far below. Ask the SAR teams putting themselves on the line to find and haul your carcass out of the mountains. Ask the owners of the houses and the people buried in the human triggered slide off of Mt. Jumbo above the town of Missoula (see TAR 33.2).

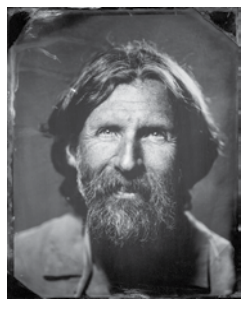
Look out below! *Photo by Graham Robertson.*

By recognizing that With Freedom comes Responsibility, we need to develop a program To promote mindfulness in the mountains….To save lives…To prevent backcountry parties from triggering avalanches onto others, infrastructure, and roads… before these decisions are made for us. Easy, huh? – just ask any teenager how well initiatives promoting rules and abstinence work. But the dirty underbelly is that failure to act now leads to real consequences: permanent or temporary backcountry closures at best (Exhibit A – Rogers Pass, Exhibit B – Cottonwood Canyons, Utah), the implementation of a Backcountry Permit plan (Exhibit A – Rogers Pass, Exhibit B – Kachina Peaks)… and personal liability at worst. Make no mistake: the DA's office weighed charges of Negligent Homicide in the Mt. Jumbo case. It very quickly becomes not just an access issue, but a liability one.

To this end, I've looked to partner with a variety of stakeholders to shape the message and drive awareness and distribution. Initial stakeholders include the Access Fund, AAA, the NAC, AAI, AIARE, DOT avalanche programs, Winter Wildlands Alliance, the NSAA, Black Diamond Equipment, and others. A Backcountry Rider's Responsibility Code is available using a similar look and feel of the Access Fund's Rock Project. We've gained some excellent press exposure through Outside, Powder, and Backcountry magazines, two regional Snow and

This is a "rendition," or sample mock-up of publicity for the project, as aligned with the Access Fund's ROCK Project.

Avalanche Workshops, implementation into avalanche education curriculum, mention in backcountry guidebooks, and more. Most importantly, this project needs your support as you are the local and regional avalanche expert and ambassador. Contact me at **drew@utahavalanchecenter.org** to offer feedback, solutions, or find out how you can be part of this grassroots project.



Drew's been with the Utah Avalanche Center since 1999 and skied the Hokkaido backcountry in the early '90s. For his understanding of snow, he owes as much to Bashō as he does to Fukuzawa. ⁂

snow science

THE EFFECT OF CHANGING SLOPE ANGLE ON COMPRESSION TEST RESULTS

Editor's Note: This article first appeared in the December TAR, 33.2, without the crucial graphs and figures. Karl Birkeland and the TAR editor agreed that we needed to reprint it with visual aids.

By Karl W. Birkeland, Ned Bair, and Doug Chabot

Figure 1: Collecting CT and ECT data (Dataset 1) on varying slope angles at our Lionhead study slope in Montana. Here our tests fractured on a buried layer of surface hoar with crystal sizes ranging from 6 to 15 mm. The grid size on the snow card is 2 mm.

INTRODUCTION

In March, 2014 a group of backcountry skiers in Montana travelled onto a steep slope to assess the avalanche conditions. Their initial observations indicated unstable conditions, but they moved further down the slope to see if similar conditions existed as it steepened. Tragically, they triggered a slide that killed one person. This accident graphically demonstrates the danger of conducting stability tests in avalanche terrain when conditions are unstable. The consequences of a mistake in these situations can clearly be severe.

Though conducting tests on slopes safe from avalanches will minimize risk to observers, conventional wisdom has been that it is necessary to get into steep terrain to get good data. Recent research on some tests runs contrary that conventional wisdom. For example, Gauthier and Jamieson and McClung both show that propagation saw test (PST) cut lengths are similar, or shorter, in lower angled terrain in comparison to steeper slopes. Further, Birkeland et al. and Simenhois et al. found that the number of taps required to initiate fracture for extended column tests (ECTs) that propagate completely across the column (ECTPs) is similar or perhaps actually decreases slightly in lower angled terrain as long as the snow structure remains consistent across a slope. This was true for both persistent and non-persistent weak layers.

The compression test (CT) has been used for more than 35 years. Its popularity continues to the present; it was the second most utilized test among SnowPilot users behind the ECT during the 2011/12 winter . Jamieson (1999) found a significant trend in CT test results with changing slope angle in 7 of 11 datasets (64%), and suggested a decrease of approximately one tap in CT score for every 10 degree increase in slope angle. Data collection for this work differed from that with the ECT. The 11 slopes used for the CTs were sampled in two to four locations with varying slope angles, with multiple tests at each sampling location, while the ECT work sampled at multiple (more than 20), closely spaced locations with varying slope angles. Though the CT work runs counter to that with the ECT, the methods differed and the reported change of one tap for every 10 degrees is small given the potential variability of CT results.

The purpose of this paper is to utilize the techniques and methods of to test the effect of slope angle on CT results. Additionally, we analyze a large amount of data from SnowPilot to compare the difference between ECTs and CTs with changing slope angle. Since ECT results are largely independent of slope angle, the relationship between the difference between ECTs and CTs and slope angle can provide additional information about the slope angle dependence of CT results.

METHODS

2.1 Field sites

We used three different slopes for our fieldwork. Our first slope was the same Lionhead study site in southwest Montana that Birkeland et al. (2010) utilized for their ECT study. On this slope we collected 22 side-by-side CTs and ECTs fracturing on surface hoar on slope angles ranging from 17 to 30 degrees *(Figure 1)*. When we tried to access terrain in the low 30 degree range we collapsed the slope and triggered a small avalanche below our study site, attesting to the unstable condition on that sampling day.

Our two other slopes are located in California's Eastern Sierra Range. On these slopes our CTs fractured on depth hoar. We conducted 8 CTs on the first slope with slope angles ranging from 7 to 24 degrees, and 14 CTs on the second slope with slope angles from 0 to 38 degrees.

For this work we specifically sought out uniform slopes. This limited the amount of data we could collect, but we felt this provided optimal datasets for testing the effect of slope angle on CT tests.

2.2 Snowpack structure for field data

The snowpack structure differed between our datasets. The tests in our first dataset fractured on surface hoar buried beneath a recently deposited slab, while the CTs in our other two datasets fractured on depth hoar. The depth hoar for Dataset 2 was dry, while the depth hoar for Dataset 3 was slightly moist *(Table 1)*. We dug one manual pit for each field day following the techniques outlined in Greene et al. (2010).

2.3 Test procedure for field data

A single observer conducted every test in each of our three datasets for consistency. We followed standard procedure for the CT. Also, at our first slope we conducted our tests side-by-side with ECTs . Prior to each test, we sighted up the snow surface with a Suunto clinometer, measuring the slope angle to an estimated accuracy of ±1°. In most cases tests were immediately upslope, or within a meter, of one another. We did this for ease of testing, as well as to minimize any spatial changes in the snow structure.

2.4 SnowPilot data analysis

Because our field data are somewhat limited, we utilized data from SnowPilot to further address our research question. In particular, since previous research suggests that the number of ECT taps is approximately independent of slope angle (Birkeland et al., 2010; Simenhois et al., 2012), testing if the relationship between CTs and ECTs varies by slope angle will give us additional information about the relationship between CTs and slope angle.

In SnowPilot we looked for cases where CTs and ECTs fractured on the same layer and where ECTs fully propagated (ECTP). We had 534 total test pairs on slope angles from zero to 45 degrees. We graphed the data and tested for the existence of statistically significant ($p<0.05$) linear trends.

RESULTS AND DISCUSSION

3.1 Field data

In all three of our field datasets the number of CT taps remained relatively constant or increased slightly with increasing slope angle *(Figure 2)*, paralleling previous work with the ECT (Birkeland et al. 2010). A side-by-side comparison of ECTs and CTs in Dataset 1 shows no trend between the difference between ECTs and CTs and slope angle *(Figure 3)*.

Our results differ from those of Jamieson. We believe the primary reason for this discrepancy lies in our differing methods of data collection. While Jamieson (1999) conducted multiple tests at two to four locations per slope, each of our tests is considered individually and we conducted all our tests in close proximity on relatively uniform slopes with a changing slope angle. A particular strength of our data is the nature of our slopes, which yielded consistent results. The average standard deviation in CT taps for our datasets was just 1.34 (Dataset 1 = 0.83, Dataset 2 = 1.19, Dataset 3 = 1.99). In comparison, Jamieson's average standard deviation was double that at 2.26 (range 0.5-4.0). We believe that our data collection techniques are better able to capture relatively subtle variations in CT scores with slope angle.

The practical implications of our work do not differ much from those of . Our work confirms that low angle slopes work well for data collection. Likewise, Jamieson's (1999) conclusion that there may be a 1

Dataset	Mountain Range	N	[deg]	h [m]	Std Dev h [m]	[kg-m-3]	F	E [mm]
1	Henry, Montana	22	17 - 30	0.47	0.012	128	Surface hoar	6 – 15
2	Sierra, California	8	7 – 26	0.87	0.066	NA	Depth hoar	2 – 4
3	Sierra, California	14	0 – 38	0.57	0.040	NA	Depth hoar	2 – 4

Table 1: Geographical location and snowpack characteristics at field sites. N: number of tests, θ : range of slope angles sampled, h: average slope normal slab thickness for all the experiments, Std Dev h: standard deviation of h for all experiments, ρ: average density of the slab measured at the site of the snow profile, F: weak layer crystal type, E: weak layer grain size. NA = Data not available for that dataset.

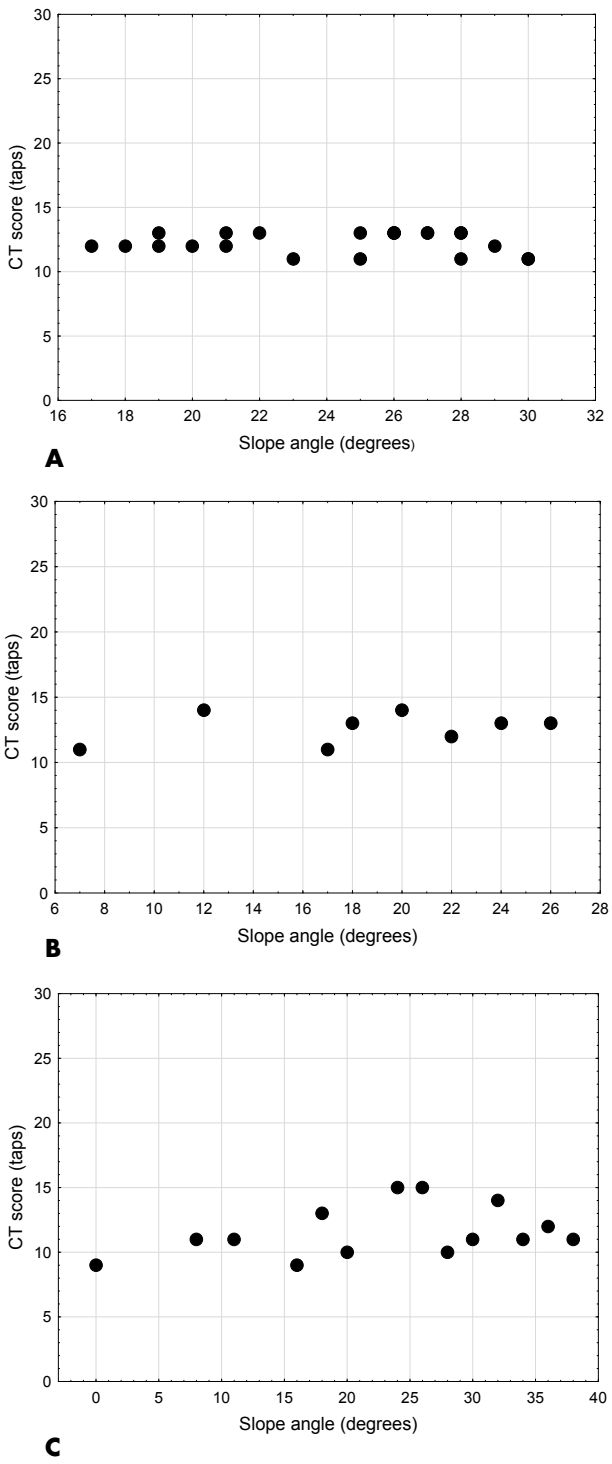


Figure 2: Field data comparing CT results to slope angle for (a) Dataset 1, (b) Dataset 2, and (c) Dataset 3. None of the datasets show a statistically significant trend (p-values: (a) = 0.67, (b) = 0.44, (c) = 0.21).

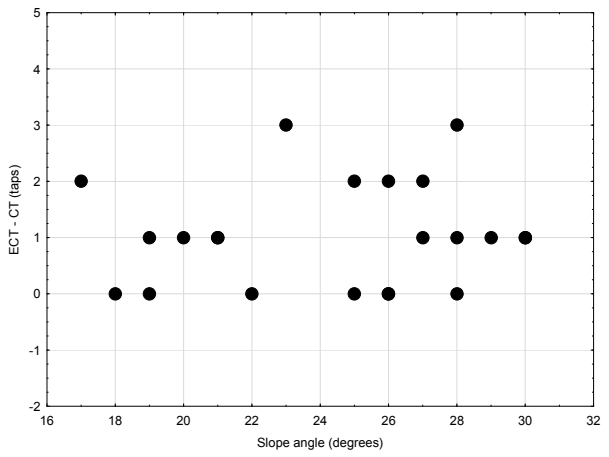


Figure 3: The difference between side-by-side CTs and ECTs from Dataset 1 do not show any statistically significant relationship with slope angle (p-value = 0.64). Throughout the range of slope angles it took between zero and three additional taps to fracture ECTs in comparison to CTs at this site.

tap decrease for every 10 degree increase in steepness means that practitioners can conduct CTs on safer 25 degree slopes rather than more dangerous 35 degree slopes and still expect quite similar results.

3.2 SnowPilot data

A plot of the difference between ECT and CT results versus slope angle shows a great deal of scatter and no statistically significant trend *(Figure 4)*. A least squares linear fit to the data has a slightly downward trend, but it is not plotted since the fit is not significant at the 5% level (p=0.19).

The scatter in these data contrasts sharply with the low scatter in our Montana field data *(Figure 3)*. However, the Montana data were collected on one fairly uniform slope with a well-defined weak layer, while the

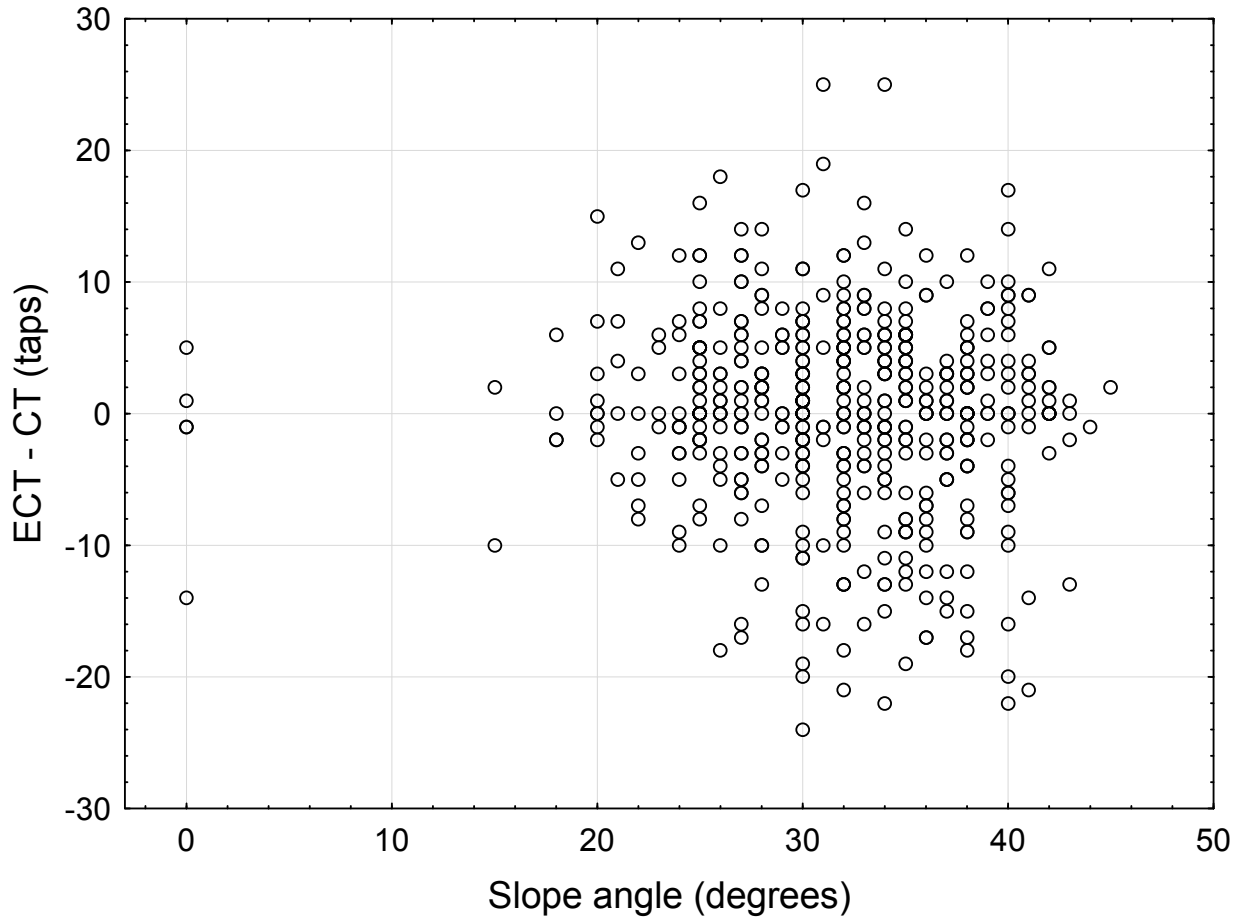


Figure 4: A scatterplot of 534 pairs of CTs and ECTs from the SnowPilot dataset does not show a statistically significant relationship between the difference between ECT and CT results and slope angle (p=0.19). This provides further evidence that CT results are largely independent of slope angle.

SnowPilot data represent data from a broad range of observers, snow climates, slopes, slabs, and weak layers. Still, if a relationship exists between the difference between ECTs and CTs and slope angle, we expect that it would be reflected in this large (n=534) dataset.

CONCLUSIONS

This research utilized two independent methods to test the slope dependence of CT results. Our first method was field-based and followed Birkeland et al. (2010), and our second method utilized SnowPilot data. Our field data show that the number of CT taps are constant, or increase slightly as slopes steepen. The SnowPilot data reinforce these results by showing that the difference between ECT and CT tests is not statistically dependent on slope angle (p=0.19).

Our results differ from those presented by Jamieson (1999), who found that CT scores decreased slightly as slope angle increased. While Jamieson collected multiple tests from two to four locations, we sampled up to 22 per slope and did one test at each location. The slopes we tested had considerably less variation than those tested by .

Our results also contradict laboratory tests which showed a decrease in sample strength with increasing slope angle for small (≤ 20 cm in length) samples with weak layers of surface hoar, depth hoar, and facets . One explanation for the discrepancy might be a geometrical effect of the CT with changing slope angle. Alternatively, it could have something to do with the difference between methods utilized (lab vs field work and the way the loading method for the snow). Currently, the exact reason for the difference in our results is unclear.

Given that CTs, ECTs, and PSTs all show slope angle independence in their scores , we suggest that crack initiation (measured by the CT), and crack propagation (measured by the ECT and PST) have little dependence on slope angle over the range of angles investigated.

The primary practical consideration of our results is that tests on safer, lower-angled terrain are useful since CTs have similar or perhaps lower scores in lower angled terrain. This result is similar to results previously reported for the ECT (Birkeland et al. 2010) and the PST (Gauthier and Jamieson 2008).

ACKNOWLEDGEMENTS

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decision-making

DIGGING PITS

Human Factors and Digging

By Doug Chabot

As an avalanche forecaster and educator I pay close attention to teaching the recreating public about heuristic traps, aka human factors, and their role in avalanche accidents. A powerful voice is Powder Magazine's riveting five-part Human Factors series which did a great job of pointing out those traps.

Doug Fesler and Jill Fredston put human factors squarely in the middle of the avalanche triangle in the 80s in their first edition of Snow Sense. Ian McCammon broadened this in 2002 by formalizing the six most common traps skiers encounter, easily remembered by the FACETS acronym (Familiarity, Acceptance, Consistency, Experts, Tracks/Scarcity, and Social Facilitation). Once we know these traps exist we can avoid them most effectively by having an open conversation with our partners raising everyone's awareness about impending human-factor disasters. But this alone is not enough. As responsible backcountry skiers we miss something very important if we do not dig a snowpit. Identifying human factors in conjunction with gathering relevant data is a winning combination.

There has been a recent push from some educators, forecasters, and other professionals away from digging. We often hear, "People do not dig and there's no way can we get them to." We disagree and, more, have found the opposite. By developing a culture of digging pits, people dig. We emphasize the importance of digging in our advisories, videos, and classes, which results in many people pulling out their shovels and learning what is under their feet. This behavior change is not anecdotal. It is real and measurable. Mark Staples writes about a survey on avalanche education and stability tests in an accompanying article (*right*).

Another excuse for failing to dig a pit is, "Stability tests are an advanced skill and too complicated to interpret." Again, this is false. In our Avalanche Awareness field classes we teach new backcountry skiers to use an Extended Column Test (ECT) and only pay attention to whether the column propagates or not. Propagation equals instability and students grasp the simplicity of the message.

When we stop and dig a few important things happen: we pause, take a breather, come together and look at the snow. Everything slows down. Communication becomes possible again instead of being spread out and checked out with ear buds pushed in. On a few days the instability is obvious and a decision to not ski is easy. Other times the danger is so low and the snowpack so strong that you can go anywhere and ski anything. Unfortunately, most of our days do not fall into these extremes, days when the dangers are more ambiguous, days when it's easy to fall into heuristic traps, days when a stability test is extremely valuable.

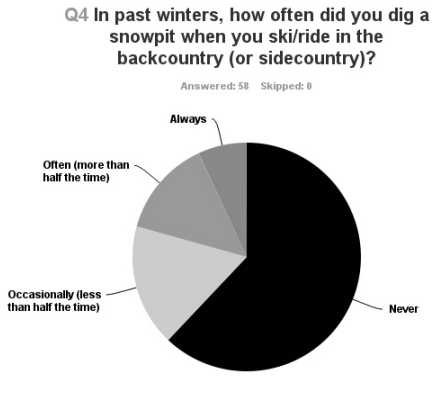
Digging is a reliable and quick way to search for instability when the signs are not obvious.

Most skiers have already made the decision to ski or not by the time they reached the top of their run, but a critical question is still unanswered: what is under our feet? We can guess or we can know. Knowledge is a powerful tool and personal responsibility requires due diligence. (use this line as pull quote for this article or the cover) Introducing the human factor into decision-making will remain a large part of our avalanche education efforts, but we are now pushing people to take one more step and perform an ECT before descending because sometimes the snowpack surprises us with her answer. In our classes and videos we teach students how to execute this test in under three minutes because we know it can save your life. After skinning for an hour or more and reaching a decision to ski, a few more seconds, 180 to be exact, is a small price for valuable information. We have investigated far too many accidents where a quick pit and test would have revealed a show-stopper instability. For a person new to avalanche country we keep the analysis simple: if it propagates do not ski the slope. This forces the most adamant in a group to do serious mental gymnastics to justify skiing a slope when the column snaps clean. There are nuances with the test and scoring that more advanced users can debate, **but people do not die from nuances. They die from an ignorance of what lies under their feet and an adamancy about that ignorance.**

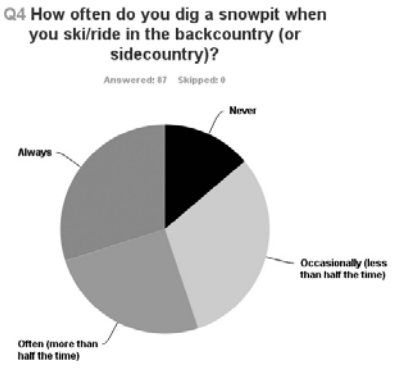
A quote in the fourth part of Powder Magazine's Human Factor series sums up their importance. "If the 504 deaths [in the study] tell us anything," McCammon concluded, "it is that the six heuristic cues have the power to lure almost anyone into thinking an avalanche slope is safe."

Any of the six heuristic traps can lure us in, but one stability test can snap us out.

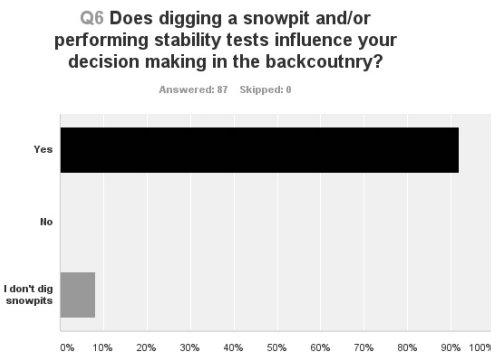
Doug, director of the Gallatin National Forest Avalanche Center (GNFAC) in Bozeman, Montana, received his B.A. in Outdoor Education from Prescott College in 1986. Since 1995 Doug has worked for the GNFAC as an avalanche specialist. He's also a mountain guide and climber. Doug has been on numerous climbing expeditions to Alaska, Nepal, India, Afghanistan, Tajikistan and Pakistan, resulting in many first ascents and new routes. ⁂



These were student's responses to how often they dig snowpits, taken at the beginning of the class prior to field instruction: Never (62%), Occasionally (17%), Often (14%), and Always (7%).



These were responses to students who had taken the class within the last two years and had at least one season of traveling in the backcountry to how often they dig snowpits: Never (14%), Occasionally (31%), Often (25%), and Always (30%).



EVERYONE who digs snowpits and performs stability tests says it influences their decision-making. Very similar results came from the group that had not taken the class except a larger percent reported not digging.

A Survey from our class at MSU

By Mark Staples

The Class

One night in 1981 Doug Richmond and Tom Pratt decided to offer an avalanche class at Montana State University for both students and people living in the community. Seven nights of lectures for $7. At the time a beer was a dollar, and they figured each lecture was worth a beer. Now, 33 years later, we only charge $30. The class has four lectures over two nights followed by a field day just out of bounds at Bridger Bowl, which has been a supporter of the class from the beginning. In the last ten years, we have taught this class to more than 3,000 people. It is called Introduction to Avalanches with a Field Session.

In recent years we noticed only a few people had snow saws, a necessary tool for good stability tests, but as the Extended Column Test became popular and only required a piece of cord, we started giving one to every student in the class. We teach them to quickly perform an ECT and see if it propagates or not.

The Survey

This fall we conducted online surveys with students from the class to see what they were doing in the backcountry. Are they digging pits? What stability tests do they perform? Do snowpits and stability tests influence their decision-making? How important are snowpits and stability tests in their decision-making? There were two groups we surveyed.

The first group had taken the class one or two years ago, and had at least one winter to ski/ride in the backcountry. The second had registered for the December 2014 class but had not taken it. We sent the survey to 578 students total and got response rates ranging from 20% to 44%.

The Results

The most striking difference between the two groups was how many of them dug snowpits. Of those students who had taken the class and had a year or two in the backcountry, 86% dug snowpits. Of those students who haven't taken the class yet, only 38% dug snowpits.

The other striking result came from asking them if snowpits and stability tests influence their decision-making, and if so, how useful are snowpits and stability tests. Of those who had taken the class and dig snowpits, EVERYONE or 100% said snowpits and stability tests influence their decision-making and rated them at least Very Helpful or Somewhat Helpful.

60% of the students who had taken the class carry knotted cord in the backcountry. Even of the group that had not taken the class yet, 20% reported carrying knotted cord.

Conclusion

Our results show that people dig snowpits, perform stability tests, and say these actions influence their decision-making. When they dig, they lose only a few minutes and give themselves concrete information upon which they can base their decision-making. Doing this quick action is helpful in their decision-making. NO ONE said it hurts their decision-making. We will continue teaching our students to put their shovel in the snow and working to develop a culture where that is normal because it works.

Mark Staples works as a forecaster at the Gallatin NF Avalanche Center. He was so amazed with the snowpack the first time he put his shovel in the snow that it drove him back to school to get his Master's in Civil Engineering at Montana State University. He never travels in avalanche terrain without knowing what's going on in the snow under his skis, his track or his crampons. Seeing his four year old son learn the basics of metamorphism and fracture mechanics has shown him that we can keep snow science simple and relevant for most students. ⁂

PROJECT ZERO

Laying the Groundwork for Backcountry Starts Here

By Rachel Reich

I have to admit, when I first read the overview for Project Zero I, like many others, was skeptical. Aiming for zero avalanche deaths with the unpredictability of snow seemed like an impossible project. Yet, at an Avalanche Awareness night in Crested Butte, I asked a room of hundreds of people who there had a personal friend or knew a friend who had lost someone in an avalanche. Almost the entire room raised their hands. I was taken aback and inspired at the same time. To have the opportunity to reduce the prevalence of avalanche deaths within our community is such a vital project to all of us.

Project Zero brings together stakeholders across North America towards a unified mission to reduce avalanche fatalities. Phase one of the project involved an in depth research project tracking the behavior of at risk user groups. This study showed males, particularly those between the ages of 18-24 years with a high skill level were entering lift accessed backcountry, often without proper gear or education, more frequently than other user segments. This information gave the Project Zero committee our first target, and our first hurdle. How do we reach a user group who primarily listens to its peers for backcountry advice? What could have the most impact on changing this group's behavior when accessing the backcountry? Can we make avalanche education sexy and cool? What is the key for creating a psychological shift before exiting a backcountry gate?

Since getting involved with the Project Zero group, I think we're on the right track. The past few years have seen a shift in popular avalanche programming across the country. The Northwest Avalanche Center (NWAC), Utah Avalanche Center (UAC) and others have increased Avalanche 101 and Know Before You Go programming across the board in late November and early December. These short, introductory programs give skiers and riders an opportunity to delve into basic snow safety concepts and gear before the snow craze takes hold. Usually staged as casual gatherings, this low pressure social scene brings together a range of user groups, often introducing novice backcountry recreationists to the equipment and resources to prepare for an amazing backcountry experience. However this is just one step in a successful campaign.

Taking a page out of emotional and socially driven marketing, Backcountry Starts Here strives to be a multiple tiered, touch point campaign structured around engaging our target user group. This is a group that tends to get its social cues from their peers and popular media rather than their local avalanche center. The Backcountry Starts Here initiative hopes to drive a positive behavior shift by increasing awareness of the proper gear, education and resources a person needs before stepping into the backcountry. In addition, the initiative is developing cohesive signage to be used at popular backcountry spots and exit gates so ski areas and National Forest trailheads can have a consistent message. It's not sidecountry anymore, once you leave that gate you need to turn on your backcountry brain and your gear. This message needs to be perpetuated.

This is where we need your help. Have a social media outlet? Great, let's talk about cross promotion. How about an upcoming project or editorial piece, let's work together. The local resort you frequent, what are their thoughts on backcountry user access? The key of this campaign is the power we have as stakeholders together. Let's lead by example as part of the avalanche community and make a difference. Can we reduce avalanche deaths to zero? We'll never know until we try, and we need your help to get there.

For more on Project Zero or to get involved, email Rachel Reich, ***rach.eden@gmail.com*** *or Tim Bennet* ***tim@avtraining.org*** ❄

SAW REPORTS

Snow & Avalanche Workshops

Crowd attending USAW. *Photo by Paul Diegel*

Educational Update from NSAW

By Patrick Fink

The ninth annual Northwest Snow and Avalanche Workshop took over the University of Washington Huskies Union Building on Nov 2. Organized by Pacific Northwest stalwart Michael Jackson, the conference has grown tremendously in recent years, and the Northwest Avalanche Center will adopt the event beginning next season. A sister event to snow and avalanche workshops in Colorado, Utah, California, Alaska, and others, the conference is an opportunity for avalanche professionals, guides, and recreationists to come together and turn their minds towards the perennial hazards of avalanches.

In recent years, the subjects discussed at avalanche conferences have reflected changes in how professionals are approaching the issue of avalanche hazard. While past years might have included snow science presentations of GIS terrain evaluations or of weak layer distributions mapped by tirelessly digging pit after pit across open slopes, human factors and decision-making are today's hot topics.

We know that the snow doesn't give us good feedback and that we should expect the unexpected. Crystal Mountain's "Three Shivas," Michelle Longstreth, Megan McCarthy, and Kim Kircher, highlighted this fact in their presentation. These ladies earned their names on March 10, 2014, when they destroyed Crystal's High Campbell by triggering a massive slab avalanche during control work. The size and destructive power of this avalanche were unanticipated and without precedent at the resort, and shows that the avalanche dragon is unpredictable even to those who make a profession of controlling it.

NSAW's first presenter this year, Montana State University's Jordy Hendrikx, built on the unpredictability of snow science by demonstrating in his research that we don't even make the decisions that we think we do. Jordy's research uses volunteers' GPS tour data combined with a post-tour survey to analyze how we are making terrain decisions on days of differing hazard. While his results are still cursory, he did find that 26% of his results came from solo skiers, 95% of whom traveled into avalanche terrain on the days in question. 100% of these skiers self-identified as experts.

If the unpredictability of objective avalanche hazard means that we have to rely on our decision-making to guide use safely through terrain, then why do we make poor decisions? Simon Trautman, National Avalanche Specialist for the USFS, said that it's because it's hard to make yourself change what you're doing when you're having fun. He highlighted his point by telling a story about two avalanche professionals in the Sawtooths having a rip-roaring time triggering predictable but large slab avalanches. Caught up in their fun, they triggered a slide that buried the highway and nearly missed the car carrying the director of their center. Trautman emphasized that our decision-making deteriorates when we're swept up in having a good time. In this mode of moment-to-moment, automatic decision-making, fun will trump risk, so we can't count on making good decisions in real time.

Colin Zacharias and Roger Atkins added to the discussion of poor decision-making by exploring the well-known issue that because our observations are often unreliable, snow-safety experience is the total of a rider's close calls. In Colin's words, "accidents provide us with compelling raw information, but they're rare". Colin described an experience guiding for CMH heli-skiing in which he led a group to center-punch a large, exposed face with terrain-trap exposure. Though the face didn't slide and his clients loved the run, he described a sinking feeling as he realized his position and decision-making mid-run, powerlessly thinking to himself, "I hope nothing happens". Roger went on to explore the psychology of 'Dual Process Theory,' which describes complimentary automatic and reflective modes of thinking. The reflective mode is very familiar to us-- it's how we process snowpit data, analyze an accident, or look at the weather forecast. The automatic, on the other hand, is how we make moment-to-moment decision while under the influence of gravity and speed. According to Roger, our automatic mind is habitual, difficult to manipulate, and depends on our values, experiences, and current emotional state. To use Colin's quote from Anaïs Nin, "We do not see things as they are, we see them as we are."

This news about our automatic mind would be problematic if Colin hadn't also offered us a way out: we can learn to train our automatic decision-making. Colin says that the reason we ought to do so is well described by USC's Antonio Damasio, as

> "Your intuition is only correct to the extent that the historical reference connects the right facts to the right reference."
>
> *– Colin Zacharias quotes USC's Antonio Damasio*

That is to say that we emotionally process our environment when acting automatically, and we will only make good decisions if we connect our current situation to the right past experiences. Deep psychology aside, Colin asked, how do we acquire the skills to accurately perceive our near-misses? How do we ensure that each day becomes a recallable learning experience? And how do we avoid repeating our errors?

The answer, Colin said, is to be more emotionally sensitive. When we experience different emotions than we expected, as Colin did when he lead his group down that open face, then we have both the signal that our automatic reasoning made an error and the opportunity to change our thinking. Further, if we can cultivate an emotional sensitivity to compliment our rational acuity, then we create more opportunities to learn from our decisions on the days when they don't lead to near misses. Colin and Roger suggest that both backcountry users and avalanche professionals incorporate automatic and reflective processes into their strategy. Forecasters should clearly present the day's information, but should consider that increasing the emotional impact of their writing could help to guide their readers into prudent terrain. Recreationists should both systematically address the avalanche concerns of the day and delve into the desires that are driving them during their tour. When possible, they should emphasize desires that lead to little overlap between desirable and hazardous terrain.

The case is by no means closed: each year we have to readdress this problem of avalanche hazard. We are fortunate to do so with a growing body of research and experts willing to share it with all levels of practitioners. The science has evolved from one of pure physics to one dominated by our personal and group psychology. We're learning that we're often inaccurate, about not just the snow we ski, but about our decision-making and behavior. It's hard to change that behavior and challenging to make our decision-making systematic. Still, we value ourselves and our partners, so we, as a community, make a yearly effort not just to learn more, but to find new and better ways to learn about avalanche hazard. As guides, snow-safety workers, and recreationists, it's our responsibility to continue to learn and to contribute to the learning of the community. So, read up on avalanches, submit reports to your avalanche center, reflect on your experiences, and next year, come to the conference and tell us what you've learned!

When he's not mainlining information as a medical student at Oregon Health Sciences University in Portland, OR, Patrick Fink is skiing, climbing, and mountain biking up and down the West Coast. A former ski patroller and avalanche instructor, he writes about his human-powered adventures at ***MountainLessons.com****. You can contact him at: (773) 988-3225 or* ***deepdrypowder@gmail.com*** ❄

Fourth Annual ESAW

Story and photos by Jonathan S. Shefftz

The fourth annual Eastern Snow & Avalanche Workshop was held on November 8 in Intervale NH, near the base of Mount Washington in the Presidential Range.

This year's ESAW was once again a collaborative effort. The organizing partners included the Snow Rangers of the USFS Mount Washington Avalanche Center as led by Chris Joosen, the Mount Washington Volunteer Ski Patrol, and International Mountain Equipment. The Mission Partners included the American Avalanche Association (AAA), led by outgoing AAA Eastern Representative Kyle Tyler and incoming Chris Joosen, assisted by your faithful correspondent as Member Representative, with additional support from the American Alpine Club.

A record attendance of 183 met at our new host, the Theater in the Wood, which also held a social event the prior evening. This year's registration fee was supplemented with a $1,000 grant from the AAA and a $500 Headline Sponsorship from Outdoor Research. Registration fee proceeds over and above the hosting costs went to the White Mountain Avalanche Education Fund, established to provide avalanche education to the youth of the Northeast.

As with similar workshops in other regions, the presentations appealed to the attendee mix of snow professionals and enthusiastic recreationists.

This year's program started with Chris Joosen's "Effect of Loose, Dry, Cold Snow Sluffing on New Slab Instabilities." For background, Chris noted that despite only one avalanche fatality over the past two years in our two micro-forecasted ravines, we have recorded 27 individuals involved in close calls. Of those, 19 have been either technical climbers in Huntington Ravine or mountaineers in Tuckerman Ravine, and eight have been skiers in Tuckerman.

The snow science level was then ratcheted up by Sam Colbeck, retired from the U.S. Army's Cold Region Research and Engineering Laboratory after three decades of groundbreaking cold lab and field research in snow crystal bonding and wet grain relationships. In his third year of ESAW presentations, this time Sam explained to us "The Two Stages of Wet Snow: Basic Physics and Why We Care" – not all of us might have been able to fully understand the physics behind all this, but he sure did convince us that it matters, especially with all our melt-freeze cycles here in the East.

Next, Mt. Washington Snow Ranger Frank Carus assessed the deep slab failure in this past season's summit cone avalanche. Although outside the official forecast area, this snowfield is just above the micro-forecasted Tuckerman and Huntington Ravines. Almost caught were (at least) both a party of six and a party of eight. The avalanche bulletin for the micro-forecasted lines that day had been Moderate yet a "Scary Moderate" given the low probability yet higher potential consequences.

Our two scheduled Western presenters were then introduced, first Karl Birkeland, Director of the National Avalanche Center, on "Toward an Improved Understanding of Avalanche Release and Stability Tests." Karl summarized many of the recent shifts in how we understand avalanches, including crack initiation versus propagation, as hilariously illustrated in the viral YouTube video of a silo demolition. Then Toby Weed presented on Utah Avalanche Center's Logan area from his professional forecaster's perspective.

After lunch, the National Ski Patrol's Eastern Division honored former Lead Snow Ranger Brad Ray with a lifetime achievement award, presented by past recipient (and 2013 ESAW presenter) Roger Damon. Then our surprise Western presenter Dale Atkins (former AAA President among with many other positions) emphasized shared avalanche responsibility for climbers: both the responsibility to be searchable and the responsibility to be able to search. Or as Shakespeare wrote in a cited passage: "A rescue! A rescue! Good people, bring a rescue or two!" Dale cautioned though that mountaineering, alpine climbing, and avalanches are all not "safe" and that beacon/probe/shovel/etc. are not safety equipment but rather rescue equipment, i.e., they don't make us safer, but rather easier to locate and rescue. Dale then joined a roundtable discussion moderated by Mt. Washington Snow Ranger Jeff Lane on "Avalanches and Climbing: Staying Alive while Pushing the Limits in Alpine Terrain" with additional participants Majka Burhardt, Ben Leoni, Kevin Mahoney, Mark Richey, and Jesse Williams. Each participant started with a short presentation on different topics, and then weighed in with responses to audience questions on a wide range of topics.

As if the roundtable discussion topic wasn't already enough to get everyone on edge, Toby Weed returned with "Into the Black: Forecasting for Extreme Avalanche Conditions (or, How to go grey in a month)."

And if, despite all of the foregoing, a skier did get caught in an avalanche, your faithful correspondent presented "Avalanche Bags: Do They Really Work? Yes! (But with some caveats...)." This presentation summarized the latest research (as published in TAR's first issue of this season) with an emphasis on implications for the high trauma rate in our at-treeline glacial cirques. Also highlighted were the various airbag systems' air travel issues for the many of us who live in the East yet who often fly West or to Europe to ski in avalanche terrain.

Mikayla Shefftz models a new lightweight airbag design, as seen in her father Jonathan's presentation.

Finally, Karl Birkeland wrapped up with a "Who We Are and What We Do" overview of the National Avalanche Center. Although he humbly revealed in a picture that the NAC is merely one cramped room, he emphasized the importance of the NAC. Also interesting was the original impetus for the NAC: approximately 90 percent of U.S. avalanches fatalities occur in national forests, the top killer of all natural causes and events.

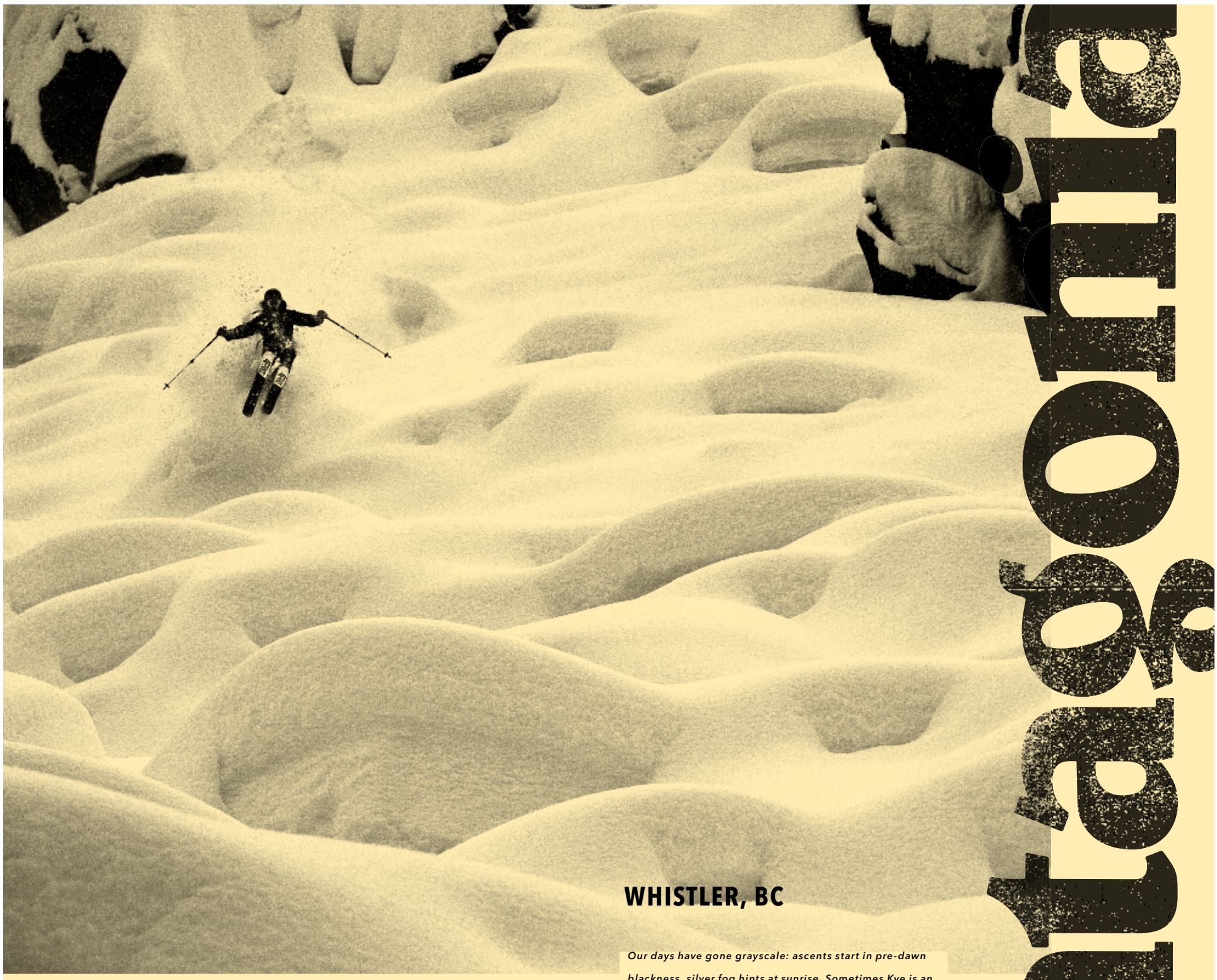
Interspersed throughout the event were raffles of prizes donated by our sponsors, including The American Avalanche Association, the American Alpine Club, American Institute for Avalanche Research and Education, ARVA, Backcountry Access, Black Diamond / Pieps, DeLorme, DPS Skis, Dynafit, Julbo, La Sportiva, Mammut, Mountain Hardwear, MSR, Off-Piste Mag, Ortovox, Outdoor Research (our "Headline Sponsor" for the event), Petzl / Adventure Medical Kits, Skimo Co, Smutty Nose Brewing, Sterling Rope, and Toko.

ESAW finally adjourned down to our second host, International Mountain Equipment, for socializing plus vendor displays from AIARE, BCA, BD/Pieps, Friends of the Mt. Washington Avalanche Center, La Sportiva, Mammut, Ortovox, Petzl, and Sterling.

Looking forward to seeing everyone again on November 7 of 2015!

Jonathan Shefftz lives with his wife and mondopoint-size 17 daughter (still too small for "Tech"-compatible ski touring boots) in Western Massachusetts, where he patrols at Northfield Mountain and Mount Greylock. He is an AIARE-qualified instructor, NSP avalanche instructor, and AAA governing board member. When he is not searching out elusive freshies in Southern New England or "coaching" in the local Bill Koch youth ski league (i.e., picking little kids off the snow), 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*** *or just look for the lycra-clad skinner training for his NE Rando Race Series.*

NSP avalanche instructor and past ESAW presenter Roger Damon presents the NSP's eponymous Roger Damon Avalanche Award to former Mount Washington Avalanche Center Lead Snow Ranger Brad Ray.



patagonia

WHISTLER, BC

Our days have gone grayscale: ascents start in pre-dawn blackness, silver fog hints at sunrise. Sometimes Kye is an opaque phantom, just 10 feet from my ski tips. Waiting for sunny mornings in this wilderness will earn you nothing but the roof overhead, so we wander into our monotone world where descent is a game of chance and feel; where we trace imaginary lines from one contour to the next, where slightly darker shades of snow signal a 20-foot drop without so much as a memo.

#Find_Away

Some pillows keep you up all night. Kye Petersen knocks the stuffing out of another field of dreams in the Whistler backcountry. See photos and videos online.
patagonia.com/findaway *Photos: Garrett Grove |*

Crown Profiles

INCIDENT on CHINOOK PASS

(Continued from Cover)

Story and photos by John Stimberis

What you DON'T see in this photo of Knob 2 is the road across the bottom of the slope.

Have you ever talked to someone while they were inside an avalanche? I don't mean a one-way conversation where you reassure them it will be alright. I'm talking about a back and forth conversation where you both share the unspoken disbelief about what is actually taking place. That's the way my day started on April 26, 2014. Well, maybe not started that way, but definitely how my day and the day for all of us working on Chinook Pass, WA took a sudden and wild turn.

The day at the work site began with moderate to heavy snow. Our area of concern that morning was a complex landscape with the plain and simple name of Knob 2. A wide and rugged series of chutes, open faces, and rock outcroppings funnel into a 60' wide chute just above the highway. State Highway 410 is cut into the hillside mid-path; the runout is another 700' below the highway. We had good ski cutting results the previous day and removed the majority of the new snow hazard.

It had been snowing on Chinook Pass for days leading up to the incident and we had been keeping up with the hazard. The night before the incident it snowed a bit more than forecast, and the day of the incident the forecast called for continued snowfall. Cooler temperatures and cloud cover would allow some time in the morning for the equipment operators to get a little work done. The plan was to allow some work then have the road crews move out as more avalanche control would likely be necessary. Overnight wasn't as cool as expected and the cloud cover and snowfall that morning quickly ended, leaving the slopes above the highway exposed to the sun.

The conditions changed quickly. Snow+Sun=Avalanche in less than 20 minutes, and it wasn't yet 10 a.m. Barely mid-morning and there I was talking to an equipment operator inside an avalanche. As surreal as it was, the reality moved in and now it was time to develop a plan. There was a second cat that was not affected, but he was in a tight spot between two paths. The buried dozer had a rear window vent exposed; this allowed fresh air to the operator. We moved up the road to assess the scene and quickly determined there was no way to access the dozer without a tremendous amount of risk; definitely a no-go situation. Avalanches continued to come down both over and around the dozer. Unless the temperatures dropped and the cloud cover returned we would not see a decrease in the instability. The plan was made: ascend the slopes via our normal ascent and mitigate the hazard.

One member of our crew remained on the highway to manage the scene while another crew member and I began the ski ascent. One suspect slope remained between us and the ridge, but surely it had slid given its easterly aspect and the current conditions? We arrived to find it had not slid. Mountains and the snowpack are cunning that way. As we debated the merits and risks of ascending this slope a sizeable release moved into our potential ascent. Not enough to make it safe, but enough to change our plan. A steeper route existed, but it would expose us to less hazard overall. The key was getting onto a sharp ridge and fortunately that approach had already slid.

We reached the ridgetop and got ready to begin the control process. Keep in mind that at least a half dozen slides have now gone over the roof of the buried dozer. His position in the track didn't really allow for any more snow to accumulate on the dozer in order to keep the small rear wing window snow free. Knowing these pieces of information did not make the first move any easier. I tossed a snowball onto the slope below me and watched the point release grow into a size 2+ avalanche. The call came back from the road side spotter that all was good.

We quickly ruled out any explosives considering how easily these avalanches were triggered. Explosives aren't always the best option in loose wet snow and this was about as loose and wet as it gets. Snowballs and ski cuts were the tool of choice. It would have been all too easy to make large ski cuts and quickly reduce the hazard, but with a person buried in the path it seemed more prudent to take our time and keep the overall avalanche size to a minimum.

Yes, really, there's a bulldozer in there.

We worked our way across the upper start zone and then dropped in to begin tackling every little detail of this complex terrain. The bed surface we exposed the previous day was very firm, allowing any and all new snow to easily slide and entrain more snow. When there wasn't more snow to entrain, the slides ran with little resistance.

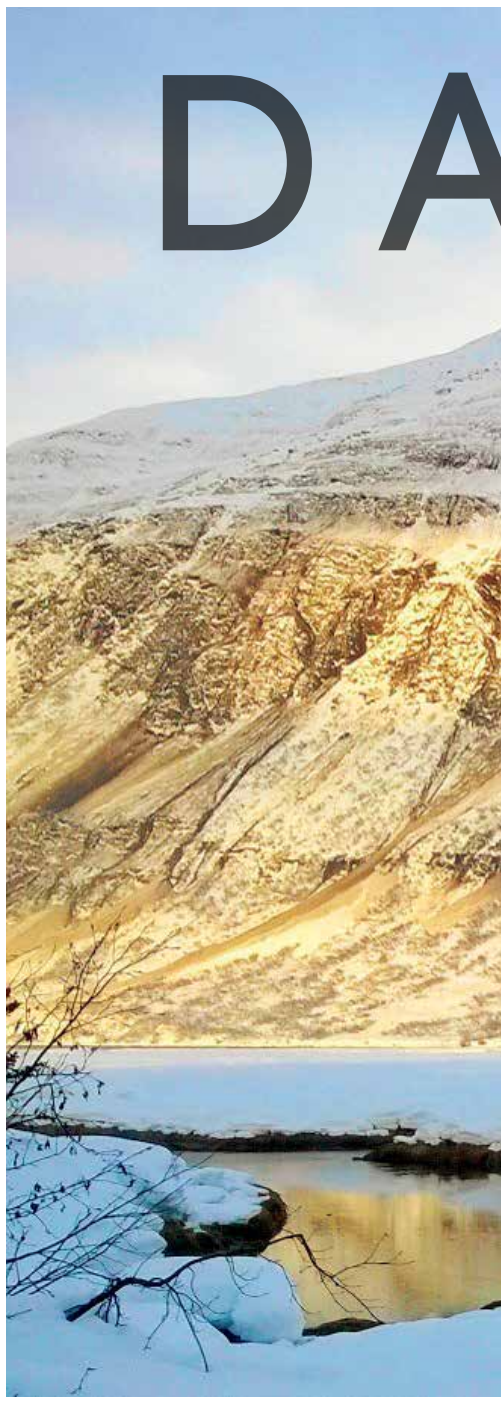
Just as we were feeling fairly comfortable with the situation we lost contact with the buried equipment operator. Probably just the battery, but we needed confirmation. After several unanswered calls a sectional probe made its way out of the rear wing window and was waved around. We had reestablished communications! The remainder of the ski cutting operation went smoothly, though it was a bit tedious given how many little spots held just enough snow to knock someone off their feet if they were shoveling in a steep and precarious location such as where the dozer was located.

I finally reached the dozer while my partner stayed up slope to warn of any potential snow. I tapped my ski pole on a small bit of exposed roof and heard the operator give a hearty laugh. I got out of my skis and began shoveling the door. After a few minutes the door was exposed and equipment operator Tom was free. We rejoiced for a quick moment then decided it was time to get out of there. One difficultly I hadn't considered was getting the equipment operator across the avalanche debris. Traversing the avalanche track seems like a simple task for those of us who spend time on steep snow. We cut some steps and lent our ski poles to provide stability.

What was learned from the incident? First off don't place too much confidence in the forecast. We have great forecasters but they are attempting to predict the future. Local conditions will vary more than the regional forecast. We also need to be more diligent in assessing the value of the work we hope to achieve. Snow removal on a day when more avalanches are certain is a losing battle. As much as the crews want to work, there comes a time when we just need to step back. A strong work ethic and outside influences are sometimes tough to overcome. It is ironic that a State Legislator was testifying about how we need to keep this pass open year-round at about the same time that the incident took place. People outside our profession don't often understand the complexity of decision-making and the risks we take to do our jobs.

Ultimately the equipment was left in place. Snow continued through the weekend and began to let up early the following week. Hand-placed explosives, ski-cutting, and heli-blasting were all employed to reduce the ongoing hazard. A week after the incident we found our crews back at the John Deere with shovels in hand. It didn't take long to clear the tracks, and it took even less time for Tom to drive the machine out of the debris. Soon both dozers and the crews were back to our safe parking zone. It was there that Tom pulled his lunch box out of the dozer and revealed a pack of hot dogs that had been inside the machine, under the snow, for the past week. We fired up the grill and enjoyed our lunch of "avalanche dogs."

Author John Stimberis, president of the AAA, works for Washington State DOT. In this photo from ISSW 2014, he visits with old friend and colleague Mark Moore, now-retired director of the Northwest Avalanche Center. ❄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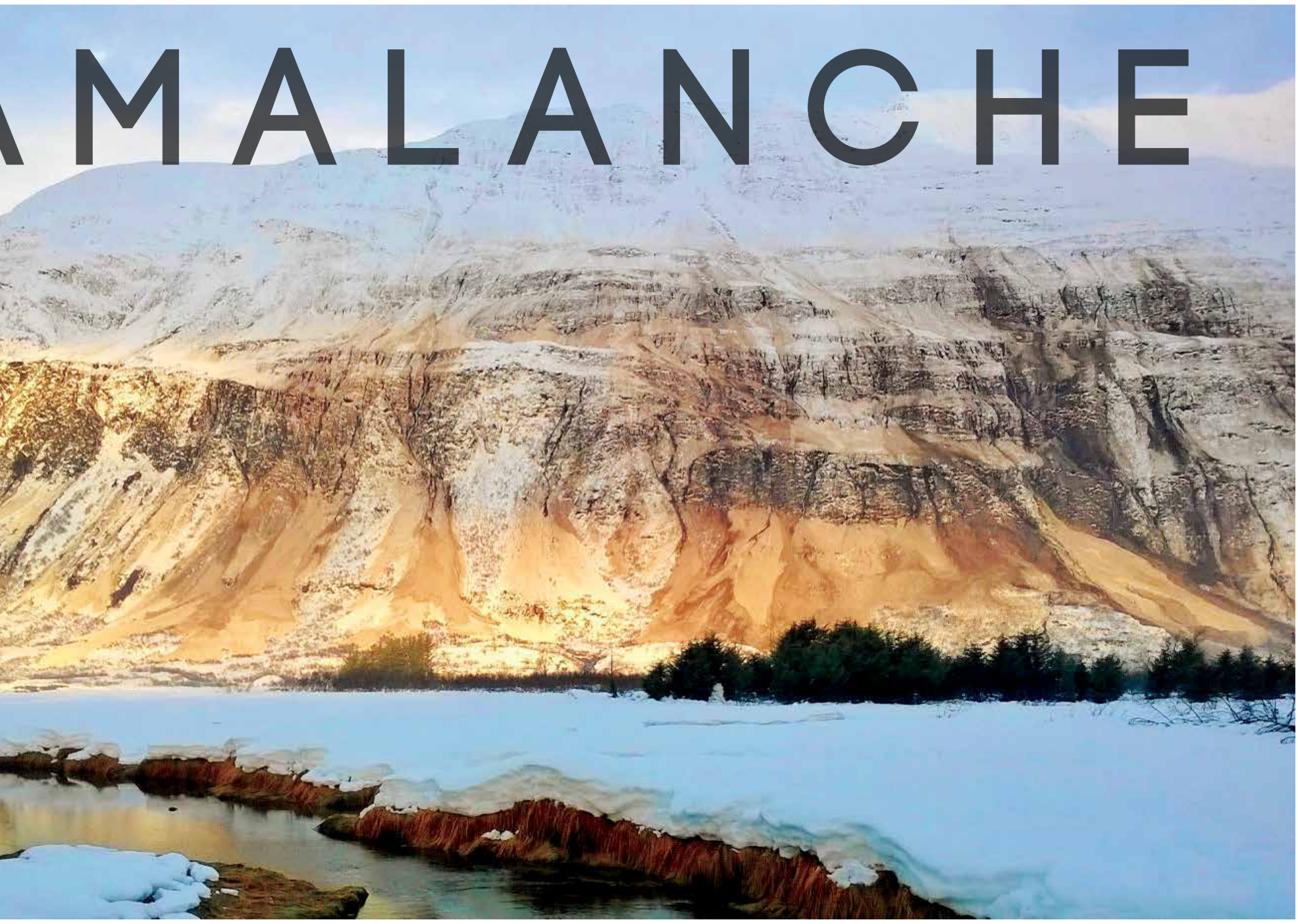


CHUGACH, ALASKA: Deep snowpack, warm temperatures, and record rainfall during late January 2014 in Alaska's south-central Chugach Range surrounding Valdez generated a surreal avalanche cycle that lasted nearly two weeks. I was fortunate enough to witness this event from ground zero in Valdez. Avalanches during this cycle ran for thousands of vertical feet and stripped meters of snowpack to dirt for hundreds if not thousands of square miles in the range.

The focus was on the monster avalanche in Snowslide Gulch on Jan. 24, 2014 at Mile 16 of the Richardson Highway near Keystone Canyon. Dubbed "Damalanche" by local Valdez residents, this slide buried the highway 20-40 feet deep and cut off the only road access to Valdez for 12 days. Alaska DOT triggered a second avalanche on Jan. 25 in Snowslide Gulch that dammed the Lowe River and created a half-mile long lake behind the dam, which drained itself after several days.

I personally witnessed dozens of other slides on the mountains surrounding Valdez, and falling asleep at night, I heard the growling and thundering of huge avalanches on the mountain behind my house. These slides came down like waterfalls containing snow, ice, dirt, rock, vegetation, and likely some small animals mixed in, and persisted for up to 15 minutes. One of the largest deposition zones I saw in Mineral Creek just outside of Valdez was easily 60 feet deep.

—Josh Cooley

RESCUE

From the AAA SAR Committee Co-Chairs, Nick Armitage and Maura Longden:

As new co-chairs of the SAR committee, our work of advancing the body of knowledge and standards in the avalanche search and rescue field has just begun.
We have already heard from fellow AAA members who are interested in learning about new developments in avalanche search and rescue or who have offered their assistance and ideas for the work of the SAR committee. Here are some of the tasks that we will be focusing on in the months ahead:

- Assist the education committee in AAA curriculum development
- Promote NIMS/ICS in avalanche search and rescue incident management
- Facilitate work groups to focus on specific avalanche search and rescue topics
- Continue to update the avalanche community on avalanche SAR-related studies, the best available science, and international practices and standards that may improve our preparedness and effectiveness during an emergency
- We are also considering the addition of a SAR resource link to the AAA web site to centralize avalanche SAR related information and references.

Overall we are intending to foster a more connected professional avalanche SAR community and support the AAA mission as it pertains to search and rescue. For further AAA SAR inquiries and interests please contact us at **ndarmitage@gmail.com** and **mjlongden1@gmail.com**.

Time To Put The RESCUE Back Into Avalanche Rescue

By Dale Atkins

For more than a generation avalanche rescue as it has been taught has focused on search – finding someone – at the expense of rescue – actually saving someone's life. If you travel in avalanche terrain, you probably have said to fellow workers, friends and students that an avalanche transceiver is the best tool to save a life. But is it always? The simple answer is no. In two recent Colorado avalanche incidents, a cell phone was in one case, and would have been in another, the better tool.

In March 2013 a backcountry skier survived a three-hour burial and was rescued alive because other skiers called 911 when they spotted the avalanche. In April that same spring, six transceiver-equipped riders were buried in a massive slide; five died. All were well equipped with transceivers, probes and shovels; two even had airbags, but were unable to deploy them. An accessible cell phone would have meant a quick call to 911 and a ski patrol that was only 15 minutes away. One rider was able to break the surface with one hand and eventually scrape away snow from his head, but was unable to dig himself out. Even after nearly four hours, he still hadn't cleared enough snow to reach his phone, which, sadly, was in his pants pocket.

Several winters ago, in Washington two backcountry skiers were caught in the Snoqualmie backcountry. One suffered life-threatening injuries. A cell phone call and a helicopter flight saved his life.

Around the country these sorts of accidents are not as unusual or rare as one might think. They happen every winter and in growing numbers.

To emphasize a single tool or device when it comes to rescue and saving lives is old-school thinking. Every avalanche accident is different, and the outcomes are always uncertain. Since some tools work better in some situations than in others, no single device, technology, or strategy is optimal. Rescuers – both companions and organized rescue teams – should embrace all devices and strategies. It is the combination of devices and methods – a rescue system – that produces the best outcome.

Rather than relying on single tools or devices, a systems approach to avalanche rescue integrates subcomponents and looks at the complete picture of rescue, which is much more than just finding someone. The reason for this change to a systems approach is that attitudes of skiers, riders and snowmobilers have changed, and so too have the types of accidents. It's time that we as avalanche rescuers and educators change our attitudes and actions too.

ACCIDENTS AND RESCUES CHANGING

A generation ago, riders used avalanche bulletins as a supplement to their knowledge and skills to avoid avalanche-prone terrain. Avalanche rescue equipment was carried as a backup, in case mistakes were made. Avalanche accidents were viewed as preventable.

Today's riders use the avalanche bulletins, their knowledge and skills, and rescue equipment to purposely push into potentially dangerous avalanche conditions. For these skiers and riders, avalanche accidents are inevitable; as such, we as rescuers have to be ready.

Traditional avalanche rescue was performed sequentially as a three-phase process *(Figure 1)*. If one couldn't self-rescue, he or she relied on others in the party. If companions couldn't rescue their friend, they called on organized rescue teams. At each step, the focus was on devices. Self-rescue relies on airbags and AvaLungs. Companion rescue relies on transceivers, shovels, probes, and airbags (acting as a big marker). Organized rescue relies on dogs, RECCO, transceivers, and probe poles. These devices all help to find someone, but they are not always the best tools or methods to save a life.

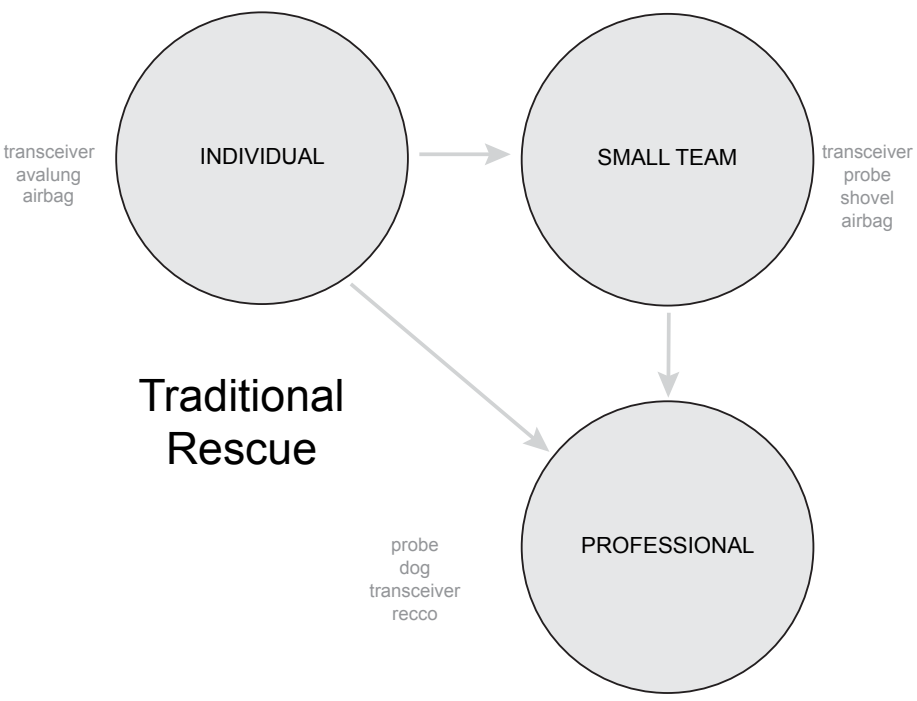


Figure 1: Traditional avalanche rescue focused on the tools to find someone.

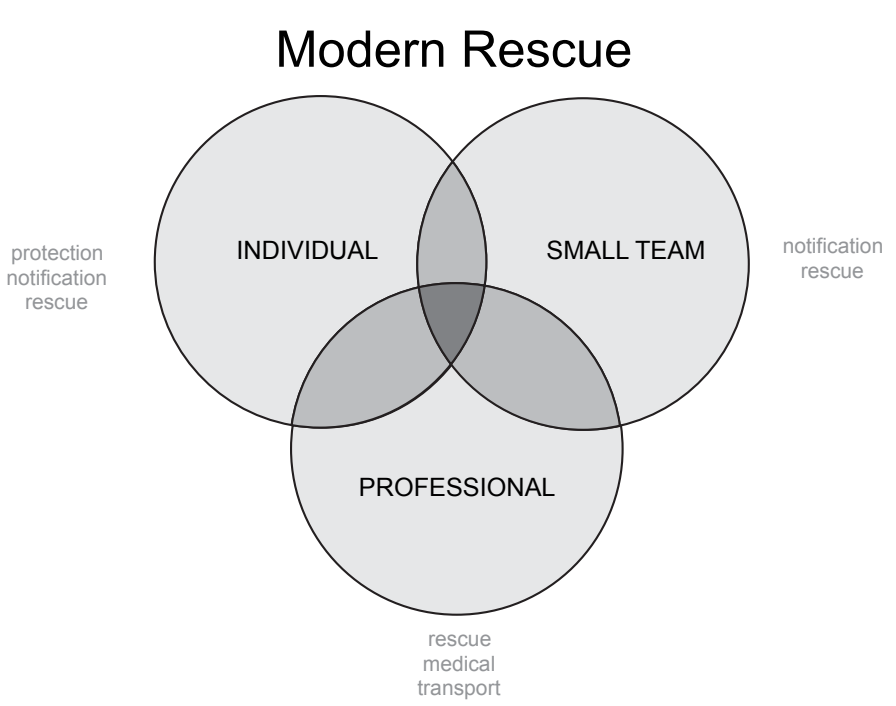


Figure 2: Modern avalanche rescue is characterized by an integrated systems approach.

Today, rescue is changing. In many rescues, especially in and near ski areas, the so-called companion and organized phases often blur together. In the backcountry a generation ago, it was uncommon for another group to be close by when an avalanche accident happened. Today, it is common for other nearby groups to come to the aid of the stricken group and assist in, or even direct, companion rescue efforts. And other times there is no companion rescue because the companions cannot reach the avalanche debris quickly, usually a consequence of topography. Avalanche rescue today is less often defined by distinct phases, but rather as an integrated structure of different classes and subsystems working together. Since rescue is changing, maybe it's time to rename and redefine the process, *(Figure 2).*

A NEW STRUCTURE OF SUBSYSTEMS

In reality, self rescue is individual rescue, as individual describes one person and takes into account what one person can do to protect one's self, notify rescuers, and to be easier to find. Helmet, body armor, AvaLung, and airbag offer body protection. A cell phone, radio, SPOT satellite messenger, or other communications devices makes it easier to notify rescuers. Lastly, the individual needs to be easy to find so the rescue can be done quickly. The rescue tools are those that make one searchable: the transceiver and RECCO reflectors.

Companion rescue is really about small-team rescue; it is a group of friends or others in the immediate area that work together as a team in an organized manner. To be most effective, people need to be organized and should know how to perform avalanche rescue, just as if they were part of a formal rescue team. The subsystems of small team rescue are notification and rescue. The standard rescue kit stays the same: transceiver, probe, shovel. And each member should also have a means for the team to call for help in case of a burial or injured person. Cell phones, radios, SPOT, or other devices can be lifesaving in the case of an avalanche accident.

Traditional "organized" rescue is really about being competent and skilled and working together as a group. It's about being professional, and you don't have to be paid to be professional. Volunteer mountain rescuers and ski patrollers provide professional-level service. For the injured person or someone in an avalanche their expectation is for high quality service and care. They don't care if the rescuer is paid or not. Professional rescue provides greater capabilities than a small team by offering more rescuers, more expertise, and more rescue tools such as long-range transceivers, dogs, RECCO detectors, etc. Professionals also can provide two critical capabilities that small teams cannot: enhanced medical care and transportation. To provide a higher level of care and faster transportation can make a difference for the critical avalanche victim.

Rather than relying on single tools or devices, a systems approach to avalanche rescue integrates subcomponents and looks at the complete picture of rescue, which is much more than just finding someone.

This new structure to avalanche rescue assumes that accidents will happen; therefore, individuals and rescue teams should be ready. The common subsystem that ties the three classes together is rescue. People headed into avalanche terrain need to make themselves searchable, and electronic means – transceiver and RECCO reflectors – are fastest. Small teams need to have and know how to use the tools to call for help and to find a buried victim. Likewise, professionals need to have all the rescue tools to locate someone quickly and to be ready to treat and transport quickly. The other subsystems of each class compliment rescue by maximizing the potential to save a life.

FINAL THOUGHTS

Certainly, avalanche avoidance is the best way to stay alive; however, today's recreationalists are demonstrating that they are not always so interested in avoidance. Therefore, rescuers must be ready. And being ready includes more than just being able to find someone; it also includes having the knowledge, tools, skills and ability to save a life.

An integrated system, as compared to a sequential process, saves time; and time saves lives. All rescue devices have limitations, and so too do the users. Because avalanche rescue can be complex and outcomes are not always known, the best strategy to save lives –after the accident – is an integrated system that focuses on saving lives, not just finding someone.

RESCUE

10 YEARS OF AVALANCHE RESCUES IN THE UNITED STATES

2003/04 to 2012/13

By Dale Atkins

INTRODUCTION

To gain insight into the state of avalanche rescue in the US, the general problem of avalanches and people should be reviewed. Within this summary are brief synopses of the avalanche problem, setting, survival statistics and rescue statistics.

After reaching a twenty-year low in the late 1980s, avalanche deaths in the United States soared during the 1990s (Figure 1) and spiked twice (2007/08 and 2009/10) with 36 deaths, the greatest number killed in the modern era (post 1950). Figure 1 also presents the five-year moving average that smoothes the data considerably. Since the end of the 1980s the average number of fatalities per winter rose from 11 to 30 but decreased slightly in the mid 2000s; however, in recent years the five-year average has edged back upwards to 30 deaths per winter. As more people head into the winter backcountry avalanches continue to be deadly. In the United States since 1950, avalanches have claimed 993 lives; however, 28% (281) of those victims died during the last 10 winters.

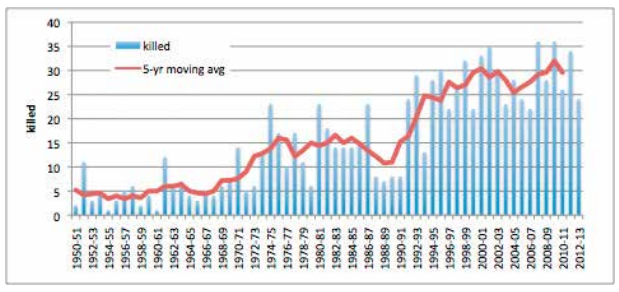


Figure 1: Avalanche fatalities by winter, 1950/51-2012/2013 and five-year moving average.

2003/04 TO 2012/13: TEN YEARS OF REVIEW

In the past 10 years on average an estimated 350 people are caught during each winter; 90, partly buried, 40 buried, 40 injured and 28 known killed. The median yearly direct losses to property were estimated at $100,000, though property losses varied significantly from year to year. Losses in the last 10 years ranged from a low of about $30,000 to a high of $6 million for destruction caused by a 2008 avalanche that destroyed a portion of the high-power transmission line supplying Juneau, Alaska. However, actual costs were nearly three times greater. The city relied on diesel-powered generators for 45 days resulting in fuel costs of $10 million. Ten months later a much smaller avalanche struck the same transmission line. Repair costs tallied $1.7 million, and fuel costs totaled $3.6 million for the three weeks to run generators. (Mean losses tallied $262,000; however, when fuel costs were added the mean value soars to $803,000.)

At this point, a word of caution is necessary about all the accident and rescue statistics reported in this paper. These data are provisional and compiled using avalanche accident reports collected by the www.avalanche.org, the Colorado Avalanche Information Center (CAIC), and by the author. During the past 20 years or so this data set has become increasingly biased towards avalanche fatalities. This trend has worsened in the past 15 years as most reported accidents involve avalanche fatalities with fewer detailed nonfatal accidents being reported. While nearly all U.S. fatalities are reported to the CAIC, fewer and fewer nonfatal accidents are being reported.

This absence of nonfatal data significantly affects the accident and rescue statistics, skewing the statistics against survival. There is no reason to think that the incidence of nonfatal accidents is decreasing; they are just not being reported and documented. Thus, the reader should keep this in mind when interpreting the data.

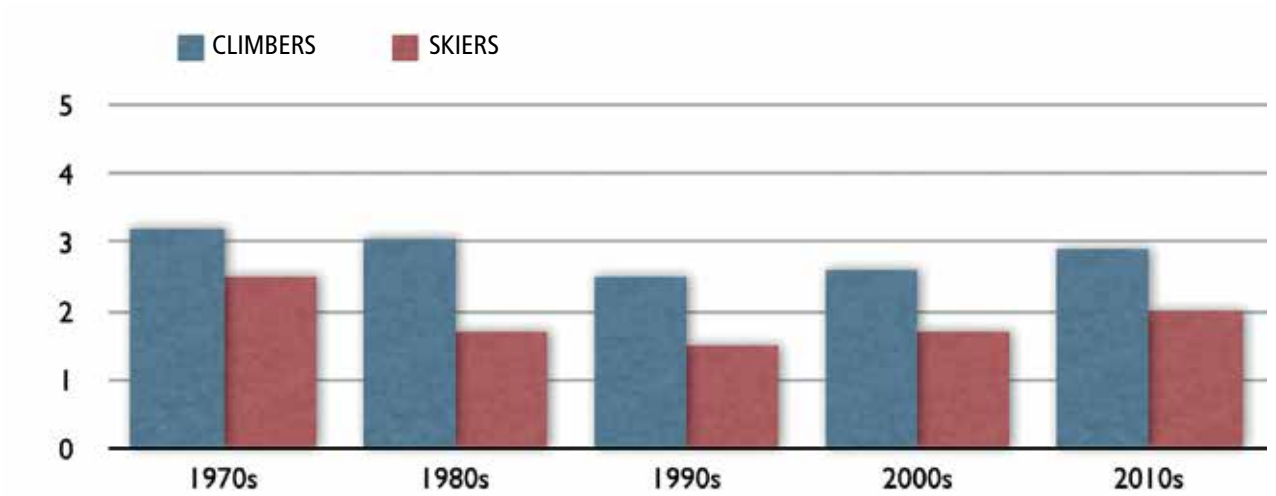


Figure 2: Number of backcountry skiers and climbers caught per avalanche, 1970–2014.

Please spread the word that all accidents and search and rescues should be documented and reported to the www.avalanche.org and/or the Colorado Avalanche Information Center. A short avalanche accident reporting form can be found in the Snow, Weather, and Avalanche: Observational Guidelines for Avalanche Programs in the United States.

THE AVALANCHE SETTING

There is a recent trend toward more accidents in the backcountry and occurring further into the backcountry than even just five years ago. Today backcountry accidents outnumber accidents in and near developed areas almost four to one. (In terms of rescue, backcountry is considered to be areas beyond 2 miles from developed-areas, such as towns and ski areas.) Nearly four in five accidents (78%) occurred in the backcountry and about one in five (22%) occurred in or near developed areas (within 2 miles). When looking at only skiing and snowboarding accidents 40% of accidents occurred within 2 miles of developed areas.

In 213 accidents the avalanche type and trigger were reported, and during the last ten years nearly all fatal-avalanches (94%) were human triggered either by the victim, a member of the victim's party, or in at least two cases by another party. Nearly all fatal avalanches (93%) involved slab avalanches *(Table 3)*. The data also show that most killer avalanches are small to medium in size, and usually result in one fatality. Of the 237 avalanche accidents, 203 (86%) claimed one life; 27, two lives; 5, three lives; 1, four lives; and 1, five lives. The worst accident in the modern era (post 1950) occurred on Mount Rainier where 11 died in an ice avalanche on June 21, 1981.

The golden rule of smart travel in avalanche terrain is to expose only one person at a time to the hazard. Despite extensive education and awareness efforts for backcountry travelers the number of backcountry skiers and climbers caught per avalanche has been increasing over the last 15 years. Though not shown the number of accidents with two or more deaths per avalanche is also on the increase in the past four years.

On average, each winter, there were eight accidents where three or more people were caught. While multiple burials are infrequent, averaging about 10% of reported accidents in the past 10 years, deaths are frequent in these accidents. Of the 48 reported accidents that resulted in 2 or more people buried, deaths occurred in 43 accidents.

SURVIVAL STATISTICS

Time

Obviously time is the enemy of the buried avalanche victim. However, a few lucky victims have survived long burials. Table 1 compares Canadian and Switzerland (taken to only up to 60 minutes) with US data (many hours). The US data shows that 2.4% (7 of 286) of buried victims survived burials longer than 5 hours. Burial times were 5, 5, 6, 8, 10, 23 and 24 hours. Rescuers should not prematurely shift attitudes from "rescue" to "recovery" after just a few hours or even after more than half a day. A few lucky victims have been known to survive much longer.

Burial Depth

For many years researchers in the United States felt that survival was dependent on both burial time and burial depth; however, today most researchers feel burial time is most important. Deeper burials take longer to dig which leads to longer burial times. To date, no one in the United States has survived a burial deeper than 10 feet.

However, elsewhere in the world, lucky victims have survived deeper burials. In Switzerland two

	UNITED STATES		CANADA		SWITZERLAND	
duration of burial, min	**no. extricated**	**no. (%) survived**	**no. extricated**	**no. (%) survived**	**no. extricated**	**no. (%) survived**
≤ 10	90	77 (85.60)	124	111 (89.5)	236	221 (93.6)
11–20	51	19 (37.3)	47	17 (36.2)	142	101 (71.1)
21–35	23	7 (30.4)	29	7 (24.1)	107	47 (43.9)
36–60	19	2 (10.5)	101	4 (4.0)	461	75 (16.3)
61–120	19	0 (0)				
121–180	8	0 (0)				
181–240	8	0 (0)				
241–300	8	2 (25.0%)				
301–360	4	1 (25.0%)				
≥ 361	56	4 (7.1%)				
ALL	**286**	**112 (39.2)**	**301**	**139 (46.2)**	**946**	**444 (46.9)**

Table 1: Proportion of people that survived complete burials, by duration. US data (2001/02–2010/11). Canada and Switzerland data from Haegeli et al. 2011.

mountain guides buried 21 and 23 feet survived (F. Tshirky and B. Durrer M.D., personal communication). Rescuers dug for four hours to uncover the men.

Injuries

Avalanche victims—both buried and not buried—get injured and sometimes those injuries are very serious. The medical community agrees that on average that 75% of buried victims die of asphyxiation, about 25% from trauma, and very few from hypothermia. These average values vary with geographical location and the terrain over which the avalanche runs.

Traumatic injury—serious and often body-altering injuries—is usually the a result of the terrain where the avalanche occurred. Data from Europe, Utah and British Columbia shows that serious traumatic injuries occur to about 25% of avalanche survivors. The British Columbia data also shows that the death rate by trauma varies by the activity from a low of 9% for snowmobilers to a high of 42% for ice climbers. Common traumatic injuries include fractures and dislocations to arms, legs and pelvis; soft tissue injuries to the belly and chest including major lacerations to internal and external organs; and head and face injuries. Victims swept into rocks and trees will suffer major traumatic injuries that can quickly lead to death. In 2011 a backcountry skier's leg was severed when he was swept through trees. He died within 15 minutes. Though hypothermia rarely kills avalanche victims, nearly all buried and seriously injured victims will incur hypothermia.

The International Commission for Alpine Rescue views an avalanche accident and especially when a burial is known or suspected as a medical emergency and recommends early notification of rescuers to be an essential action.

RESCUE STATISTICS

Type of Rescue

A buried victim's chance for survival directly relates not only to length of time and burial depth but also to the type of rescue. Table 2 compiles the statistics on survival as a function of the type of rescue. Obviously, buried victims rescued by companions or another group nearby the accident site have a much better chance of survival than those found by professional rescue groups—time being the major influencing factor. Of all those found alive, companions and others nearby rescued only 42%; professional rescue parties (volunteer or paid) saved 9% of buried victims.

Method of Rescue

	INDIVIDUAL RESCUE	SMALL TEAM RESCUE	PROFESSIONAL RESCUE
ALIVE	9 (9%)	83 (42%)	14 (9%)
DEAD	—	116 (58%)	138 (91%)
TOTALS	—	199 (100%)	152 (100%)

Table 2: Type of rescue for buried avalanche victims in direct contact with snow, 2003/04–2012/13.

Table 3 describe the method of rescue for 351 buried avalanche victims; unfortunately the data is becoming more biased toward mortality because of less reporting of burials with survivors. Fifty-one percent (36 of 70) of victims who were buried with a body part, like a hand or foot, or an attached object, like a ski tip, protruding from the snow were found alive. However, when considering only small team rescue, that number is 62% (32 of 52). This statistic also shows the advantages of a shallow burial resulting in shorter digging time. Of the fatalities in this category, some were traveling solo with no one to spot the hand or ski tip and rescue them. In several incidents the search was abandoned prematurely to seek organized rescue. When rescue teams arrived they found a skis or hand sticking out of the snow.

The avalanche transceiver (aka beacon) has been used to find more victims in the past 10 years than any other method, and the use of transceivers reveals both good news and bad news. A transceiver is the best method for a companion to find a completely friend, if carried and used correctly. The bad news is the mortality rate—based on reported incidents—over the last 10 years has been rising steadily and now stands at a disappointing 73% (109 of 150). More people die with transceivers on than survive. There is also another disturbing trend that many people equipped with transceivers are being found by professional rescue rather than by their companions. A rescuer might say this is because professional rescuers are arriving sooner. However, the most likely reason is that many companions are not capable with their transceivers. Despite improvements in usability, users continue to not practice, make mistakes, forget to carry one, or even purposely choose not to carry a transceiver. In the past four winters there have been at least six cases where very experienced and avalanche savvy people chose purposely to not take their transceiver. All died in avalanche burials. An avalanche rescue transceiver and shovel in trained hands of a companion are a buried victim's best hope for survival, but it is no guarantee of a live recovery. Even in textbook rescues—the signal is quickly located and the victim is dug out in a short time—most victims do not survive.

Organized probe lines have recovered the next greatest number of buried victims, but because of the time required, nearly all (93%) are recovered dead. Only 3 were found alive by this method, 40 were recovered dead.

Trained avalanche dogs found many buried victims (20) and even personal dogs owned by the buried victim helped locate their master (in all three cases the dogs were with their master when the avalanche happened). Since 1950 there have only been nine reported live recoveries. Six of the nine involved trained dogs: four at ski areas, one along a highway and one in the backcountry. Three other burials involved personal dogs who found their owners in the backcountry. Burial depths of those found alive ranged from 1 to 5 feet; burial depths of those killed ranged up to 15 feet. In the search of a destroyed house a rescue dog alerted for victim buried about 35 feet. However, the median burial depth for all burials is only 3 feet. It should be noted that dogs find "scent" and not people, though sometimes they find both. On numerous occasions dogs alerted in the vicinity, which may extend out as far as 30–40 feet from a buried victim. These scent clues then led to searchers finding victims with other technologies.

Despite the insulating properties of snow, 10 victims buried shallowly were able to yell and be heard by their rescuers (voice).

For 14 buried victims, the search was called off after several days. The bodies were recovered weeks to months later.

In the category not found, not recovered, four victims were never found. The four shared a rope and were swept into a glacial crevasse.

	SMALL TEAM			PROFESSIONAL			ALL
METHOD	Alive	Dead	Total	Alive	Dead	Total	TOTAL
Attached object or body part	32	20	52	4	14	18	70
Spot probe	2	3	5	1	11	12	17
Probe Line	1	9	10	2	31	33	43
Rescue transceiver	37	76	113	4	33	37	150
Avalanche dog	1	2	3	1	19	20	23
Voice	9	0	9	1	0	1	10
Digging	1	6	7	1	6	7	14
Recco	0	0	0	0	4	4	4
Melted out	0	0	0	0	14	14	14
Not found, not recovered	–	–	–	0	4	4	4
Inside vehicle	0	0	0	0	0	0	0
Inside structure	–	–	–	0	2	2	2
TOTALS	83	116	199	14	138	152	351

Table 3: Method of rescue for buried avalanche victims, 2003/04 - 2012/13.

Continued on next page ➡

RESCUE

CONCLUSIONS

Some important conclusions can be drawn from this review.

1. Avalanche accidents are a medical emergency. For 15 years the International Commission for Alpine Rescue has repeatedly stated that avalanche accidents are medical emergencies. This is true even when burial is suspected. Try to call for help right away and be ready to give your specific location along with where you started your trip, like a trailhead or ski area. Remember dispatchers (and likely rescuers, too) don't know that "Atlantic Bowl" is on Loveland Pass (Colorado), since it is not an official geographic name. Don't get stuck on the details of your emergency. Rescuers assume the worst, but if you can't say where you are, the rescuer might not be able to find you. Much better to call rescuers early and not need them than to call late and need them.

2. Be searchable. Invest in a transceiver, learn how to use it and always carry it. Make sure your friends are even better with their transceiver than you are. Transceivers make one searchable to our companions. Be equipped with Recco reflectors so you're also searchable to professional rescuers, and be sure to carry a light and whistle. Both can help attract rescuers to your location, especially in the dark and bad weather.

3. People caught in avalanches get hurt, and often seriously. Avalanches turn violent when people collide with trees and rocks, or get swept over cliffs. The collisions are similar to being hit by a fast moving car. Take a CPR and wilderness first aid course, so you will be ready to provide first aid and extended care to an injured friend.

4. Burial statistics do not favor the buried victim—more will die than will live. While there is certainly a bias cause by not reporting close calls, the critical trend he bottom line is that only one in four completely buried—no part sticking above the surface and not in vehicles or buildings—victims survives. This 22% survival rate of totally buried victims has remained consistent for decades. Even when an object or body part is visible on the snow surface the survival rate is still poor. Table 3 shows a dismal survival rate for the buried victim that has plummeted 38%. This value is very suspect because for the 30 years prior to this 10-year study period the survival rate had hovered around 60%. The bias caused by not reporting, or incomplete (missing data) reporting, of buried survivors has most likely caused the general survival rate to drop.

5. Surviving an avalanche burial is luck. Devices like transceivers, airbags, Recco reflectors, and Avalungs help put one in a place to be lucky, but these devices do not guarantee survival. One should never rely on luck to survive.

6. The number of people caught and killed per avalanche is going up. Recreationalists and professional rescuers need to be prepared to solve multiple victim accidents. Also recreationalists should know that when more than one person gets buried most likely at least one will die. In 90% of accidents that buried two or more people, at least one person died.

7. Some lucky buried victims do survive for many hours. No rescue should be abandoned prematurely on the assumption that the victim could not possibly be alive. For even up to 24 hours, some victims have been found alive, and no avalanche victim should ever be denied this small chance at life. Rescuers should not ask if a buried victim might still be dead, but rather, rescuers should ask if a buried victim might still be alive.

When we consider the large numbers of people exposed to avalanche hazard each winter compared to the annual average number of avalanche fatalities (30 for the last five years), there is a low probability that someone will be caught in an avalanche at a given time and location. However, once a victim is buried, chances for survival are low—about one in four.

Thus, prevention of accidents is the key to saving lives. No rescue method or device is an adequate substitute for proper route finding and decision-making. But when an accident does occur, speed of recovery is still the critical factor in live rescues. More than three-fourths (81%) of all live rescues were made by the victim's companions. While one's best chance of being found alive is in the hands of companions, everyone must remember the actual chances of being found alive even by companions is only slightly better than 50/50. Pick your friends carefully.

Dale Atkins has been involved in the rescue world for many years, as a forecaster and researcher at the CAIC, then with the Mountain Rescue Association, the American Avalanche Association, and RECCO.

IKAR / CISA 2014 Update

By Jake Urban

The Mountain Rescue Association, along with the Douglas County Search and Rescue team, hosted the International Commission for Alpine Rescue (IKAR) annual Congress in Lake Tahoe, Nevada from October 6-9, 2014. This was the first time in IKAR's 66-year history that the Congress was held in the United States.

Over 300 rescuers from all over the world came together to share improved rescue techniques, and knowledge and equipment shown to improve the safety and effectiveness of mountain rescue. The commissions of Avalanche Rescue, Medical Treatment, Air Rescue and Terrestrial Rescue each provided the most current research and applications from their disciplines.

One of the many highlights of the Congress was the day-long, pre-conference workshop attended by nearly 200 rescuers in leadership positions within their respective organization. This workshop focused on skills associated with avalanche rescue and included companion rescue and resuscitation checklist, patient rewarming techniques, mass casualty incidents (MCI), RECCO technology, new transceiver technology, and new probing methods.

For the companion rescue and resuscitation checklist training, participants worked in groups to solve a multi person burial. Via patient presentation and the use of a checklist, participants made decisions regarding the most appropriate treatment for the patient. See M. Blancher, A Kottman's paper, *Avalanche Victim Resuscitation Checklist*: http://www.ikar-cisa.org/ikar-cisa/documents/2013/ikar20131206001112.pdf

The patient rewarming training was very real and hands on as volunteer "patients" (me!) had their core body temperature lowered (read "ice bath") before being rewarmed through various techniques. Effectiveness was measured over time by assessing core temperature in these "patients."

The MCI training consisted of developing an incident command structure appropriate for solving a multi agency response. This scenario demonstrated the complexity and advanced training necessary for Incident Commanders.

The RECCO technology presentation focused on how to properly prepare to search. Distracting signals can cause trouble for the not prepared and not practiced detector operator. With detectors, teams practiced preparing to search, which included practicing separation, self-scans, blocking, and shielding.

BCA, Mammut and ARVA provided seminars on their latest contributions to beacon and communication technologies.

Finally, demonstration and practice sessions were provided for slalom probe line techniques. Read more about slalom here: http://www.ikar-cisa.org/ikar-cisa/documents/2014/ikar20141205001397.pdf

The Congress followed over the next three days with presentations from the four Commissions. All of the Commissions provided presentations supporting the preconference workshop activities in addition to rescue and accident review and analysis.

Some additional topics included the continued development of the White Risk Avalanche Prevention Program, Methods for Searching for Humans with Phone Apps, Preparing Personnel for Rescues, and Communications between Flight Crew.

I had the opportunity to attend ISSW before IKAR; and it was nothing short of a privilege and proved how complimentary these two programs are for one another. I strongly recommend attendance to not only rescuers but also avalanche practitioners.

Jacob Urban is the Training Director for Teton County Search and Rescue and Owner/Operator of Jackson Hole Outdoor Leadership Institute. When not training or teaching you can find him in the mountains practicing what he preaches in an effort to avoid his own rescue.

RESCUE

An Analysis of

SKI PATROLLER AVALANCHE ACCIDENT CAUSES

The Triangle of Complacency

By Alex Bergeron and Jerry Johnson

WHAT DID WE DO AND WHY?

We set out to learn about the causes of avalanche-related accidents and near misses experienced on the job. In order to do so, we conducted a survey of roughly 500 individuals, aiming to find out why avalanche-related accidents and near misses happen to avalanche professionals while they are working in their respective occupations. This article serves as a summary of the responses given specifically by professional ski area patrollers (pro patrollers).

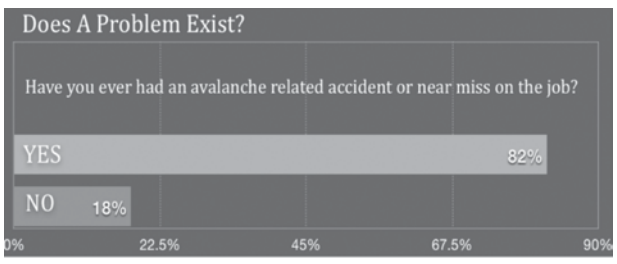


Figure 1: Incidents were defined as resulting in: an injury; a fatality; causing damage to a vehicle or to a structure; or a near miss with no personal consequences. Respondents were asked to report the number of times that they experienced one of these. The 82% shown above as "YES" represents those who reported at least one of these incidents. The remaining 18% did not indicate having experienced one of these incidents.

WHAT DID WE LEARN?

We received 487 responses to the survey. Most (>95%) were from North America. Of those respondents, 151 (31%) self-identified as pro patrollers.

Demographics of pro patrollers

Demographic information is used to get a feel for the characteristics of the individual pro patroller. Most respondents (>90%) are male. The average age is 42 years, over half are married, over a third have children, almost half have a Bachelor's degree and over half of those possess either a math or a science degree. The average number of days worked is 75 (roughly full time for a complete winter season). The number of years worked as pro patroller range from less than one to roughly 50, and is centered around an average length around 14 years.

Pro patrol's perception of organizational culture

The survey shows that almost 50% of respondents work for organizations that employ over 20 avalanche professionals. Over 85% of these organizations have been in existence for over 30 years and almost 90% are privately owned. Over 60% of pro patrollers agree that their employer has provided them with a formal best practices statement or policy for their job as an avalanche professional, and almost 70% agree that they understand the best practices procedures as defined by their employer for their job as avalanche professionals. Over 50% of pro patrollers agree that their organization has provided them with opportunities to receive the highest level of training possible given their positions and years on the job. Avalanche meetings/briefings are conducted daily before each shift in over 60% of these pro patrol organizations. Finally, over 90% report that communication with their organization is open and easy.

Potential contributors to pro patrol on the job avalanche accidents

Over 80% of pro patrollers have had an avalanche-related accident or near miss on the job *(see figure 1)*. Of the pro patrollers who were involved in an avalanche-related accident or near miss, over 75% claimed that they themselves were the most responsible for the event. Of thirteen available options as contributing factors for why the accident or near miss occurred, the three most important are "poor personal decision-making," "pre-assumptions" (decisions based on past data or experience), and "loss of situational awareness" *(see figure 2)*.

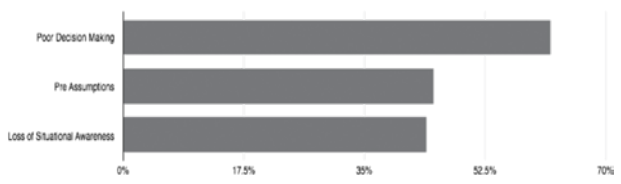


Figure 2: The three most important contributors to avalanche related accidents or near misses on the job reported by survey respondents who self-identified as pro patrollers.

Non-contributors to pro patrol on the job avalanche accidents

Over 70% are always confident that when they see a dangerous situation, they can ask operations to stop and reassess. Over 70% agreed that they know what they are expected to accomplish when they start a control mission. When rating the three most important contributors to on the job near misses and accidents, the three contributors identified as the least important were: " bad luck;" "competitiveness with others;" and "a sense of responsibility to the profession" *(see figure 3)*.

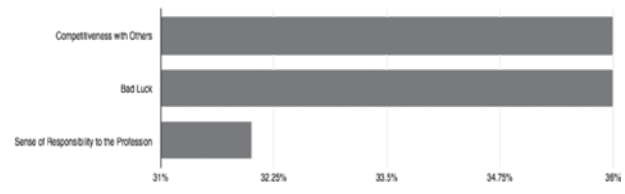


Figure 3: The three least important contributors to avalanche related accidents or near misses on the job reported by survey respondents who self-identified as pro patrollers.

DISCUSSION

Institutional procedures seem to be in place that help prevent accidents; there seem to be few if any organizational causes. Rather, respondents take personal responsibility for accidents that happen on the job. The culture of learning from error seems robust amongst the professional patrol community. In an effort to effectively demonstrate what we learned in this analysis, we looked into what "poor decision-making," "pre-assumptions," and "loss of situational awareness" signify in the context of high-consequence occupational settings. We found that the three are connected and that one of these contributors to on the job accidents can easily lead to another contributor in a cyclical but reversible fashion. In order to better demonstrate this cycle, we created "The Triangle of Complacency," which shows the multiple ways ski patrollers get caught in the cycle without even realizing it *(see figure 4)*.

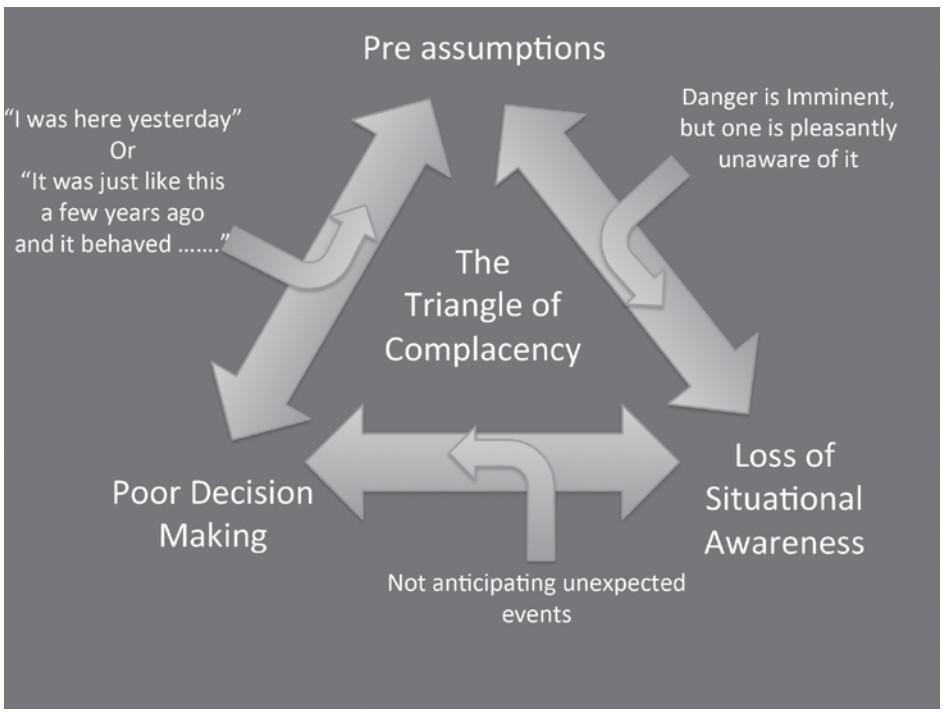


Figure 4: The "Triangle of Complacency" shows the process of getting caught in the cyclical process of poor decision making identified as contributing to avalanche related accidents and near misses on the job by ski patrollers. Not anticipating unexpected events leads to poor decision-making. Decisions being made while relying heavily on past data or experience leads to decisions made based on pre assumptions. Loss of situational awareness occurs when danger is imminent but the decision maker is pleasantly unaware of it.

WHAT CAN WE DO ABOUT WHAT WE HAVE LEARNED?

The need exists to learn more about and adapt to environmental and physiological processes that are present in the aforementioned decision-making processes. In doing so, we will be able to identify the environmental patterns and physiological trends that either positively or negatively influence a practitioner's ability to make sound decisions. After these patterns and trends are identified, systems can be developed and incorporated in order to recognize the existence of conditions that lead to higher frequency of avalanche related accidents. Eventually, tools (i.e. checklists or changing pattern and ritual) aimed at reducing such events can be effectively employed. In addition, data-keeping methods designed to track the occurrence of avalanche-related accidents and near misses and their associated causes need to be concurrently implemented in a way that can be quantitatively demonstrated over time in order to record the effectiveness of systems, techniques and tools such as those suggested in this article. In short, we need more accurate forms that are easy to use and file but that also capture the necessary information.

Alex Bergeron is a Professional Ski Patrolman at Big Sky Resort, and a graduate student in the Health Sciences Department at Montana State University, Bozeman, MT.

Jerry Johnson is a professor in the department of Political Science at Montana State University, Bozeman, MT, and a frequent contributor to TAR.

RESCUE

BEACON OVERLOAD:

Making Sense of Transceiver Multiple-Burial Functions

By Bruce Edgerly

What happens if I press this button over here?

How come this icon just disappeared for no reason?

Why do I keep coming back to this victim that I already marked?

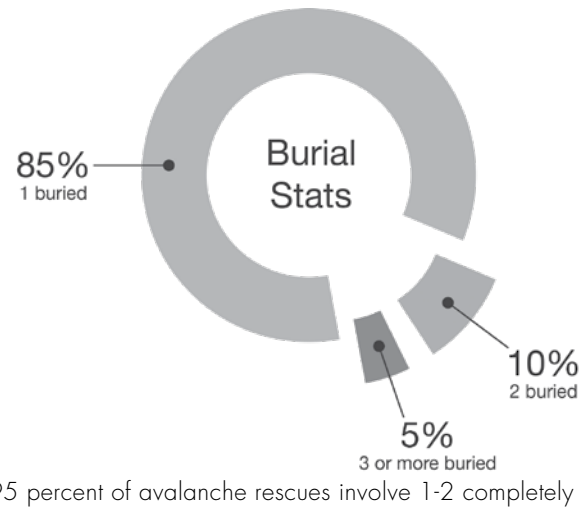
If you're an avalanche instructor, rescue trainer, or just plain old beacon user, you've probably been at the receiving end of these kinds of frustrating questions. As an assumed "expert" on the subject, you're expected to have answers.

Transceivers are only part of the rescue process—and they all have weaknesses, just like us humans. In recreational level courses, the key is to explain the "big picture" instead of getting wrapped up in the technology. Make sure you cover the skills needed in ALL rescues, not just a small subset of "boutique" scenarios.

THE BIG PICTURE

Like anything else in the media, the sexiest stories get the most attention. In our case, this means the epic multiple-burial incidents that occur once every several years. You rarely hear about the success stories involving live recoveries and near misses. Several studies have shown that about 40 percent of avalanche rescues are never even reported. This translates to several dozen live recoveries a year that happen behind the scenes.

So how common are multiple burials? Statistics show that as recreational backcountry use has increased relative to guided backcountry use–and equipment and avalanche education have become more widespread–the proportion of multiple burials has decreased over time. Currently in the US, Canada and Europe, about 15 percent of accidents involve multiple burials. Those involving three or more victims are decreasing too. A 2012 report by researchers Juerg Schweizer, Dominic LeTang, and Manuel Genswein concluded that burials involving more than two people have gone from 10 percent before 2000 to less than 5 percent since 2000.



95 percent of avalanche rescues involve 1-2 completely buried victims. Only 5 percent involve more than that).

This is a relatively low number, which means that if you're spending most of your time teaching boutique multiple-burial techniques then you might be missing the bigger picture. Especially if you consider that most of these multiple burials are solved no differently than single burials. Only in close-proximity situations are most multiple burials solved any differently than a single burial. But research shows that only about 1 percent of accidents involve close-proximity burials, in which the victims are buried within 10 meters of each other (see http://www.backcountryaccess.com/research).

The big picture clearly shows that "special case" close-proximity multiple burials are extremely rare. While it's important to address special cases in professional-level training, in recreational courses your time should be focused on those skills that are required in ALL avalanche rescues, not just a small proportion of rescues. This includes search strategy for one to two victims, shoveling strategy, treating the injured, and the biggest challenge of all, group management: "Renegade" signals from clueless searchers on the surface are usually a much bigger problem than multiple signals coming from the victims!

"MARKING" IS BORN

If multiple burials are such a small part of the picture, then where does all the talk come from? It comes from the guiding world. For economic reasons, large guided groups often ski together—and occasionally get buried together. If an accident occurs, the rescue expert in the group (usually the guide) is expected to find all the victims while guests act as assistants or bystanders. To become a certified guide, a candidate is usually required to find at least three victims (one more than two meters deep and two in close proximity) in a short period of time, with minimal assistance. In more realistic guiding exams, the candidate is required to find only some of the victims, but must dig them out within the time limit, usually well under ten minutes. In even more realistic scenarios, they must also administer first aid. From the world of specialized guiding exams, "marking" functions on avalanche beacons were born. Marking enables the most skilled searcher to suppress the signal of the found victim, then move on to the next victim while less skilled rescuers begin shoveling.

If you're teaching avalanche courses, it's important to tailor the content of your rescue training to your audience. Most recreational course takers are better off working on big-picture rescue skills instead of boutique, special-case rescue skills like the ones above. If you're teaching pros, then you can start getting into more detail—but only after you've truly got the fundamentals wired.

REAL WORLD BEACON SEARCHING

In the real world, beacon searching can actually be simpler than it is in some avalanche courses: probing is done for bodies, not Tupperware, and if a multiple burial does occur, the victims are usually located the same way as single burials–either "in series" or "in parallel." In the former, a single rescuer locates the first victim, digs enough to provide that victim an airway, then continues the signal search for the next victim ("in series"), preferably turning off that victim's beacon before moving on. In the latter, two or more searchers fan out across the avalanche debris pile ("in parallel") and isolate signals as they go.

The only exception is when the victims are close together, within about ten meters of each other. In this case, it's possible to skip right over one victim's signal by charging off in the wrong direction. Or in the "parallel" multiple-searcher scenario above, one searcher might end up isolating two signals, but the other searchers might not isolate any. In rare close-proximity burials like this, special search techniques or technologies can come in handy.

SPECIAL TECHNIQUES

Proven techniques used to solve these situations include micro search strips–popular in Canada–and the German Alpine Club's three circle method. Both of these are based on using signal strength to isolate each victim. Generally, the searcher begins at the victim's last seen point and systematically travels through the debris, making sure he or she doesn't miss any areas. All modern avalanche transceivers are programmed to bring you to the strongest signal, although the ones with faster processing speeds do this a lot better than others. As long as you keep moving–and stick to a disciplined search pattern–you'll find all of them. Keep in mind that if you can't turn off the found victim's beacon, you'll have to ignore that signal as you move away from it.

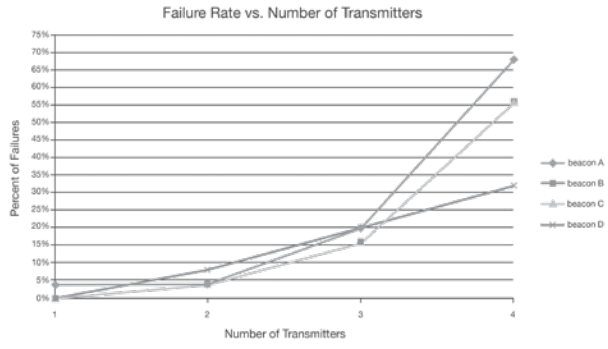
These two techniques are very similar, but are customized for different scenarios: micro search strips work best in smaller deposition areas (such as guiding exams) and the three circle method works best in larger areas, preferably not very steep, since you sometimes end up moving uphill. With both techniques, the searcher takes passes through the suspected burial area in small lengths of 3-5 meters, always remaining in Search mode, not marking or using any other signal suppression mode.

SPECIAL TECHNOLOGIES

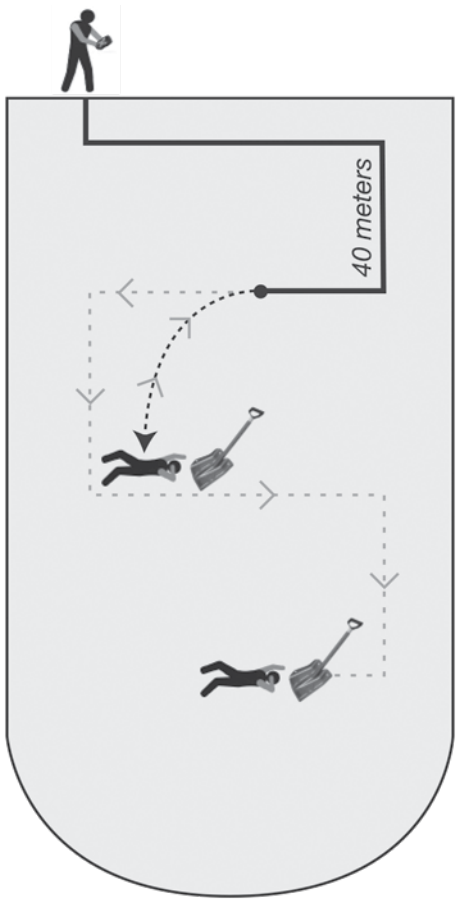
The above might seem like a lot of excess running around, especially when lives are at stake and the clock is ticking. Enter "marking," also known as "flagging" or "signal suppression." Most digital avalanche transceivers now offer a feature that enables the rescuer to press a button that suppresses the signal of a victim that has been found, then immediately see the signal of the next-closest victim and move directly to that location.

This technology can work exceptionally well, especially with only two victims. But once there are more than two, it gets increasingly unreliable. This has not gone unnoticed–resulting in more than a few failed transceiver exams! The German Alpine Club published a "security advisory" in 2014 about the perils of marking. In their 2012 ISSW report, Schweizer, LeTang and Genswein found that with four out of five transceivers, one-third of novices using marking failed to find the third victim. In 2011, a report in The Avalanche Review concluded that marking functions failed up to 70 percent of the time in scenarios involving four victims ("Having Problems in Multiple Burial Searches? Signal Overlap Explained," Steve Christie, The Avalanche Review, vol. 30, issue 1, October 2011, pg. 11).

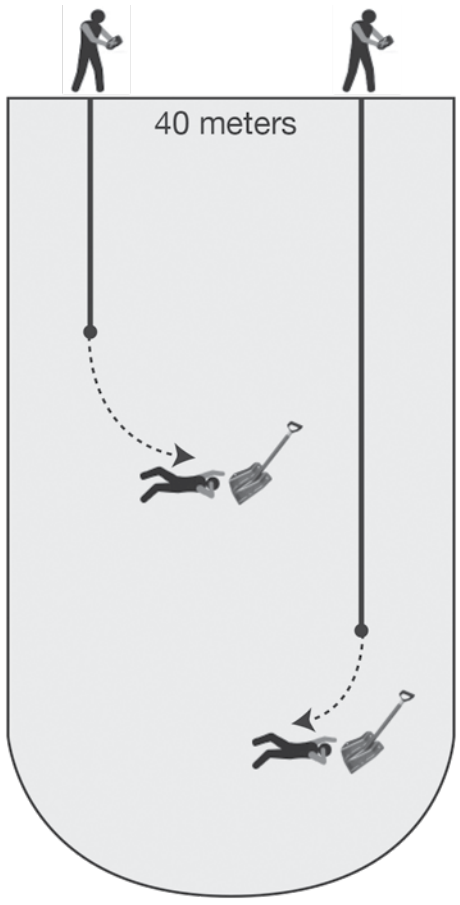
Once marking fails, then you're usually worse off than if you simply used one of the proven signal-strength techniques above. That's because when using marking, the user abandons the disciplined signal search pattern that's necessary to "eliminate terrain" and ensure that all victims are found. Once you get off that pattern, all bets are off on a thorough search.



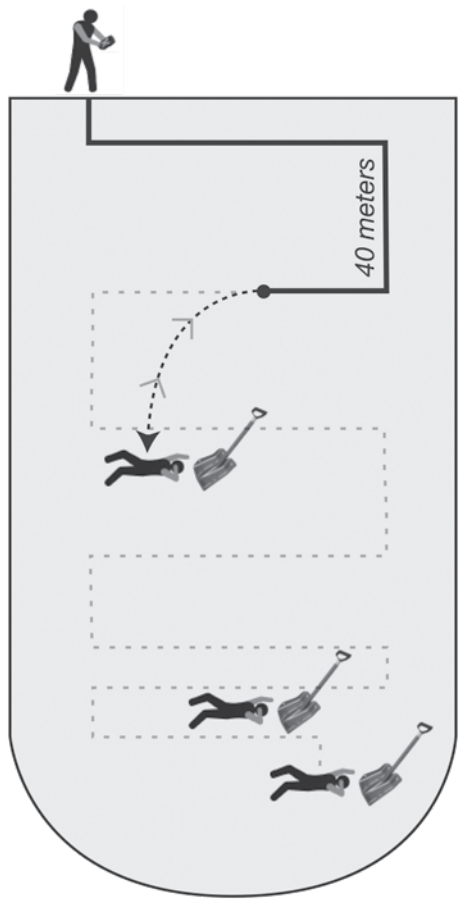
The failure rate for marking increases dramatically when there are more than two victims. This is why all manufacturers recommend learning "backup techniques" in case marking fails–and why marking is not recommended for use in guiding exams.



Searching in Series: In the real world, multiple victims are usually located the same way as single burials, "in series." This can be done by simply following a standard signal search pattern through the debris in search mode, isolating the strongest signal(s) as you go. If the first beacon can't be turned off, it's best to resume the signal search back at the point where it was abandoned, to ensure no areas are left unchecked.



Searching in Parallel: When multiple searchers are present, a multiple burial is performed the same way as a single burial, "in parallel." It's important for the searchers to stick to their "lane" until the distance displayed is less than their agreed upon search strip width. The only time multiple burials become different than single burials is when the buried victims are in close proximity to each other (less than 10 meters apart).



Micro Search Strips: In complex scenarios involving three or more victims, it's best to stay in search mode (or use analog mode on some brands) and move systematically through the debris. If you suspect at least two of the victims are in close proximity to each other, then use micro-search strips through that area. Otherwise, simply maintain your normal search strip widths (up to 40 meters for most transceivers).

What causes this failure? Signal overlap. This is when the "beep" from one victim's transceiver occurs at the same time as another victim's "beep." When this happens, the searcher's transceiver no longer knows how many signals are present. If the rescuer marks a victim, then both signals could be eliminated–whether or not both victims have been located. Also, when signals overlap like this, a signal that has been marked can all of a sudden become unmarked. Other common symptoms are that the distance and direction to the next victim simply don't change as the searcher moves through the debris–or an extended "Stop" message appears in the transceiver's display. The only way to salvage your search at this point is to "reboot" your transceiver (turn it off and on again), go to analog mode with some models, or go to the "scan" function on others. But if you don't know you should do this—or aren't very good at it—then your search can quickly turn into a veritable train wreck.

REALITIES

As you can see, avalanche transceivers are not foolproof in multiple burials–even the most expensive and sophisticated ones. So keep it real and remember the following:

- The biggest technical challenge in most avalanche rescues is digging. This takes far more time than the beacon search. In most recreational avalanche incidents there are barely enough shovelers to excavate a single victim, let alone two or more. Are you really going to NOT dig somebody up? For these reasons, in almost all multiple burial scenarios, marking is a luxury. People will die if you don't start shoveling immediately. The only exception might be in scenarios where a skilled professional might be qualified to make triage decisions on which victims get priority–or in mechanized scenarios, where manpower can be called in to provide rescue support.

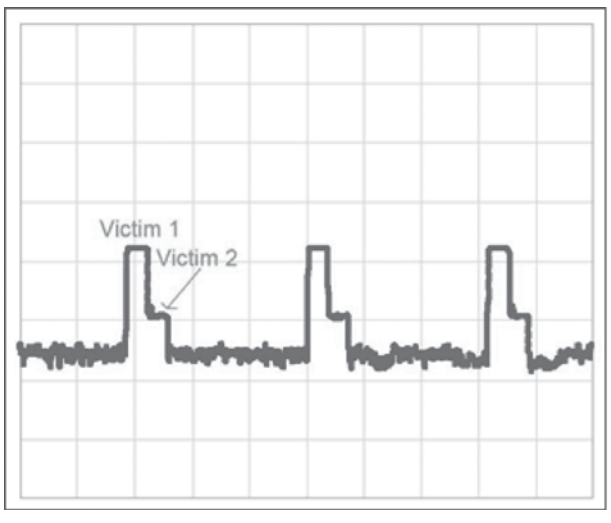
- Don't rely entirely on marking: as many of us have experienced, it has major limitations. In most guiding exams involving three or more victims, guides generally do not use marking. They use proven signal-strength search techniques such as micro search strips. This is because there's a good chance marking will fail. This is also why some beacon brands don't allow the user to mark or suppress more than one signal at a time. Or the suppression mode defaults back to normal search mode after a specified period of time–so the user doesn't have to know to "reboot" or switch modes in the case of a train wreck.

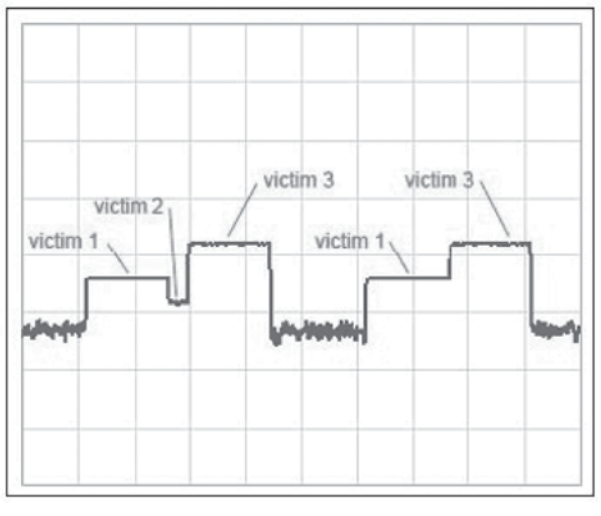
- Likewise, do not count on the "counting" function of your transceiver. Most modern beacons have an icon that will indicate whether more than one victim is in range. If there are more than two, then these functions can become unreliable (especially when an Ortovox F1 is present, as its long pulse is often counted as several victims). This is why some brands do not attempt to indicate more than two, but will display a "+" when there are more than that. In most cases, it's preferable to have limited but reliable information rather than lots of information that may or may not be true.

- When teaching recreational-level avalanche courses, it's more important to master 1- and 2-victim scenarios (in series and in parallel), group management, and strategic shoveling than it is to focus on boutique, special-case multiple burials. Once the essentials are covered, then get into basic micro search strips. Ideally, marking and suppression should be taught last.

- Better yet, prevent multiple burials from happening. You can do this through smart route planning, safe travel techniques (one at a time), and effective group communication: lots of discussion, open sharing of ideas, and the efficient use of two-way radios.

No need for you or your students to suffer from beacon overload. Keep your eyes on the big picture and focus on those skills that are required in ALL avalanche rescues–not just the boutique skill set that might be required to pass a guiding exam.





When signals overlap, marking functions often fail. On the left, two Tracker DTS signals overlap. Note the short duration (width) of each pulse, which mean the overlaps tend to be short. On the right, three Ortovox F1 pulses overlap. Since the pulses are much wider, the overlaps can be extremely long, especially when there are more than two present.

Bruce Edgerly (a.k.a. "Edge" or sometimes "Shaggy") is co-founder and VP at Backcountry Access (BCA). Before co-founding BCA, he was an environmental engineer in Denver, CO and a contributing editor for Powder and Couloir magazines. Edge is responsible for creating BCA's education-based marketing program. He has presented over a dozen papers on avalanche rescue techniques and statistics at the International Snow Science Workshop and International Commission on Alpine Rescue. He is a dedicated backcountry skier, whitewater kayaker, and a recent convert to mountain snowmobiling (which means he does lots and lots of shoveling). ❄

RESCUE

NOT DEAD YET:
LESSONS LEARNED FROM BEING BURIED ALIVE

By Terry O'Connor, MD

'I heard what sounded like a baseball bat hitting a ball – a loud crack. I turned around to look and saw a feathery white cloud of snow heading for us . .

After being buried, as soon as I could, I tried to push my hands out away from my face. They didn't go very far. I tried to raise myself up, tried to lift my head up, but nothing would give. I didn't know if there was someone who could find and help me. I didn't know if anyone else was dead or alive. I couldn't move. I tried to not panic. I knew if I did, I would use up the air that I had, really quick.'

—L. M., AVALANCHE SURVIVOR

In February 2014 in south central Idaho, all four members in a snowmobiling party were completely buried in a destructive force size 3 avalanche. What ensued was an improbable tale of three survivors. One particular woman lived to tell the tale above. Rescued by a team of bystanders from the community who arrived late to the scene, she endured a burial lasting over 90 minutes.

The incident became the inspiration for Scott Savage's presentation at the most recent ISSW in Banff, CA. In following, Emily Procter revealed new data from Austria and reminded us of practical implications of avalanche burial survival curves. Both authors convey important points to keep in mind that we'll review below. Whether you are a professional rescuer or a bystander called upon to assist on a burial, we ask that you pack along this food for thought with you.

SURVIVAL HAPPENS

When they told me how long I had been buried – at least an hour and a half, I was in disbelief. I had no concept that it had been that long. This leads me to think that maybe I passed out for a while, but I don't know.

— L.M.

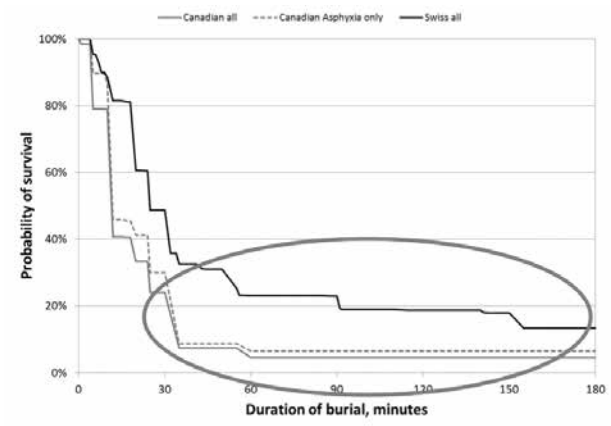
I was notified of the Idaho incident through EMS dispatch. Having heard reports that companion rescue was not successful, and at least one other victim remained buried one hour after the slide, I assumed that a body recovery would ensue. Colleagues admitted to a similar pessimism at the time. As it turns out, three individuals each survived burial longer than 40 minutes.

Although I wasn't on the scene, I had mentally resigned that someone was dead while they were still struggling to survive. It was a clear call to challenge a few of my own assumptions and look to the data.

In fact, since 2000, nine people have survived burials of four hours or longer in the US alone.

A closer inspection of the same data that drives our bias reveals that 'slim chance' does not mean

View of L.M. recovery site. She was successfully recovered from this spot after buried for 104 minutes. *Photo by Savage 2014, Sawtooth Avalanche Center.*



Circle depicts ranges of anticipated survival rates in prolonged burial >35 mins. *(adapted from Savage 2014 with reference data Haegli et al 2011).*

'no chance'. In review of our most robust avalanche survival data set to date, one discovers that burial over 35 minutes does not mean 0% chance of survival, but perhaps anywhere from 5-20% chance of survival.

The avalanche community has done an excellent job educating recreationists, professionals, and educators that we must find buried victims in the initial 15-30 minutes of their burial or they probably will not survive. While this tactic deserves respect and is evidence-based, perhaps it has unintentionally led us to assume that all rescue operations extending beyond 30 minutes will be futile. In my subsequent discussions with Savage, Atkins and other professional colleagues we shared a collective observation and experience that rescuers' attitudes, intensity, and speed change as rescues become protracted.

So perhaps it's time to consider changing a few of those assumptions.

BURIED AND BREATHING

I scratched again, had a little snow come down and saw a little more light. It was then that I felt a little cold air come in also. At that point, I quit scratching, afraid I would pull too much snow down and plugging up what tiny bit of air I had gotten.

— L.M.

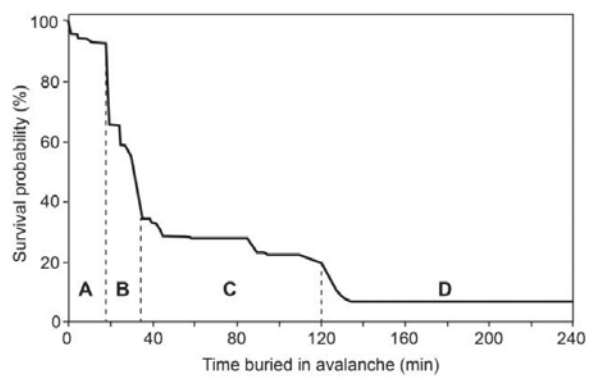
In her presentation, Emily Procter reminded us of the practical implications of interpreting survival curves. In other words, what factors are thought to be involved in survival as burial time progresses and are these factors the same in different regions.

The duration of these phases and associated survival probability differ between regions, partially due to geographic and climatic factors but also to rescue procedures.

The comments of our survivor above and the details of her case support that she survived, likely due to a combination of a patent airway, a lack of significant trauma, and adequate airflow to prolong her survival through the latent phase. Savage, in his commentary, shared an intriguing insight that perhaps the shallow depth and associated debris characteristics helped her survive. This remains an interesting proposition for future research.

But the question remains. How would a rescuer ever know if the presumed victim has a patent airway, no bad trauma, and adequate airflow to sustain a prolong burial and make rescue successful? What's the chance they may be one of the lucky 10%? Without going to look . . . well you would never know. And yet, I fear at times we assume that it's a lost cause without going to take a peek.

Are we unfairly triaging the patient before we even lay eyes on them?



An example survival curve showing the survival phase (A), asphyxia phase (B), latent phase (B) and long-term burial phase (D). In the survival phase (A), survival remains high and deaths occur primarily from trauma. In the asphyxia phase (B), there is a precipitous drop in survival rates due to lack of a patent airway. In the latent phase (C), survival does not change drastically and reflects the survival of victims with patent airways, although for a limited time. In this phase survival gradually decreases and deaths occur from the insidious impacts of hypothermia, limited oxygen, or accumulation of carbon dioxide. In the long-term burial phase (D), long-term survival is possible in a very low percentage of victims if oxygen support is sufficient.

FINAL THOUGHTS

Assume you're on patrol on a god forsaken day of low vis and snot snow, indulging in your 6th cup of joe at the tram deck. A massive man waddles over in his rear entries with eyes bulging, sweat beads rolling down his forehead, he then clutches his chest with his pale hand and drops to the floor. Sure it'd be great if he didn't double up on the bacon with every cheeseburger and chase every martini with a Cuban cigar. It would be nice if the defibrillator wasn't up at the top shack, but I doubt you're going to carry any hesitation in starting chest compressions ASAP. And what are the odds he's gonna pull out of this okay? Well in one robust data set of 417,000 out of hospital cardiac arrest patients, only 9.6% actually survived to discharge from the hospital. This includes those that suffer severe disability.

So now imagine responding to a avalanche accident, looking out over that slide path. Sure it would be nice if that party decided not to head out on a red light day. Perhaps it wasn't a good idea for them to cross the wind loaded slope. Of course it would have been better if they could have been proficient enough to rescue their partner. But just because you're there 45 minutes later, is all hope truly lost? What does the survival curve say? It may be no worse than that cardiac arrest case we channel so much urgency into.

I don't intend to suggest that we're all lazy, overly pessimistic, or cynical when it comes to buried victims. Perhaps it's a simple psychology of out of sight out of mind. Maybe we fail to be adequately emotionally invested, because we can't look our patient in the eye. Buried under all that white rubble, they can't show us how much they need help. We have no idea how close they are to giving up.

I'm not advocating for a hasty response at reckless abandon and hazard to ourselves; but let's do our best to not write an obituary before heading to the debris pile.

Think of the survival curve.

Uncover and lay eyes on your patient.

Tell me what you find. We can talk about what happens from there with your patient on my next visit to *The Avalanche Review.*

Prior to his job as an ER doc in the Wood River Valley, Terry O'Connor, lived the lives of a ski patroller, NPS climbing ranger, high altitude researcher and expedition physician. In that time he has cataloged an overindulgent amount of apres ski canned beer with forecaster friends. It was only a matter of time before the fates would conspire to place him in the pages of The Avalanche Review.

Overview of the AAA Pro/Rec Avalanche Education Project

By Kirk Bachman

Background of Project

Folks in the U.S. avalanche industry who have been responsible for education or training of either recreationists or professionals, often query:

Are we meeting the needs of the audiences for the training courses we run?

Does our structure for US Avalanche Education best meet the Learning Objectives for the target audience we serve?

While preparing avalanche course instruction and developing curriculum, avalanche trainers broach questions like these above. Course providers and instructors have utilized the American Avalanche Association Guidelines for Avalanche Education in the United States by relying on them as a benchmark and reference for training and curriculum development.

As the AAA Guidelines currently exist, the two main audiences: recreationists and Pros have largely trained together. And in reality the Guidelines have never really formally addressed this question:

How do Avalanche Professionals Train in the United States?

During a Fall 2013 meeting of the AAA Education Committee membership, we began to more formally address these questions. Committee member Brian Lazar from AIARE submitted a proto-proposal for us to consider. This was the basis for making a decision to gather an array of avalanche educators and avalanche professionals, following a well attended National Avalanche School in Little Cottonwood Canyon that October. The meeting was timed with a USAW workshop and a AAA Board meeting, so we were able to gather a group of 15 professionals- a diverse array of prominent professionals, avalanche education providers, ski area snow safety, public forecasters, and avalanche SAR representatives.. During the Halloween meeting, these questions were raised in an open forum. And the take-home message was that the AAA should begin to explore the development and separation of avalanche education tracks. More specifically, we tasked ourselves to accomplish the following:

- Develop a clear avalanche training progression for both professionals and recreationists.
- Maintain an affordable training program for both user groups while maintaining or increasing course enrollment for providers.
- Facilitate improvements in the education for both user group
- Create a solution that permits reciprocity between as many of the stakeholders as possible.
- Following AAA Governing Board review and support, the working group will seek input and review by identified additional stakeholders on the proposal.

Following the AAA Board Meeting Fall of 2013, as the chair of the Education Committee I was appointed to make formal observations/audits of existing professional avalanche programs in the U.S. During the winter of 2013 and 14, I observed the National Avalanche School, American Avalanche Institute (AAI Level 3), American Institute of Avalanche Research and Education (AIARE 3), and the AAA's course for Avalanche Professionals (AVPRO).

> I'm excited for the changes in the pro/rec split. I see a win-win situation for both student groups and instructors alike. Recreational users looking to increase their knowledge and understanding of more advanced concepts will no longer need to be bogged down in SWAG, record keeping, and full data pits, while the professionals will benefit from a course specifically designed for operational avalanche forecasting and decision-making.
>
> Jake Hutchinson
> *Lead Instructor, American Avalanche Institute,*
> *Certified Instructor Rep to the AAA Governing Board*

Findings

Having been a working ski guide and avalanche educator for over thirty years, I have participated in a variety of forums for avalanche training in a variety of snowy mountain environments. A very important part of my experience has been derived from participating in an array of snow worker programs and in a variety of terrain settings. I considered the task of observing programs being taught by a variety of industry pros in their home venues as a tremendous opportunity.

Last winter's observation project offered an insight into the strengths and distinguishing characteristics of American avalanche education programs, as well as the experience and strength of our working peers and the diversity of our terrain. Along with these strengths, it was apparent that as professionals, and for our industry, there would be a significant benefit if the individual programs would 'cross-pollinate' and collaborate more formally as there was significant variation in programs, as well as region to region.

As a professional industry in the United States in (2006?) we adopted the SWAG to serve as a formal set of guidelines to make observations, document, and communicate. What became clear through the auditing was that there existed a wide variation as to how instructors and students made observations, conducted snowpack tests, and even how observations were documented and communicated.

Formation of Working Group

In the Spring of 2014 the AAA Governing Board reviewed a summary of the observation findings and formally approved the formation of a working group to begin the task of developing a study to explore a revised approach to US avalanche education where recreationists and pros are better served. Again, this fell under the purview of AAA's Education Committee, and I was identified as the Project Manager.

The starting point for this process was to work with the leaders of the existing professional avalanche programs. Our summer meeting group consisted of individuals who had not only spent a considerable among of time around avalanche education, but also had considerable experience in decades of ski guiding worldwide, public avalanche forecasting, avalanche mitigation at ski areas and with roads. Working group members included: Colin Zacharias (Canada/US); Brian Lazar and Ben Pritchett from AIARE; Don Sharaf from AAI; Janet Kellam of the National Avalanche School and NAF Board; and Blase Reardon, Scott Savage, Dallas Glass and myself from the AAA.

Needless to say, there were many strong opinions and perspectives, but in the end, the working group embraced the high ground of:

- *First priority*: WHAT IS BEST for the US AVALANCHE INDUSTRY + AVALANCHE TRAINING IN THE US
- *Second priority:* WHAT IS BEST FOR OUR INDIVIDUAL PROGRAMS?

Collaborations and Review

At the outset, the process of the AAA Pro/Rec Avalanche Education Project has relied upon collaboration since strong programs are already in place, and collectively one of the strengths has been the innovation of individual programs and regions. In part to launch this project, the AAA began this spring with a Survey of 67 pros who run snow safety programs. At ISSW 2014, the AAA began to reach out through the broader professional avalanche community. While at the ISSW in Banff and formally at the AAA General Membership Meeting, the Pro/Rec Proposal was introduced. Throughout the week, a variety of conference attendees engaged to discuss their ideas and offer support to the general proposal. Later this Fall, the AAA offered a limited release of the proposal and working drafts to industry professionals in order to consider and review course specifics, pro trainings, and standards for training core competency.

At the same time the AAA Education Committee began to consider Recreational Course Guidelines in more detail for: L1- Avalanche Fundamentals updates, as well as new course guidelines for the Rescue Fundamentals course, and Advanced Recreational Avalanche Training (ARAT). These guidelines are now also currently up for review and part of the more detailed proposal.

As the proposal now goes into The Avalanche Review, a number of prominent and engaged individuals in the avalanche community continue to take interest in the AAA Pro/Rec Project, and provide valuable input and feedback from their work experience and perspective. Constructive comments and input continue to assist in moving the project along.

Current Review/Next Steps

In order to review the Proposed Professional/ Recreational Avalanche Education Project and the working drafts for course details go to: http://www.americanavalancheassociation.org/ Follow the specific instructions at the site on how to provide comments. We are looking for feedback from our professional AAA membership. The comment period will be open through March 31, 2015.

Through the winter, active collaboration and input will continue and be considered. This April an on-snow workshop among a professional working group will further consider standards specifically for professional avalanche technicians.

In order for this proposal to be successful, the process will need support and engagement, patience, and the willingness for distinct interests to support the collective common interest as this Project evolves and develops. Collectively, the leadership in the American Avalanche Association believes we can improve avalanche training in the US for both recreationists and professionals .

AAA Education Committee Chair. Kirk continues to shovel storm snow and watch it slide from the yurts he custom designs & builds. He now embraces his status as a 'senior ski guide,' an active 30 year career in guiding and teaching avy courses from his home in the Sawtooths, where he resides with his wife, two dogs, and a cat.

Proposal for a Revised U.S. Professional & Recreational Avalanche Training Curriculum

Editor's Note: *The full text and appendices to this proposal can be found at the AAA website, on the education page:* ***www.americanavalancheassociation.org/education***

Summary:
This Proposal is an outline that would:

- Create a consistent, professional-level avalanche training curriculum for aspiring and existing snow workers in the United States.
- Revise the current avalanche education guidelines to specifically address the needs of people recreating in avalanche terrain.

The Proposal summarizes the rationale and development and highlights the mission, audience, and course goals for each course in the professional and recreational avalanche training progressions.

If adopted, following the review and comment period and subsequent revisions and updates, the proposed curricula would be implemented in the 2016-17 winter.

Proposal Development:
The proposed curricula have been developed by representatives of the four organizations and businesses that provide current professional-level avalanche training in the US (American Avalanche Association, American Institute for Avalanche Research and Education, National Avalanche School, and American Avalanche Institute). This working group met in Stanley, Idaho, in June 2014 to develop the initial proposal and received further review through input and outreach of key professionals through the Fall 2014. Input has also been received by additional AAA Certified Instructors, industry professionals from ski areas, public avalanche forecasters, and highway programs. Among the information used to develop the proposal was a survey of operational avalanche workers and supervisors conducted by the AAA in the spring of 2014.

Purpose and Need:
The proposal addresses notable shortcomings of the current avalanche training curriculum:

- Existing avalanche education courses mix professional and recreational students, particularly in Level 2 classes, resulting in training that is often inadequate or irrelevant for both audiences.
- Students in current Level 2 courses are not tested, resulting in students completing training with a wide range of skills and knowledge.
- Some existing professional-level courses have partially parallel topics and learning outcomes yet no clear measure of equivalency. The lack of a single, clear training progression makes it difficult for employers to evaluate the skills of prospective employees, and sometimes requires redundant training by professionals.
- The fragmentation and inconsistency of professional training is not helping to improve workplace safety.

Proposal
The working group proposes creating separate recreational and professional avalanche training curricula, which would address the distinct needs of each group with focused course guidelines and learning outcomes.

The **recreational track** would:

- retain current lower-level courses (Awareness, Intro and Level 1),
- eliminate the existing Level 2
- upgrade the existing Companion Rescue Course
- establish a new advanced recreational course

Training focused on the specific needs of recreationists should increase the number of people taking courses through a more tailored curriculum, improve recreational decision-making in avalanche terrain, and hopefully better address a goal of reducing the number of recreational avalanche accidents.

The **professional curriculum** would:

- eliminate the existing Level 2 and 3 courses and
- establish three new courses:
  1. Avalanche Technician
  2. Avalanche Forecasting for Operations
  3. Professional Avalanche Search and Rescue

It aims to ensure similar levels of preparation for all participants, though formal education, in-house training and experience could all be accepted as part of course prerequisites.

To promote consistent skills and knowledge, professional courses would:

- Utilize a AAA hosted Pro Instructor/Assessors Training Workshop
- Require pass/ fail skills assessments
- Require Continuing Professional Development to maintain certification

Professional courses could be offered by current course providers (AAA, AAI, AIARE, NAS) or any organization that agreed to an audit and participated in the AAA Pro/Instructors Assessors' Workshop with the other organizations providing professional training. Individual programs may emphasize specific types of operations. The National Avalanche School, for example, would retain its ski area operations focus.

PROPOSED RECREATION PROGRESSION:

Level 1: Avalanche Fundamentals
The 24-hour L1 course would remain the common starting point for anyone wanting training beyond Awareness/ Intro level courses. It would continue to provide training for the largest number of students. It would maintain the current focus on the avalanche fundamentals of snow, weather, terrain and decision-making rules.

Audience: Current and aspiring backcountry travelers; aspiring professionals.
Mission: To train students in avalanche fundamentals and safe practices for winter backcountry travel

Rescue Fundamentals
This new 8-hour course would expand the current Companion Rescue training. It would serve as a pre-requisite for higher-level training, both recreational and professional. Students would not be tested, though the course would be targeted to any rescue testing required for professional training.

Audience: Current and aspiring backcountry travelers who want to develop their backcountry avalanche rescue skills.
Mission: To train students to perform fast and effective companion rescues for backcountry avalanche accidents.

Scope of Course
On completion of Rescue Fundamentals, students will have practiced and developed the skills needed to conduct an immediate response to an avalanche accident involving one or more people from their party. The course topics will include the potential limitations and advantage of various search techniques and strategies. Each course will include multiple chances to practice the individual components of an avalanche rescue (organization, transceiver searches, spot probing, excavation, etc) as well as scenarios combining multiple components and victims. The course will also address equipment advances and limitations, introduce students to the Incident Command System (ICS), and describe resources that may be utilized in organized avalanche incident responses.

Prerequisites
There are no formal pre-requisites for this course, though students should be familiar with basic avalanche awareness and competent in their preferred mode of backcountry travel. The Course Provider may choose to focus on the needs of a more specific backcountry audience (e.g. skiers, snowboarders, snowmobilers, winter mountaineers, or rescue groups).

Advanced Recreational Avalanche Training (ARAT)
This new course would serve as the terminal training for recreationists, though course providers could offer short refreshers. It would emphasize opportunities for extensive skill practice with mentors/ coaches.

Audience: Experienced skiers, snowboarders, snowmobilers, and climbers who face challenging situations or who travel in challenging avalanche terrain.
Mission: To address more in-depth training in the planning, observation and decision-making skills necessary for safe decision-making and travel in avalanche terrain.

Scope of Course
On completion of the ARAT, students will have addressed the knowledge and practical skills to more safely face challenging situations such as peak ascents and descents, traveling in unfamiliar terrain not covered by an avalanche bulletin, and multi-day trips in terrain not covered by an avalanche bulletin. The course topics will focus on avalanche problems, the development of the mountain snowpack, avalanche initiation and release and safe decision-making practices. Each course will include multiple opportunities to practice trip planning, making relevant field observations and conduct tests appropriate to existing and developing avalanche problems, route-finding, and daily trip debriefing. The course emphasizes the importance of group communication and risk management principles. The course will also address how to effectively use available resources to assist in information-gathering to effectively assess current avalanche conditions and trends.

Prerequisites
Students are required to have successfully completed an L1 Avalanche Fundamentals Course and a Rescue Fundamentals course, and to have accumulated a minimum of one year of field experience following the L1.

Proposed Professional Progression:

Avalanche Technician (AvTech):
This new course would provide baseline professional training for snow workers in all settings. The common curriculum and assessments would promote shared vocabulary and practices between settings.

Audience:

- Ski area avalanche control team members
- Researchers
- Aspiring and working Guides
- Backcountry Educators
- Avalanche Center Observers

Mission: To train early career and aspiring snow workers in the best practices for professional risk assessment, workplace safety, snow, weather and avalanche observation/ documentation, communication, and team decision-making.

Scope of Course

On successfully completing the course, students would be able to:
Select routes and move safely through operational terrain using practices appropriate to current avalanche problems, stability, and expected avalanche size.

- Observe and record to standards (SWAG).
- Communicate Professionally
- Perform slope-scale stability analysis and hazard evaluation
- Be familiar with larger-scale forecasting goals and practices
- Recognize critical interfaces in the snowpack
- Describe mountain snowpack evolution/ season snowpack history
- Understand and apply risk management methods
- Interpret data from manual and automated weather stations
- Pass/fail avalanche rescue skills test at beginning of course (material from Rescue Fundamentals): 2 buried victims (with beacons) to include recovery within a set time.

Prerequisites

- Avalanche Fundamentals AND Rescue Fundamentals or equivalent via Prior Learning Assessment
- 60 days experience accumulated over two or more seasons of applied and documented decision-making in avalanche terrain
- Letter of recommendation from AAA pro member or equivalent
- OR AAA professional membership
- OR successful completion of National Avalanche School classroom session.

Avalanche Forecasting for Operations (AVFO)

This new course would provide baseline operational training for professional snow workers in all settings. The common curriculum and assessments would promote shared vocabulary and practices between settings.

Audience:

- Lead Guides (mechanized, human-powered)
- Forecasters (public BC centers, highways, industrial)
- Ski area snow safety personnel
- Outdoor program managers
- Avalanche educators

Mission: To train avalanche program leaders to develop and apply avalanche forecasts and enhance operational safety. This training would emphasize the necessary value of acquiring experience in the operational workplace and time to gain expertise.

Scope of Course

On successfully completing the course, students will have addressed:

- Effective and safe management of teams/ guides/ personnel in challenging avalanche terrain and conditions
- Leading first response to operational avalanche rescues and participate effectively in prolonged multi-agency rescues and recoveries
- Assessing quality and relevancy of weather, avalanche and snowpack data at multiple scales
- Accurate Identification of avalanche problems, trigger sensitivity, distribution and consequences at operational scale
- Generate and communicate an avalanche forecast
- Make operational decisions that reduce avalanche risk in the operational workplace

Prerequisites

- Avalanche Technician course or Prior Learning Assessment
- Continuing Professional Development
- Required to maintain certification
- Self-recorded
- Administered by AAA
- Uses existing matrix developed for AAA Certified Instructors
- Requirements according to level of training
- AvTech: 30 hours in various categories/ 3 seasons
- AVFO: 60 hours in various categories/ 3 seasons
- AAA Certified Instructor: 90 hours in various categories/ 3 seasons

Possible topics:

- Organized Rescue
- Avalanche Hazard Mapping
- Mountain Weather
- SWAG refresher
- Wet Snow / Deep Slabs, etc
- Multiple avenuesRegional SAWS
- Exchanges
- Mentoring
- Professional Avalanche Search and Rescue
- Currently under Collaboration and Development by the AAA Search and Rescue Committee and AAA Education Committee.

Separating Professional & Recreational Avalanche Training Programs

By Ethan Greene

Should we provide different training programs for people who work in avalanche safety and people who recreate in avalanche terrain? For me the answer is simply, 'Yes.' I think it is important for us to provide different training for these two groups because the goals of each group are different. The avalanche safety industry has grown and the base skills required of an avalanche worker have increased. Recreationalists are hungry for techniques they can apply to traveling in very complex terrain. Training programs should focus on the needs of the students and provide them with the skills they need to be successful.

People starting out in the avalanche safety industry need to know how to make good observations. It will help them learn about avalanches and it allows them to contribute to the mission of an avalanche forecasting program. Most of what we record as field practitioners is qualitative information, where the observation is influenced by the observer. We use destructive techniques; we try to observe phenomena that are changing at a variety of spatial and temporal scales. It is a noisy place to collect data. Avalanche workers need training on how to select a site, make standardized observations, and record that information. This is the solid foundation upon which we build a career of experience.

Effective communication within and between avalanche safety programs has become a complex problem. For many years I knew everyone that worked in the operations around me by name (and I am bad with names). We shared information through phone calls, often several within a day. Now I work with 16 other forecasters, who are based in 10 offices. Our forecast area is about 50,000 square miles with 27 sections of highway. Within that area there are 25 ski areas, 11 cat skiing operations, 2 heliskiing operations, and a host of government and private groups that send us information. For the information we collect to be useful to us, and all the groups around us, we need to know that everyone is observing, recording, and coding the information within a basic set of standard practices. For the US avalanche worker, that basic set of standard practices is a 152 page document affectionately known as SWAG. If you want to work in avalanche safety it is important to know about this document and its contents. If you want to ride up or down big lines in the backcountry, it is probably not that important.

Standard practice is the mark of any professional group. We see best practices defined, and training programs to teach them, in all professional fields. Our profession deals with a complex natural phenomenon. It is a natural hazard that lies at the intersection of the atmosphere, cryosphere, and lithosphere. The applications addressed by our industry range from guiding people through complex patterns in mountainous terrain to evaluating and understanding every detail of the snowpack within a political boundary. To be successful we will need every tool at our disposal. It is not a simple problem and these are not simple jobs. To prepare successful workers, we need to focus our training on methods that will help them approach the problems they will face in their work environment.

By mixing professional and recreational training programs we ensure that neither group gets the training they need. Although there are some things that both groups need to know, the context of how these topics are presented, discussed, and applied is different. What each group needs to do to be successful is different. As educators we should provide training programs that help students reach clear learning objectives. The training they get in these courses should help them evaluate and navigate avalanche safety problems they will face in the future. By focusing on the needs of the students, whether they are a budding avalanche worker or a winter sports enthusiast that wants to hone their skills, we will serve both groups better.

Ethan has been working with snow, weather, or avalanches for more than twenty years, and is currently the director of the Colorado Avalanche Information Center. He lives in Leadville, Colorado, with his wife and two children.

> Level 2s have been a challenge to teach due to the mixed rec/pro audience, and we haven't served either group well. Designing a 3-day Level 2 Course targeted specifically at recreational skiers will encourage more Level 1 graduates to take it - which is a good thing. In my experience, many Level 1 graduates are skiing in terrain more appropriate for a Level 2 education.
>
> Chris Lundy
> *Sawtooth Mountain Guides*
> *AIARE L1 & L2 Course Leader*

Thoughts From the Pros:

1.I think there are some benefits to the professional track. ADOT&PF has challenges in hiring avalanche specific employees. We always hire good people but it is very difficult. Most of our avalanche jobs are part of a union that is specific for equipment operators. In order to make it easier to hire a person with professional level avalanche experience, it would be nice to be able to add "Avalanche Tech, etc." as a required skill. Since there is currently no defined skill level for an avalanche professional, it makes it difficult to create agreements with the union to hire an avalanche professional and train them to become equipment operators.

2.The current class progression for avalanche level 2 and 3 is not very applicable to highway operations and it's not worth an agency like a DOT to send highway-based employees to that type of training. It would be nice to create some curriculum specific to highway workers like snowplow drivers who are exposed to avalanche risk. We currently cover this issue with "in-house" training but it might be good to look into addition training opportunities. I think adding this type of track to the National Avalanche School would be a good fit for agencies like ADOT&PF to send employees for training. However I think we should have a clear distinction of who the industry thinks needs to have one of the professional track certs. It would be way too expensive to send all ADOT&PF employees who work near avalanche terrain through a formal professional track.

3.I think there needs to be a clear method of qualifying for the professional certs based on previous specialized experience. Some of the best avalanche professionals on this planet do not even have an avalanche level 1. There need to be methods for qualifying these types of folks on specialized experience alone. There is no better education than actual work experience in the avalanche business.

Matt Murphy
Alaska Department of Transportation and Public Facilities
Safety and Emergency Support Specialist
Seward Highway Avalanche Program

It has been evident for some time that there needs to be different pathways in the training of avalanche professionals in the U.S. The contrast between the background and interests of those involved with education, Avalanche Forecast Centers, and guiding, vs. those in the Forecasting/Control business, is easily recognized. And whereas it would be ill-advised to completely separate the practitioners of these two disciplines, recognizing each groups different needs seems like a good idea.

It would seem that once a person achieves a certain level of avalanche training (Level 1?) that they may develop a different focus depending on what path the individual wishes to take.

The past 20 years has seen a dramatic increase in the need for increased avalanche awareness for the backcountry skier. This has led to a watershed of opportunity for avalanche educators, and the need for local Avalanche Forecast Centers. It would seem that the focus of avalanche education/training in the U.S. during this period has been towards this group. At the same time the other group (Forecasting/Control for Ski Areas, DOTs. etc.) may have received slightly less attention.

There are obviously enough experienced avalanche workers out there to provide the needed training and mentoring to address this deficiency. What is needed is the appropriate training/education format.

In reference to Matt Murphy's comments on training maintenance crews (plow drivers), it would seem that in most locations there is enough expertise to conduct training on a local level (much like military weapons training occurring on a local level), perhaps with a loose structure of required topics.

I strongly agree with Matt's final comment that as far as the Forecasting/Control avalanche worker, "there is no better education than actual work experience in the avalanche business."

The origins of avalanche training/education in this country began with the need to train avalanche workers (the other group) in order to promote safety for the worker, and for the public. The need for this has certainly not diminished.

Liam FitzGerald
Former Manager, Utah Department of Transportation
Highway Avalanche Safety Program

The Alaska Avalanche School Level 2 instructional staff met December 18 to discuss L2 curriculum. We are intrigued by the prospect of the Pro/Rec Avalanche Education Project. We feel that both professional and recreational students in Alaska would benefit from curriculum that has been crafted to be more specific to the decision-making challenges that each group faces. We are also in support of creating a clear track for professionals with testing and certification. We look forward to the evolution of this project.

Aleph Johnston-Bloom
Alaska Avalanche School, Executive Director

From the standpoint of a long time practitioner and a manager in mountain operations, I am excited about the course of action that AAA has decided to take in regard to future avalanche training. Creating specific training tracks for the recreationist and professional is going to be highly beneficial not only for trainees, but for the avalanche community as a whole. By offering different branches of training, the AAA gives recreationists the chance to learn skills that will be appropriate and memorable for their experiences in the field. Those who choose the professional path of training will be exposed to concepts and topics which will be more focused to the level of training they are seeking.

From an operational point-of-view, having these new distinctions between trainings will provide me with a concrete and valuable assessment tool when hiring new employees who have participated in either branch of the trainings. I will have confidence if they have completed the professional track then they have gained a skill set applicable and beneficial to the duties expected of a ski patroller. This branching of training will provide me and other supervisors and employers in a similar position a peace-of-mind. We will know when we send current patrollers to training for continuing education purposes that they will receive a level of training that meets a consistently high professional standard relevant to the avalanche work performed at their home resort.

Tom Leonard
Ski Patrol/Snow Safety Director, Yellowstone Mountain Club

> I believe the split in educational paths between recreationist and professionals will be a big improvement allowing for the development of the strong fundamentals required in the operational world.

Bill Nicholson
Idaho Transportation Dept.
Director Avalanche Mitigation

Reflections from Sterbie

Last Saturday night 'The Ski Company' threw me a big retirement party. I was overwhelmed by the turn-out of old friends and a good hearted roasting... but It was dumping outside. I was at work the next morning at 0630 and spent my entire last day as a ski patroller running routes, throwing shots and skiing deep powder like I was still 22.

Today it's a bluebird Colorado day with fresh snow blanketing the ski area. As I hang out on my deck and watch the patrollers at work I'm wondering what's next for me now that I'm "retiring" into the void. I'm also reflecting on what a great run I've had and how much things have changed since I was a young patroller. From turntable heels with long-thongs to releaseable lightweight AT gear, from long skinny 207s and 215s to 181 twin tips and Pontoons, and from avalanche cords to three-antenna digital beacons and air bags; the entire industry seems to have grown exponentially.

As I reflect on my long career as an avalanche technician and educator unfortunately it seems that avalanche education in the U.S has failed to keep pace with the rest of the industry. A few years back I taught a level 1 course that was followed two weeks later by a level 2 course a couple of weeks later. I was shocked to find some of the same students in my level 2 class that I had just tried to teach two weeks earlier in the level 1. Unfortunately they didn't really understand the basic concepts from the first course, and their presence in the level two degraded the learning experience for the students that were qualified. Students in the class hoping to pursue a professional career path came away empty handed. Where were the in-depth discussions on slab mechanics or organizing inter-agency rescue within the incident command system? And for the 'way-gnar' recreational skier or rider that just wants to know, "can I huck it?", why are we trying to teach them about organized rescue? They should be perfecting their safe travel protocols or practicing self rescue and companion rescue skills rather than learning how to organize a probe-line. (Isn't Recco just one of those wafer candies?)

It seems obvious that it is high time to re-direct our avalanche education efforts and create separate paths for recreational and professional avalanche education in the U.S. For several years many avalanche professionals in the U.S. have traveled to Canada in order to receive the professional training they need. For the last five seasons "the ski company" I worked for has brought in an outside professional AAA-certified avalanche instructor to teach a customized "level 2" class specifically geared toward professional patrollers. All new patrollers are provided with basic level one avalanche education. Candidates for this level 2 patroller's class must have several years of experience and mastery of all "level 1" skills as well as pass a "pop-quiz." They must also pass a test at the end of the course. Once they have passed the course they often get a "patroller level" grade bump which usually means an increase in responsibility and pay. This could well serve as a model for the ski industry with support from NSAA.

Everyone that works or plays in the snow will benefit from developing parallel paths for recreational and professional avalanche education. Everyone starts with the basic skills. Then each user group can learn the skills they need and be able to master those skills without the clutter and confusion of adding another skill set they don't have interest in or need for. Educators will benefit by being able to provide more courses and being able to provide a quality education to each user group. Seems like a win-win to me. Now if I could just figure out what's next in retirement.

Craig Sterbenz
Former Ski Patrol Director, Telluride Ski Resort

Avalanche PROBLEM Topics

Deep Persistent Slab Avalanches: A Forecasting Challenge

By Alex Marienthal

It is mid-December and the snowpack is 80cm deep. With every change in the weather I consider two avalanche problems. The potential to trigger an avalanche due to recent snow and wind, and the potential to trigger a deep persistent slab in February, March, or April on the currently forming weak layers. I have been watching the snowpack for about two months now, but know that a lot can still happen over the coming months as the slab depth increases. The deep persistent slab problems that we are sure to see later this season are not yet known, but I hope to be less surprised by them because I have watched the snowpack develop.

Avalanches on deep persistent weak layers become less likely over time, but come with potentially higher consequences. In addition, they are accompanied by less certain evidence of instability (e.g., minimal avalanches or collapsing), and stability tests on deep weak layers are harder to perform and interpret. Therefore, more insight into which evidence to consider when forecasting deep persistent slabs is necessary. If it is now February or March and there is a deep persistent slab problem, then consider the pits that were dug when the snow began to fall and metamorphose last fall. Also consider the general weather patterns and avalanche activity that took place from the beginning of the season until now.

Many studies have explored the weather over days that directly precede deep slabs, and have found that greater cumulative load, wind, and warming often precede deep slabs. However, deep slabs do not always occur after these weather events, which results in high false alarm rates. Deep persistent slabs are born when the weak layer is formed and buried, and they reach maturity through a series of avalanche cycles and meteorological events. Therefore, we should watch seasonal weather and snowpack developments from the beginning of the season in addition to the weather that occurs directly before deep persistent slabs.

In my recent AAA funded research of deep dry-slabs and deep wet-slabs at Bridger Bowl, I found that seasons with relatively less precipitation from November through January more frequently had deep persistent slabs. Also, a snow depth in November that was deep enough to form a sufficient weak layer was common during seasons that had deep persistent slabs. It is suggested that a weak layer should be high enough in the snowpack to "connect" terrain features (i.e., form above the surface roughness) to have a better chance of becoming a deep persistent slab problem.

In addition to considering the whole season's weather trends, keep track of the weather characteristics that accompany avalanches on specific persistent weak layers of concern. For example, similar amounts of SWE and wind-loading may occur prior to different avalanche cycles on the same weak layer. (another, more complex, version of pattern recognition) Also, when a snowpack has had deep persistent slabs through the season, deep wet-slabs are more common. Track the "funny business", depth and distribution, so you aren't surprised.

In historical records I observed that deep wet-slabs often followed sustained above freezing temperatures shortly after the snowpack went isothermal. At the 2014 ISSW in Banff Cristoph Mitterer discussed various models that he used to predict wet-snow avalanches in Switzerland in his paper titled: *Comparing Models of Different Levels of Complexity for the Prediction of Wet-Snow Avalanches*. While many models featured factors that may indicate wet avalanches, they also had high false alarm rates. He was able to reduce false alarm rates, in some cases, by only looking at days after the snowpack went isothermal.

Also at the 2014 ISSW, Reed Ryan, Jeffrey Davis, and William Blair reviewed a historic deep-slab avalanche cycle at Copper Mountain in 2014 that created a new slide path and destroyed mature timber in the runout of another avalanche path. They noted high winds with wet new snow on a snowpack with weak layers from October and December that contributed to these deep-slabs. They also stated the presence of ECTPs and CTs with sudden planar fracture characters over the weeks prior to the deep-slabs.

Example of the Deep Slab Travel Advice icon that Drew Hardesty and Wendy Wagner have been developing and testing for winter of 2014-15.

During the 2011-2012 season at Bridger Bowl I recorded continuous ECTPs, with sudden planar fracture character or Q1 shear quality, over the months leading up to a historic wet slab cycle on depth hoar. These unstable results occasionally occurred during times of avalanche activity on the depth hoar layer, but were still present between times of activity. Despite false alarms, these results gave warnings of a deep persistent slab problem.

In TAR issue 26/3 Dale Atkins and Knox Williams stated, "…if you tackle steep slopes with deep instabilities your safety does not rely on skill, technique, or equipment; it relies on luck." Six years later, with more published research and in depth discussion of when or exactly where deep slabs will occur, I would conclude that we may be beginning to reduce our reliance on luck, but the uncertainty of forecasting deep persistent slabs is still relatively high. If a widespread persistent weak layer exists, it is important to always travel with the potential for large destructive avalanches in mind. Avoid runout zones, avoid exposing more than one person at a time in all avalanche terrain (as always), recognize the destructive potential, and if necessary to travel in avalanche terrain, avoid shallow spots in the snowpack.

Another suggestion may be to avoid travelling in, or opening, avalanche terrain after large accumulations of precipitation and wind, but this may be difficult for some operations. Deep slab avalanches also can occur on days without prior loading. The consequences for implementing closure or high danger due to false alarms are possibly a threat to credibility or profit. But, if a conservative decision is followed, then physical harm is unlikely. When we do choose, or our jobs require us, to face some level of risk related to deep persistent slabs, more data or tools describing the phenomenon are desirable.

Data I have recently reviewed are this season's values for the weather summaries that I used to predict deep slabs in my thesis. The average to high total monthly SWE amounts, which are posted in plain view in the locker room (easy access), support the hypothesis that our deep persistent instabilities will not be too bad in the next few months. However, recent persistent slab avalanches (artificial triggers) might dispute that hypothesis. These are a few examples of data to observe when forecasting deep persistent slabs. I have also recorded SWE amounts in storms prior to the observed persistent slabs. Maybe this is a rough estimate for load amount/rate required to affect that layer.

While deep persistent slabs can be difficult to forecast, they do not typically catch us completely off guard. We can often see the evidence that can build up to an event or avalanche cycle (e.g., an active persistent weak layer). However, data that normally indicate instability, such as large amounts of recent loading and unstable test results, have an increase in false alarms the longer a persistent weak layer is buried. When forecasting deep persistent slabs we can begin to recognize and familiarize ourselves with the problem and reduce our uncertainty by considering the whole season's snowpack, weather, and avalanche history.

Alex is a ski patroller at Bridger Bowl and education coordinator for the Friends of the GNFAC. He recently completed a snow science Masters degree with support from the American Avalanche Association Graduate Student Research Grant.

The Danger Scale, Avalanche Problems, & Public Avalanche Safety Messaging

By Brian Lazar, Karl Klassen, Simon Trautman

AS PUBLIC AVALANCHE FORECASTING in North America has come to rely more on a combination of danger ratings and avalanche problems, guidance on how to describe real-world backcountry conditions using this approach is somewhat ambiguous. As a result, individual avalanche centers have resolved questions differently, creating inconsistency between centers in similar scenarios. Consistency between avalanche groups with public safety missions serves the public interest; there is a benefit to presenting a similar and understandable message across North America when describing similar avalanche conditions.

Over the last few years the Colorado Avalanche Information Center (CAIC), Avalanche Canada, (formerly the Canadian Avalanche Centre), and Parks Canada have informally discussed some of these scenarios as they have arisen.

Recently, ISSW 2014 provided a great opportunity to work through some of these issues in person. We formed a working group that was big enough to foster debate, but small enough to maintain a manageable discussion. The resulting notes are relevant to the larger forecasting community, and are not intended to present final answers to these issues. Rather, our intention is to describe consensus gained amongst the workshop attendees and get some feedback from those not in attendance.

Who was at this meeting?

Taking advantage of the regional and international reach at ISSW, representatives from the following groups attended:

- Colorado Avalanche Information Center
- Avalanche Canada
- Parks Canada
- Alberta Parks
- USFS National Avalanche Center
- Utah Avalanche Center
- European Avalanche Warning Service Group
- Avalanche Québec (formerly Cente d'Avalanche Haute Gaspésie) participated via email.

NORTH AMERICAN DANGER SCALE

LOW DANGER QUESTION:

Does Low danger allow for isolated large and/or very large avalanches that are unlikely to be triggered?

THE PROBLEM: The North American Public Avalanche Danger Scale describes LOW danger as "Natural and human triggered avalanches unlikely." and "Small avalanches in isolated areas or extreme terrain." It explicitly does not allow for the remote possibility of large or very large avalanches. Some forecasters and forecast centers operationally allow for this possibility based on the assumption that it is self-evident that there is always the remote possibility of a large avalanche somewhere in the terrain. Other forecasters and forecast centers do not allow for this possibility under LOW conditions, and adhere to a strict reading of the language in the Danger Scale. This inconsistency in use and interpretation can and has caused confusion for both avalanche forecasters creating public safety messages and the people that use their products.

CONSENSUS: The working group proposes that LOW danger does allow for the remote (unlikely) possibility of isolated large or very large avalanches. We discussed the following measures to clarify this idea for both forecasters and the public:

- Add a footnote to the danger scale
- Educate people that the Danger Rating should be based primarily on travel advice

DISCUSSION: After further discussion, the authors believe that most of the debate/difficulty with the danger scale (not just LOW danger) stems from literal application of the Likelihood and Size / Distribution descriptions. If used as an accessory to the travel advice, these descriptions are useful from a forecasting perspective. Conversely, for operations using Avalanche Problem elements, the Likelihood and Size / Distribution can be redundant, if not confusing to the public. Consequently, we propose that a streamlined version of the Danger Scale (color, graphic and travel advice) be available to the public. In other words, we do not change the danger scale or add to it. Rather, we simply provide the public with a danger level and the matching travel advice.

LOW PROBABILITY/HIGH CONSEQUENCE QUESTION:

When communicating risk to the public, does MODERATE danger adequately capture this scenario, which often involves Deep Persistent Slabs (DPS)? What else could we do? When do we add or remove DPS from the problem list?

THE PROBLEM: Unlikely but very large avalanches pose a special worry for avalanche forecasters. If we defer to Travel Advice in the Danger Scale, we often end up assigning these conditions a MODERATE danger rating. The concern is that this may not effectively communicate the consequences of an unlikely but very destructive avalanche. Another consistency issue arises when forecasting operations apply different criteria for adding and/or removing deep persistent slab to the avalanche problem list in a public forecast.

CONSENSUS: The working group believes the Avalanche Problem elements in the public bulletin, when used in conjunction with the danger rating, adequately conveys the message to the public. A MODERATE danger rating, with a Deep Persistent Slab avalanche problem, and assigned Unlikely probability and Very Large size does capture the low probability/high consequence nature of this situation.

Guidance for adding DPS to the problem list (all criteria should be satisfied):

- Buried persistent weak layer
- Unlikely (i.e. stubborn to trigger)
- Size ≥ 3 avalanches

Guidance for removing DPS from the problem list:

- Liquid water production increases to the point where the problem transitions to a Wet Slab avalanche
- The likelihood of triggering becomes insignificant and there are other Avalanche Problems of greater concern.

DISCUSSION: This type of situation highlights the fact the Danger Scale has inherent limitations, but this does not mean the danger scale is ineffective. The application of danger ratings is a judgment based process. Applying the danger scale literally requires forecasters to confine a highly complex set of conditions that fall somewhere on a continuum into small, fairly rigidly defined boxes. In the end, if we give the public the right travel advice, and properly describe the avalanche character using Avalanche Problems, the rating becomes part of a larger whole rather than the sole piece of information available to users.

SPRING DANGER RATING QUESTION:

How to rate danger for diurnal fluctuations in predictable melt-freeze cycles: Rate for melted state? Rate for frozen state? Dual ratings? No ratings?

THE PROBLEM: Different forecast centers and forecasters apply different approaches to assigning avalanche danger when there are large diurnal fluctuations in the danger. This leads to inconsistent messaging to the public. In these types of conditions, we essentially have two approaches that use danger ratings:

The approach used by the most U.S. and European avalanche centers**:** Rate the avalanche danger to reflect the highest anticipated danger for the

This deep slab failed on a layer of depth hoar in March 2012 south of Saddle Peak in the Bridger Range.
Photo by Fish Eye Guy Photography

forecast period. For example, if the danger is LOW overnight due to a good solid freeze, but is expected to rise to CONSIDERABLE by late afternoon due to warm temperatures and/or strong solar radiation, then rate the danger CONSIDERABLE for that day. This approach ensures that the novice or uninitiated user receives the appropriate public safety message. The diurnal fluctuations can be described in the text of the forecast. This more complicated and nuanced message is important for the more advanced users who will have a better grasp on the temporal fluctuations inherent in spring time conditions.

The approach used by the Canadian avalanche centers: Rate the danger for the predominant condition. For example if the frozen state, corn snow, and good stability is expected from sunup to 2 p.m. or so as occurs in a fully-fledged melt-freeze cycle, rate LOW and talk about increasing afternoon hazard in the text. If overnight freeze is lame or none, rate CONSIDERABLE or HIGH and talk about a potentially small window of lower danger very early or very late in the day.

CONSENSUS: Despite some reservations from Parks Canada and Avalanche Canada, the consensus, in the spirit of consistency, was to agree to rate for highest danger of the day (approach 1) in spring diurnal melt-freeze conditions.

DISCUSSION: Some avalanche centers also issue "No-Ratings" information at a certain point in the spring when spring conditions have taken hold and data becomes increasingly scarce. Once the transition to a no-ratings forecast is made, policy is for most centers that use a "No Ratings" option is to refrain from going back to a product that includes danger ratings.

AVALANCHE PROBLEMS

Terminology and guidance for determining the type, or character of avalanche and transitioning from one type of avalanche to another is relatively new and has not yet been fully adopted in all regions or facets of the business. Bringing all public avalanche safety agencies and indeed, the industry as a whole, to consensus is desirable.

THE PROBLEM: In North America, the terms "primary avalanche concern," "avalanche problem," "avalanche character," and "avalanche type" are used. In other parts of the world "avalanche threat" and "avalanche situation" are common (Jamieson et al., 2010). These terms are often used interchangeably and inconsistently, which creates confusion.

Most North American public forecasting agencies incorporate eight avalanche character designations (Statham et al., 2010) into their forecasting procedures and public forecasts.

- Loose wet
- Loose dry
- Wet slab
- Wind slab
- Storm slab
- Persistent slab
- Persistent deep slab
- Cornice
- In some agencies and operations, a ninth avalanche character is used: Glide

These designations are increasingly being adopted by commercial and industrial avalanche operations also (e.g. the newest version of InfoEx allows operations to describe their avalanche problem using these designations).

CONSENSUS: The group proposes that the public forecasting operations use the term 'Avalanche Problem' in lieu of the other terms listed above. In addition, the term Avalanche Problem is defined as "A set of factors that describes the avalanche hazard" and includes four elements (character, aspect/elevation, likelihood, and size).

DISCUSSION: These elements are congruent with the Conceptual Model of Avalanche Hazard and the definition comes from the CAA's Level 3 course glossary. In this construct, the Avalanche Problem includes: "what": avalanche character, "where": at minimum elevation and aspect, "how likely": likelihood as a function of sensitivity to triggering and distribution, and "how big": avalanche size. Further, we suggest that the avalanche characters noted above be used as the standard when describing avalanche problems.

GOOD READING: Guidance for determining character is available on the Avalanche Canada website in the various Avalanche Essentials papers found here: http://www.old.avalanche.ca/cac/pre-trip-planning/decisionmaking.

The CAIC has help links on their website for each avalanche problem, and an Avalanche Problems web page (http://avalanche.state.co.us/forecasts/help/avalanche-problems/). This information is designed to bridge avalanche problem definitions with the more reference-oriented Avalanche Essential documents. They also use a flowchart as an operational tool for forecasters (The Avalanche Review, Dec. 2012. Vol. 31, No.2, pg. 14).

Another reference is a paper recently published in the CAA Avalanche Journal (#105, Winter 2012-2014, p. 10.) This topic is also explored in Karl Klassen's 2013 ISSW paper: http://arc.lib.montana.edu/snow-science/item.php?id=1824

Additionally, the Utah Avalanche Center recently developed a graphics-based Avalanche Problem tutorial to augment public forecasts: http://utahavalanchecenter.org/avalanche-problem-toolbox.

CONCLUSIONS

So … nothing earth-shattering. However, agreeing on this low-hanging fruit has important implications for public forecasting communication and public safety. It also gives us a starting point to begin to work through the rest of the tangible questions, problems, and inconsistencies that exist between and within our operations. We'd love to hear your thoughts on the consensus and discussion points. In the end, we hope that North American avalanche centers can adopt a single consistent approach to communicating avalanche conditions.

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Avalanche Problem Toolbox: Travel Advice Updates

By Wendy Wagner

IT HAS BEEN JUST OVER A YEAR NOW since Drew Hardesty and I began working on a project seeking to craft travel recommendations for the Avalanche Problems (TAR Volume 32 No 4). In short, similar to the travel advice within the North American Danger Scale, the online toolbox provides travel advice specific to each Avalanche Problem. The toolbox also differentiates between "Normal Caution" Problems and "Extra Caution" Problems. After much back and forth amongst ourselves, feedback from public users and the professional community, we are off and running with a first edition of the Avalanche Problem Toolbox (http://utahavalanchecenter.org/avalanche-problem-toolbox) and as accompaniment to this article.

The Avalanche Problems continue their fast paced evolution in North America. Beginning in 2004 at the Jackson, Wyoming ISSW, Roger Atkins presented his groundbreaking thoughts on defining different avalanche regimes that require different risk management strategies and terrain selection. Atkins writes, this paper is to help backcountry practitioners "communicate their subjective thought processes and to provide structure for assessing the character of potential avalanche activity." A year later, spurred by this concept, the Utah Avalanche Center wordsmithed a few names and Jim Conway (Glissemedia) drafted up a set of info-graphics for eight different avalanche "concerns". Many of these names already existed in the avalanche community, such as wind slab, but one infamous name in particular was standardized - the "persistent slab". The Utah Avalanche Center went live with the concerns and associated info-graphics during Christmas of 2005.

The idea of using avalanche character in public advisories was beginning to spread across borders as well. In 2010, along with the revision of the North American Danger Scale, the Conceptual Model for Avalanche Hazard (Statham et al. 2010) was created and officially categorized eight avalanche characters. During the 2009/2010 season, the link between the Avalanche Problems and the North American Danger Scale was studied in Canada (Haegeli, Falk and Klassen 2012). The Canadian Avalanche Centre published their Avalanche Essentials documents in 2010. They include everything from problem formation, location in the terrain, duration, and risk management/travel advice, etc.

At this time, a look into the role of avalanche character in public safety products was investigated and specific recommendations were made (Klassen, Haegeli and Statham 2013). Just prior to this, an effort for consistency with terminology was occurring back in the U.S. and the Colorado Avalanche Information Center (CAIC) began drafting a set of definitions for the Avalanche Problems. After incorporating feedback from other Avalanche Centers and the National Avalanche Center, the definitions were finalized and are included with the travel advice in the online toolbox.

In 2012, the CAIC developed the Avalanche Problems webpage which provides guidance and risk management/travel advice. The CAIC also drafted "risk treatment" statements to accompany the avalanche problem in public forecasts. Currently called "what you need to know about these avalanches". They also developed an operational flowchart to guide forecasters. All of this is outlined in the 2012 article Avalanche Problems Defined (Lazar, Greene and Birkeland TAR Volume 31, No 2), along with AIARE's Avalanche and Observations Reference Tool.

The Avalanche Problem Toolbox is attempting to carve another notch in the evolution process, with the focus on providing our users with additional practical information to aid in appropriate terrain selection. The toolbox is located in the tutorial section on the Utah Avalanche Center's webpage and the resources section of the Chugach National Forest Avalanche Center's webpage. It is also hyperlinked from the advisory page next to the 'Problem(s)' for the day. Take a look at the examples here as well as the online toolbox itself - let us know what you think!

After four years forecasting with the Chugach National Forest Avalanche Center, Wendy has just stepped into the Director role at the CNFAIC. She is working on her decision-making and management techniques for a successful day in the office chutes. wendy@chugachavalanche.org

The Technology Trap

Do you really want that new gizmo?

By David Hamre

Back when I first started in the avalanche game at Alta, we had availability to all the latest technologies. We had a phone line that we could call Binx Sandahl up at the Guard Station with. Binx was the Head Snow Ranger back when there was such a thing, so he would let us know the amount of snow and water off the snowboards, and had one of those fancy analog anemometers out behind the guard station on a telephone pole to record the wind on a squiggly line. He could let you know the numbers on the wind, but didn't really need to because we were out in it all day every day. Oh yea, Alta Ski Lifts issued us an aluminum shovel with a wood handle that you could disassemble and modify so you could get it in a pack, and the latest version of the 50-foot red avalanche cord. These were the tools of the trade for the day. My second year they actually got some of those Skadi hot dog beacons which we were pretty enthused about. The third year Bob Smith showed up with some double lens goggles that worked a whole lot better in Alta powder then the single lens ones we had. We were off and running on the game of technology solving all our problems.

Fast forward about forty-five years and that rat race continues to intensify. I recognize the importance of keeping up with technology. In our program at the Alaska Railroad we have wholly embraced the implementation of cutting edge products. We have lots of weather stations reporting in hourly with observations to a network server that queries them all through our fiber optic/Freewave radio communications backbone. We have blaster boxes that launch explosives at the push of a finger on a computer screen. There's also a complicated avalanche detection system of multiple stations on several avalanche paths. Some of these are on the mountain and talk to us when things cut loose, others are at the bottom and tell us if the avalanches that cut loose actually hit us or not. We are working on expanding all of these systems. There are also initiatives with other kinds of products such as optical time domain reflectometry to see whether it can help us gee whiz our way into being fully aware from our office about what is going on in our avalanche world. The downside? It all breaks and you have to fix it.

As I sit here, we are still fighting a persistent problem with power on one of our weather stations. A repeater has dropped out three times this fall and we can't figure out exactly why, but pretty soon we will have every part replaced. Recently installed detection equipment apparently has some short in a circuit board or panel that we have to fly up to fix. We even had a time this summer when not a single station anywhere was working properly. We have techno'ed our way into a rat's maze and it's hard to find the way out. You can never go back, but I'm finding it pays to have a clear vision of the forward view. What seems really easy to sell in today's world is the idea that technology can give us all the information we need to make good decisions. In reality, the technology starts marrying you to it, and you become a slave to keeping it all up and looking at it.

I miss the old days of getting my wind information by hanging out at the top of Sunspots and feeling the gusts. Gone is the daily feel of the snowpack interacting with the skis in a way that gives away its secrets. No more hourly poking the snow as it falls to feel the different densities. Some of us, like ski patrollers and guides, probably still maintain these long traditions. Others like me find it hard to hire people to relieve some of the tech burden and become bogged down by devices of our making. My vision going forward is to find a way to balance more effort towards the intuitive rather than the objective side of analysis.

After stints working on snow safety at Alta, Alyeska Resort, and more recently at the Alaska Railroad, Dave Hamre is looking forward to being phased out of full time employment in the avalanche field soon.

Three "pillars of old Alta" at the ISSW 2014 banquet (left to right): Dave Hamre, Ron Perla (who received the AAA Honorary Membership award), and Alta GM Onno Wieringa. *Photo by Don Bachman*