THE Avalanche REVIEW

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the Lull

Doug Krause searching for the threshold of acceptable risk. Cerro Entre Rios, Las Leñas, Argentina.
Photo by David Dellamora

December 23, 2008 — Silverton, Colorado

It's stopped snowing and the wind is calm in town, but up high in the San Juans it's blowing a perfect 15 miles per hour and gusting to 30 at 240 degrees. This is the lull. We've received 5-10' of snow in the last week, and there is another two in the forecast.

Of course, now I've jinxed it. Colorado is plagued with a particularly angry layer of basal facets, and the most active avalanche cycle I've seen in the last couple of years drew to a close a few days ago. Now those paths that ran are reloading, and those that held tough are getting fatter and meaner.

I'm not doing much backcountry skiing lately. I'm lucky because I ski all summer, the in-bounds powder has been outstanding, and I'm just busy enough to keep me off of the hills when I'm not working. If those things weren't true, the only reason I'd have to not go backcountry skiing is that it's particularly dangerous right here, right now. That wouldn't be enough.

I'm a very experienced 37-year-old male intimately familiar with the local terrain and snowpack. I know that my favorite slope angles lie between 37 and 45 degrees, and my favorite snow is found during and immediately after storms. I enjoy challenges and sometimes ski by myself. I'm exactly the kind of person who dies in avalanches. If you are my mother, you must put this paper down immediately and never think of it again.

Exposure and avalanche hazards are things I deal with on a daily basis for most of the year, and my biggest fear is becoming complacent in their omnipresent shadows. It's hard to keep track of that threshold of acceptable risk when it keeps moving back and forth and blowing all over the place. It's pretty easy to trip over it and smash your face on a sliding block of reality.

I guess my threshold is lowest when I'm guiding non-mechanized clients deep in the backcountry; it's highest when I'm with trusted partners and we've just

Story by Doug Krause, continued on page 13 ➡

The Avalanche Review
P.O. Box 2831
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in this issue

I promise that I won't die in an avalanche this season.

—oath administered by Rod Newcomb during an Avalanche Awareness Night in Jackson, Wyoming. Story on page 27

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The mission of the AAA is:

A. To provide information about snow and avalanches;

B. To represent the professional interests of the United States avalanche community;

C. To contribute toward high standards of professional competence and ethics for persons engaged in avalanche activities;

D. To exchange technical information and maintain communications among persons engaged in avalanche activities;

E. To promote and act as a resource base for public awareness programs about avalanche hazards and safety measures;

F. To promote research and development in avalanche safety.

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from the president

The American Association of Avalanche Professionals

As I write this, we are facing economic upheavals throughout the United States. We have yet to see how the trickle-down will impact the avalanche industry, but we can anticipate some challenges. In addition, December found many areas throughout the Intermountain West facing a late start to the winter season due to exceptionally warm and dry weather.

Now is a good time to revisit who we are and what we do, the American Association of Avalanche Professionals. We do business as the American Avalanche Association for ease of identity and name use, but I want to assure our membership we exist for you and because of you. We have always operated lean and mean, and we are ready to carry through with this policy during the next few years.

Our programs and policies have grown out of a grassroots need for organization and leadership in the US avalanche community, uniting the voices of all the different avalanche professions. We remain grassroots. We have a part-time executive director who works a full-time job in the avalanche industry. We have a volunteer governing board made up of avalanche professionals from the different regions and avalanche industries throughout the country, and a European board member.

We accomplish a lot given our makeup and limitations of time and money. Ten years ago the governing board reviewed a strategic planning study – do we go bigger; do we go smaller; how do we improve if we continue along the same path? We chose to make some adjustments yet remain grassroots and exist for the professional avalanche community. Sometimes it is too easy to compare ourselves with large, corporate-like institutions. We can learn a lot and benefit from other avalanche programs throughout the world, yet we also need to retain a sense of what we can aim for and achieve given our structure.

Our ongoing offerings are due to the efforts and time of our governing board, our membership, and informal partnerships with avalanche centers and other avalanche-related programs. AAA projects such as *The Avalanche Review*, *SWAG*, various grants and scholarships, and professional development programs directly benefit avalanche professionals. Education guidelines and partnership programs such as updating www.avalanche.org assist both the professional world and the general public. The more avalanche aware, the more avalanche educated the public and media are, the more likely a reduction in the number of US recreational avalanche accidents.

We have to prioritize and make choices matching our funds and abilities. Each program we choose to take on needs to meet three requirements: 1) be fiscally sound, 2) be operationally do-able, and 3) be sustainable given our grassroots structure. Check *The Avalanche Review* and US avalanche Web sites for updates on our programs.

In closing, thanks for your membership, and thanks for your participation. I hope this edition of TAR finds all of you with plenty of snow, interesting work, and time to enjoy it all.

—Janet Kellam, Ketchum, Dec 10, 2008

from the editor

Observant readers will notice something different about this issue of *The Avalanche Review*: it took up more room in your mailbox, it shoved around the other rags on the coffee table, and it elbowed its way to the top of the pile on the back of the john. Yup, we're big and beefy. As former TAR editor Blase Reardon commented, "This issue will be thick enough to roll up and use as a baseball bat!"

While we didn't particularly envision that sporty use for this issue, we do think we knocked this one out of the park. There are just so many remarkable articles and, especially, cool maps in our special section on terrain, that we added four pages to create the first 32-page issue of TAR. All for a mere $100 extra print cost.

I love maps; I can pore over them for hours and plan a range of adventures from half a day to superhuman. These articles bring us to many vicarious wandering-around spots; we can imagine standing at the top of that couloir etched in tiny black lines and skiing onto the obvious apron. Thanks to the map, we know what's around the corner and can thus make better decisions. In the same vein, we have several views of the ATES system that helps classify terrain and plan tours: first from its author Grant Statham, who gives us perspective on its evolution; then to Sean McManamy up in Turnagain Arm, where the ATES system is intended to help match terrain with conditions; and finally to John Fitzgerald at NOLS, where clarity helps facilitate consistent decisions among diverse staff.

Two views of the use of GIS technology – from Doug Scott of Avalanche Mapping and from Mike Richardson of Scenomics – illustrate possibilities for the use of technology in improving decision-making on many scales, from the personal slope-scale to keeping accurate long-term records for roads and ski areas.

Lynne and Chili-dog drop into yet another un-named Teton chute.
Photo by John Fitzgerald

Rounding out the terrain-theme articles, Drew Hardesty shows off some of the new tools being developed at the Utah Avalanche Center. Combining the best of Google Earth maps with terrain classification for a busy urban interface, a wealth of products are now available for Wasatch travelers. Drew described the recent open house to introduce these terrain products and classifications as exhausting, but "everyone is enthusiastic about the project, and everyone has great ideas." That's also the idea behind these themed TAR issues: to share ideas and inspiration about how to explain things better, and how to find and use crucial information.

Also in this issue you'll read Steve Jay's reflections on running the Castle Creek gauntlet in Colorado last year; musings on risk and focus from Doug Krause; and a history from Jerry Roberts of desperate days in the San Juans, where the early miners single-mindedly pursued ore in avalanche country.

Don't miss the Mailbag, where you'll find comments from a number of avalanche professionals who ponder our current and very troubling facet/ crust problem. This "funny business," to steal a phrase from Blase Reardon and Chris Lundy's work on wet slabs, is widespread throughout the West, and as it has loaded, we have seen huge and deadly deep-slab avalanches from Utah to Wyoming to Montana to British Columbia. A big learning year is in store as we watch how these layers react to load and heat over time: will they be the funny business for a big wet-slab cycle as well? What do you think? Why?

—Lynne Wolfe, editor

mailbag

Great Story on Companion Rescue

Lynne, Received TAR 27/2 the other day. Good issue with lots of articles covering different angles on the same subject. Edge's article (on companion rescue) was great. I read the original draft before he revised it for you. It is an important message that I believe is being readily accepted and integrated with avy classes. At least, instructors say they will. *—Craig Dostie*

From: ladblanchard@comcast.net
Subject: Publication Question
Date: December 17, 2008
To: lwolfe.avalanchereview@gmail.com

Lynne, Has anyone built a new recording field book for pits and weather obs that go with the new guidelines to be published in the updated SWAG?

—Thanks, Doug Blanchard

Question to a random selection of avalanchistas:

In light of the structure we are wrestling with this winter all across the West, do you have any forecasting thoughts/ tips/ tricks for dealing with/interpreting the facet/crust problem?

Trying to Interpret a Shit Sandwich

My main trick for dealing with the facet/crust problem is a 15lb ANFO shot. …Just kidding, but not really.

In times like these, as a bc skier, I go conservative and listen to the pack. I wait for the cracking/collapsing to subside then I move to steeper test slopes to see if I can get a failure. I like skiing paths that have already run big and reloaded so I'm dealing more with the near-surface layers than the basal layers. I also like skiing in higher traffic zones that see volunteer stability testers with a higher risk threshold than myself. That's practical.

In terms of theoretical interpretation of the shit sandwich, I start with mucho respect. That structural instability can persist for a long time in Colorado, and I've found the tiny little sweet spot on a huge path on more than one occasion. As a skier, I address it by carefully considering the exposure and consequences of acceptance of a persistent hazard that I can't mitigate. Where is the edge? Wish I knew.

I consider us lucky here in the San Juans in that our pack is typically subjected to large cycles on a regular basis. These shock loads provide good tests and frequently also develop into a very strong mid-pack layer even when our basal instabilities persist.

—Doug Krause, Silverton Mtn

Crusts and Facets Don't Forgive

Crust/facet combos are when most of the big wrecks have happened over the years. There is not much forgiveness over time with that type of layering.

In my non-scientific language: facet layers or depth hoar without crusts have a little leeway with stress and how it is distributed in the layering interfaces. Crusts and facets or surface hoar just don't allow for much.

—Janet Kellam, Ketchum

Recipe for a Nasty Snowpack

The main thing I talked about in Jackson is that there's almost always a November crust in BC, but not all are problematic. The real nasty ones seem to come on top of a decent early season snowpack (so the crust forms above the ground roughness) and are usually a good soak-to-mountaintop so the crust is thick, smooth, and present in the start zones. During the winter and spring, prolonged snowfall and warming (i.e., over three to five days) seem to be required to get the loading rates high and sustained enough to trigger them. Also, of course, lots of wind helps because with variable slab thickness the chance of triggering seems to increase. I'll leave the rest to the experts, I'm also trying to wrap my head around the deep-slab problem!

—Dave Gauthier, ASARC

And the Dreaded Crusts...

I fear crusts for many reasons. The inherent temperature that they possess in their birth (0º Celsius), the temperature gradient resulting in a weak layer on both sides of the damn things makes me cranky and lose sleep.

I know they are there throughout the season and oftentimes they (and their influence) don't go away until April around here. I know many skiers feel secure with them as a great turning surface, some crazies even use the term "bridging." But possessing a negative world view, I anguish about WHEN they will collapse/shear and what it will take to make them FAIL. So I creep around with great trepidation.

If you remember in one of my ramblings a few years back in TAR, I quoted an ex-girlfriend who said, "Roberts, you've made an artform out of being absolutely wrong – all of the time!" I live by her opinion when it comes to forecasting weak layers in the San Juan snowpack.

—Jerry Roberts, Silverton

A Notch More Serious

I have been thinking a bunch about your question regarding crust/facet combos. I don't know if I really have any revelations, but there are a couple of things that I'm thinking right now.

The first is that they really have the ability to propagate into areas they might not normally, which includes pulling onto flatter terrain. Sympathetic releases seem to really like this condition as people can trigger things really far away.

Faceting associated with the crusts adds another somewhat unknown effect; it really makes things bad. It seems like a facet/crust combo just makes me think everything is one notch more serious then just a regular PWL. The last crust/facet combo that I remember produced avalanches for a very long period and it seems like our current set up is doing the same. We're almost two weeks straight with large slides every day, and I don't think we're done yet.

One more thought about the crust/facet combo: better give it a little extra room while settlement occurs. The crust just may impede normal settlement and fool us into thinking things are stable when it finally trends that way.

—Brett Kobernik, UAC

aaa news

2008 AAA Awards

Story by Halsted Morris

The American Avalanche Association bestows four awards to recognize individuals for outstanding achievements and services in the avalanche community. Traditionally these are presented at the AAA annual membership meeting during the ISSW. This year the AAA awarded the Bernie Kingery Award, two Honorary Memberships, one Special Service Award, and one Honorary Fellowship Award.

The Honorary Membership is the highest award bestowed by the AAA, reserved for individuals who have distinguished themselves through special achievements in the field of snow avalanches. This year honorary memberships were awarded to Don Bachman and Knox Williams. Both Don and Knox have been highly involved in the growth of the American avalanche community and with the AAA.

Honorary Membership recipient Don Bachman (left) accepts his award from Chris Landry, who himself received the AAA Special Service award. *Photo courtesy Chris Landry*

Honorary Membership: Don Bachman

Don Bachman got his start in the avalanche business after studying forestry at Oregon State University. He came to Colorado in the fall of 1960 and soon was shooting avalanches with the Berthoud Pass ski patrol. He worked with snow rangers Art Judson and Dick Stillman, as well as the avalanche engineer at the Urad Mine, Den Davidson. His first avalanche rescue played out on the Palivacinni lift at Arapahoe Basin in 1961. Soon after, Don was standing in a shot hole at Berthoud Pass when a speeding fracture line sliced the snow above him. This caused a commotion of flying spruce twigs, rising snow dust, and an explosion of words: "I'm in it!" The snow ranger above him swished through the trees to save him, but Don was laying on the debris below, marveling at lumps of soft slab.

This flying start in avalanche work stayed with him. By the time he left the pass for the starting zones of Crested Butte, he was one of the best forecasters around and already had pulled the lanyard on one of the first avalaunchers tested for avalanche control.

Don's work in Colorado continued with outstanding success in field studies of San Juan avalanches at Red Mountain Pass under the auspices of the Institute for Arctic and Alpine Research of the University of Colorado. After the completion of that project, his reputation as a forecaster led to a job with Knox Williams at what became the Colorado Avalanche Information Center. He subsequently worked in many snowy settings as a specialist in snow behavior for the Seward Highway project of Alaska, the Greys River area of Wyoming, with Hal Boyne on snow testing for I-80 projects, with Art Mears in Colorado on fracture-line profiles and highway avalanche problems, and with Monty Atwater and Dick Stillman at Berthoud Pass. Experience on these and many other projects placed him in the forefront of expertise on Rocky Mountain avalanches, culminating with the avalanche forecasting and safety responsibility for the southern passes of the San Juan Mountains in Colorado during the 1990s. In addition, Don was instrumental in founding The International Snow Science Workshop in 1982 and continues to be a strong supporter of this and other national meetings of the snow community.

Don used his impressive diplomatic skills to represent the American Association of Avalanche Professionals (now the American Avalanche Association) in Washington and abroad, and beginning in 1997 he served as executive director for several years. The American Avalanche Association owes much to the effective work of Don Bachman.

Honorary Membership: Knox Williams

For more than 35 years, Knox T. Williams has been a dedicated avalanche professional whose knowledge, skills, and results have touched virtually every avalanche professional with influence that will continue far into the future.

Knox developed an avalanche-safety program recognized throughout the world. He built the Colorado Avalanche Information Center (CAIC), the oldest avalanche-forecast program in the United States, into one of the most respected centers in the world. He developed a methodology for archiving weather and avalanche data, which allowed for more accurate mountain weather and avalanche forecasting in the US.

Knox began his career with the US Forest Service (USFS) in 1970, where he created a national system to collect, manage, and report mountain weather, avalanche, and avalanche-accident data. Over the next 13 years, in addition to managing the Westwide Avalanche Network, Knox was also a forecaster in the USFS Colorado Avalanche Warning Program. In 1983 the USFS ended its avalanche program, and Knox helped found the CAIC with the state of Colorado, serving as its director until his retirement in 2005. By starting the state's avalanche program, Knox suddenly and successfully added the unofficial titles of accountant, fundraiser, marketer, PR spokesman, and politician to his traditional roles as scientist, forecaster, and educator.

While plenty busy in Colorado, Knox still found the time and energy to be active at national and international levels. Knox has instructed at every National Avalanche School since 1971 and served as its director for 13 years. In 1992 Knox organized the International Snow Science Workshop's stop in Breckenridge, Colorado. He has authored numerous technical papers and articles, he wrote two volumes of *The Snowy Torrents* and served as editor for the fourth volume, and he co-authored *The Avalanche Book*.

From 1995 to 1998 Knox applied his executive skills as president of the American Association of Avalanche Professionals (now the American Avalanche Association). He has also served the organization as its secretary and treasurer. Knox continues to work as a private avalanche consultant.

The Bernie Kingery Award is awarded for dedicated professional practice and recognizes a sustained career of contributions by a dedicated avalanche field professional. This award is in honor of John Bernier Kingery's long career of ski patrol and snow-safety work. Kingery became the mountain manager of Alpine Meadows resort and was killed there in 1982 in the most deadly avalanche in North American ski area history.

In addition to receiving the Bernie Kingery Award, Karl Birkeland was also named "Friend of *The Avalanche Review*" and received this snazzy red hat. *Photo by Doug Chabot*

Bernie Kingery Award: Karl Birkeland

This year's Bernie Kingery Award recipient is Karl Birkeland. As Kelly Elder wrote of Karl in an email, "Karl is one of the few individuals who truly capture the full extent of the Kingery Award's purpose: avalanche forecasting, mitigation, research or education, and safety. Although Karl still seems to have a great career ahead, he made early accomplishments and has never slowed down. He is a successful and highly regarded avalanche forecaster, working at ski areas and starting, running, and perfecting an avalanche center – all from scratch and against all odds. He has developed methods and tools related to forecasting and mitigation. He is involved in mitigation through his current job and is called on as an expert in a variety of venues. Karl has provided outstanding research results that run the full gamut from nuts-and-bolts to theory – or more commonly stated as basic and applied research. Both are critical to the body of knowledge that moves avalanche science and applications forward, and Karl is a big contributor to both.

"Karl has been involved in avalanche education for a couple of decades and is one of the top educators in North America. All of the above lead to avalanche-safety synthesis. Karl has a national and international reputation for being a leader in all aspects of avalanche research, education, forecasting, and service."

It is appropriate for Karl that the inscription on the Kingery Award reads, "For your significant contributions to the reduction of avalanche hazard, furthering research, and mentoring others as a dedicated avalanche professional."

The AAA Special Service Award recognizes specific and outstanding achievement in the service of North American snow-avalanche activity.

Special Service Award: Chris Landry

This year the AAA awarded the Special Service Award to Chris Landry. Chris's latest contribution to the avalanche community has been stewarding and coordinating the installation of the LaChapelle library in the Silverton archival facilities.

Chris's many avalanche-related achievements include founding the Center for Snow and Avalanche Studies in Silverton, Colorado, in 2003. Roots of their projects go back much earlier to the INSTAAR Silverton Avalanche Project in the early 1970s. The center initiates and facilitates studies of mountain snow systems with an interdisciplinary approach.

In snow and avalanche work, Chris is a pioneer, an innovator, a continually generous and humble contributor, and an incredible mentor.

The Honorary Fellowship Award honors those folks by their peers in the AAA for significant contribution to avalanche-related programs in countries other than the United States and, in general, for communicating their work to those in the US so that those contributions may be shared for common benefit.

Honorary Fellowship awardee Chris Pielmeier (left) celebrates with AAA president Janet Kellam at the Avalanche Divas party in Whistler, September 2008. *Photo courtesy Nicole Greene*

Honorary Fellowship Award: Christine Pielmeier

This year the AAA awarded an Honorary Fellowship Award to Christine Pielmeier of the Swiss Federal Institute (SLF). Dr. Chris Pielmeier is a scientist and avalanche forecaster at the Swiss Federal Institute for Snow and Avalanche Research (SLF) in Davos, Switzerland. Chris received her geography diploma in 1998 from the Ludwig-Maximilians-Universtät in Munich. Her thesis, Analysis and Discrimination of Snow Structure and Snow Profiles using a *High-Resolution Penetrometer*, involved detailed snow micro-penetrometer (SMP) measurements in the cold lab at SLF. She received her PhD from the University at Berne, Switzerland, in 2003. Her doctoral thesis, *Textural and Mechanical Variability of Mountain Snowpacks*, was the first detailed application of SMP measurements in the field. This work resulted in models which estimate density and texture index from SMP measurements, and her important current research is focused on estimating stability from SMP tests.

Chris has more than 10 refereed publications, has been an author on at least three presentations at each of the last three ISSWs, and authored an important review paper in *Surveys in Geophysics*, entitled *Developments in the Stratigraphy of Snow*. Her position at SLF, focused on transferring state-of-the-art technology to avalanche forecasting, is truly the essence of the International Snow Science Workshop's theme: "a merging of theory and practice."

Halsted Morris is the Awards Chair for the AAA.

metamorphism

HP Marshall has recently moved from Durango, Colorado, to Boise, Idaho, for an assistant professor job in geophysics at Boise State University. He's currently advertising for a PhD student to work on snow research (cgiss.boisestate.edu/~hpm/student_opportunities/). He will continue his snow research projects every winter/spring in Colorado at the Center for Snow and Avalanche Studies' site on Red Mountain Pass in Silverton with Andy Gleason and Chris Landry. He will also continue work at the USFS Fraser Experimental Forest with Kelly Elder and Mark Dixon. He plans to start pursuing research locally with Janet Kellum, Chris Lundy, and Blase Reardon at the Ketchum FS avalanche center.

In January, Chris Pielmeier (SLF) will visit for two weeks to do fieldwork with HP at all of these sites. Also this year, Karl Birkeland, Kelly Elder, and Ethan Greene will join HP for fieldwork in Valdez with Theo Meiners and others at Alaska Rendezvous Heli Guides.

Doug Krause reports that he is now officially the snow safety director at Silverton Mountain, Colorado.

Blase Reardon began work in December as a full-time forecaster/avalanche specialist with the Sawtooth NFAC. He brings many skills to the center, although he reportedly needs to sharpen up his snowmobile-wrestling talents.

Thanks to **Andy Anderson**, who is the latest Life Member of the AAA.

AAA thanks the following members for contributing an additional donation to further our efforts in 2008. Donations totaled $16,347 and amounted to 20% of our total income.

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Attention Avalanche Course Providers!

For the NEW avalanche.org site, avalanche course providers will need to resubmit information to be listed in the new and improved course provider directory. In order to be included, someone on staff must be a pro member of the AAA.

Please submit: Organization Name, Location, Phone, Email, Web Site, Courses Taught (Intro/Awareness, Level 1, Level 1 refresher/ASAW, Level 2, Level 3). Email to clundy.avalanche.org@gmail.com.

SWAG Update

The new SWAG will not be available until summer 2009 due to the busy winter schedules of the update team.

what's new

Brooks-Range Emergency Sleds

Review by Craig Dostie

The concept of carrying an emergency rescue sled in your pack implies a level of responsibility and, from a practical level, additional weight that most of us are loathe to consider. However, with the development of compact, light-weight rescue sleds from Brooks-Range, that knee-jerk reaction may be outdated. It all depends on your inherent sense of responsibility.

In the case of guides it's a matter of professionalism and, at a minimum, a rite of passage. To become certified as a guide you need to demonstrate your ability to perform an emergency rescue. Commenting on the test requirements, Colin Zacharias – one of the masterminds behind the Canadian Mountain and Ski Guide Training Programs – says, "The evacuation system must be light enough to be carried whenever they are professionally guiding clients, assemble quickly…be rigid enough to reduce exacerbating… injuries, and durable enough to permit evacuation over several kilometers."

Emergency sled designs are usually variations on the classic Sonde design, consisting of a pair of skis and poles plus a few strategic lashings and a tarp that can be transformed into a sled capable of moving a body over snow without falling apart. Unfortunately the cheap imitations rarely inspire confidence, and the Sonde package weighed close to five pounds, effectively eliminating it as standard equipment.

Recognizing that the crux problem with the Sonde was weight, Brooks-Range developed a lightweight version substituting super-light, super-strong ripstop material for the hypalon™ tarp, lashing straps, and lightweight spreader bars to enhance ease of assembly and structural integrity. The patented aluminum spreader bars come with slots cut in them for holding any commonly used pair of mountaineering skis. Two versions are available, both weighing 11 ounces. The Backcountry version consists of two 18" tubes that nest inside each other, while the Pro version uses four tubes that also nest consecutively inside each other down to a compressed length of only 10" which expand to the same 18" length.

There are four different models of Mountaineering Rescue Sled to chose from, varying from the minimalist Ultralite Sled to the All-in-One Ultralite Sled/Tarp package, where the fabric for the sled is an integral part of a larger tarp that could also be used as a temporary shelter. In addition to sled tarp and spreader bars, each rescue sled also comes with two straps integrated into the sled bed material for longitudinal tension and five rubber Backcountry Ski Straps™ to lash poles to the skis and enhance overall stability of the assembled sled. The bungeed straps are the healthy-sized 21" variety. Straps to bind the jacket of the litter around the shoulders of your victim and zig-zagging along the torso to hold him securely are tucked in hidden pockets in the upper corners of the tarp.

Naturally you'll want to assemble the sled at least once before trying it under duress. Like the spreader bars, everything has a specific purpose and place. Some pieces, such as the second push pin for the large cylinder pair used on the tip spreader bar (Pro version), are stored in the smallest cylinder. The mechanically inclined will see that it needs to be transferred to the larger diameter cylinder, but the field rescuer will want to figure out that little twister beforehand. For the bulk of assembly, the key directions are printed on the bed of the litter in case you're befuddled.

Besides assembly instructions, Brooks-Range also provides Clif notes on helicopter etiquette and basic signals, as well as SOS signals, international emergency phone numbers, and even a Morse code legend.

If there is a fault with this sled, it would be to the ultimate transportability of even a light body. The sled is plenty sturdy; the concern is with the glide. The crossed poles that reinforce the stability of the sled will almost certainly increase drag. Depending on the situation, that might be a good thing, but if you have much distance to go, you may find this to be the niggling flaw that impedes the rescue. In a real emergency I suspect it will be the least of your worries.

Although it is certainly possible for one to construct an emergency sled as light, the attention to detail on things like the strap system and the bar-tacked pull handle at either end could simply not be done for even twice the cost in development time, let alone considering the convenience of carrying a complete package that is found at a reasonable price. When it matters, this is a form of insurance that may well be priceless.

With a bit of careful observation and care, you can also get it back in the original size and form. It's reassuring to know it will work if you need it, but most of the time you'll be satisfied with it using as little space as possible in your pack.

The question remains if recreational backcountry skiers would have any interest in carrying one of these as standard equipment in their pack. For short day trips where we're always looking to lighten our packs, it's unlikely. But for more committing trips, the compact size and light weight bears consideration. Bela Vadasz, technical director for Alpine Skills International in Truckee, California and a technical advisor to Brooks-Range looks at it as part of group gear, like a first-aid kit or repair kit. "If you split the group gear among three or four people, two pounds is easy to absorb," he says.

Indeed, the Ultralite Sled package weighs in at only 23 ounces, but it's possible to lighten the load even more. Though few recreational backcountry skiers currently consider a rescue sled as part of their minimal safety kit, nearly all carry a shovel. Brooks-Range offers their own line of shovels that are modified Voilé shovel blades with Shark's Teeth on the cutting edge, a reinforced yoke to attach to their telescoping shaft, and slots cut in the blade to use in creating a rescue sled. The two-piece shaft has the same patented slots cut into it as the Backcountry spreaders bars, plus a beefy D-handle on the end. Extended, it provides 30" of serious leveraging power. If you are carrying this shovel, all you need to make a rescue sled is an additional sled tarp and straps. With an Ultralite sled package, you would only need to add another 12 ounces to your pack. At that point, carrying a rescue sled is worth considering, even for recreationists; for guides, it's a no-brainer.

After many years of editing Couloir *magazine, Craig Dostie is now not only able to contribute to* Backcountry *magazine, he also finds time to work as a freelance writer. Look for his pieces and opinions in future issues of TAR.*

Brooks-Range Mountain Rescue Sleds

Backcountry Rescue Sled
MSRP: $198, Weight: 36 oz. (1021 g)

Pro Rescue Sled
MSRP: $218, Weight: 36 oz. (1021 g)

Ultralite™ Rescue Sled
MSRP: $238, Weight: 23 oz. (652 g)

All-In-One Rescue Sled/Tarp
MSRP: $288, Weight: 27.2 oz. (711 g)

www.brooks-range.com

Carnegie Heroes Awards 19 Medals, Cash for Bravery

PITTSBURGH (AP)

The Carnegie Heroes Fund gave its fourth group of awards this year to 19 people who risked their own lives to save others. Some of the people died or were injured rescuing others who were drowning, being attacked, or were trapped in fires.

Among the other heroes was Walter Rosenthal, 58, of Toms Place, California. He died trying to save James J. Juarez and John S. McAndrews from suffocation after they were buried by snow at a resort at Mammoth Mountain, California, on April 6, 2006.

Steel baron Andrew Carnegie launched the hero fund in 1904 after hearing about rescue stories from a mine disaster that had killed 181 people. Since then, $31.1 million has been awarded to 9,243 people. Each recipient, or their heirs, receives $6,000 and a medal.

International Symposium on Snow and Avalanches Slated for April in India

The International Glaciological Society and the Snow and Avalanche Study Establishment will present the International Symposium On Snow And Avalanches in Manali, India, on April 6–10, 2009. For information, contact the International Glaciological Society at [44] (0)1223 355 974, igsoc@igsoc.org, http://www.igsoc.org/symposia/ or http://issa2009.in/

35th Annual Conference on Explosives and Blasting Techniques set for February

The International Society of Explosives Engineers (ISEE) has slated their 35th Annual Conference on Explosives and Blasting Techniques for February 8-11, 2009. The event will be held in Denver, Colorado, and will feature exhibits and more.

Conference participants can register on the internet at www.isee.org. For more information, call ISEE at (440) 349-4400.

Correction for TAR 27/2

In *How Efficient is Companion Rescue with Minimal Training*, published in TAR 27/2, the captions of the two avalanche rescue scenarios on page 15 indicate that the Pulse was used. These captions should have instead read:

Triple-antenna digital/analog transceiver with marking capabilities. The results obtained in the test can be achieved with any transceiver that meets the above specifications, regardless of brand and model.

The new CSAS building, with the obvious Green Ribbon path of Kendall Mountain looming behind.

CSAS Moves into New Building in Silverton

Story and photo by Chris Landry

In late October 2008, the Center for Snow and Avalanche Studies (CSAS) of Silverton, Colorado, moved across town into a new facility at 321 East 12th Street. The near-new timber frame structure is being leased by the CSAS from Bob and Pat Schmidt, formerly of Silverton, who lived in and operated a custom furniture and cabinet shop from the facility since 2000.

The move consolidated the CSAS's various office, storage, residential, and lab facilities (formerly the staff's kitchen) into a single, very efficient, full-fledged center facility that will better serve their current stable of hosted researchers, enable them to host classes and workshops, and accommodate growth in their programs and services, perfectly complementing their outstanding Senator Beck Basin Study Area research and monitoring infrastructure at Red Mountain Pass. CSAS also has an option to purchase the facility and adjoining lots during the next five years thanks to the extraordinarily creative terms provided by the Schmidts.

Among the building's many outstanding attributes – it's almost as if the Schmidts designed it with the CSAS's space needs in mind – is the fact that the building lies within the "blue zone" (powder blast zone, only) of the Green Ribbon slide path (also known locally as the Arcade and/or Rabbit Ears path) running into Silverton off of Kendall Mountain. Art Mears, now a member of the CSAS board of directors, analyzed the path and runout back in 1994 for the Schmidts, and the structure was (over)engineered and (over)built accordingly, to withstand a 100-year event's powder blast forces. The CSAS looks forward to experiencing that rare event and, more importantly, to a long future of service to the American and international snow science community from their fantastic new center.

CSAS Executive Director Chris Landry invites readers of *The Avalanche Review* to stop by for a visit anytime! Watch for additional details on the facility's capabilities and features on their Web site at www.snowstudies.org.

Chris Landry is the executive director of the Center for Snow and Avalanche Studies in Silverton, Colorado.

Matt Murphy of the Chugach Wins Award

Congratulations to Chugach National Forest avalanche forecaster Matt Murphy who recently received the prestigious USDA Secretary of Agriculture Award.

"I'm glad to be back in Alaska, but it was great to be in DC," Matt explained about receiving his award. "I feel very honored to have gotten this award. I tried my best to represent FS Avalanche Centers well. It was easy because I really believe in what we do and I'm proud to be a part of the FS avalanche program."

Chief Kimbell remarked, "Matt Murphy's quick action, technical expertise, and leadership during a moment of crisis contributed to the successful recovery and survival of an avalanche victim.

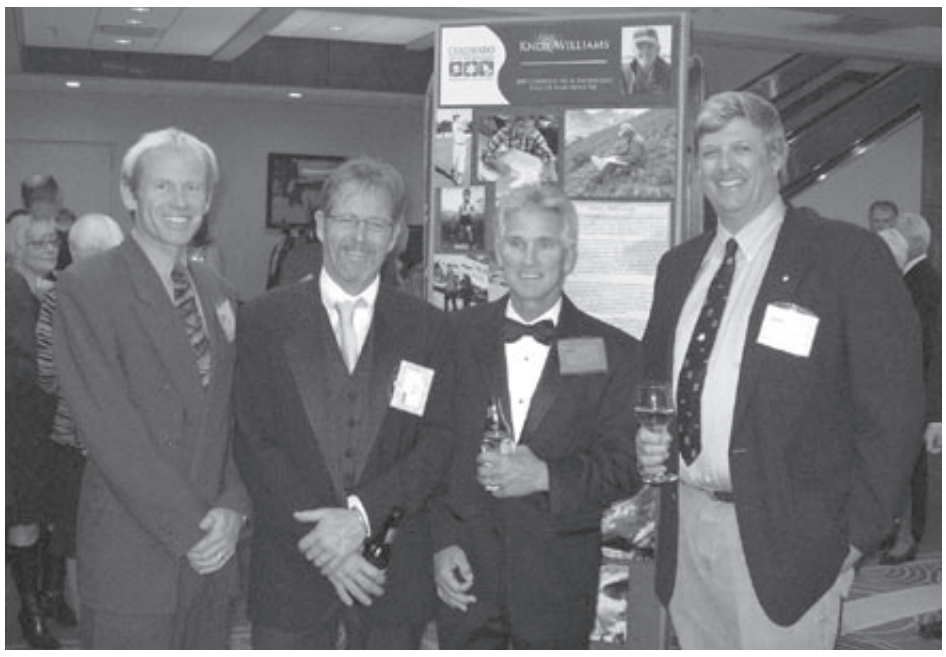
"Matt was ski touring with friends on his day off, when he saw and heard a violent wave of snow that buried Ian Wilson, a 24-year-old skier visiting from Portland, Oregon. As Matt arrived on scene, the victim's friends were searching, but were confused, disorganized, and losing valuable minutes in their rescue attempt. Other members of the public began to arrive, wondering what had happened and how they could help.

"Matt quickly redirected the efforts of the group. He defined the last point the victim was seen, directed an avalanche beacon search, and organized others in the party with probes and shovels. Within minutes, he had directed a crew of more than 20 – people who had never met – in a miraculous rescue."

Avalanche forecaster Matt Murphy grins for the camera.
Photo courtesy Carl Skustad of the Chugach National Forest Avalanche Center

Knox Williams Inducted into Colorado Ski & Snowboard Hall of Fame

Story by Halsted Morris
AAA Awards Chairman


Four Monkeys in Suits (l-r): Dale Atkins, Scott Toepfer, honoree Knox Williams, and Halsted Morris clean up nicely for Knox's induction into the Colorado Ski Hall of Fame.
Photo by Lou Dawson, WildSnow.com

Coming on the heels of Knox Williams being awarded AAA honorary membership at the 2008 ISSW, he was inducted into the Colorado Ski & Snowboard Hall of Fame on October 18, 2008.

The Colorado Ski & Snowboard Hall of Fame honors those individuals who have made significant contributions to the Colorado skiing community. As the first director of the Colorado Avalanche Information Center (CAIC), Knox spearheaded the implementation of accurate weather and avalanche forecasting and increased and upgraded avalanche-education programs. CAIC staff member Scott Toepfer spearheaded the effort to have Knox inducted into the hall of fame.

The 32nd annual Colorado Ski & Snowboard Hall of Fame induction gala in Denver was a black-tie dinner affair at the downtown Marriott hotel. It may have been the first time that so many CAIC staff (past and present) have all been in formal attire at one time. Noting this historic occasion, Knox commented in his acceptance speech, "Chicks dig tuxedos."

For more information about the Colorado Ski & Snowboard Hall of Fame, check out their Web site at www.coloradoskihalloffame.com

Bela Vadasz Receives AMGA Lifetime Achievement Award

Story by Craig Dostie

During the recent annual meeting of the American Mountain Guides Association (AMGA) in Smith Rock, Oregon, during October 2008, Bela Vadasz was presented with a Lifetime Achievement Award.

Bela and Mimi Vadasz founded Alpine Skills International in California in 1979. Their goal as guides was to teach the whole mountain experience, which included the realm of ski mountaineering – skills few other American guides bothered with. As a result, they were instrumental in being on the front line of promoting the then-fledging sport of backcountry skiing – or as it was more commonly referred to back in the 1980s, telemarking.

In the late '80s Bela began working with other guides in the AMGA to create a certification program. One of the early internal debates centered around the push for international acceptance, with many guides arguing that American guiding was different and didn't require certification. Bela remained adamant that the technical standards must at least meet international standards, while allowing a distinctly American process to impart and maintain the cultural differences stateside.

In presenting the award, Rob Hess, the AMGA's technical director, pointed out, "[Bela] started the ski program which was the crux of [the AMGA] being admitted into the IFMGA. Without his vision and perspiration, the AMGA wouldn't be where it is today." Bela started and remains the technical director of the AMGA's ski program,

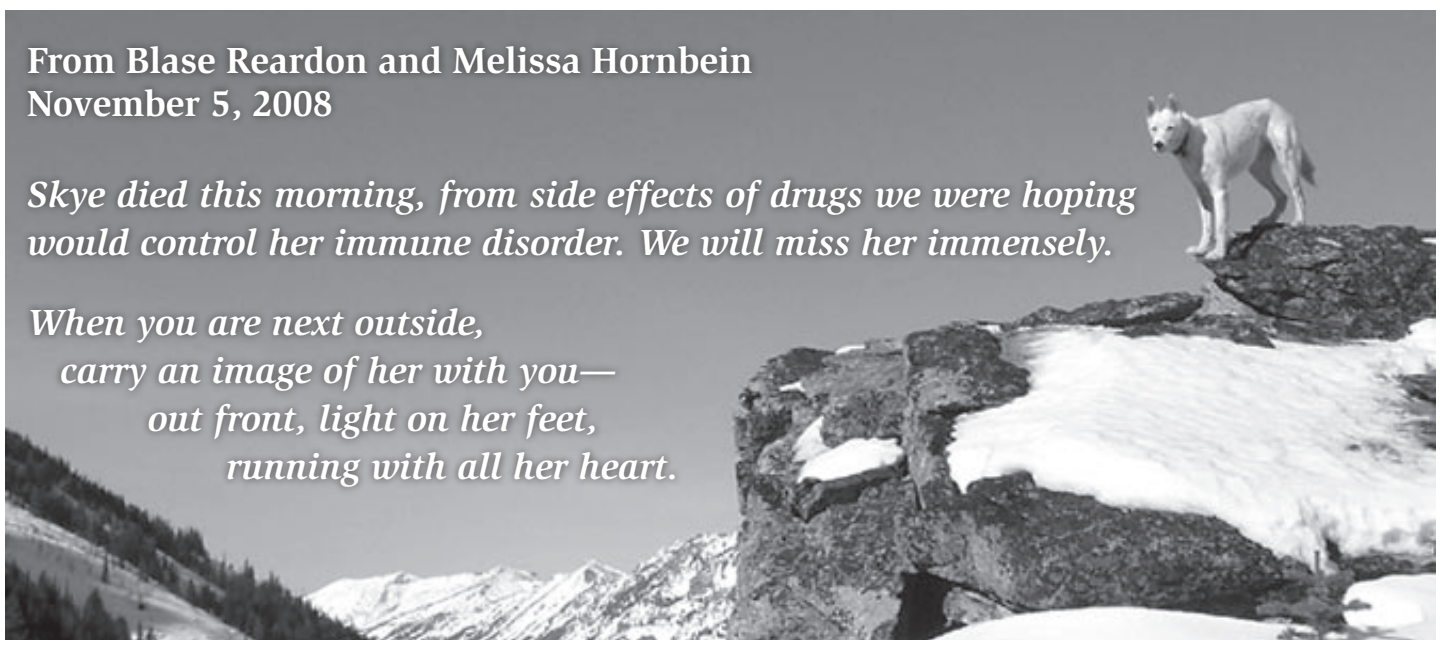

Bela Vadasz (right) poses with Keith Garvey, AMGA instructor, Board of Directors member, and recipient of the Guide of the Year award.
Photo courtesy AMGA

and was one of the first two guides to be internationally certified through the program he started.

Through ASI, Bela and Mimi Vadasz have guided throughout the world. Mimi is one of the few American women to summit Everest. Together they completed the first ascent of the Puterey Ridge on Mont Blanc, the longest alpine route in the Alps. They completed the first Nordic ski descent of Denali.

In accepting the award, Bela G. Vadasz began by reflecting on the goals of the program. He said, "When we started this, it wasn't really for our generation. It was for the future. We knew that we wanted American guides to be better than we were. But that future is now. Just look at everybody in this room."

The full article was first published and can be found at Wildsnow.com.



Northwest Snow and Avalanche Summit 2008

Story by Craig Wilbour • Photos by Don Svela

The second annual Northwest Snow and Avalanche Summit (NSAS) was held in Seattle November 8, 2008, with a packed house of 250 attendees. The $25 entry fee covered costs and benefited the Alpine Safety Awareness Program (ASAP) and the Northwest Weather and Avalanche Center (NWAC). Similar to a day at the ISSW, the Avalanche Summit featured presentations related to decision-making in avalanche terrain.

This event was organized by Michael Jackson and emceed by Steve Christy of Backcountry Access. Sponsors included Outdoor Research, Karhu, Friends of the Avalanche Center, Ortovox, Cascade Powder Cats, Backcountry Access, American Avalanche Association, Marmot, Cafe Humana, and Stevens Pass ski area. Thanks to all the sponsors for their commitment to avalanche education and safety. A lot of volunteer effort made the Avalanche Summit a success, and Mike and Joanne Stanford deserve special recognition.

Garth Ferber of NWAC started the presentations with *A Day in the Life of a Forecaster*, where he discussed the tools and methods used to produce the forecast products of NWAC. Ken White and Roland Emetaz received awards for their long-term support of NWAC and their dedication to avalanche education.

Don Sharaf followed with a thorough explanation of the various stability tests. He described strengths and weakness, limitations, and best applications of each.

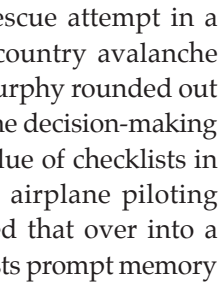
Martin Volken presented a simple, easy-to-apply diagram that uses likelihood and consequences of an accident as a means of risk assessment. He then discussed the dichotomy between doing things for the right reasons versus the possible motivation and far greater risk that comes with doing extreme things for competitive or monetary reasons. *(editor's note: watch for Martin's article in TAR 27/4 based on his presentation.)*

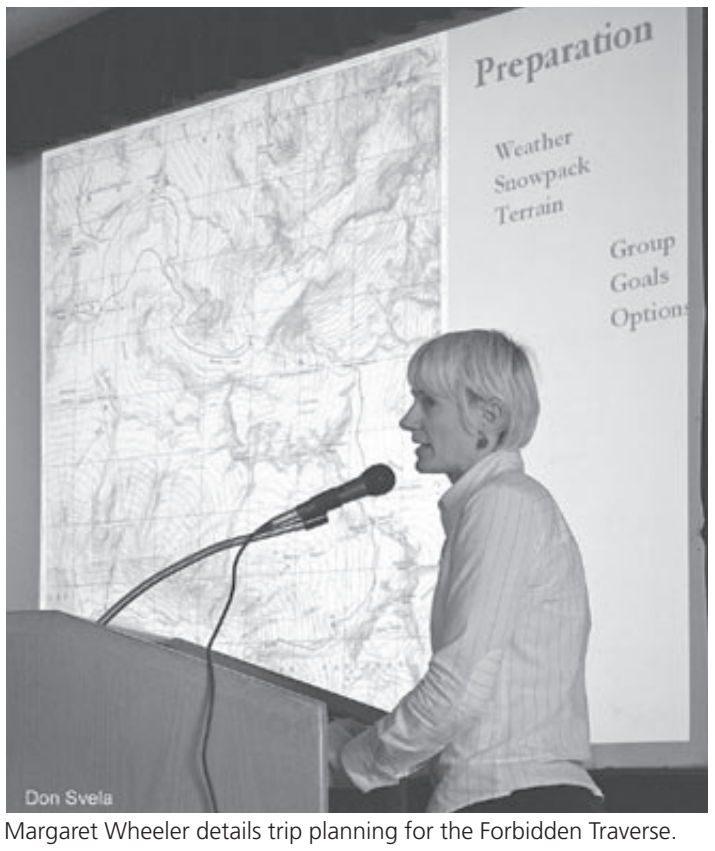
A panel then discussed *Decision-Making in a High-Risk Environment*. Margaret Wheeler articulated some of the decisions she made while guiding a party on a multi-day ski mountaineering trip on the Forbidden Traverse. Sky Sjue then discussed various risk-reduction methods he uses on remote mountain first descents. Don Sharaf presented some of the pressures and realities of heli-ski guiding in Alaska and methods used to reduce risk while meeting the high expectations of big-dollar powder junkies. I provided good and bad decisions and techniques made in two situations. One situation was the most serious avalanche ride I have taken, closely followed by the second situation, an unsuccessful rescue attempt in a double fatality from a backcountry avalanche accident a mile away. Tom Murphy rounded out the discussion by analyzing the decision-making process. He discussed the value of checklists in high-risk situations such as airplane piloting and in medicine, then carried that over into a ski-touring situation. Checklists prompt memory recall by listing the minimum steps or observations required in a complex decision-making process.

Lowell Skoog then talked about safety and success on Cascade high ski routes in all seasons. Analyzing 53 of his extended high-route tours over 26 years, he found that the most successful tours took place after the snow had consolidated in late May and June. He provided the basic guidance for multi-day trips of eight miles and 4000' of climbing per day.

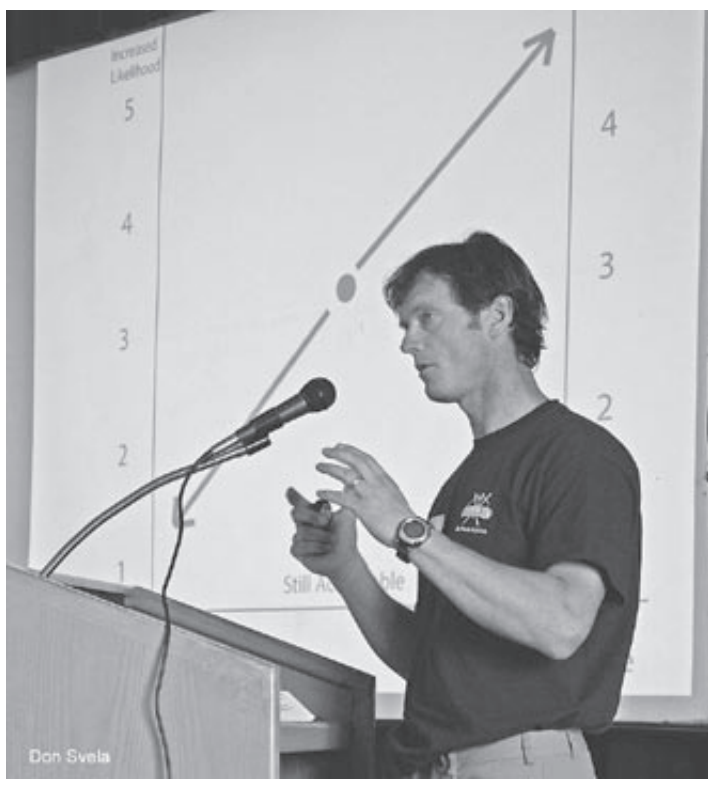
Sam Kavanaugh put the day's avalanche-safety presentations into an up-close-and-very-personal perspective on lessons learned in an avalanche accident with the powerful DVD, *A Dozen More Turns*. Sam's remarkable spirit, inspiration of his rehab, and his love of skiing and the mountains gave tremendous impact to his message.

Craig Wilbour was a ski racer and climber in college. He started on the pro patrol at Alpental in 1968-69 and worked there seven years, five of those as assistant patrol director. He then went to work for WSDOT doing avalanche control on Snoqualmie Pass. In 1978 he became the avalanche-control supervisor, an ongoing position he still finds interesting and challenging.





Margaret Wheeler details trip planning for the Forbidden Traverse.



Martin Volken describes his deceptively simple "Likelihood versus Consequences" decision-making model.

Applied Snow and Avalanche Research ASARC — UNIVERSITY OF CALGARY

ECT/ PST Scoring Sheet Available Free Online

During the recent training seminars there were many requests for tip sheets. A field book tip sheet for the Propagation Saw Test (PST) and Extended Column Tests (ECT) is shown below. The cards were prepared by Cameron Ross of the ASARC team at the U of Calgary.

If you cut the first page in four equal sections, each should paste onto a field book page. If you print double sided, then the ASARC logo appears on the back of each cut page. It is fine to not print the logos on the backside, but please note that the procedures are based on Dave Gauthier's research on the PST as well as Ron and Karl's research on the ECT. The procedures have been submitted to but not approved by the CAA Technical Committee.

Editor's note: A PDF of the scoring sheet should be available at **http://webdisk.ucalgary.ca/~asarc/public_html**. *If it is not, please contact Lynne Wolfe at lwolfe.avalanchereview@gmail.com to receive an electronic copy.*

Craig Sterbenz, snow safety director at Telluride Ski Resort, accepts a donation for the AAA education fund from Everett Clausen of CIL/Orion. The $4,727 check was presented at the CAA annual meeting last spring in Penticton, BC. CIL/Orion donates 3% of their profits annually to the AAA and CAA.

EXTENDED COLUMN TEST (ECT) - 2008

- Column is 90 cm cross slope and 30 cm upslope.
- Isolate the column along the front wall by digging and along the back and sides by cord or saw cut. All walls should be vertical.
- Place a shovel blade at one end of the column and apply the same loading steps as in the compression test: 10 from the wrist, 10 from the elbow, 10 from the shoulder. When a fracture is *initiated*, note the number of taps (#*)* and the layer depth.
- Four results are possible:
  ECTV: a fracture propagates across the full column during isolation
  ECTP #: a fracture propagates across the full column on the *same (#)* or *one additional (#+1)* tap as initiation. *#* is the tap that *initiated* fracture.
  ECTN #: a fracture initiates but *does not* propagate across the full column on the #th or (#+1)th tap.
  ECTX: no fractures are initiated in the 30 standard loading steps.
- Propagation is predicted to be likely *only* when the fracture propagates to the end of the column on the *same* or *one additional tap* as initiation (Simenhois & Birkeland 2007). For example **ECTP 13** fully propagated on the 13th or 14th tap.

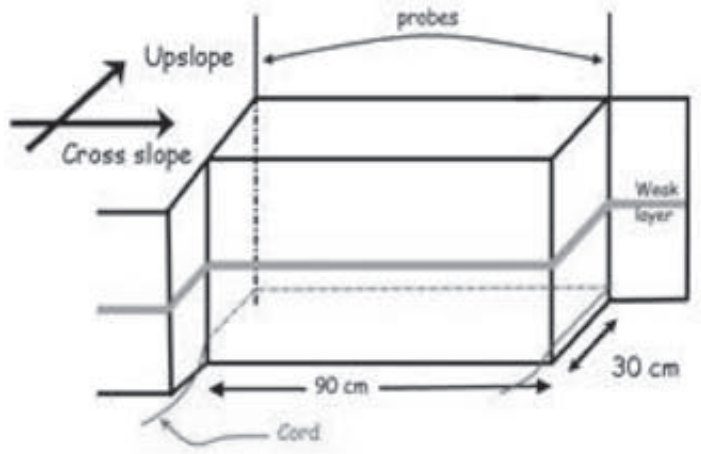


Fig. 1: ECT column schematic (from Ron Simenhois, 2008).

Fig. 2: Isolating an ECT column (left) and loading the column in the same manner as the compression test (right).

PROPAGATION SAW TEST (PST) - 2008

- 30 cm cross slope and 100 cm upslope. If the weak layer is deeper than 100 cm, the length should be equal to the layer depth.
- Isolate the column at the front and one side by digging and on the remaining two sides by cord cut or saw cut. All walls should be vertical.
- Identify weak layer along column with aid of glove or brush, then drag the blunt edge of saw upslope along through the weak layer at 10-20 cm/s being careful to stay within layer until the fracture jumps ahead of the saw. Stop cutting and mark the spot in the layer where the fracture began to propagate ahead of the saw. Repeat the test if you suspect the saw left the weak layer.
- The propagating fracture will either reach the end of column (End), stop at a slab fracture (SF), or self-arrest within the layer (Arr).
- Record results as **PST x/y (Arr, SF or End) down z on yymmdd** where *x* is cut length, *y* is col. length, z and *yymmdd* are layer depth and ID.
- Propagation is predicted to be likely *only* when the fracture propagates to the end and less than half the column has been cut (Gauthier and others, 2008).

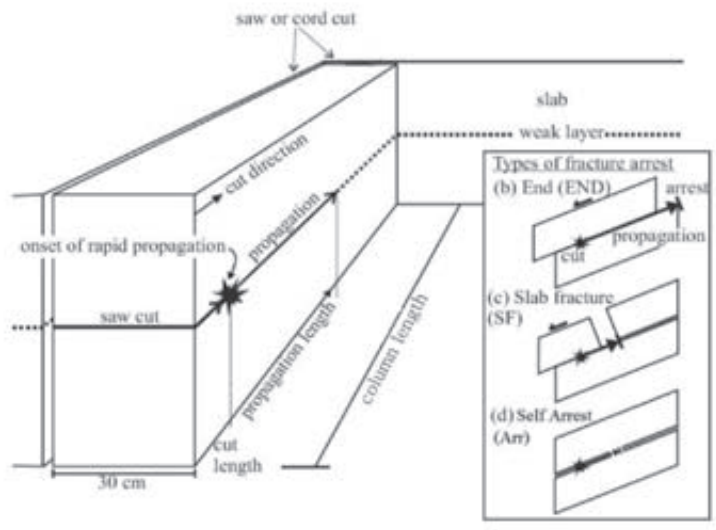


Fig. 1: PST column schematic with observable result types.

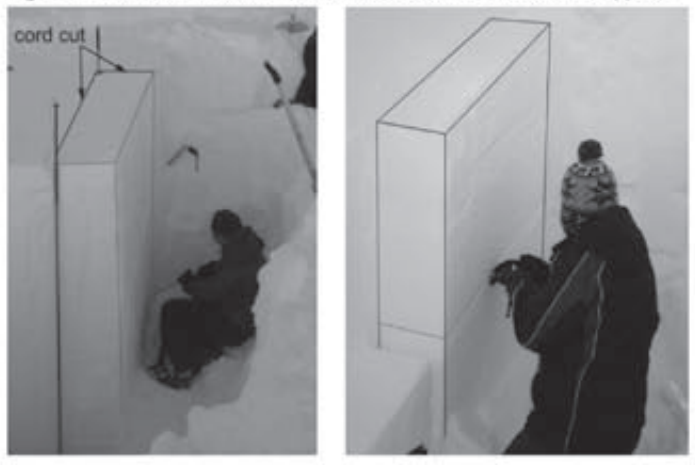


Fig. 2: Isolating a PST column (left) and saw-cutting upslope along the weak layer with the blunt edge (right).

Avalanche Divas Gather at ISSW 2008

Story by Wren McElroy • Photos courtesy Nicole Greene

A merging of theory and practice may be the ISSW theme, yet so much more is gained from these gatherings. Bringing together like minds in formal and informal discussions has an immeasurable value.

The 2008 ISSW in Whistler gathered 840 delegates from 20 different countries, of whom just 10% were female. Many said there were more women at this ISSW than they had ever seen, although while walking the halls it didn't seem that way. Most women in this industry have spent much of their career as the only woman in their work environment. Forging ahead with thick skin, laughing at the jokes, and being "one of the guys" has just been the way it is – part of the business. These women are strong, capable, and accommodating. It is an interesting minority role to carry, yet often soft-pedaled.

A new tradition, begun at 2006 ISSW, was creating an event to bring that 10% together for their own special night. Nicole Greene, 2006 ISSW co-chair, and Leslie Ross of Babes in the Backcountry created the first Avalanche Divas event with a Ladies Night in Telluride, Colorado, where more than 100 female ISSW participants gathered to share stories, acknowledge significant female role models in the field, and to foster a professional exchange.

"The goal of the Avalanche Divas is to offer female attendees an opportunity to gather, share information, and network with other professional women in the snow and avalanche field," event coordinators Greene and Ross explain. "By honoring the pioneering women in our industry, we create a format in which female ISSW participants can connect with other avalanche professionals and engage in mentorship opportunities. At some point we also hope to create a scholarship fund for women to pursue objectives in snow-related careers."

In 2008, the ISSW steering committee again partnered with Babes in the Backcountry to host the second biennial ISSW Ladies Night, officially re-dubbed the "Avalanche Divas Social." The event included dinner, complimentary drinks, and gift bags containing items from generous sponsors, including skis, hats, sunglasses, goggles, and more.

Each honoree was charged with selecting a peer to introduce her. This brought a very personal sense of friendship and mentorship to the event, not to mention some very funny stories. This year's honorees were Margie Jamieson, Mary Clayton, Nancy Pfeiffer, Lynne Wolfe, and Lin Ballard. The evening's tone was inspirational and irreverent, cross-border and cross-generational.

Avalanche Divas 2008 (l-r): Lin Ballard, Margie Jamieson, Lynne Wolfe, Mary Clayton, and Nancy Pfeiffer. Margie won the best costume award; her black hat and gloves were the envy of many.

In addition to recognizing these five women currently working in the avalanche field, the 2008 Avalanche Divas Social provided an opportunity for Janet Kellam to pay a special tribute to Jerry Nunn, a retired National Ski Patrol avalanche specialist who was largely responsible for the avalauncher's success *(see article on Jerry Nunn in TAR 25/3)*. The presentation featured great photos of Jerry as a beautiful young woman driving around the country with an avalauncher in the trunk of her car doing demos. One memorable story about Jerry related her arrival at the first US Forest Service avalanche course in Alta only to be told that she couldn't participate since she was a female. With a name like Jerry on the course roster, her gender had apparently gone unnoticed. Despite this initial refusal, she didn't go away – Jerry was very successful during that course and went on to contribute an incredible amount to the snow and avalanche industry.

What's Next for the Divas?

The Avalanche Divas' next gathering will be held during the first-ever European ISSW in the fall of 2009 in Davos, Switzerland. Founders Greene and Ross are looking for new leadership to take over and plan for the Divas night out in Squaw Valley, California, during the 2010 ISSW. They would also like to create a formal steering committee to oversee the event. The Divas committee would also seek to create, establish and administrate a scholarship fund for females working in the snow and avalanche field.

Commitment from corporate sponsors is one of the keys to the longstanding success of this program. Sponsors for the 2006 and 2008 events included the American Avalanche Association, American Institute for Avalanche Research and Education, Athleta, Backcountry Access, Backcountry.com, Black Diamond, Clif Bar, Cloudveil, G3, Isis, Julbo, Malakeye.com, Marmot, Oakley, Patagonia, Pistil, Recco, and the ISSW 2006 and 2008 organizing committees.

Wren McElroy is a professional member of the Canadian Avalanche Association. She has spent lots of time as one of the boys. Wren was the first female firefighter on the Castlegar, BC Initial Attack Crew for Ministry of Forests and ski patrolled at Whitewater Winter Resort in Nelson, BC, where she worked as the only female patroller. Currently she is working for the CAA as part of the Industry Training Program Team.

Avalanche Divas

HONOREES AT THE 2008 INTERNATIONAL SNOW SCIENCE WORKSHOP, WHISTLER, BRITISH COLUMBIA

LIN BALLARD

- Joined Loveland Ski Patrol in 1965
- Taught her first Avalanche Level I in 1973
- BMNSP Avalanche Advisor, 1981-1986
- Division Avalanche Program Supervisor, 1986-1992
- National Avalanche Program Director, 1992-1997
- Monty Atwater Avalanche Award, 1997
- RMD Leadership Development Team, 1997-2003

MARY CLAYTON

- Pro Patrol, Red Mountain: first woman to work on the avalanche control team, 1982-1985
- Member of the first all-female ascent of the east ridge of Canada's highest peak, Mt Logan
- Avalanche Technician, Snow Research & Avalanche Warning Section, Roger's Pass: first woman to work avalanche control, 1985-1989
- Climbing Instructor & Ski Guide, one of the early women to take ACMG guiding exams
- Producer, CBC Newsworld, Canada's first 24-hour news network, 1995-2004
- Communications Director for the Canadian Avalanche Association and the Canadian Avalanche Centre, 2004-present

MARGIE JAMIESON

- One of two female charter members of the Canadian Avalanche Association, now teaching professional-level CAA industry avalanche courses
- Built and operated oldest running backcountry lodge in Canada
- Owner/Operator of Ptarmigan Tours, a 30-year-old adventure tour company
- 30-year Environmental Activist, worked to establish Purcell Wilderness Conservancy, the largest wilderness are in southern British Columbia
- Founding Member, Nordic Guides Association
- Limited Full Ski Guide, ACMG (grand*mothered*)
- Helped to start CARDA and has raised numerous avalanche rescue dogs

NANCY PFEIFFER

- Founder & Director of Challenge Alaska, adaptive ski program, 1980-1985
- Owner, Director & Instructor, Hatcher Pass Ski School, 1986-1995
- Mountain Guide, Mountain Trip & Aventuras Patagonia, 1993-1997
- Alaska Pacific University Instructor, teaching semester-long course, *Snow & Avalanche Science for Professionals*, 1998-2003
- Avalanche Mountain Safety Center Instructor, 1990-2003
- National Outdoor Leadership School Instructor, 1993-2007
- Alaska Avalanche School Director, 2004-2007, and Lead Instructor, winter 2008

LYNNE WOLFE

- NPS Park Ranger, Devil's Tower National Monument, 1984
- Instructor & Course Leader, National Outdoor Leadership School, 1985-2008
- Jackson Hole Mountain Guides, 1988-2007
- Adjunct Faculty & Visiting Instructor, Prescott College, 1999-2008, teaching ski mountaineering and avalanche forecasting courses
- Co-editor & Editor, *The Avalanche Review*, a publication of the American Avalanche Association, 2002-present
- Avalanche Education Instructor, AAI, Silverton Avalanche School, Babes, etc.
- Mountain Guide, Exum Mountain Guides, summer 2007-2008

decision·making

Close Call at Castle Creek Valley

Story by Steve Jay

On January 3, 2008, I left with a group of friends from the Ashcroft trailhead just south of Aspen, Colorado, for a three-night trip to the Tagert and Green-Wilson huts up the Castle Creek drainage between Aspen and Crested Butte. Skinning to the huts under blue skies and moderate temperatures, we knew snow was in the forecast, and sure enough the next morning we had been treated to 2' of snow overnight. The next three days were spent skiing low-angle trees – the storm had socked us in, so visibility and suspected poor stability kept us below treeline. There still had not been a major avalanche cycle in Colorado, and the snowpack was getting loaded with the heavy snow.

On the morning of our planned departure, nearly 3.5' had fallen over the last three days. We were very concerned because the ski out crossed several large avalanche paths with no real safe way around them, and we knew the snowpack was active because a very large slide could be viewed from the huts. During discussion, the group determined three choices: spend another night, wait until later in the day, or try to get out as fast as possible. After weighing these options (four of us had avalanche training), it was decided to wait a while to let things settle down a bit, then split into three groups and maintain contact with hand-held radios. We skied another lap in low-angle trees to soak up more powder, then packed up at the huts, and the first group left.

The other two groups went to ski another lap with our radios on, and by the time we reached the top of the run (approximately 10 minutes) the first group radioed frantically about several slides across the road. As we skied, the first group continued to updated us about several slides, including one that covered their tracks. Everyone in each group knew to go one at a time across potential slide paths while the rest of the group waited in a safe area.

After our second run of the day, the second group left. Again, they radioed several times about the number of slides. The last of us finished cleaning and packing the cabin, and we left directly from the hut approximately 15 minutes behind the second group.

On our way out, we also noted several moderate-size slides but felt comfortable because most things had already slid. Our first shock was crossing a footbridge across Castle Creek. It looked like a bomb had gone off – a massive slide had taken out the bridge and toppled trees almost 200' up the other side of the valley. We poked around in the debris, completely blown away at the sheer size of the slide. We knew everyone was out safe because of the radios, so we just beelined it down the road as fast as we could.

At the last avalanche crossing, the Kellogg Pond Slide, we were stopped in our tracks before we could drop into the valley by the largest avalanche I had ever seen. It was probably 100- to 150-yards wide and had run summit to valley. One of the unique things about the slide was that it had hit a pond and splashed all the water out of it; the lower half of the slide was just giant, waterlogged snow chunks that were as hard as cement. With an eerie feeling, we skied across the debris and skied out to the trailhead.

At the trailhead, we asked the other two groups if they had crossed the slide that had hit the pond. Neither group had seen the slide, and we all fell silent. The avalanche had happened between the second and third groups, who were separated at most by 15 minutes. The drive out was pretty somber with all of us realizing that we had missed certain death by a matter of minutes.

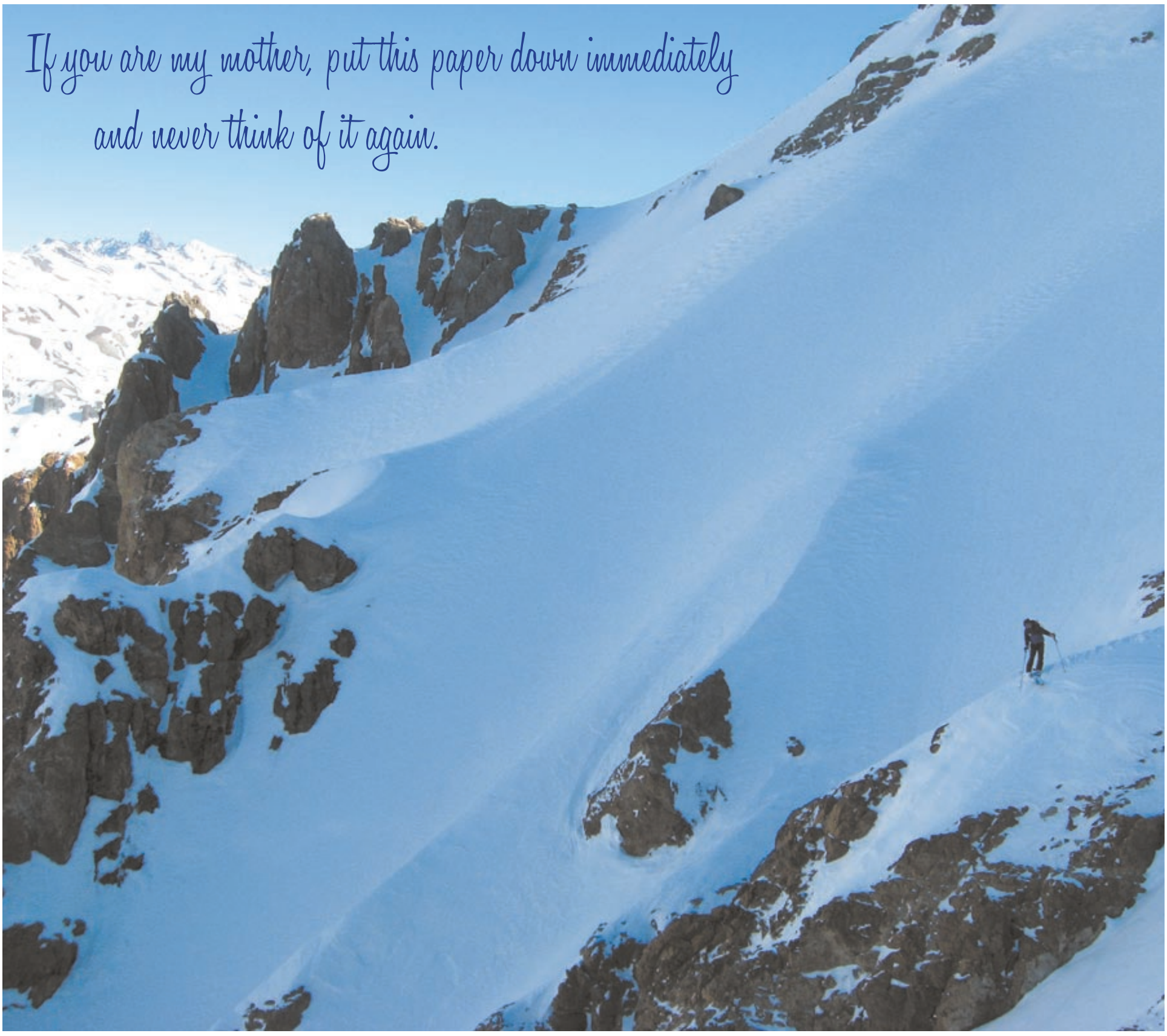
Nearly a year later I still think about that slide and the decisions that we made. I feel that we were extremely lucky, but at the same time I feel that we made the best decision we could in the circumstances. Looking back it would have been a much better to wait another night and leave the next day, but prior obligations back in civilization (several of us had to work, and I was leaving for a trip to Canada) made us throw out that choice. When making our decision we had no idea what was happening at the higher elevations with the snowpack. In the trees, the snowpack felt fairly stable, and we felt comfortable skiing. We had no weather information or avalanche information for the last four days to warn us that this was going to be such a large avalanche cycle. When we left the hut we had no clue what had slid, what was going to slide, and that those slides could be so large. We reasoned that if we waited till later in the day, everything that was primed to slide would have slid, and we would get out that evening without triggering a search (search and rescue was waiting for us at the trailhead) and make our commitments.

On the way up for a three-day hut trip, the Kellogg Pond avalanche path provided some striking scenery. *Photo by Steve Jay*

After this experience, I am much more humbled by the mountains. The damage that the avalanches had caused still amazes me, and I am more cautious about avalanches and crossing large slide paths as a result. We must always remember to respect the mountains and think through decisions with the best information available. We were all extremely lucky that day, and I hope to never test that luck again.

Steven Jay is a native of the Roaring Fork Valley in Colorado and a graduate student at Montana State University, Bozeman studying environmental science. He is an avid skier and rock climber who enjoys a cold beer, especially after near-death experiences.

Three days and 3.5' of new snow later, the area presented a dramatically different scene on the way out. The avalanche occurred during a 15-minute interval between groups traversing the area. *Photo by Charlie Noone*



Doug Krause checking out the consequences, mid-couloir, Las Leñas, Argentina. *Photo by David Dellamora*

THE LULL

continued from cover

pumped 100 pounds of explosives into a slope with help near at hand. There's a pretty wide gulf between those extremes. Professional skiing versus personal, inbounds versus backcountry, maritime versus continental, and skiing with trusted partners versus all alone…just a few of the myriad considerations that must be balanced. It's no wonder you get bonked with the scales every once in a while.

I've been pretty lucky because I bear plenty of scars from crashing over that risk threshold, but I'm still around to remember all the stupid stuff I've done and hopefully learn from it. Most of my big close calls have been mind-numbingly asinine in retrospect, and it's that fiendishly sweet complacency that keeps stabbing and tumbling me time and again.

Summer 2005 — Las Leñas, Argentina

It's bluebird; the skiing is awesome. I'm by myself working towards The Hidden Couloir, standing on a rock outcropping looking down some 3500' towards the creek at the bottom of Sans Nom. It's been a few days since the last storm, and the Las Leñas snowpack has settled out to it's signature pleasing level of stability. There are numerous tracks around the cornices sneaking into Sans Nom but I know there's just fresh pow and a private couloir where I'm going. I've been here a hundred times before and stink of confidence and control. I can see humans approaching across the plateau so it's time to go. As I slide towards the cornice I see that there's not much overhang, a lot of tracks in the area, and it looks pretty soft below. Without conscious effort and in a fraction of a second, my threshold of acceptable risk accelerates and veers towards a bit of overhang. Funny that it accelerated so fast but not fast enough. There's another fraction of a second when the cornice makes that sound and opens up, and I can see straight down 15 feet or so to the slope below. The stink of confidence is replaced with an earthier sort: elevator going down.

I twist my skis as I fall to avoid the Toyota-sized hunk of debris that is peeling away in front of me. I land perpendicular to the fall line but just can't quite get it, and then my complacency falls from the sky and pushes me head downhill onto the surface sluff that the falling Toyota debris has triggered. I twist and roll to get my skis downhill, and one of them peels off as I tweak my knee ever-so-deservedly. The lost ski surfaces next to me; I pounce on it and am able to ferry out of the flowing debris. It was a small event. If it had been a big one, I would be dead. Didn't get to ski The Hidden Couloir that day. I was carried down about 150' too low to make the approach.

Solo Backcountry Skier with Many Years of Local Experience, Victim of Cornice Fall and Ensuing Avalanche

Pretty obvious failures in judgment there – I wonder what on Earth he was thinking? Answer: I wasn't. I was in my element, and everything was going great when for a scintilla of time I stopped thinking and just tasted the moment. That's all it takes.

Just one story, for now

I've got more stories about dumber and scarier things I've done, but one is enough for now. Believe it or not I consider myself a moderately conservative backcountry skier. I like big lines, but I take them very seriously…except when I space out for a fraction of a second. I like skiing low-angle pow too and have finally got to the point where I don't have to lay waste to every inch of powder the second it hits the ground.

That threshold of acceptable risk continues to move around at a dizzying pace, and I know that just when I think I've got a handle on all the variables, one of them is most likely to sucker-punch me. There's room on my body for more scars, but I'm not so into the Frankenstein look. The consequences lurking in the middle of the couloir may take hold of me someday. They have lightning reflexes and sense complacency like a hungry shark smells blood in the water. I'm not going to stop taking risks, so I just have to learn how to maintain perfect vigilance for every quantum of exposure time. I've heard of zen – how hard could that be?

Wind's picking up again with some flakes in the air. The lull must be over.

Doug Krause is a backcountry skier, lead guide for South America Ski, and the snow safety director at Silverton Mountain ski area in southwest Colorado.

snow science

Avalanches are part of life in the mountains, an integral piece of the winter cycle. Anytime snow and steep slopes are combined, avalanche potential results. If you wish to travel through backcountry terrain that is exposed to avalanches, you must accept that you are taking a risk. You need to understand these risks before taking them, and the information included here will help give you a better sense of the type of trip you are planning.

Traditional models for rating avalanche danger are based on the stability of snow, which changes regularly with the weather – from day to day, or even hour to hour. Terrain however, doesn't change with the weather. The angle and shape of the ground, or the number of established avalanche paths won't vary from day to day. By using the Avalanche Terrain Exposure Scale (ATES), you can begin to measure your skills, experience and risk tolerance against the landscapes through which you choose to travel.

AVALANCHE TERRAIN RATINGS AND AVALANCHE BULLETINS MUST BE USED TOGETHER FOR EVALUATING HAZARDS AND MANAGING PERSONAL RISK IN THE BACKCOUNTRY.

Parks Canada Parcs Canada

Canada

Do I still need to read to the avalanche bulletin every day?

Absolutely - terrain is only part of the picture. When the avalanche advisory is rated "Poor", you should select very conservative terrain. Alternatively, when the avalanche advisory is rated 'Good', this might be the time to consider that next level of terrain you have been contemplating. The two must be used together for understanding the big picture of how to manage your risk in the backcountry. Backcountry Avalanche Advisories are provided by the media, and avalanche bulletins are available at Park Information Centres, **1 800 667 1105** , or on the web at: **www.avalanche.ca**

When should I use this system?

These ratings are intended to supplement pre-trip planning material. This means reading guidebooks, studying maps and photos, talking to friends, checking weather and avalanche conditions, and referring to the ATES ratings while planning the trip. All of these resources together will give you a better sense of the route you are choosing.

How do I use the scale?

The list of rated trips represents the most common destinations in the Mountain National Parks. Don't use this scale alone – you'll need additional material to learn about the trip you are proposing. The following guidebooks are recommended:

1. *Summits & Icefields, Columbia Mountains* – by Chic Scott
2. *Summits & Icefields, Canadian Rockies* – by Chic Scott
3. *Ski Trails in the Canadian Rockies* – by Chic Scott
4. *Ski Touring in Rogers Pass* – by J.P. Kors and John Kelly

These publications are widely available at local mountain specialty stores. For further information on specific trips visit any Parks Canada Information Centre in the Mountain National Parks – or check with a local professional guide service.

How much experience do I need for these trips?

Simple(Class 1) terrain requires common sense, proper equipment, first aid skills, and the discipline to respect avalanche warnings. Simple terrain is usually low avalanche risk, ideal for novices gaining backcountry experience. These trips may not be entirely free from avalanche hazards, and on days when the Backcountry Avalanche Advisory is rated 'Poor', you may want to re-think any backcountry travel that has exposure to avalanches – stick to groomed x-country trails or within the boundaries of a ski resort.

Challenging (Class 2) terrain requires skills to recognize and avoid avalanche prone terrain – big slopes exist on these trips. You must also know how to understand the Public Avalanche Bulletin, perform avalanche self rescue, basic first aid, and be confident in your routefinding skills. You should take a Recreational Avalanche Course (RAC) prior to traveling in this type of terrain. If you are unsure of your own, or your group's ability to navigate through avalanche terrain - consider hiring a professional, ACMG certified guide.

Complex (Class 3) terrain demands a strong group with years of critical decision making experience in avalanche terrain. There can be no safe options on these trips, forcing exposure to big slopes. A recommended minimum is that you or someone in your group should have taken an Advanced Recreational Avalanche Course (ARAC) and have several years of backcountry experience. Be prepared! Check the Public Avalanche Bulletin regularly, and ensure everyone in your group is up for the task and aware of the risk. This is serious country - not a place to consider unless you're confident in the skills of your group. If you are uncertain - consider hiring a professional, ACMG certified guide.

Disclaimer

There are inherent risks in backcountry travel, and most of the routes described here will at times be unsafe due to potential snow avalanches. The Parks Canada Agency has done its best to provide accurate information and to describe the terrain characteristics typical of each general region. However, it is up to the users of this information to learn the necessary skills for safe backcountry travel, access additional trip planning materials, and to exercise caution while traveling through the backcountry in any national park.

Users of this information do so entirely at their own risk, and the Parks Canada Agency disclaims any liability for injury, injury resulting in death or damage to anyone undertaking a trip into any of the regions described. This information is no substitute for experience and good judgment.

Avalanche Terrain Exposure Scale (ATES) v.1/04

Description	Class	Terrain Criteria
Simple	**1**	Exposure to low angle or primarily forested terrain. Some forest openings may involve the runout zones of infrequent avalanches. Many options to reduce or eliminate exposure. No glacier travel.
Challenging	**2**	Exposure to well defined avalanche paths, starting zones or terrain traps; options exist to reduce or eliminate exposure with careful routefinding. Glacier travel is straightforward but crevasse hazards may exist.
Complex	**3**	Exposure to multiple overlapping avalanche paths or large expanses of steep, open terrain; multiple avalanche starting zones and terrain traps below; minimal options to reduce exposure. Complicated glacier travel with extensive crevasse bands or icefalls.

SIMPLE – CLASS 1

Banff National Park
Baker Creek
Baker Creek Powerline
Bath Creek -7 km from Hwy 1
Bow Riverside Loop
Bryant Creek Trail
Cascade Fire Road
Cave and Basin Trails
Fairview Loop
Glacier Lake
Great Divide Trail
Johnstons Creek to the Inkpots
Lake Louise shoreline trail
Merlin Valley from Skoki
Moraine Lake Road trackset
Natural Bridge from Skoki
Old Healy Creek Road/Sundance Lodge
Pipestone Trails
Redearth Creek to Shadow Lake Lodge
Skoki via Boulder and Deception Passes
Skoki via Pipestone River
Spray River Trail
Sulphur Mt. Backside Road
Sulphur Mt. Trail under gondola
Sundance Pass
Taylor Lake Trail
Telemark Trail
Tower Lake
Tramline Trail
Twin Lakes from Hwy 1
Upper Lk Louise Nordic Trails

Jasper National Park
Athabasca Falls Loop
Athabasca Falls/Meeting of the Waters
Bald Hills Lookout Trail
Cabin Lake Fire Road
Edith Cavell Road to the hostel
Maligne Lake Trails
Marjorie and Caledonia Lake
Mina Lake Loop
Moab Lake
Palisade Lookout
Patricia Lake loop
Poboktan Creek
Pyramid Bench Loop
Shangri-La to Snowbowl only
Stutfield Creek (valley flats only)
Summit Lakes/Jacques Lake
Sunwapta Falls/Athabasca River
Valley of the Five Lakes/Wabasso Lakes
Whistler Campground Loop

Kootenay National Park
Chickadee Valley (valley bottom only)
Dog Lake
Dolly Varden
East Kootenay
Hector Gorge
Simpson River (to KNP boundary)
West Kootenay

Yoho National Park
Chancellor Peak Campground
Emerald Lake designated Nordic trails
Field to Emerald Lake Nordic trail
Ice River Fire Road
Kicking Horse trail
Lake O'Hara Circuit (avoid the north shoreline)
Lake O'Hara Road to EP Hut
Morning Glory Lakes
Ross Lake Circuit
Sherbrooke Lake (to lake only)
Wapta Falls
Yoho Valley Road trackset

Glacier National Park
Beaver River
Rogers Pass Ski Hill (forest cuts behind hotel)
Wheeler Hut approach and vicinity

Mt. Revelstoke National Park
2km & 5km Loop trails
Inspiration in the Woods
Lindmark trail to Parkway Intersection
Meadows in the Sky Parkway
Summit Trail to 8 Mile Crossing

Waterton Lakes National Park
Akamina Pass
Akamina Pass to Forum Lake
Bear's Hump
Cameron Lake trail to lake only
Crandel Lake
Dipper
Wishbone

CHALLENGING – CLASS 2

Banff National Park
Boom Lake
Bow hut to Balfour hut via Nic/Olive col
Bow Summit area
Castlegard Mt.
Cirque Peak
Crowfoot Pass
Diablaret glacier
Egypt Lake via Healy Pass
Elk Lake Summit
Forty Mile Creek
Fossil Mountain loop
Gibbon Pass
Haiduk Lake via Shadow Lake
Hidden Bowl region
Hilda Ridge
Katherine/Helen Lake circuit
Lake Louise resort backcountry accessed from ski area
Mosquito Creek to Molar Meadows
Mt. Gordon (YNP)
Mt. Olive
Mt. Rhonda S from huts
Mt. Thompson
Observation Subpeaks
Packers Pass
Paradise Valley
Parker Ridge
Peyto hut to Bow hut
Saskatchewan glacier
Skoki Mountain loop
Sunshine to Healy Creek
Sunshine Village backcountry accessed from ski area

Jasper National Park
Amethyst Lakes/Moat Lake
Athabasca Glacier to first icefall
Bald Hills area
Fraser Glacier
Fryatt Creek
Little Shovel Pass
Maligne Pass
Marmot Basin backcountry accessed from ski area
Shangri-La past Snowbowl
Skyline Trail
The Brazeau Icefield
Tonquin Valley via Astoria River
Tonquin Valley via Maccarib Pass
Whistlers Creek
Wilcox Pass

Yoho National Park
Amiskwi Fire Road
Kiwetinok Pass
McArthur Pass
Odaray Plateau
Opabin Plateau
Ottertail Valley Fire Road

Glacier National Park
Avalanche Crest - to treeline
Cheops Glades
Flat Creek
Grizzly Shoulder
Hermit Meadows
McGill Shoulder
Sifton Col
The Hourglass

Mt. Revelstoke National Park
Balsam Lake to Eva & Miller Lakes
Balsam Lake to Mt Revelstoke Summit
Lindmark Trail above Parkway Intersection
Summit Trail above 8 Mile Crossing
Woolsey Creek Road

Waterton Lakes National Park
Akamina Pass to Wall Lake
Bertha Lake
Forum Ridge
Lakeshore
Summit Knob to Cameron Lake
Summit Lake

COMPLEX-CLASS 3

Banff National Park
Balfour to Scott Duncan Huts
Ball Pass
Bath Glacier exit to Hwy 1
Bonnet Icefield
Bow Hut approach
Castle Mt. - to summit
Cirrus Mountain
Crowfoot Mt.
Dolomite Peak Circuit
Drummond Icefield
Hector Lake Wapta access
Mike Wynn Circuit
Mistaya Mt.
Mt. Baker
Mt. Balfour
Mt. Coleman
Mt. Fairview
Mt. Hector
Mt. Jimmy Junior
Mt. Jimmy Simpson
Mt. Niblock via Divide Creek
Mt. Patterson
Mt. Rhonda N
Mt. Wilson
Mystic Pass
Observation Peak (summit)
Oyster Lake
Pat Sheehan Traverse
Peyto Glacier approach
Plain of Six Glaciers trail
Ptarmigan Peak
Pumpkin Traverse
Surprise Pass
White Pyramid

Jasper National Park
Athabasca Glacier past first icefall
Diadem Creek
Mt. Columbia
Mt. Kitchener
North Twin
Snow Dome
South Twin
Stutfield Peak

Kootenay National Park
Chickadee Valley - above valley bottom
Stanley Glacier Valley
Storm Mt.
Tokkum Creek

Yoho National Park
Cathedral Mt.
Emerald Pass
Emerald Peak/Slide Path
Isolated Col
Little Yoho Valley approach
Mt. Collie
Mt. Des Poilus
Mt. Field
Mt. McArthur
Opabin/ Wenkchemna circuit
Popes Peak
President Pass
Schaefer Basin
Scheisser/Lomas route
Sherbrook Lake Wapta access
Yoho Traverse

Glacier National Park
8812 Bowl
Asulkan Hut/Tree Triangle
Asulkan Pass
Asulkan Valley Practice Slopes
Avalanche Crest Bowl and Slidepath
Balu Pass
Bonney Glacier
Bruins Pass
Dome Glacier
Glacier Circle
Grizzly /Little Sifton Traverse
Illecillewaet Practice Slopes
Illecillewaet Neve access
Lily Glacier
Lizards Tail
Lookout Col
McGill Bowl - McGill Pass
Mt. Rogers
Mt. Swanzy
Mt. Tupper Traverse
NRC Gullies
Perley Rock
Sapphire Col
Steps of Paradise – Youngs Pk
Terminal Peak
The Cone
The Mouse Trap
The Ravens
Ursus Major
Ursus Trees
Vaux Moraines/Sir Donald/Uto Col
Video Peak
Youngs Pk via Illecillewaet

Mt Revelstoke National Park
Hamilton Creek Upper Meadows
Clachnacudain Creek
Clachnacudain Creek East Fork
Saint Syr Creek
Coursier Creek
Woolsey Glacier-Coursier Peak
Clachnacudain Glacier-Inverness Peaks
Mount Klotz above treeline
West Woolsey Creek
Maunder Creek

Waterton Lakes National Park
Rowe Lake
Lineham Lake
Alderson-Carthew

Catalogue No: R62-369/2005E
ISBN: 0-662-42089-6

This Parks Canada brochure communicates the avalanche terrain ratings for backcountry touring in Canada's National Parks. The brochure outlines the Avalanche Terrain Exposure Scale (top) for park visitors, and the interior panels (bottom) list the ski tours in western Canada's national parks and organize them by terrain rating. A similar brochure outlines avalanche hazard for ice climbing routes and ranks them according to the ATES.

ATES Terrain Type	Custodial Group Policy
Class 1 - Simple	Custodial groups may travel with no specific leadership or custodial permitting requirements. Parks Canada recommends that custodial groups avoid backcountry travel entirely during Backcountry Avalanche Advisories of POOR.
Class 2 - Challenging	An ACMG certified guide must lead all custodial groups. Group size must not exceed 10. Travel on avalanche terrain only when the guide rates the slope specific snow stability as GOOD or VERY GOOD.
Class 3 - Complex	Custodial groups are not permitted in complex terrain under any conditions.

Parks Canada's custodial group policy based on ATES.

ATES: The Avalanche Terrain Exposure Scale

Story by Grant Statham

The following article was provided in early December as an email, responding to the editor's request for information about the Avalanche Terrain Exposure Scale.

I wanted to get back to you in response to your questions about the Avalanche Terrain Exposure Scale now that it has been used in Canada for a few years. Following your questions, here are a few of my perspectives:

Overall I would say the ATES has been a very effective tool, and judging by the speed with which it has been accepted by the community (pros and public), it clearly filled a void. Its initial purpose was to provide National Park visitors with simple and clear information regarding the seriousness of the avalanche terrain on the various popular backcountry trips in the parks. The public communication piece of the system has fulfilled this goal completely.

Introducing the ATES brought on a whole bunch of other unforeseen applications, most of which I think have been positive. While we initially thought the technical model would be reserved for professionals who were trying to "classify" specific trips, we soon realized an even greater educational value of providing a structured breakdown of avalanche terrain. Providing people with a structured method to analyze and learn about avalanche terrain has really helped with education. In this context, the actual "rating" doesn't even really matter – what matters is the clarity achieved through the details inside the rating about slope angle, shape, runouts, forest density, etc. People are finding real value here; they can be prompted for what they should be looking for. Eventually people grow out of using a system like this, but it gives a great head start when learning about what to look for.

I have tried to apply the ATES to specific terrain features, and it does not work at this small scale. It was designed for "trips," and so works well when used in this manner. Probably the biggest drawback of the system that I can see is that our current classifications are at rather large scales (drainages), which limits their practical value to an experienced user. A better (and future) application of these ratings would be at the smaller scales (runs), just the same as an avalanche bulletin improves when applied at smaller spatial scales.

Another key point in publishing actual terrain ratings is to provide an easy link to more information. You aren't doing anyone a favour by simply saying the trip is Class 2, you need to link them to guidebooks and maps where they can do further research and learn the important details. Use of the ATES in guidebooks or on maps is a natural future direction, and it's already used in several ski touring guidebooks in Canada.

It is also been very important that we apply the system uniformly across regions. It's a mistake to "tweak" the ATES to fit someone's specific local needs and I strongly encourage anyone who uses this system to not make their own individual changes to it – there is huge value in consistency between regions and despite what some may think, the parameters of avalanche terrain are not really that different between regions.

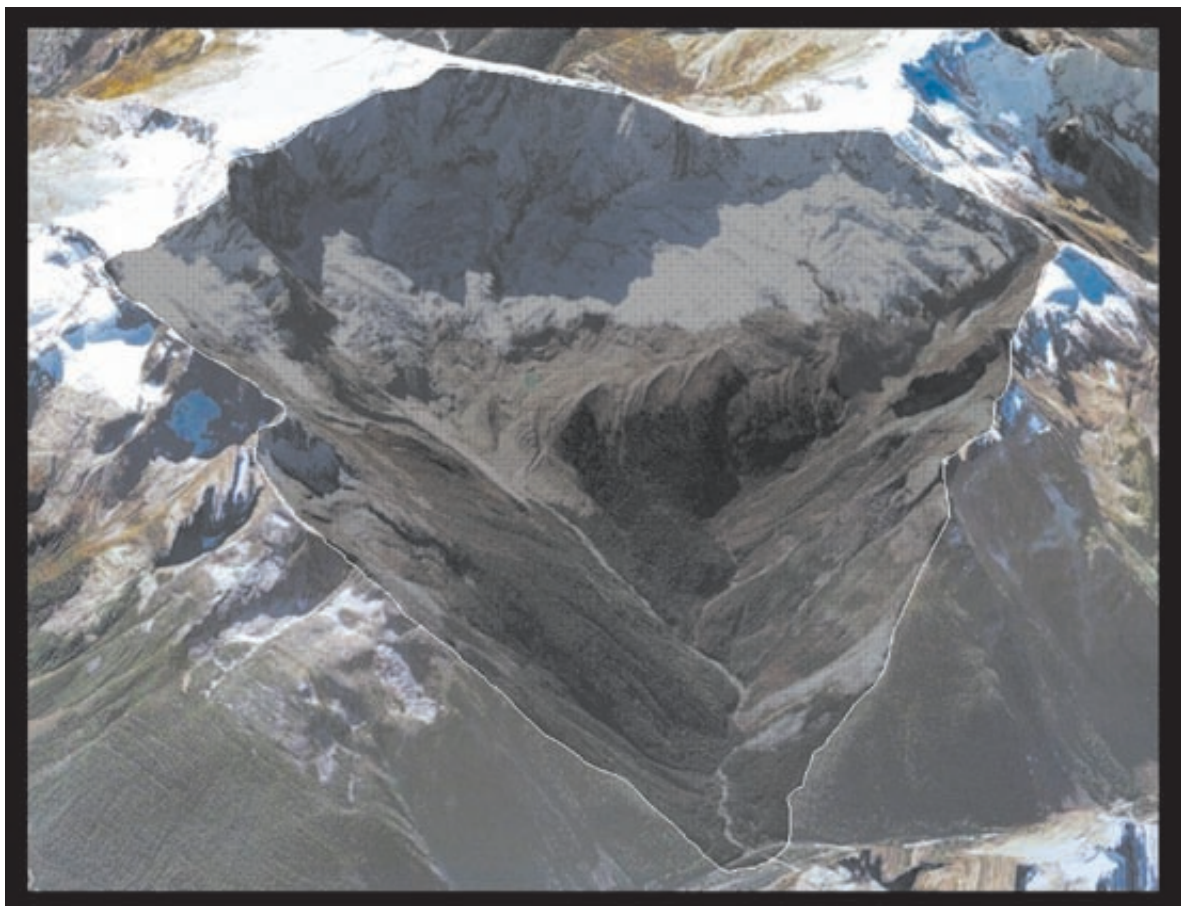
Lastly, we also learned an awful lot about communication with this system. Public forecasters live in the divided world of technical details and public communication, where the two are not often compatible. Designing a method for analyzing terrain in a technical fashion, and then communicating that analysis to the public using simple and clear language has been a good development. To be able to articulate the same thing in two different languages is an essential skill in public avalanche warning.

I look forward to hearing a few other perspectives on this from south of the 49th.

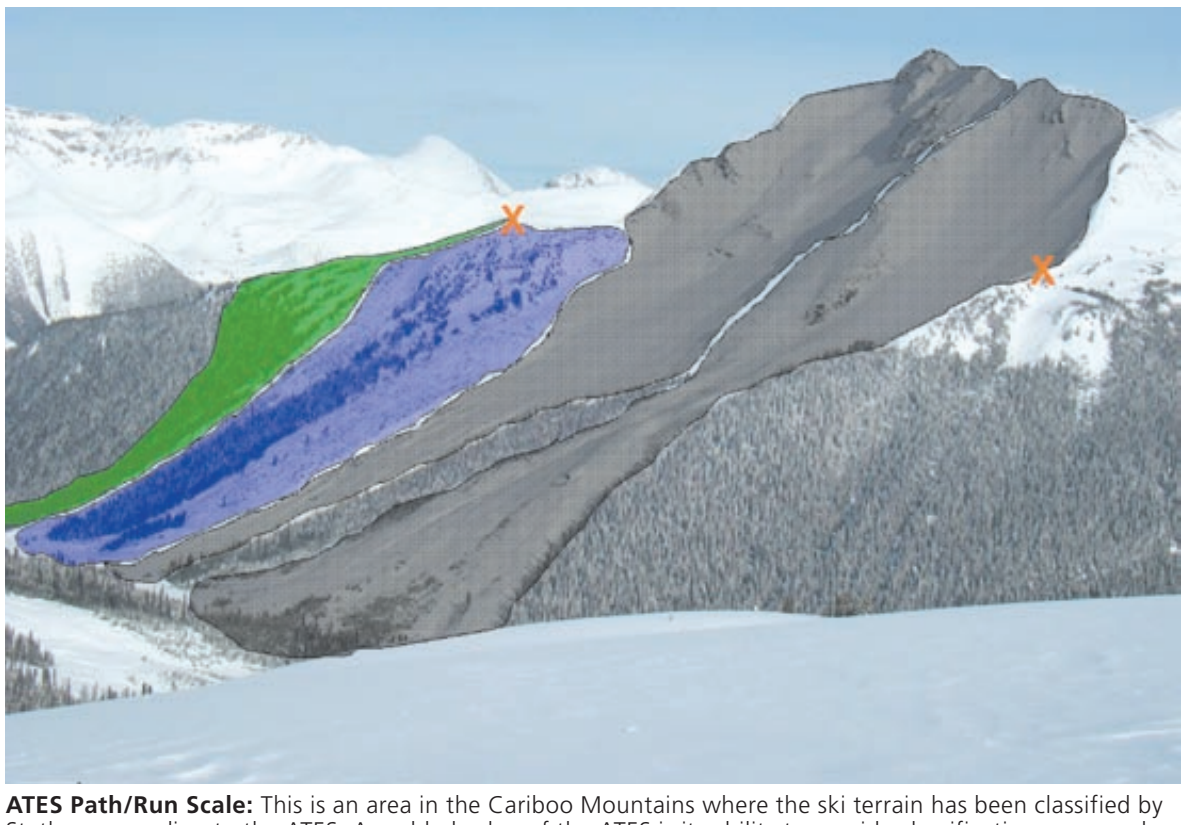
Grant Statham is Parks Canada's Mountain Risk Specialist and an IFMGA Mountain Guide. He is based from Banff, Alberta, where he works on Parks Canada's mountain safety programs and policy development.

	1 – Simple	2 - Challenging	3 - Complex
Slope angle	Angles generally < 30º	***Mostly low angle, isolated slopes >35º***	***Variable with large % >35º***
Slope shape	Uniform	Some convexities	Convoluted
Forest density	Primarily treed with some forest openings	Mixed trees and open terrain	Large expanses of open terrain. Isolated tree bands
Terrain traps	Minimal, some creek slopes or cutbanks	Some depressions, gullies and/or overhead avalanche terrain	***Many depressions, gullies, cliffs, hidden slopes above gullies, cornices***
Avalanche frequency (events:years)	1:30 ≥ size 2	1:1 for < size 2 ***1:3 for ≥ size 2***	1:1 < size 3 ***1:1 ≥ size 3***
Start zone density	Limited open terrain	Some open terrain. Isolated avalanche paths leading to valley bottom	Large expanses of open terrain. Multiple avalanche paths leading to valley bottom
Runout zone characteristics	Solitary, well defined areas, smooth transitions, spread deposits	Abrupt transitions or depressions with deep deposits	Multiple converging runout zones, confined deposition area, steep tracks overhead
Interaction with avalanche paths	Runout zones only	Single path or paths with separation	***Numerous and overlapping paths***
Route options	Numerous, terrain allows multiple choices	A selection of choices of varying exposure, options to avoid avalanche paths	***Limited chances to reduce exposure, avoidance not possible***
Exposure time	None, or limited exposure crossing runouts only	***Isolated exposure to start zones and tracks***	***Frequent exposure to start zones and tracks***
Glaciation	None	***Generally smooth with isolated bands of crevasses***	***Broken or steep sections of crevasses, icefalls or serac exposure***

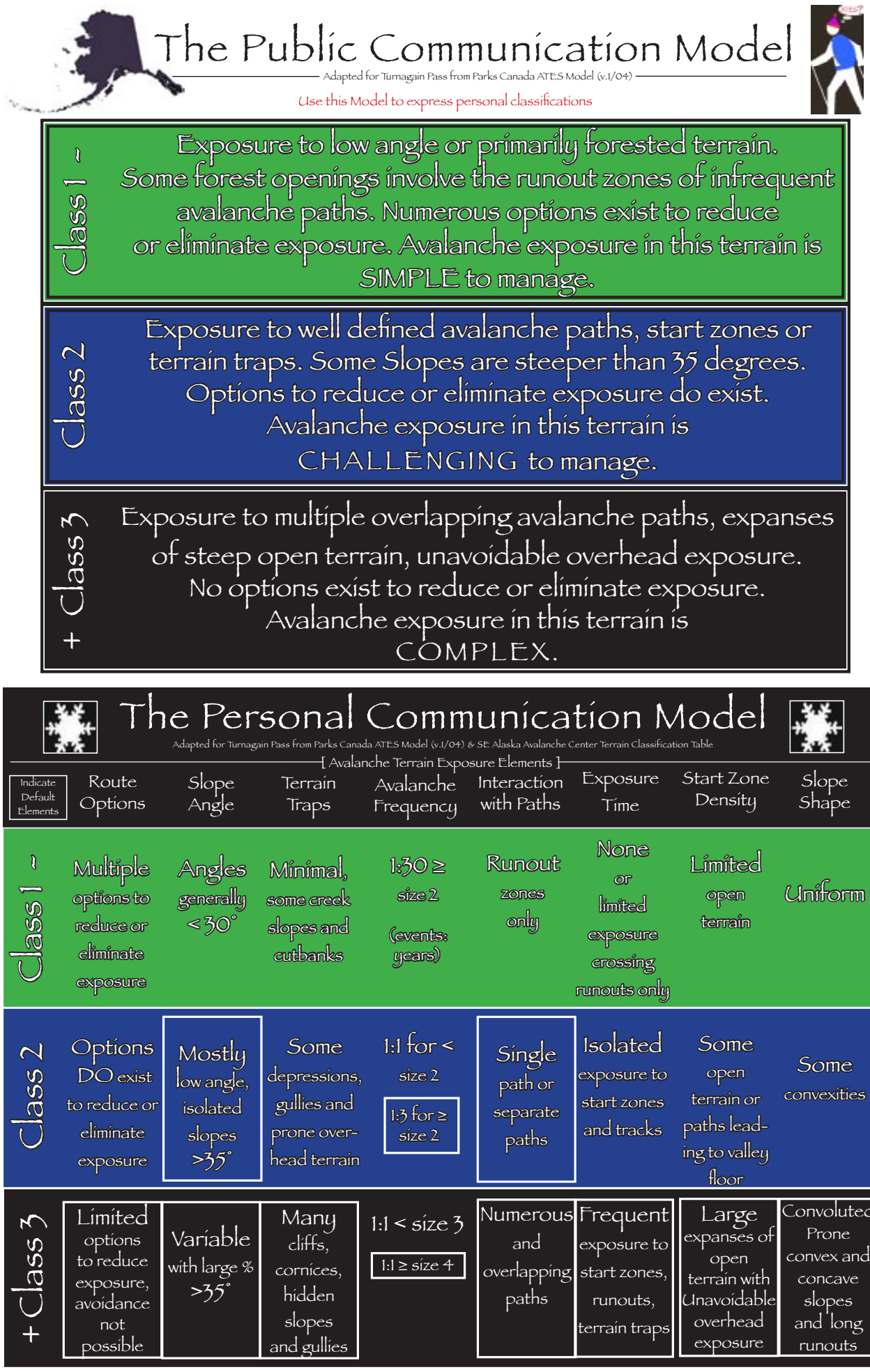
ATES Technical Model



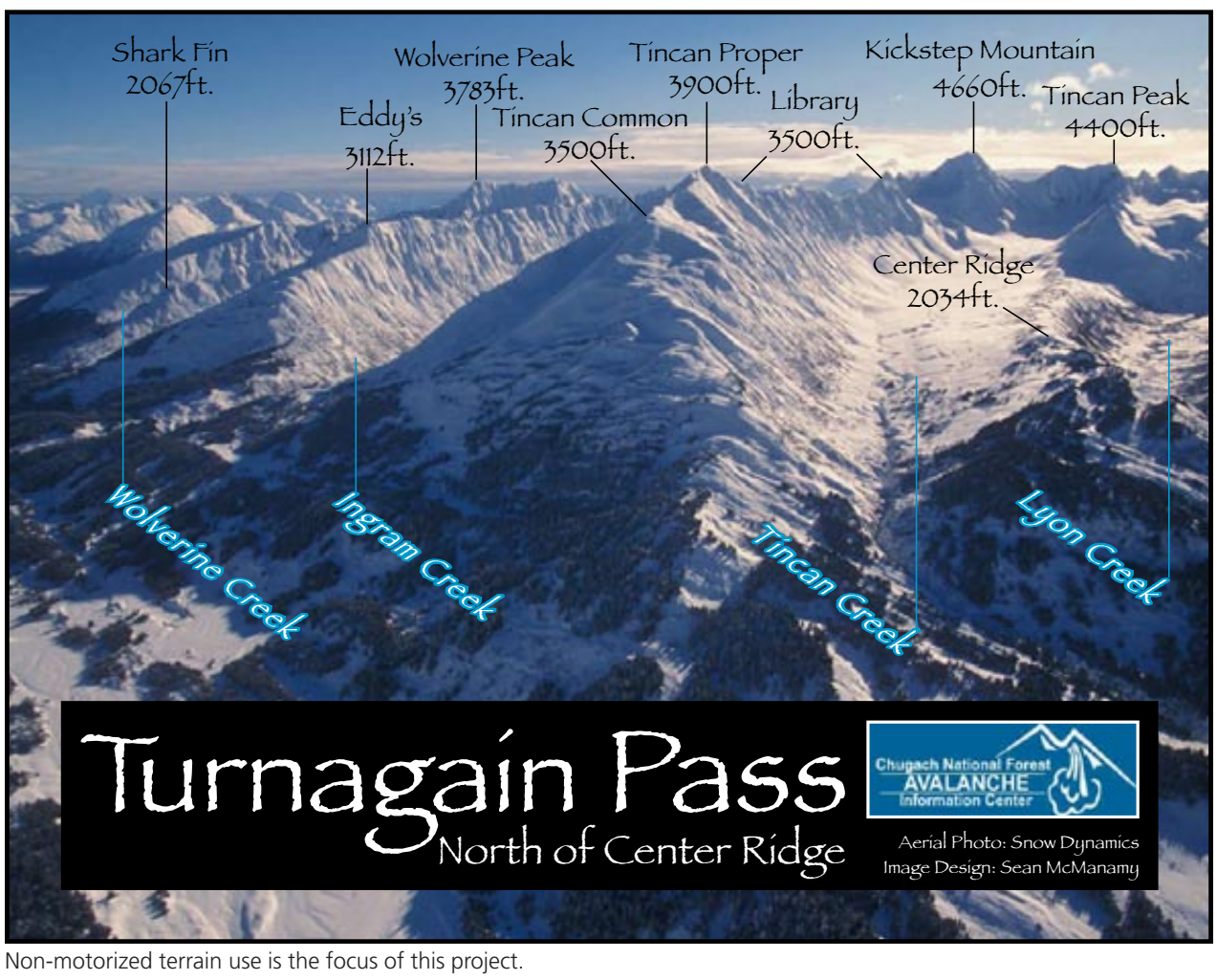
ATES Drainage Scale: This is Loop Brook in Glacier National Park. Current terrain classifications are done on the drainage scale, which means that all of Loop Brook becomes classified as Complex Terrain. A smaller scale resolution would provide a more accurate representation of the terrain.



ATES Path/Run Scale: This is an area in the Cariboo Mountains where the ski terrain has been classified by Statham according to the ATES. An added value of the ATES is its ability to provide classifications on a scale that is useful for helping with people's more specific terrain choices.



The Turnagain Pass Hazard Communication Models: The personal model becomes the intellectual property of its users.



Non-motorized terrain use is the focus of this project.

ATES and Turnagain Glisse

Story by Sean McManamy

Glisse is adapted from the mountaineering term glissade and the French verb *glisser*. It is meant to encompass every method of controlled downhill sliding on a metal-edged board. Last year on Sunburst, my party and I allowed intricate reasoning to justify skiing a slope too steep for conditions. Had our party stuck to terrain-based decisions, that mountainside would not have slid on top of us. *(watch for further analysis of this accident in TAR 27/4)*

Voluntary exposure to avalanche hazard is inherent to avalanche-terrain use. The Canadian Avalanche Terrain Exposure Scale (ATES) classifies terrain for avalanche education and hazard mitigation. The scale's effectiveness is rooted in simplicity – using numbers and colors it communicates a party's degree of exposure in a user-friendly format. It empowers users to assess the exposure they volunteer and the significance of options to reduce it. The ATES offers a systematic approach to managing exposure with concise discourse. It provides a universal concept relevant in south-central Alaska and specifically Turnagain Pass: manage your terrain exposure first.

Avalanche-terrain users make decisions based on experience. Users with less experience travel in terrain varying in exposure and weight heavily on professional input. Advanced users spend more time in complex terrain and base decisions more on personal assessment.

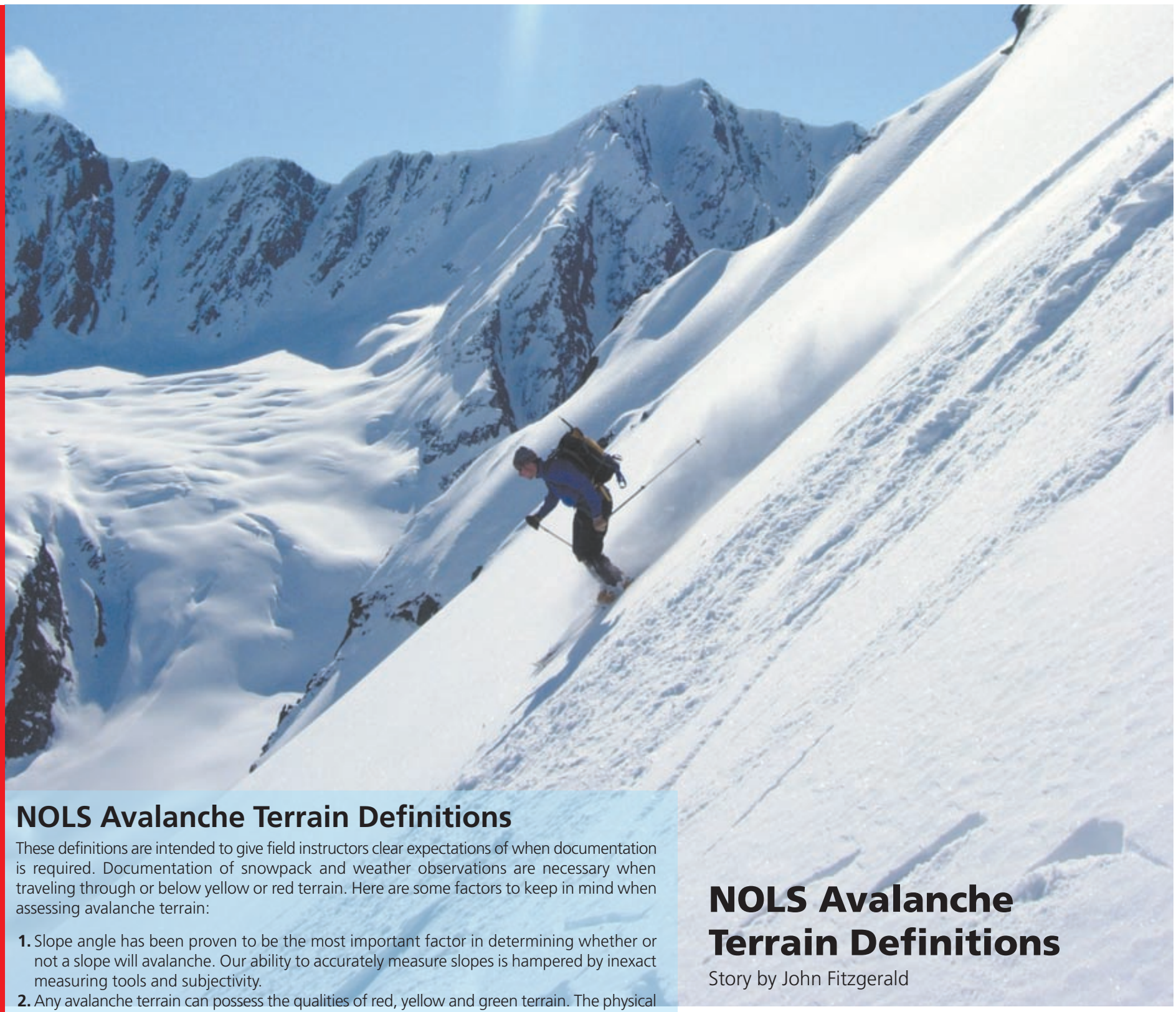
This pilot curriculum, *Turnagain Glisse: Information for Avalanche Terrain Use*, offers specialized materials to an active community in a region of high consequence. Originally, my intent was to change ATES text descriptors and its colors from the ski area scheme green, blue, and black to the oh-so-American stoplight green, yellow, and red. The priority was to map and classify popular glisse areas. Limitations to this application ranged from a lack of motorized use and knowledge, to limited agency participation.

Now the focus is on dropping the Parks Canada ATES Custodial Group Policy, (government involvement clashes with the Last Frontier mindset) and morphing the Technical Model into the Personal Communication Model. Doing so makes terrain classifications the intellectual property of its user. The challenge to this application is fine-tuning these models to be more effective for users who spend their time on either end of the scale. The Southeast Alaska Avalanche Center addresses this issue with the Terrain Classification Table. Their table adds a zero and ± principles to the matrix. It relates clearly to its local avalanche terrain. In this context, the scale is an effective education tool for the level-one student. As the matrix evolves, terrain-based decisions move to the forefront of avalanche education, uniting a multitude of different disciplines.

While minor ATES change is inevitable, continuity in North American dialogue takes precedence. In Canada, the ATES provides pertinent long-term information. Locally it is the backbone of efficient education tools.

I acknowledge all lovers of glisse but especially, Sean Brennan, Grant Statham, Alaska Avalanche Specialists, Brad Cosgrove, and Caitlin Hague.

Sean McManamy lives on the Turnagain Arm in Hope, Alaska. He summers on Denali as a guide for Mountain Trip and works in the winter as adjunct faculty at Alaska Pacific University. His passion is free-heel-ski-raft-aineering. Photo at right by Sam Piper.



NOLS Avalanche Terrain Definitions

Story by John Fitzgerald

The NOLS winter program has used terrain definitions for over a decade to help give our instructors clear guidelines for documenting observations in the field. In order to back up decisions, we require that our instructors not only use as much useful information as possible, but also have "proof" of their decisions in the form of stability roses and snow profiles. The initial definitions drew much of their text and information from *Snow Sense*, with specific input from Doug Fesler, Ian McCammon, and others. Two years ago, at the request of many of our current and former instructors, I updated our definitions with the goal of accurately reflecting 1) objective terrain factors and 2) mirroring the realities/limitations of how we assess these objective factors through our (faulty) human senses.

In my research at the time, I didn't come across any other organizations that defined terrain other than Parks Canada. I am thankful to Grant Statham for his thoughts and input. Our current definitions are adapted from the very thorough ATES technical model. They also exist as a living document and are designed to adapt and change, as people much smarter than I often have great ideas for altering them.

The key difference between our definitions and the ATES is the application in the field. We have our definitions in place for a professional audience and those definitions apply to terrain on a smaller scale (any given piece of terrain can have qualities of all three levels), rather than giving entire routes one rating.

The secondary difference is that we have our definitions in place to create clear guidelines for our field staff as to when they are required to document snow, weather, and avalanche observations.

One of our main goals in educating our students (and instructors) is heightening awareness of important terrain factors as both sets of travelers develop their assessment skills, rather than simply "pigeon-holing" a particular slope into one color rating. By having clear guidelines we can start folks out with a simple tool from which they can develop their judgment. Slope angle and the corresponding levels likely appear conservative to many practitioners out there. This is done intentionally and is meant to push our instructors to be thorough in their assessment, evaluation, and documentation.

John Fitzgerald (in photo, above) is a long-time winter program supervisor for NOLS. He lives in Teton Valley, Idaho, where he can often be found on the Glory bootpack.

NOLS Avalanche Terrain Definitions

These definitions are intended to give field instructors clear expectations of when documentation is required. Documentation of snowpack and weather observations are necessary when traveling through or below yellow or red terrain. Here are some factors to keep in mind when assessing avalanche terrain:

1. Slope angle has been proven to be the most important factor in determining whether or not a slope will avalanche. Our ability to accurately measure slopes is hampered by inexact measuring tools and subjectivity.
2. Any avalanche terrain can possess the qualities of red, yellow and green terrain. The physical line between these levels of terrain can be centimeters.
3. Decisions in avalanche terrain must incorporate information about snowpack, weather, terrain, and human factors. Terrain alone should not influence decisions.
4. Terrain assessment is a skill to be developed over time. These simple rules for assessing terrain are to be used in conjunction with (and are not a replacement for) experience and judgment.

TERRAIN DEFINITIONS

GREEN terrain may contain some or all of these characteristics:

- Slope <25 degrees
- No obvious vegetation clues of past activity
- Uniform slopes void of terrain traps
- Dense forestation
- No identifiable starting zone(s)
- Numerous route options with no exposure to steeper terrain
- Smooth transitions into runout zones

YELLOW terrain may contain some or all of these characteristics:

- Slope 25-35 degrees
- Limited vegetation clues of past activity
- Some convoluted slope shapes with obvious, but avoidable terrain traps
- Limited open areas, limited forestation
- Limited starting zone(s), limited exposure to wind loading
- Route options with limited exposure to steeper terrain
- Limited abrupt transitions and/or depressions into runout zones

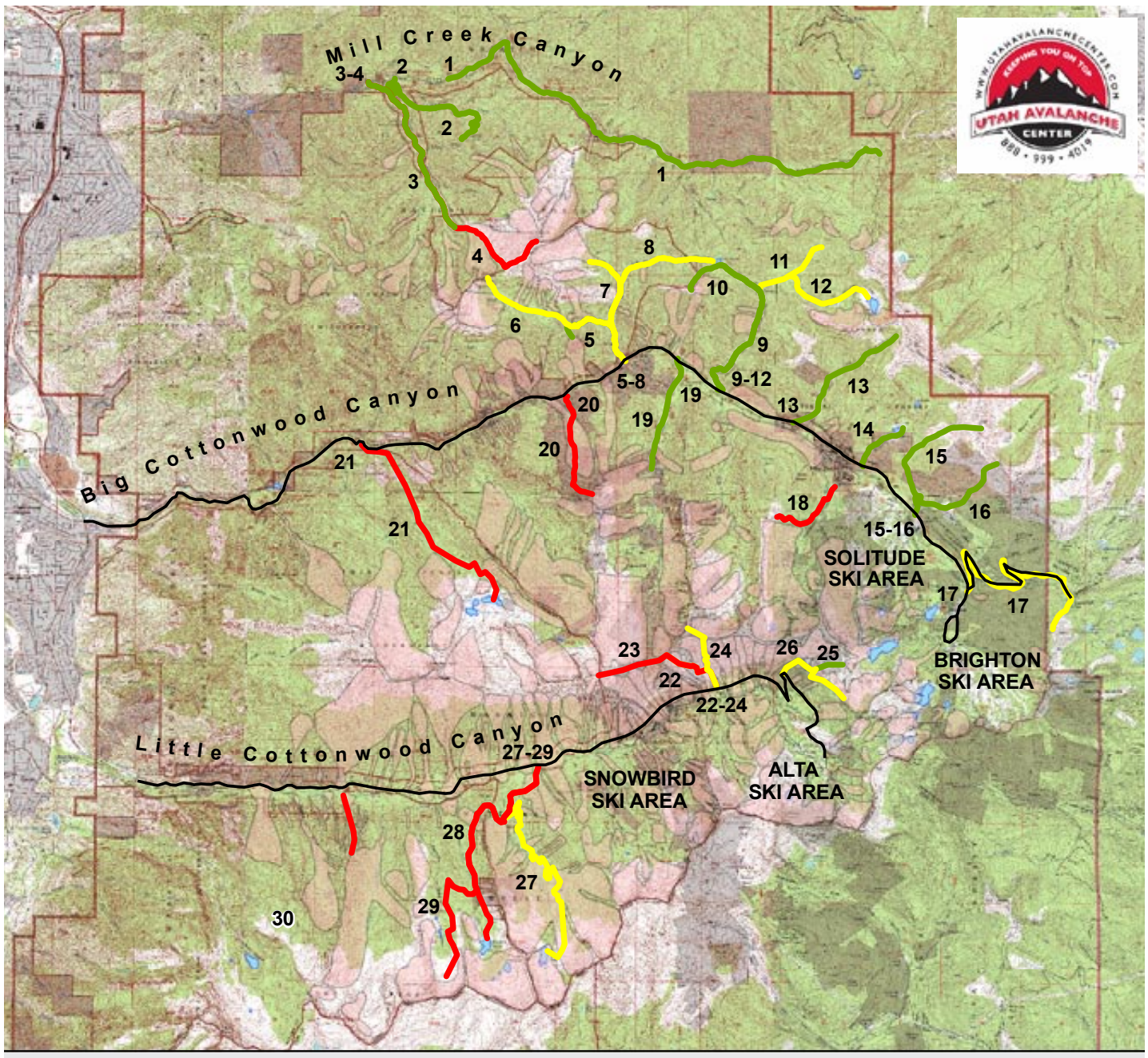
RED terrain may contain some or all of the characteristics:

- Slope >30 degrees
- Obvious vegetation clues of past activity
- Convoluted slope shapes with obvious significant terrain traps that are difficult to avoid
- Open areas and multiple paths converging
- Open starting zone(s), prone to wind loading
- Little or no route options, extended exposure to steeper terrain
- Abrupt transitions into runout zones

SNOWPACK DOCUMENTATION EXPECTATIONS

NOLS will supply each instructor with a field notebook for recording snow and weather observations. Instructors are expected to document one full pit during the first few days of the course to establish a baseline understanding of the local snowpack. As noted above, instructors are expected to document snow and weather observations in a stability rose whenever entering yellow- or red-light terrain. Daily weather observations must be recorded in the course log or field book.

Selected Touring Routes in the Central Wasatch

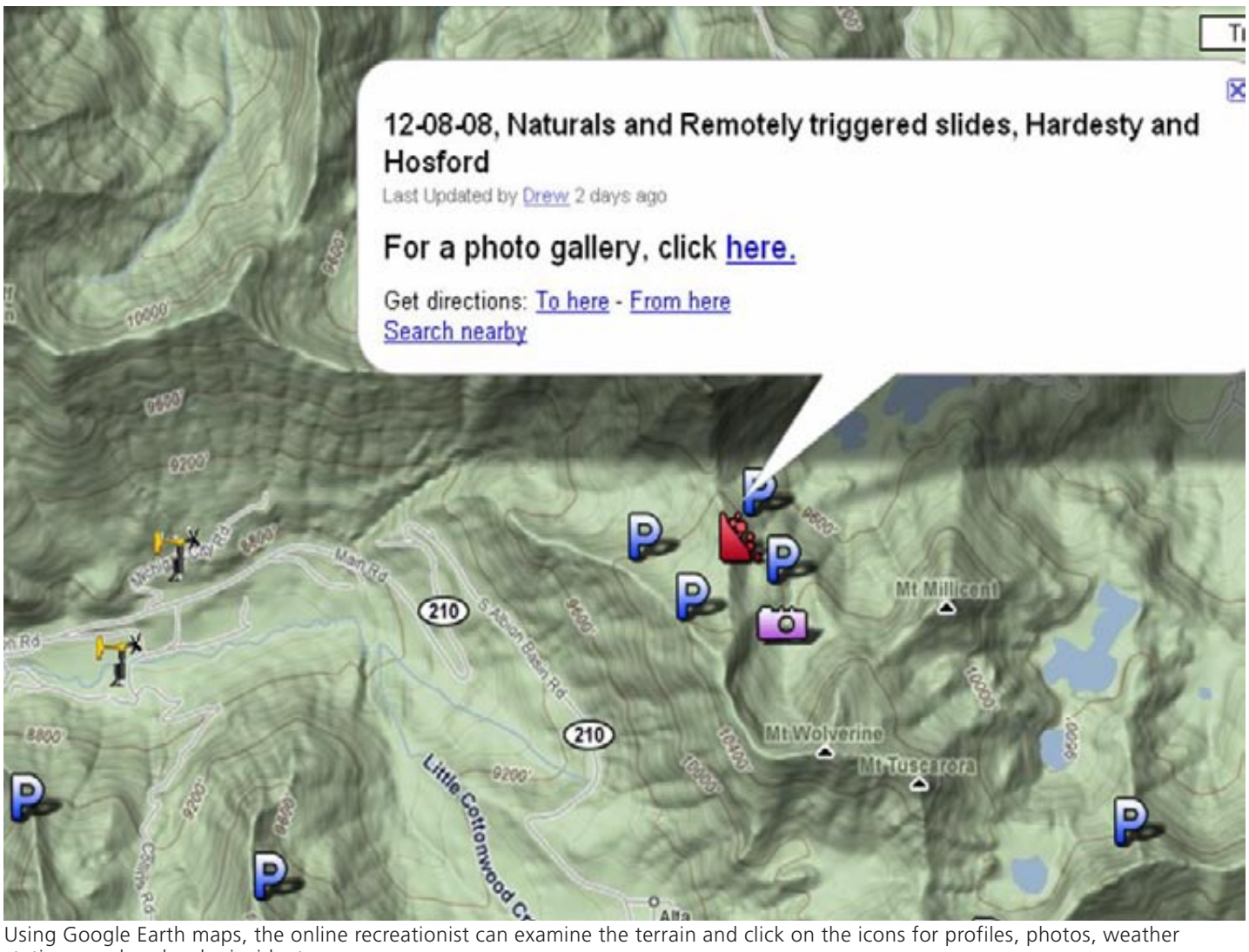


ROUTE NAMES

1. Upper Mill Creek
2. Bowman Trail
3. Main Porter Fork
4. Main Porter Fork
5. Butler Fork
6. Butler Fork
7. Butler Fork
8. Butler Fork
9. Mill D North
10. Mill D North
11. Mill D North
12. Mill D North
13. Beartrap Fork
14. The Willows
15. The Willows
16. Mill F and USA Bowl
17. 10,420' and Hidden Canyon
18. Silver Fork
19. Cardiff Fork
20. Cardiff Fork
21. Mill B South
22. Toledo Bowl to Cardiff Pass
23. Superior
24. Flagstaff Ridge
25. Grizzly Gulch
26. Grizzly Gulch
27. White Pine
28. Red Pine
29. Maybird Gulch
30. Y Couloir

LEGEND
Roads
ROUTES
Simple
Challenging
Complex
Avalanche Paths
Lakes

Color-coded tours give the backcountry traveler a variety of options for a variety of conditions.



Using Google Earth maps, the online recreationist can examine the terrain and click on the icons for profiles, photos, weather stations, and avalanche incidents.

New Tools & Toys from the UAC Help Guide Users' Terrain Choices

Story by Drew Hardesty

On Tue, Dec 16, 2008 at 3:39 PM, Jeff**** sent a message using the contact form at http://utahavalanchecenter.org/contact.

I have a question and I realize that asking this may put you in a bad position to answer, but, I will ask it anyway. Are there places that you can recommend that I can take my 12-year-old son and really have no worries about avalanches? I have skied Tom's hill, up Mill D, many times and have never seen it slide nor do I think that it is steep enough to go, but I'm a little leary, considering I'm not very good at estimating slope angle and I realize that with the current conditions, lower-angled slopes may still be dangerous. Skiing through the aspens is not going to work until he gets a little more comfortable on skis. I have thought of Powder Park as well, but there are a few rollovers that I worry about and it can get cornices on top.

Thank you in advance if you can help. Jeff****

At the Utah Avalanche Center, we receive email correspondence similar to the above all the time, which inspired us to add a few whizbang tools for the backcountry recreationists:

- maps with the names of the popular backcountry runs
- interactive Google maps in both 2D and Google Earth, populated with up-to-date avalanches, accidents, snow profiles, and weather data

These new resources allow folks to look at a certain drainage or ridgeline, gather recent profiles and weather data, and make a plan for that area or perhaps choose another, potentially more stable area. I can only imagine how many people have been "virtually" tooling around the Wasatch, clicking on this profile or that weather station, or inspecting a photo of a detailed crown profile instead of working their day job.

For our next new planned toy/tool, we've taken a look at the terrain in terms of complexity and exposure. We followed the skin-track of the Canadian Avalanche Association's Avalanche Terrain Exposure Scale (ATES), and we thank Grant Statham and the CAA for all their work developing this excellent tool. *(see* ATES: The Avalanche Terrain Exposure Scale, *beginning on page 14.)*

Last winter, with the help of Dr. Phoebe McNeally, Department of Geography at the University of Utah, and three of her shining students, Max Felker-Kantor, Sheila Grindstaff, and Mark Hammond, we created a home-page map of *Selected Touring Routes in the Wasatch Range*, with routes rated by a modified ATES technical model (Utah's a little thin on glacier travel). We incorporated route designations of simple (green), challenging (yellow), or complex (red) ratings. And then we

VERY IMPORTANT - YOU MUST READ AND UNDERSTAND THE FOLLOWING TO USE THE MATRIX

These ratings only apply to the designated route, and significant danger may exist in immediately adjacent terrain.

These routes are primarily "out-and-back," intended to convey the hazard to the route and not recreational terrain in its vicinity. Route colors denote the most aggressive terrain that the recreationist should be able to manage. For example, a beginner can go on a yellow route when the danger is rated as moderate, but should stick to green routes on considerable or high danger days.

DANGER RATING FOR THE DAY

EXPERIENCE LEVEL	LOW	MODERATE	CONSIDERABLE	HIGH
Beginner	O	Y	G	G
Intermediate	R	O	Y	G
Advanced	R	R	O	Y
Expert	R	R	R	O

color blocks refer to TERRAIN RATINGS, indicating most aggressive terrain to be entered

TERRAIN RATINGS

GREEN: ***Green means go.*** Dangerous avalanches are not expected except during extreme or very unusual conditions.

YELLOW: ***You gotta think now.*** Generally low-angle terrain. May cross under steep avalanche runout zones.

ORANGE: ***On your game.*** Some interaction with steep starting zones and/or significant exposure to numerous runouts of common-running avalanche paths.

RED: ***Radical.*** Significant avalanche terrain often with multiple terrain traps.

RECREATIONISTS' EXPERIENCE LEVEL

BEGINNER: Has gone to an avalanche-awareness talk and read/listened to the day's avalanche advisory. Good with map and compass and able to stay on route.

INTERMEDIATE: Has taken a Level 1 avalanche class and has roughly 3-5 years experience in avalanche terrain. Read/listened to the day's avalanche advisory. Able to recognize and avoid avalanche terrain.

ADVANCED: Probably has taken a Level 2 avalanche class and has 5-10 years experience in avalanche terrain. Aware of the day's avalanche advisory to augment their own opinions of the avalanche danger for their intended objective or route.

EXPERT: 10+ years experience, most likely as a practitioner in the field. Able to expertly and efficiently move through complicated and dangerous terrain. Grasps subtleties of the snowpack, terrain, and weather to make own analysis. Confidence tempered by humility and respect of the dynamic elements in the mountains.

above: The route matrix is a work in progress. Users must take the time to carefully read Drew's instructions.
right: An example of one of the new UAC route maps. According to the ATES scale, this route has been rated as Challenging (Yellow).

let it sit until mid-August. In review, it troubled me that in the terrain rated as simple, a person out walking their dog could still get killed by an avalanche on a stroll through a runout zone.

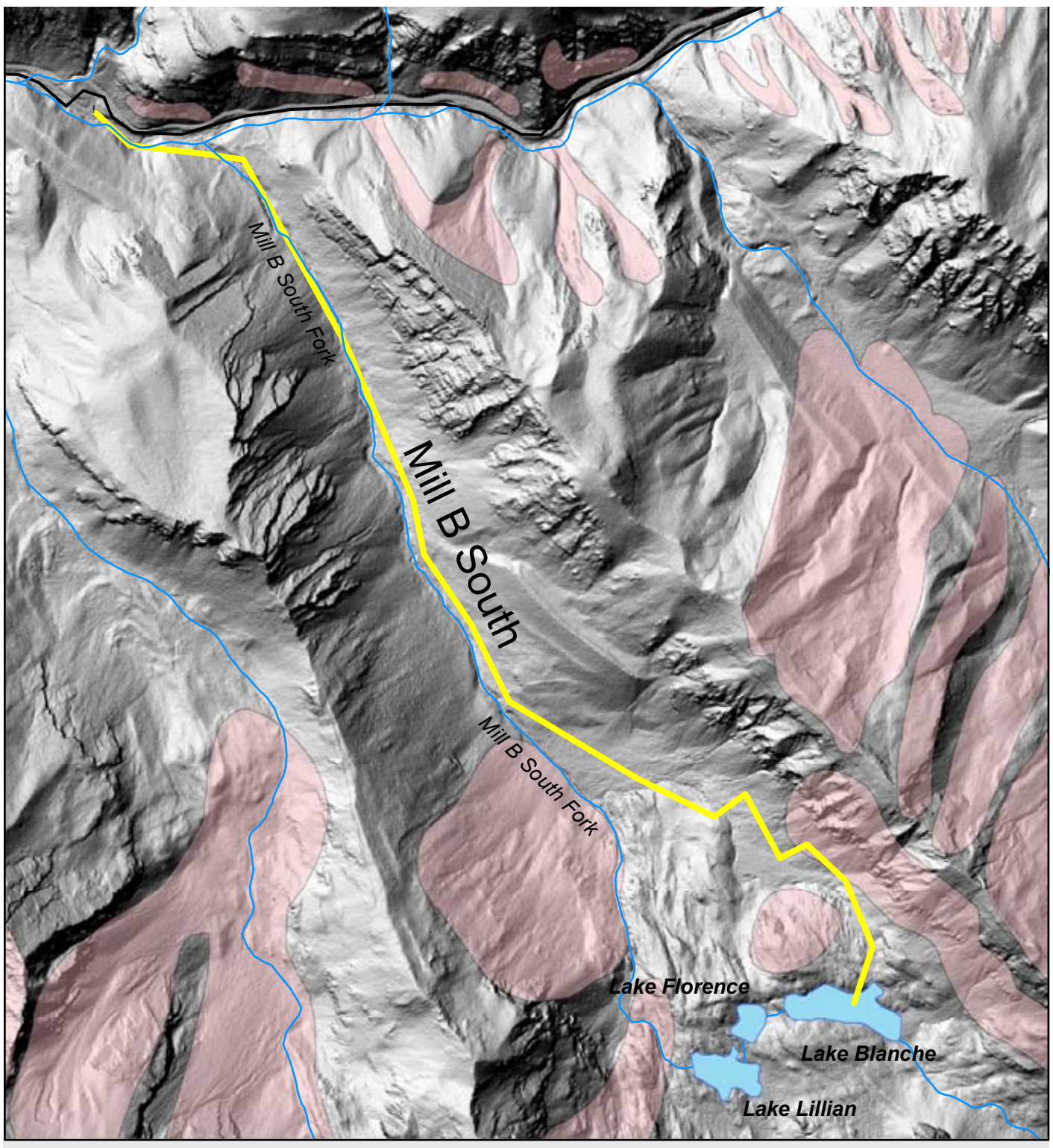
So, at the cost of simplicity, I added another terrain rating and bought the ability to say that "green really does mean go" for the Wasatch consumer. If the father/son team, by their own admission, can't gauge avalanche paths from Adam, then they will want to know that the terrain is good to go. Considerable danger? Green. High danger? Green. We felt it was too much to ask beginners to look at the danger rating and then assess whether they were in a runout zone or not.

We took this even one step further, adding another variable to the equation. We set up a matrix where the experience level of the individual intersects the day's danger rating, producing a terrain-rating maximum. The route matrix presupposes that the individual rates their own experience level accurately and can follow a route on a map.

The applied ratings are in their beta version for the winter 2008-09. By the time you've read this, we've had multiple public comment periods and presentations. We want this process to be driven by the consumer, to be another tool in the backcountry user's toolbox to help them make good decisions before they even head out the door.

I hope this article will inspire more comments from you, the avalanche community at large. Please direct comments to me at drew@utahavalanchecenter.org.

Drew's been at the Utah Avalanche Center for about 10 years. In the summer you'll find him working the salt mines at Grand Teton National Park in Wyoming as a Jenny Lake climbing ranger.



ROUTE CRITERIA

Drainage/Area	Big Cottonwood Canyon
Access Point/Elevation	6200' BCC @ S-Curves
Objective/Elevation	Lake Blanche
Slope Angles	Many >35 degrees
Slope Shape	Convoluted
Forest Density	Open
Terrain Traps	Many
Avalanche Frequency	Frequent
Start Zone Density	Open
Runout Zone Characteristics	Convoluted
Interaction with Avalanche Paths	Numerous Overlapping Paths
Route Options	Limited
Exposure Time	Significant

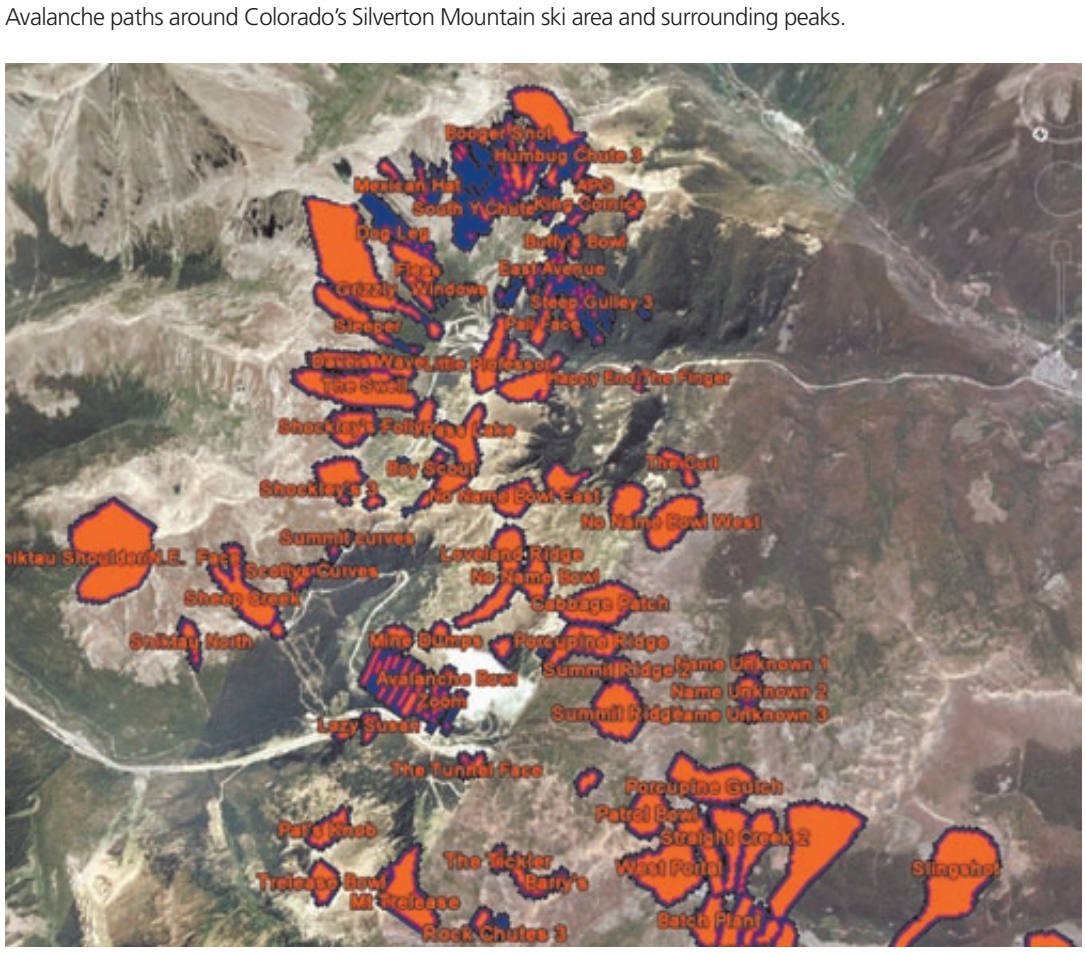
Mill B South to Lake Blanche
CHALLENGING

LEGEND
! Trailheads
Roads
Streams
Avalanche Slidepaths
Lakes

Lake Blanche Touring Route
ATES RATING
Challenging

Avalanche-path mapping of the San Juan Mountains along US Highway 550 assist Colorado Department of Transportation (CDOT) road-maintenance workers. Highlighted red areas indicate the slide paths, making it easy to track and identify avalanche activity. Use of the GIS system is also a powerful budgetary tool, allowing CDOT to track avalanche control work by path and facilitating cost analysis on amount of explosives used, man hours and equipment wear and tear. For more about the history of avalanche control efforts along this particular stretch of road, see *Red Mountain Pass – Chief Ouray Highway: A History of Forecasting and Mitigation*, beginning on page 24.

Avalanche paths around Colorado's Silverton Mountain ski area and surrounding peaks.



Loveland Ski Area, Loveland Pass and Arapahoe Basin, Colorado, mapping in Google Earth. This map was created by the author as his capstone project during GIS studies at college. At the time, he also served on the volunteer ski patrol at Arapahoe Basin.

AVALANCHE MAPPING: GIS for Avalanche Studies and Snow Science

Story by Douglas Scott

Swiss, Canadian, and other snow scientists had been using GIS for many years to monitor and document avalanche occurrences, snow profiles, and weather. The United States, however, has had limited GIS use for this discipline. In the past almost all avalanche and snow-profile data observations have been recorded as hard copies with no digital spatial component. Recent technology advances now make it possible to bring observations and data into a GIS for referencing, modeling, and sharing. Historical hand-drawn avalanche path data is converted to digital GIS data, then loaded into a database that can be related to the original hard-copy occurrence, snow profile, and weather data. These data layers can be displayed over other GIS base layers such as DEM, DRG, DOQ, NAIP, soils/geology, and vegetation cover. Then integration of real-time weather and snow-profile data can be added for analysis. Digital data-collection tools can load new data directly into the GIS database. Historical avalanche-path data consists of archived records, photographs, hard-copy mapping of starting zones, and the extent area of danger. High-resolution DEMs allow various terrain analyses: mean slope, minimum slope, maximum slope, mean aspect, and curvature. When the avalanche path data is overlaid on the DEM, it can be analyzed using nearest-neighbor modeling techniques.

Avalanche Mapping has been developing a US-wide GIS database (also know as geodatabase) since 2000. When I went back to school in 1999 to enter the GIS industry, I found there had been almost no US GIS work done with avalanches, although much had been done in Europe. There had been some use of the GIS technology at the La Sal Forest Service Avalanche Center in Utah, but some of the efforts they were proposing went too far into forecasting on DEM terrain models, so was abandoned for being too rough and inaccurate. In addition, the software at the time was expensive, cumbersome, and required special training.

With that history in mind, my capstone project became the creation of a digital avalanche atlas for Arapahoe Basin ski area, where I was part of the volunteer ski patrol. After that project was finished and after graduation, I acquired the URLs for Avalanche Mapping and created a Web site with the goal of building avalanche atlas maps and collecting snow and avalanche observations using digital GIS and GPS technology.

While working on the 2002 Olympics in Salt Lake City, I came upon the GIS data sets for the Cottonwood Canyons and Provo Canyon, which I believe was developed by Utah's AGRC and UDOT. A grant from Backcountry Access and a copy of the Arapahoe Basin Atlas resulted in the construction of a map for Little Cottonwood Canyon. Around that time I had given one of the atlas maps to long-time friend Gary Neptune, owner of Neptune Mountaineering, who told me, "If you start producing these, I will sell them for you." So that became the start of the client base.

I began tracking down different sources of historical data in earnest. For Colorado, there was an existing highway avalanche atlas built by the Colorado Avalanche Information Center (CAIC) in pdf format. This was one of the main sources for the Colorado data. In other areas, I tracked down old hard-copy atlases and land-use planning reports. I also contacted long-time locals for their help in delineating the paths they knew by hand, drawing on top of hard-copy topographic maps which were then digitized.

Data is acquired from a number of places: it is purchased from Digital Data Services or the Geocommunity GIS data warehouse, or it is downloaded from the NRCS data gateway, university data warehouses, and the USGS. The most common base dataset setup for the mapping projects is a 10m DEM hillshade to show the surface terrain, digital topographic maps that we stitch together using GIS software to make them continuous. Grayscale aerial photography shot between 1999-2000 and some color satellite imagery shot between 2005-06 is also available from government Web sites.

Topo maps allow us to correlate to the old avalanche atlases since almost all of them were done with topo backgrounds. The other data provides more detail so we can see ridge break lines from the terrain model. The aerial imagery allows us to see the avalanche tracks more clearly than on topo maps, and the different years show changes over time. We sometimes use the DEM data to derive slope and aspect data to populate the attributes of a path.

It should be noted that the 10m DEM is a resampled 30m DEM. According to remote sensing experts, DEMs can have anywhere from 70-100' of error. These errors create inaccuracies in modeling and forecasting avalanches. There have been some projects done around the country using very expensive high-resolution Lidar data, and this is better but by no means perfect.

Using the above techniques, Avalanche Mapping has developed a GIS database of over 2500 historically observed avalanche paths in Alaska, Arizona, Colorado, Utah, Washington, and Wyoming. We are currently collecting information for California and Montana.

So how has this data been used?

One of the primary ideas of the digital avalanche atlases was to produce mapping of the historically observed paths around popular backcountry ski and riding areas. A map may help give people a heads-up when out-of-bounds travel has potentially high consequences.

In addition, clear mapping leads to consistency in path and area names. The majority of the users of these maps have been winter backcountry users; other groups include search-and-rescue and law-enforcement departments. Some avalanche-instruction schools have been utilizing the maps as training tools, helping students visualize the terrain they are about to enter as an aid to determine proper avalanche-safety protocol.

The Colorado Department of Transportation (CDOT) maintenance group that works in the San Juan Mountains utilizes the data to help plow drivers identify the names of the avalanche paths they are plowing and report what ran. In addition, use of the GIS system allows CDOT to track the avalanche control work by path, allowing for cost analysis on the amount of explosives used, control work results, number of man-hours, and equipment wear and tear. This may be one of the best applications of GIS technology for the avalanche-control community.

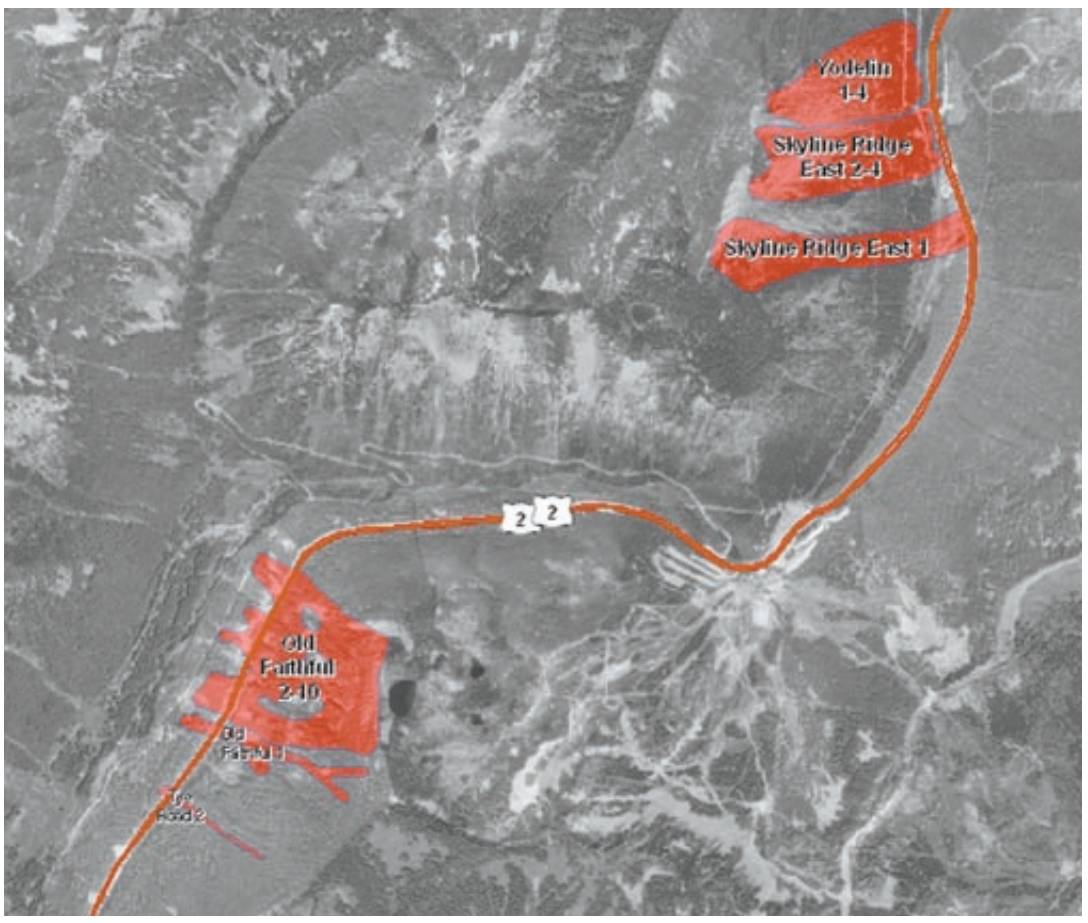
The CAIC will be using the statewide avalanche path database to track occurrence information and tie the historic occurrence/accident records to the avalanche-path polygon. The CAIC is also interested in tracking information for mitigation and explosives use.

Some helicopter skiing companies also want a full GIS to manage their lease areas – tracking runs, avalanche, wildlife, other backcountry users – plus more information too diverse to list. These companies have found this a very useful method to manage information, especially for permitting processes with the Forest Service and other agencies.

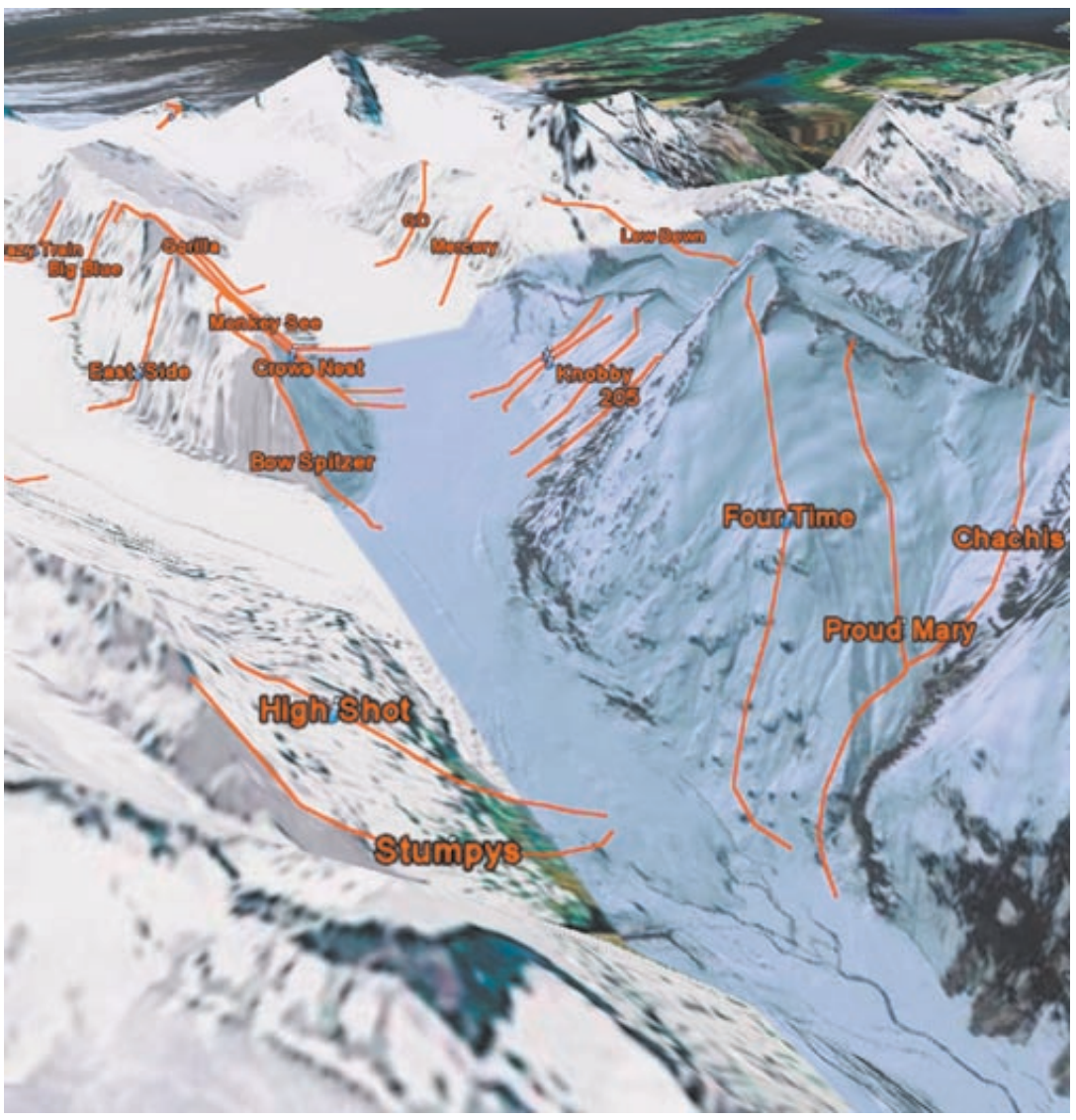
There are possibilities for forecasting, but without the high accuracy (-2ft) DEM data and high-frequency weather data that is very close to the site of interest, there is still a lot of variability as to its accuracy. We have had many promising discussions on the use of GIS as a tool for regions that have well-documented historic data, such as ski areas and small mountain communities. But as a large forecast tool for the avalanche centers, the US areas are just too vast. In Colorado the San Juan Mountains are about the same size as Switzerland, and that is just one of our 10 mountain ranges that have avalanches. The Swiss model would be extremely expensive to implement here in the US, so please let me know if anyone would like to contribute the appropriate technology.

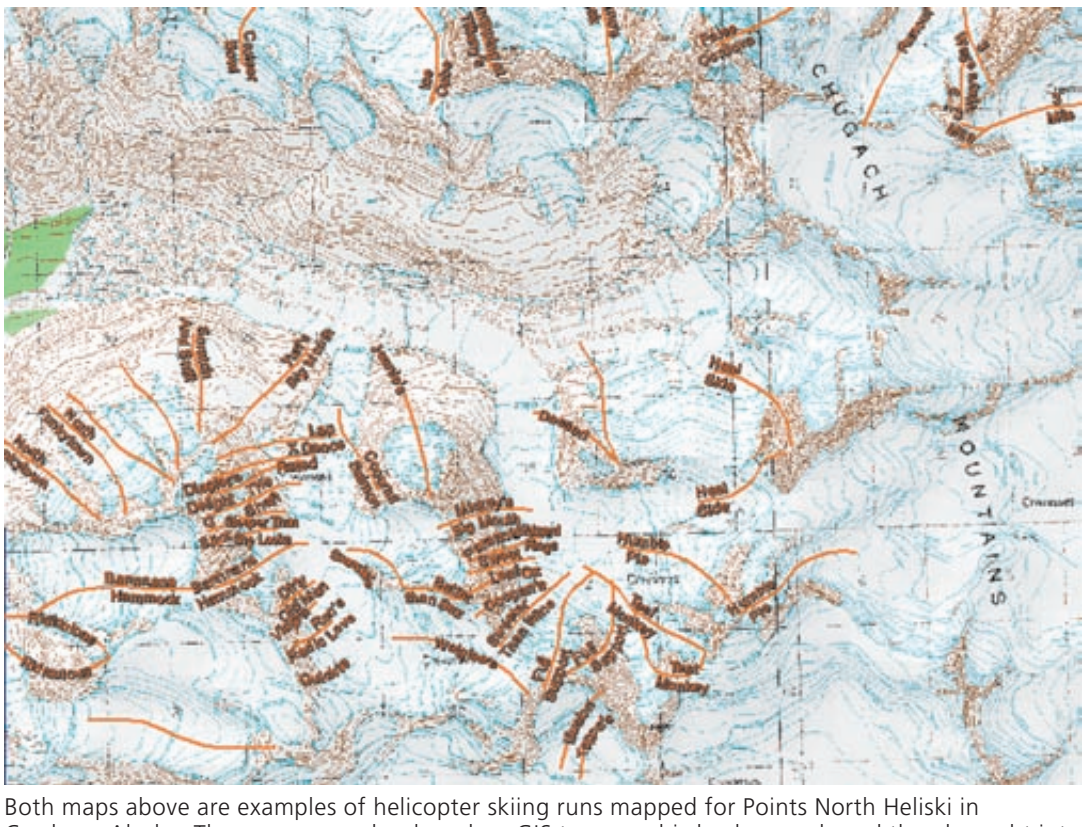
Douglas Scott is the owner/director of Avalanche Mapping which can be found at www.avalanchemapping.org. He is also the geospatial data manager for the US Geological Survey in Lakewood, Colorado, and resides with his family in Lafayette, Colorado. ❄

Doug enjoys a ski day with daughters Gabi and Cheyenne at Loveland Ski Area.

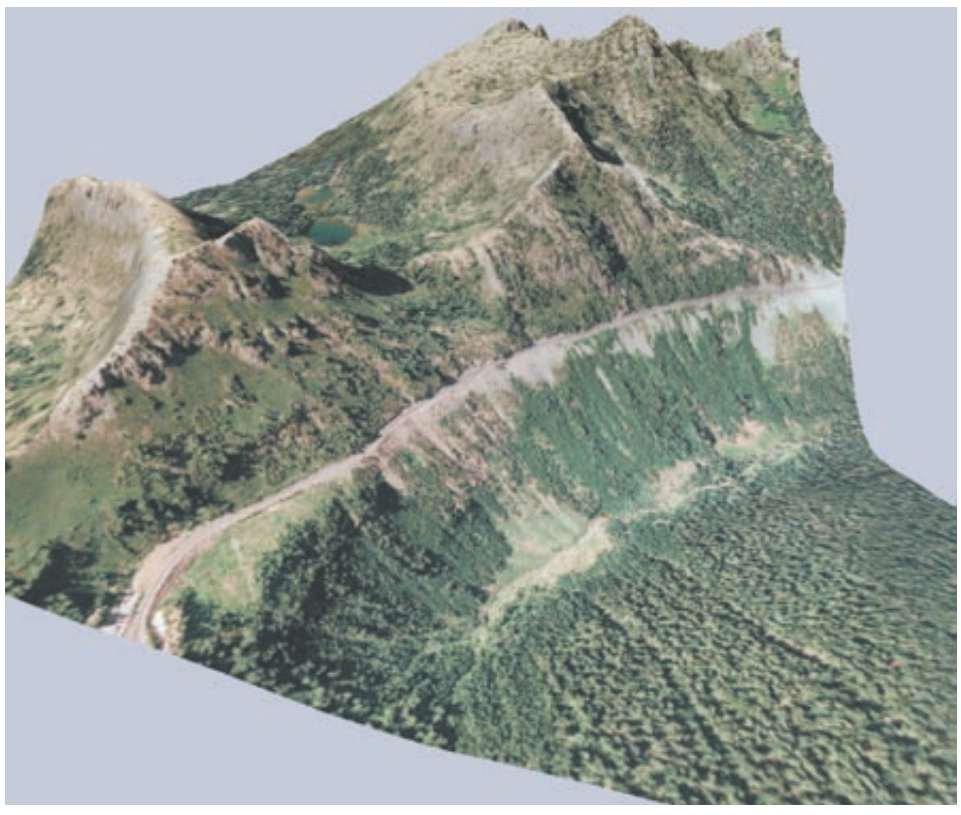


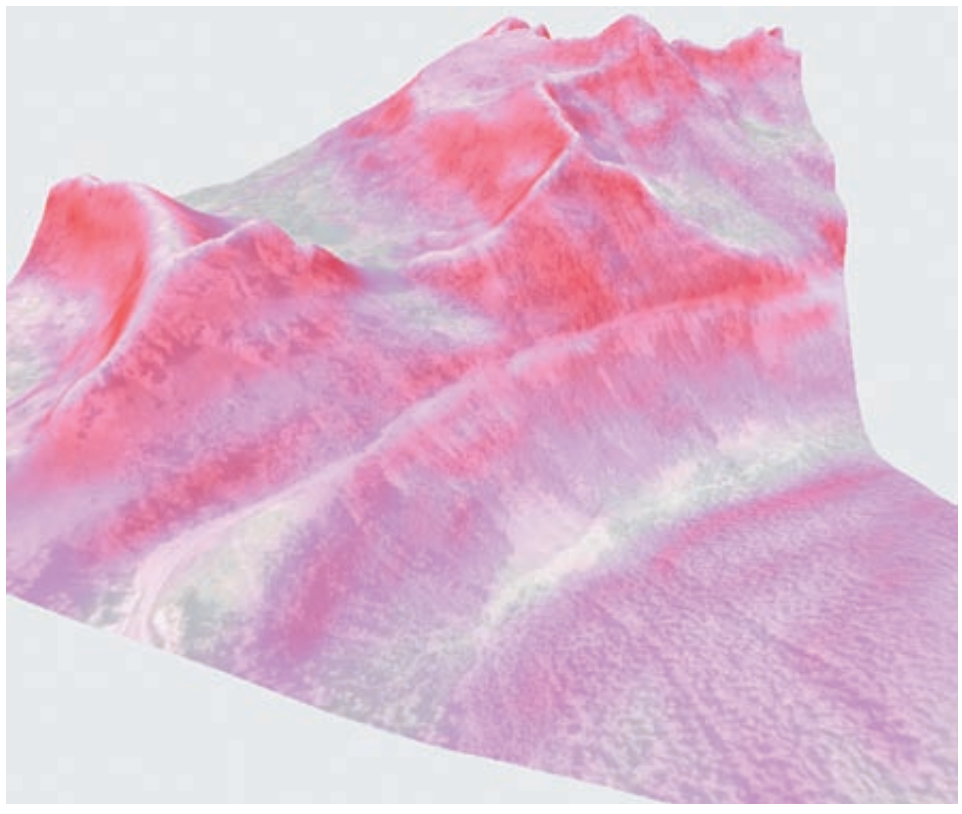
above and left: Avalanche mapping around Stevens Pass ski area in Washington. Scott highlights slide paths in red overlays over topographical maps as well as grayscale photography available from government Web sites.





Both maps above are examples of helicopter skiing runs mapped for Points North Heliski in Cordova, Alaska. The maps were developed on GIS topographic backgrounds and then brought into Google Earth.





Chinook Pass, Washington. Visualization is a useful tool, as it allows you to "visit" the pass before you go skiing.

UNCERTAINTY: Terrain Perspectives and the Use of GIS

Story and photos by Mike Richardson

Uncertainty is the central element of my personal avalanche triangle. Instead of human factors at the center, I use "uncertainty" because accounting for uncertainty prior to decision-making is the most important part of my backcountry travel skills.

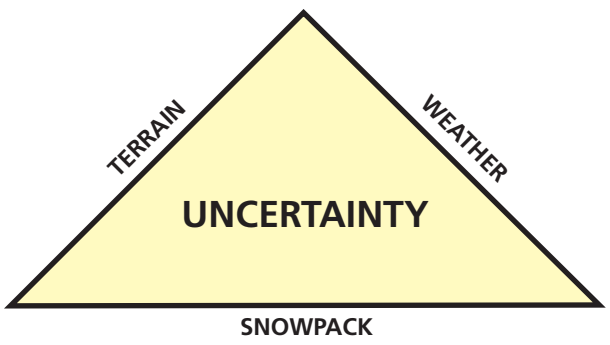
My research in terrain involves staring for hours at complex landscapes, often pacing back and forth while thinking. Spend enough time staring at landscapes, and you eventually notice similarities. Spend enough time staring at the data structures behind the landscapes, and you notice the "similarities" are constructed by the pattern-matching software in our brains. In reality, all terrain is unique.

As a skier, you learn to evaluate avalanche exposure in part by analyzing terrain. As part of this process, you learn to differentiate between terrain that is clearly safe and terrain that is clearly exposed. What about the terrain in the middle for which exposure is unclear? This is high-uncertainty terrain. Borrowing from others, it's safe to say that perceptual errors are highest when uncertainty is highest.

How can you gauge exposure by obtaining facts about terrain? Frame this question not in the context of methodology; many suitable methods exist. Instead frame the question in the context of uncertainty. How do you obtain facts about terrain that reduce uncertainty?

Well-written software has an objectivity that few humans can match – this is the best and worst feature of computer science. If you write an algorithm to determine what percent of terrain in a given geographic region is steep enough to avalanche, the computer provides an absolutely accurate answer. You don't worry about terms such as "maybe" because the computer provides an exact answer. Even allowing for outright stupidity, perceptual errors are always lowest when uncertainty is lowest.

My interest in technology at the intersection of GIS and avalanches lies in the ability to create vivid renderings that reduce uncertainty about the distribution of avalanche terrain and instability. At some point in the future, integrating local avalanche forecast data with these renderings might prove useful. Even taking into account the increasing computer graphics use in avalanche forecasting and communication, much more can be done with little additional cost. Many avalanche centers specify elevations and aspects where instability is forecast. Rendering scenery with this data is trivial, even across vast geographic areas.



The use of GIS in forecasting underlines an interesting problem. An avalanche forecast is produced by analyzing current data about terrain, weather, and snowpack. Very often, historical data are used as well. Some of this data is non-numeric in the sense that a report of shooting fractures doesn't have a numeric equivalent. However, the location of shooting fractures does have a numeric value. Furthermore, it is possible to derive additional numeric data such as aspect, elevation, and time from any such report.

The Avalanche Handbook compares the information database used by helicopter skiing operations to the information database used by the average backcountry recreationist. Naturally helicopter skiing operations have very large databases and recreationists have very small databases. This is especially true with respect to distributional information (information that constitutes the prior, if avalanche forecasting is viewed as a Bayesian process).

Does this mean that such data are unavailable to recreationists? No. Current data for popular terrain (such as Mt Rainier, Rogers Pass, and Cottonwood Canyon) are each year assembled by both professionals and recreationists. Historical data are likely available in large quantities. Stated simply, although a lot of "beta" about past and current conditions is available, much work remains with respect to "repackaging" this information for public communication. Washington State produces avalanche atlases for paths near towns and roadways. While some of these documents are quite old, this is a good example of historical data available to the general public. To paraphrase: The avalanche paths at Liberty Bell run after every major storm. Decision-making is much easier when this historic information is integrated with current conditions.

Information technology in general makes it possible to produce a rich seasonal database for any area with enough forecasters and recreationists to provide reports. GIS technology makes it possible to present this information in a manner that recreationists can easily integrate, along with information about current conditions, into their travel plans. Perhaps just as important, such a system would provide visualizations of areas for which historical data and current conditions are unavailable. Travel through "blank spots" requires extra caution and an even wider margin of safety.

These advances would be easy if the information were collected, integrated, and correlated with latitude and longitude values. Inexpensive open-source Web technology already provides methods for collecting the data from recreationists and professionals. GIS technology provides a means of crystal-clear communication. Regional avalanche centers already provide some of this information, but the presentation is not always well-suited for comprehension by the public. A list of avalanche photos, outside the context of the surrounding landscape, is of little use to a recreationist who doesn't understand how to form a prediction using past and current data. On the other hand, a cluster of yellow (past) and red (current) instability "dots" on a map provides information anybody can readily integrate with their travel plans.

Canada already has a similar system, in the form of maps that provide historic data about avalanches for the area in the map. No such system is in place anywhere in the United States. Rather than building a collection of static maps, I believe GIS technology provides the means to create a dynamic system that that could help recreationists make better decisions.

More images and information are available at www.scenomics.com/internal/accounts/richardm/avalanche/topics/index.htm.

Rogers Pass, British Columbia. "High winds throughout the past 24 hours resulted in high instability on east aspect slopes."

Mike Richardson is a software developer from the Pacific Northwest. His interests include dogs and skiing. Mike is happy to answer questions at mike@scenomics.com in exchange for cookies.

crown profiles

GREAT ACHIEVEMENTS IN AVALANCHE PREDICTION AMONG AMERICA'S FIRST: Edward A. Beals

Story by Greg Johnson

"It was not the quantity of snow alone which fell this year that caused so many avalanches, but it was the manner in which it fell."

Edward A. Beals, 1910

During the time period from about 1860 to 1910 the mountains of the western US were populated with miners and railroaders. Miners flooded the high country in search of riches, and the railroads pierced mountain ranges, eager to facilitate commerce, transporting people and delivering mail. During the winter, avalanches affected roads and rail lines, causing accidents and long delays – people died. At that time, few people grasped general concepts of avalanche prediction, recognizing where and when avalanches occurred. One person was a notable exception. His name was Edward A. Beals, the US Weather Bureau district forecaster based in Portland, Oregon.

Edward Beals was born in 1855 in Troy, New York. His career in meteorology began in the US Signal Corps in 1880. Early on, he served at locations around the country, including Mt. Washington, New Hampshire, during the winter of 1883-1884. In 1900 he headed west to manage the US Weather Bureau office in Portland. Over the next 17 years, he predicted some of the legendary Cascade winter storms that caused avalanches and observed the wrath of their destruction. During this time, Beals slowly started to understand avalanches, and as a meteorologist, he became one of America's earliest avalanche experts.

In late February 1910, three successive storms swept over the northwestern US and southwestern Canada, causing a widespread avalanche cycle. On March 1, 1910, the most destructive avalanche killed over 95 people and destroyed trains in a town called Wellington, located in Washington state at the western portal of the old Cascade Tunnel just below Stevens Pass. News of the accident was shocking and must have been a turning point for Beals, spurring him to share his knowledge and write the outstanding article, *Avalanches in the Cascades and Northern Rocky Mountains During the Winter of 1909-1910*. His article summarizes that avalanche cycle; he included the Wellington accident as well as others that were smaller yet similarly deadly throughout Washington, Idaho, Montana, and Oregon. This is one of the earliest articles written about avalanches in the US; I recommend it highly to any avalanche professional. Beals simply captures the essence of North America's most destructive avalanche cycle. It was published in the June 1910 issue of the *Monthly Weather Review* and is accessible online at the American Meteorological Society's Web site at **http://ams.allenpress.com.**

As the years passed many more storms caused havoc in the mountains, solidifying Beals's "feel" for conditions that caused avalanches. The winter of 1915-16 was legendary in the western US due to extraordinary cold temperatures and deep snow. Avalanches were becoming common knowledge to the public as low-elevation slopes near towns slid and prolonged closure of rail lines, and horrific news of thousands of soldiers being swept away in Europe was reported during WWI.

In early February 1916, a storm – likely a strong Pineapple Express – was on the doorstep of the Pacific Northwest. To Beals, the ensuing avalanche cycle was obvious: warm temperatures and copious amounts of rain and snow would fall on a deep and very cold snowpack. Knowing that avalanches were imminent, he decided to issue an avalanche warning to the public. This was probably the first time a US federal agency issued an avalanche warning.

The first warning went out on February 7, 1916, and was printed in the *Oregonian*, Oregon's primary newspaper, published in Portland. The warning remained in effect through February 10, when it made the front page of the *Oregonian*. It was also distributed to newspapers in Washington, Oregon, and Idaho, and the warning was telegraphed to other parties who received regular weather forecasts.

Morning Oregonian.

VOL. LVI—NO. 17,229. PORTLAND, OREGON, THURSDAY, FEBRUARY 10, 1916. PRICE FIVE CENTS.

INDEX OF TODAY'S NEWS

AIRMAN VISITS FOES FOR CAPTIVE'S GARB

HOSTILE PLANE PERMITTED TO BRING PAIR OF TROUSERS.

CHARITY BALL IS TONIGHT

FORD JUNKETER IS FOR PREPAREDNESS

Lamar Tooze Uneasy After Seeing Europe.

AMERICA DECLARED IN DANGER

"Out-of-Trenches" Slogan Is Worst Thing of All.

FORD ROW LAID TO WOMAN

90 DAYS IN JAIL IS SCHULTZ SENTENCE

Leniency Is Asked for Perkins Bar Lessee.

SALES BRAZEN, COURT SAYS

Use of Paid Agents Inspires Attack by Defense.

APPEAL NOTICE IS GIVEN

Judge Dayton Sympathizes With Defendant, but Says Fine Is Not Enough in View of Open Defiance of Law.

VIOLENT BATTLE IS ON NEAR DVINSK

BOTH SIDES CONDUCTING INTENSE BOMBARDMENT.

POSTOFFICE FLOATS AWAY

CREST OF FRESHET MAY COME TODAY

Oregon City Mills Are Forced to Stop.

RISE TO 17.7 FEET PREDICTED

Log Rafts Break, and Barge Drifts About Harbor.

DOCK OFFICES MOVE ALOFT

Avalanche Warning Out.

Rain fell in Oregon, Washington and Northern California yesterday, and the Weather Bureau last night issued a warning that danger of avalanches would be increased during the ensuing 36 hours, not alone on the slopes of the Cascades, but on the Rocky Mountains and their offshoots in Idaho.

The first avalanche warning in the United States, issued by Edward Beals, was published in the *Oregonian* on February 7, 1916. The warning remained in effect through February 10. The clipping (above) summarizes the warning and was printed on the front page of the morning edition (top).

In addition, Beals discusses his reasoning behind the avalanche warning in the February, 1916 issue of the *Monthly Weather Review*. It is clear that his decision-making process reflects the basic concepts of modern avalanche prediction.

The avalanche warning Beals issued appears to be his first and last. A year later, in 1917, Beals moved to San Francisco. In 1924 he moved again, this time to Honolulu where he retired after a 45-year career. Beals died of lung cancer in 1931 at the age of 76 in San Francisco.

Edward Beals made a pioneering effort for avalanche safety nearly 100 years ago in a time period when people were struggling to make a living in the mountains. He wasn't alone – there were others trying to steer people clear of avalanches – but his Weather Bureau job took his knowledge to the public.

Notifying the public was a first and very important step, but his foresight did not take hold. In subsequent winters, it does not appear that other forecasters in Portland or other Weather Bureau offices issued avalanche warnings. The next 25 years saw miners moving out of the mountains, and the railroads got smart by going underground, realigning rail lines, and building more snow sheds. Momentum for avalanche safety programs did not appear to surface in the US until the 1940s and early 1950s with the invasion of skiers.

San Francisco	62	0.00	12	S	Cloudy
Seattle	60	0.90	..	E	Rain
Spokane	46	0.20	..	NE	Rain
Tacoma	50	0.82	..	SE	Cloudy
Walla Walla	54	0.02	..	SE	Cloudy
Washington	38	0.26	..	SW	Pt. cloudy
Winnipeg	-4	0.00	..	S	Pt. cloudy

WEATHER CONDITIONS.

The depression noted yesterday evening as approaching the Washington Coast proved to be of decided character and storm warnings were extended at 6:40 P. M. to include all stations in this district. A maximum wind velocity of 60 miles from the south occurred this afternoon at North Head, Wash. Rain has fallen in Washington, Oregon and Northern California and mild temperatures prevail throughout this district and in Northern California.

Conditions are favorable for rain in this district tonight and Thursday, with a strong southerly wind along the coast and increasing southeasterly winds in the interior. The danger of avalanches will be greatly increased during the next 36 hours and they are liable to occur not only on slopes of the Cascade Mountains along the slopes of the Rocky Mountains their off-shoots in Idaho.

FORECASTS:

Portland and vicinity—Rain, southerly winds.

Oregon—Rain, increasing with strong southerly gale

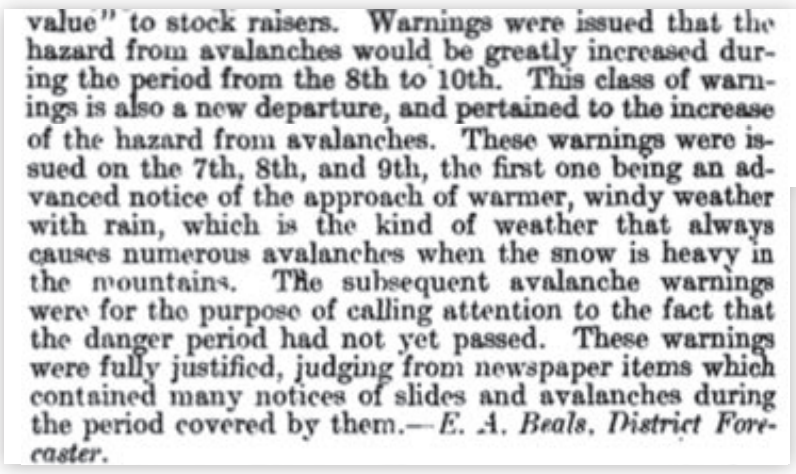
Washington—Rain; increasing erly winds with strong southerly the coast.

Idaho—Rain; increasing winds.

EDWARD A. BEALS

DRINK HOT WA IF YOU DESIR

The first avalanche warning, in its entirety, from the *Oregonian*, page 19, February 10, 1916.



value" to stock raisers. Warnings were issued that the hazard from avalanches would be greatly increased during the period from the 8th to 10th. This class of warnings is also a new departure, and pertained to the increase of the hazard from avalanches. These warnings were issued on the 7th, 8th, and 9th, the first one being an advanced notice of the approach of warmer, windy weather with rain, which is the kind of weather that always causes numerous avalanches when the snow is heavy in the mountains. The subsequent avalanche warnings were for the purpose of calling attention to the fact that the danger period had not yet passed. These warnings were fully justified, judging from newspaper items which contained many notices of slides and avalanches during the period covered by them.—*E. A. Beals, District Forecaster.*

Beals discussed his warning in the *Monthly Weather Review*, February 1916.

A big thanks to Peter Crane, Director of the Mt. Washington Observatory, for his generous research help. Thanks also to Don Bachman, Art Judson, and Ron Perla for their informing discussions.

Greg Johnson works as an engineer, avalanche forecaster, and guide in Canada and the US. He can be reached at gjohnson72@hotmail.com.

RED MOUNTAIN PASS – CHIEF OURAY HIGHWAY: A History of Forecasting and Mitigation, Part I

Story and haiku by Jerry Roberts

left: The East Riverside Path's first snowshed was dug through the snow with the timber that came down from above. *Photo courtesy Ouray Historical Society*
right: West Riverside boiling up after being shot, hitting the wall and roiling through the snowshed. *Photo by Jerry Roberts*

The San Juan Mountains of southwestern Colorado are an abrupt and youthful range infamous for a very fragile, unstable snowpack. They are also the most avalanche-prone region in Colorado and rank high in this regard when compared to other avalanche regions of the world.

Avalanches are natural geologic hazards that have challenged travelers and disrupted commerce since the first explorers, settlers, and prospectors entered this ruggedly spectacular mountain region. The mountains are steep and unforgiving. Many people have lost their lives to avalanches due to their work, travel, and structures built in hazardous mountain terrain. Nearly 200 miners, mule skinners, mail carriers, and others lost their lives in the Telluride-Ouray-Silverton triangle; yet the San Juans still had a hold on the hearts and minds of the people who lived there.

Where roads could possibly be built, they hung precipitously on mountain sides. Where impossible, narrow trails were scratched out that were extremely dangerous to man and pack animal. In the last quarter of the 19th century, mining interests penetrated the San Juans, pushing the limits of transport even further. Wagon roads were created from animal trails, which eventually became railroad lines. Several of these traveled routes later evolved into primary arteries and eventually became paved highways for automobile travel.

Much of the San Juan Mountains belonged to the Ute Indians until 1873. With the help of Otto Mears, "Pathfinder of the San Juans," and his friendship with Chief Ouray and his Ute tribe, The US government essentially swindled the tribe on a bad real estate deal. Desert property along the Colorado/Utah border was traded for the mountain property. This opened the northern San Juan Mountains to mining and settlement, and this was the historical Zeitgeist that changed the area forever.

According to Betsy Armstrong, who authored the Institute of Arctic and Alpine Research Occasional Paper 24, 1977, *Avalanche Hazard in Ouray County 1877-1976*, "Before the San Juans were invaded by the prospectors and miners in the 1870s the Ute Indians traveled in the mountains only during the summer months. Once settlement began and the mountains were inhabited year-round, then 'the monstrous avalanche' became a hazard to be feared and respected."

According to Armstrong, the amount of avalanche burials and damaged property correlated with fluctuations in the mining industry and with the total number of people working and traveling the mountain paths. In 1893, avalanche damage to mining property fell along with the price of silver when mines closed; however there were still frequent encounters with people and avalanches because they continued to travel the popular routes in the mountains. When the bottom fell out of the silver/gold market, most of the mines closed and avalanche-related deaths also declined. Because the main arteries into the belly of the beast had become established, the avalanche hazard moved from the mining districts to the well-traveled trails and wagon roads that eventually became Hwy 550, which runs from Ouray to Durango, Colorado. Modern-day travelers pass under 64 named avalanche paths that cross the highway at varying frequency.

Other mountain professions affected by avalanches were the packers and teamsters with their pack animals who supplied the mines. Traveling in all conditions and hauling ore from the mines, they suffered the same fate as the miners. Mail carriers were exposed to the same hazards, but were lucky (or perhaps were better forecasters) for fewer of them were caught and killed.

Otto Mears, a Russian immigrant, was an entrepreneur and a former Union soldier. Initially he ran a bakery in Santa Fe and was involved in the dry good business. Upon hearing that road building in the mining district of the San Juans was needed and profitable, he quickly changed professions. His arrival came with perfect timing. Mining was booming and a more efficient transportation method for hauling supplies and the extracted ore was needed. Mears first built roads and later narrow-gauge railroad routes. Rails were laid from Durango to Silverton and from Silverton north of Red Mt Pass to Ironton Park where Mears worked on a trail and carved it into a wagon road through the steep and precipitous Uncompahgre Gorge north to Ouray. He and his men built or completed over 300 miles of toll roads from Lake City to Silverton, Howardsville, Eureka, and other locations in the mountains.

U S Hwy 550 has a rich history and much has been written about it. Over the years RMP has been known by a variety of names: the Million Dollar Highway, the DSO or Durango-Silverton-Ouray Highway, and the Chief Ouray Highway. The toll road was taken over by Ouray County and the state of Colorado in

left: Chief Ouray and Otto Mears. Mears helped broker the deal took the San Juan Mountains out of Ute tribal hands, opening the door for miners to work and settle in the ore-rich, avalanche-prone area.
above: Mule train going by East Riverside where the snowshed is now. The West Riverside also traditionally initially impacts this spot as well. *Both photos courtesy Ouray Historical Society*

above: The Fairview ran bigger than expected, so the forecasters ran away in another vehicle, leaving the truck with the avalauncher to be the target.
right: Robert Miller was driving this cat when he was hit by the East Riverside.
Both photos courtesy Noel Peterson

1877. It wasn't until 1919 that the wagon trail became suitable for the automobile and was still questionable.

The attempt to keep this steep and dangerous road open in the winter didn't happen until The Great Depression in 1929, and then not with much success. When the highway workers got the road open, they often lost it quickly, usually by the running of the Mother Cline and East Riverside avalanche path that took its first victim in 1908. Miner Elias Fritz was swept away while pulling a freight sled with two horses and his dog under the path. It wasn't until the late 1940s that the road was kept open with regularity due to the improvement of heavy equipment and the implementation of explosives in the mid-'50s to trigger avalanches.

above: Noel Peterson stands next to the 75mm pack howitzer. *Photo courtesy Noel Peterson*
below: Noel in a lighter moment, out on the range where he still chases cows in the Bayfield, Colorado, area. *Photo by Jerry Roberts*

CDOT began avalanche mitigation in 1956 when the National Guard provided the first artillery piece. Two former WWII artillery officers who headed the new program traveled to Denver (a long 8-10 hour trip) to pick up a 75mm pack howitzer and drive it back behind a Ford station wagon when they needed to shoot. Noel "Pete" Peterson, a rookie engineer was a new hire back in '58. He was involved from the beginning, bringing a keen interest in avalanches to the program. After Sid Foster and Willard Croonenberghs retired, Noel became the main man. During his career he acquired 30 years of avalanche experience that tempered him through some very good and very sorrowful times.

Noel liked the 75mm pack howitzer because it was a good tool, easy to use and load (it was called a pack howitzer because it could be disassembled and packed in pieces by horses/mules in the war). In the 1980s CDOT tried using a 105mm recoilless rifle, but Noel was very apprehensive about its use. He felt it was dangerous: "The back blast was almost as hazardous as what came out of the front of the barrel." Throughout the years the avalauncher (initiated in 1975) and a 105mm howitzer (CDOT began training with the fall of 1998 and began using in 1999) were the main weapons for fighting avalanches.

In 1986, Mike Friedman and Telluride Helitrax, a heli-ski operation, provided heli-bombing that became the new mitigation tool for the program. Noel especially felt helicopter mitigation was the wave of the future; this method was unaffected by road blockage from avalanche debris, faster, easier, and more efficient than moving the cumbersome artillery pieces with the required manpower to muscle the weapons around. "It just proved cost effective even with the high price of renting the ship." It also allowed more precise shot placement of charges and experimentation

Continued on page 32 ➡

Project Skywater

Described by Don Bachman in his San Juan Project article for the *Silverton Mountain Journal*, 2001.

In 1970 the Bureau of Reclamation called for proposals to determine this potential (water augmentation). Several groups of hydrologists, climate and avalanche specialists were formed and submitted their proposals. The award went to the University of Colorado Institute of Arctic and Alpine Research (INSTAAR), and the San Juan Avalanche Project was born. The proposal was put together by INSTAAR Director Jack Ives with extensive consultation by Ed LaChapelle, University of Washington, who was to remain a constant contributor and virtual principal investigator for the bulk of the investigation period from 1971 through 1976.

The original Project Skywater pilot augmentation scheme was to encompass the entire western San Juans, but the scope was reduced to eliminate the avalanche project area. This accommodation was made so an avalanche predictive methodology could be developed in the absence of whatever effect cloud seeding might have. Research was to be directed toward study of the relationships between avalanche activity and natural precipitation patterns and other climatic and environmental factors.

The initial objective of the research was to identify and catalog those areas of significant avalanche activity within the study area (US Highway 550 corridor from Coal Bank Pass to Ouray, and Colorado Highway 110, Cement Creek, and the environs of the town of Silverton) and to acquire an understanding of the nature and type of its snow-avalanche releases. Further, the project would develop a methodology that would determine the specific causes of local avalanche activity and finally, to construct a forecast model for the prediction of avalanche occurrence. An initial inventory of the project area identified 214 avalanche paths that were to be monitored.

Many of these paths had been named, usually for topographic features or mining claims or local lore. Thus *Mother Cline* and *Jennie Parker* memorialized characters from the turn of the century, *The Eagle* for frequent sightings of golden eagles above the starting zone, *The Brooklyns* for an adjacent mine, and *Idaho Gulch* for its track. Names were given if none existed, thus *Sam's Slide* was named for my dog and *Ernest and Julio* on Red Mountain #1 were named on the morning after an evening in Ridgway.

The research methodology of the San Juan Avalanche Project encompassed the following procedures: 1) collection of historical data; 2) identification of avalanche areas; 3) collection of current snow, weather, and avalanche data; 4) observation of internal snowpack evolution.

Ives and LaChapelle drafted the project design and assembled support and field personnel. Additional input came from consultants Malcom Mellor and Willy Weeks of the US Army Cold Regions Engineering and Environmental Laboratory. By the start of the 1972-73 season, Silverton staff included Don Alford, Richard Armstrong, Betsy Vessalago (soon to become Armstrong), Rod Newcomb, and myself. Richard became field leader after the first year, and Len Miller joined in the fourth season. Rod and I were the non-academic field research technicians. Other personnel and many subsequent participants combined their analytical skills and graduate degree pursuits with field work to contribute to project data collection, analysis, and publication.

The forecasting program focused on several distinct avalanche groups including Ledge, Muleshoe, Brooklyns, Champions, Cement Fill, and the East Riverside. Based on daily forecasting periods, an overall accuracy of 81% was achieved during the last two years of the project using conventional (non-statistical) forecasting methods. Forecasting accuracy for spontaneous avalanche release and magnitude within a three-hour period was 71%.

Interestingly, the original question of whether snowpack augmentation would create greater danger from avalanches was never definitively answered. Due to concerns about downwind drying effects of seeded storms, spring flooding potential, water rights, and storage questions, operational cloud seeding came under state scrutiny and, ultimately, regulation with appropriate limitations being specified. I think we felt that conservative incremental augmentation would have no demonstrable effect on avalanche occurrence or magnitude, but there was no way to effectively prove this without unrestrained broadly targeted cloud seeding episodes; no one wanted to take that risk.

See 2008 AAA Awards *on page 4 for a biography on Don Bachman, recipient of the AAA Honorary Membership in 2008.*

History 101: Avalanche Cords

Story by Dale Atkins

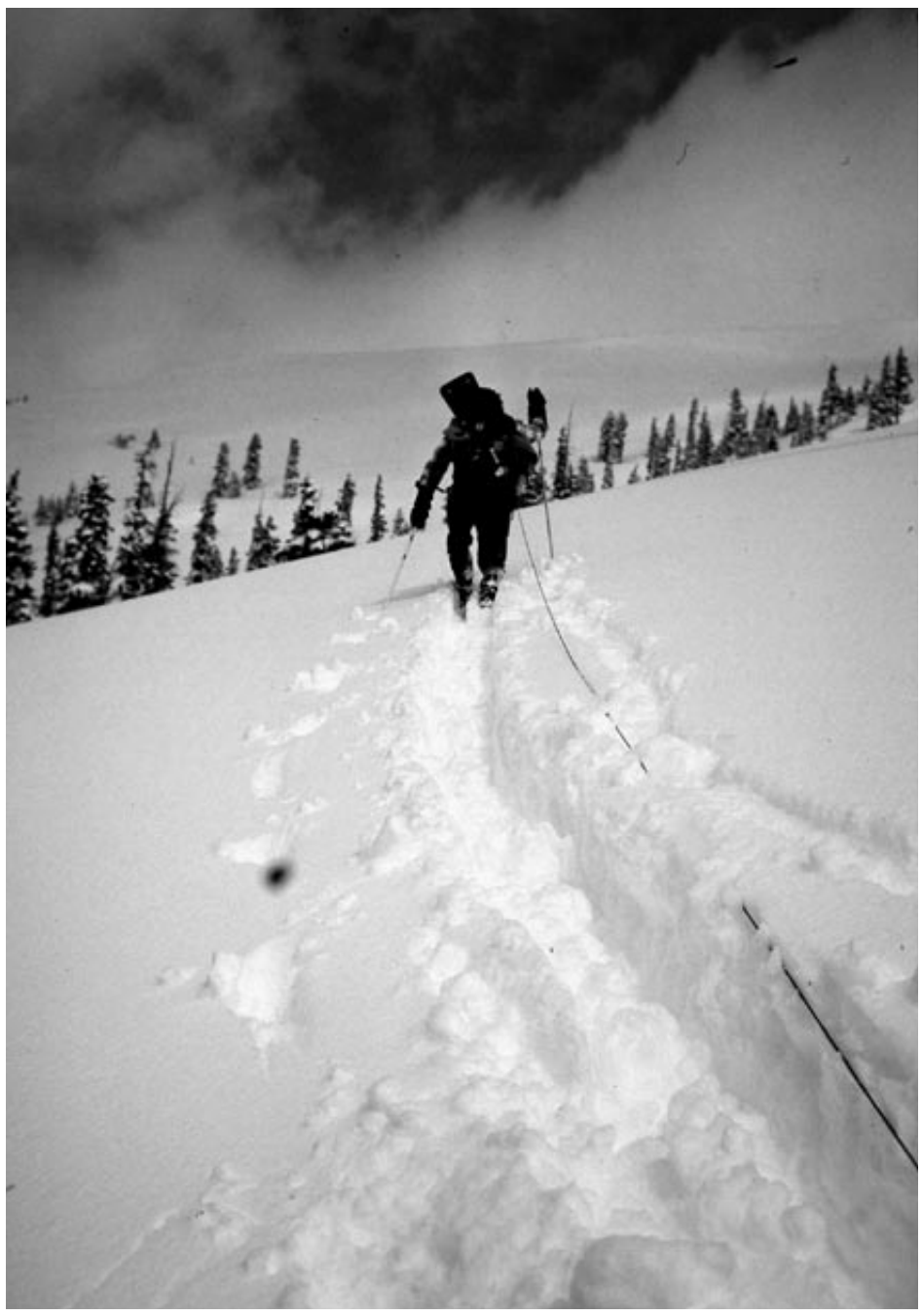
Thanks to Colin Fraser's 1966 book, *The Avalanche Enigma*, we know the use of avalanche cords goes back just over 100 years to a Bavarian mountaineer named Eugen Oertel. (Years ago the cords were sometimes called Oertel Cords.) In Colorado the first mention goes back to 1908 when the *Ouray Herald* (Nov 13) repeated the suggestion that miners in the San Juans adopt "snowslide ribbons" to safeguard their travels to and from the mines. In the early years the use of and the sentiment toward avalanche cords was mixed. Thirty years earlier Gerald Seligman, who was "inclined to its use," quoted an unnamed person in his seminal *Snow Structures and Ski Fields* who provided a colorful, and perhaps unfavorable, description of cords by writing, "The vision of a line of sturdy mountaineers tripping intricately across a snowfield like embarrassed macaws in pursuit of each others' scarlet tails may give us some pleasurable moments." In 1966 Fraser was not too worried about looking like an "embarrassed macaw" and recommended, "…every skier embarking on a tour should carry one [avalanche cord] in his rucksack."

The big question has always been, "How well do avalanche cords work?" The short and simple answer is, "Cords are ineffective." In 1966, Fraser wrote "…avalanche cords have saved many lives." However, he provides no statistics or examples. Instead, he offered two stories contradicting his supposition. One report is a firsthand account of the rescue of a buried fellow ski patroller – with cord deployed. The lucky patroller was only saved because his gloved fingers stuck above the snow. His 30-yard-long avalanche cord was completely covered. While Fraser offers a simple and reasonable explanation to why the cord was buried, he then tells another story of a prominent ski patrol leader who years earlier found himself on top of the avalanche but his cord completely buried.

In the early 1970s the Swiss took a hard look at avalanche cords. Melchoir Schild, of the Swiss Federal Institute for Snow and Avalanche Research (SLF) and a great expert on avalanche rescue dogs, reviewed 30 years of Swiss avalanche accidents and rescues from 1944/45 to 1973/74. Out of the 2042 avalanche victims, he found only seven cases where avalanche cords were used (not including the two mentioned above). In five cases part of the cord was visible on the surface, but so too were part of the victims. In the sixth case the victim was completely buried, but part of the cord was visible. Sadly, this victim died of trauma. In the seventh case the completely buried avalanche cord was located by an avalanche rescue dog, however, the cord had become detached from the victim. Her body was found much later. In 1975, at a symposium of avalanche-rescue experts hosted by the International Vanni Eigenmann Foundation, Schild concluded, "On the basis of these results the avalanche cord can no longer be considered reliable."

Though not mentioned by Schild, a research project funded by the International Vanni Egenmann Foundation may have also influenced his opinion. In their 1986 book, *The Avalanche Book*, Knox Williams and Betsy Armstrong cite an early 1970s study where avalanche cords were tested on sandbag dummies. The dummies were placed onto steep slopes where explosives were used to trigger avalanches. Trials showed a portion of the cord remained on the surface only 40% of the time. The other 60% of the time the cord was completely buried along with the dummy. I was told years ago that in most of those buried cases the cords were spooled around the dummies.

Experience with avalanche cords in the US has been just as disappointing. In 50 years of records from 1950-1999 involving 782 reported burials (1999 was the last year I mentioned avalanche cords in the US summary of accidents) there were only two accidents involving five buried victims who wore cords. The first accident resulted in the live rescue of a buried victim on Christmas Day, 1969. The second incident nearly 10 years later should have, as Knox Williams described, wiped away any charm affixed to cords. In January 1978, five ski mountaineers triggered an avalanche with cords deployed. One skier was partly buried, but his four friends and cords were completely buried. Moderate snow and the loss of the survivor's eyeglasses only worsened the situation. The search was called off a few days later. The four were all found many months later after their bodies with attached cords melted out of the snow. On one victim the cord was wrapped tightly around the body.



Hi gang,

Well, I pulled out all my old avalanche-related slide notebooks. And about mid-morning I found the one shot that I knew had an avalanche cord in it. So, here it is. I took this back in the '80s or late '70s. The gent with the cord on is Steve Baker, and we were skiing in the Gore Range, CO.

Cheers, Halsted

Being wrapped up by an avalanche cord certainly can cause problems. A bunch of years ago a ski patrol friend was buried while wearing his cord. He and his cord both ended up completely buried. Though buried less than a foot down, he could not self-extricate because his cord had spooled around him, binding his arms and hands to his body. Fortunately the slide was small, and his partner knew right where to look and literally pulled him free.

While traditional avalanche cords are not effective markers, over the years modified versions have appeared with varying degrees of success. In the 1960s and '70s, French ski patrollers would tie a helium-filled balloon to the end of a short, 3-5m long cord. This method was said to work much better than the simple cord. Also, in the late 1990s a couple of Austrians added a spring-frame ball to the end of the avalanche cord. The "Avalanche Ball" has shown promise as an effective surface marker (but not in all situations). Check out this online video for some info on the ball: www.youtube.com/watch?v=qTKLdBe3VBc.

For decades I have been a nonbeliever in avalanche cords because of their ineffectiveness and the possibility to impair the user. The Flash Avalanche seems to be an old product, repackaged for a new time. Is it a waste of money? Not necessarily. If someone wants to spend the $85ish dollars for the device and use it in addition to their transceiver, that's fine. Even the small chance that a ribbon will be visible will greatly speed up the transceiver search for a buried friend. However, the Flash Avalanche should not be considered a replacement to transceivers and used only by itself.

Dale Atkins is the US representative to IKAR, the international commission on alpine rescue, and the rescue representative to the AAA board. He lives in Colorado where he is reputedly starting work on the next volume of The Snowy Torrents.

Avalanche Cords Make a Comeback

Story from www.pistehors.com

A new avalanche safety system is about to be launched onto the market. Called the "Flash Avalanche," the system is a development of the avalanche cords used by ski tourers before the widespread adoption of avalanche beacons. The main advantage is that is consists of four cords which are only deployed in the event of a slide. Aimed at off-piste skiers, the Flash Avalanche will sell for 55 euros.

The system is worn on the wrist and weighs just 220 grams. The four cords are 10-meters long and made of 15mm wide red polyester tape. It is triggered by a hand movement at which time the cords are, hopefully, dispersed around the victim. Assuming one is visible on the surface, the searcher merely has to follow the cord.

We have several doubts about the device. Although visual indications are often responsible for the rescue of avalanche victims, we are normally talking about skis or poles visible on the surface and still attached to the skier. This implies that the victim is not deeply buried, which is another key factor in avalanche survival. The idea behind the avalanche cord was that it was made of strong but thin cord, and the distance to the victim was marked on the cord. A searcher could pull on the cord and cut through the snow until it he was vertically above the victim. The distance marks would give the burial depth. It is not clear if the polyester cords of the Flash Avalanche will be strong enough to cut through avalanche debris. Searchers could be faced with a considerable longitudinal dig to the victim. We are also concerned if the device will be robust enough to resist being ripped off the victim's wrist by the considerable forces of an avalanche. Finally, how practical is the triggering mechanism? Take a look at the Web site at www.flash-avalanche.com and judge for yourself. Flash Avalanche quotes from the ANENA (French Avalanche Research Institute); however, the ANENA is sceptical about avalanche cords.

The Flash Avalanche is not the only such device on the market. The avalanche ball is a spring-loaded ball with cord that attaches to a skier's rucksack.

education

SCENOMICS RESEARCH: Ignorance Is The Ultimate Human Factor

Story by Mike Richardson

A straightforward framework for basic avalanche education already exists. This education takes place at a recreational avalanche course (which, in the US, meets AAA level 1 guidelines), and the curriculum is designed to teach basic facts. For professionals, education options are considerably better – at considerably greater expense. How does a recreationist advance when no rigorous and affordable method of advanced education exists? Skimming a book repeatedly does not improve retention. Teachers call this "reading without learning."

My own experience with backcountry skiing has been as follows: get interested, get education, and go skiing in spectacular alpine settings. I spent these days managing a vague and unsettling feeling that I could not explain. This feeling is called uncertainty. I diligently read *The Avalanche Handbook* cover to cover several times, yet could not retain enough material to evaluate instability. With each pass through the book, I found myself highlighting key facts and reminding myself not to forget them. This learning process contributed little toward the conceptual understanding required to make decisions in high-uncertainty environments.

Eventually I found myself alone at the top of an avalanche path known for producing large, destructive avalanches. Should I descend via the avalanche path or return via the approach? At that point I didn't understand that my inability to measure and account for uncertainty was a serious problem. My head was full of generalizations about instability, but few were relevant to the situation. I lacked the conceptual understanding necessary to evaluate the current snowpack and weather conditions.

For more than a decade, my dog Indy was the center of my life. On a cloudy morning in February 2007, following a recurrence of cancer that chemotherapy could no longer treat, Indy, without words, told me she could go no further. Later that day, my brothers and I took her to the vet where she lay quietly on a light blue blanket, looking up at me. The act of dying left her once lustrous eyes utterly vacant. These things I will never forget. What if my life ended on a cloudy morning in some distant February? Would my mother be forced to stare into my lifeless eyes?

At some point the idea of an exam fluttered into my head. When nothing substantial turned up on the internet, I wrote questions for the first chapter of *The Avalanche Handbook*. On my first pass through these simple questions, I did not provide a single correct answer. Frustrated, I studied the first chapter, drilling myself at intervals. Then I wrote the answers in my own words and passed. Even a small success was delightful after months of failure.

Because avalanche education is technical communication, I asked a small group of technical writers and educators to help design the exam. Educators realize that conceptual knowledge is the bedrock of education. For example, simply memorizing "1 + 1 = 2" does not mean you know how to perform addition. Knowing a fact is not the same as understanding the concept from which the fact is drawn. In avalanche education, instability facts often lead to numerous conclusions. Instability concepts provide a framework for generating new facts relevant to the situation at hand.

You can observe this phenomenon at any recreational avalanche course: a student asks a question in response to a generalization provided by the instructor. The instructor includes a few points of clarification with numerous qualifications for every tidbit. Novices wallow through "generalization soup" until they understand the concepts of instability relative to terrain, snowpack, and weather. This is not a criticism of avalanche education but a fact of life for most novices. Experience is valuable. As children we quickly learn not to put our hands on hot stoves. Unfortunately the mountains offer much harder lessons than scorched fingers. Affordable, advanced education accelerates the process of gaining experience without risking life or limb.

With this in mind, we wrote most of the questions inside a framework designed to teach concepts. To increase retention, the exam contains many abstract questions designed for toughness. This forces the student to understand and link the concepts. Conceptual understanding helps the student move past the generalizations taught at a recreational avalanche course and learn how to generate facts relevant to the situation at hand. The line between facts relevant to the situation and generalizations about instability is exceedingly fine. Stated simply, generalizations are useful only when the terrain, weather, and snowpack just happen to line up with the generalizations floating around in your head.

Passing this exam increased my competence by several orders of magnitude. Over the long term, conceptual knowledge is required for decision-making anchored in reasoning instead of guessing. The spatial and temporal variability of the snowpack, along with incremental changes to the snowpack, and variations in human perception, are enormous engines of uncertainty. Managing this uncertainty requires real knowledge.

It's as simple and complicated as that.

Mike Richardson is a software developer from the Pacific Northwest. His interests include dogs and skiing. Mike is happy to answer questions in exchange for cookies. Please contact him if you would like the link to the online exam based on The Avalanche Handbook. *mike@scenomics.com*

Skinny Skis Avalanche Awareness Night

Story and photos by Sava Malachowski

The annual installment of Skinny Skis Avalanche Awareness Night at Snow King Resort on December 4, 2008, had a record number of people attending and raised the largest amount of money ever with $5,500 for the Bridger-Teton National Forest Avalanche Center and $3,370 for Teton County Search and Rescue. Over 600 people paid the $5 entry fee and got a free raffle ticket. The Grand Prize was an All-Mountain Season Pass donated by Jerry Blann, president of Jackson Hole Mountain Resort, and an All-Mountain Season Pass to Snow King Mountain donated by Jim Sullivan, public relations director for Snow King Ski Area.

The raffle also featured a huge pile of gear donated by top manufacturers of outdoor equipment: jackets, avalanche transceivers, avalanche shovels and probes, backpacks, and gloves.The large turnout may have been influenced by backcountry travelers' concerns about this winter's sketchy snowpack.

Rod Newcomb, of the American Avalanche Institute, who traditionally opens the event with an assessment of the season's snowpack, reflected this concern. After declaring the snowpack on Teton Pass to be shallow and therefore dangerous, he made everybody in the room stand up, raise their right hand and repeat after him, "I promise that I won't die in an avalanche this season."

Newcomb's brief and dramatic presentation was followed by an entertaining talk on weather and avalanches by Jim Woodmency of MountainWeather.com. Jay Pistono, Teton Pass Ambassador for the Bridger-Teton National Forest, then gave an effective presentation on Teton Pass-related concerns from the Wyoming Department of Transportation. Pistono reminded people that an avalanche triggered on Glory Bowl or Twin Slides can come all the way down to the road and threaten the lives of people in cars. He also asked people to inform the authorities if they trigger an avalanche, providing as much detail as possible. In addition, avalanche debris on the road has to be probed by TCSAR to make certain that no one is buried before the road can be cleared with rotary plows.

Bob Comey of the Bridger-Teton National Avalanche Forecast Center (BTAFC) gave an update on the workings of the Avalanche Lab at the Jackson Hole Mountain Resort. John Griber, a local filmmaker, snowboarder, and internationally recognized Himalayan climber, then finished the evening with a multi-media presentation of his latest expedition to Gasherbrum II in Pakistan. John mixed his personal narration with slides and video from the climb of the 26,360' mountain. His most important point was that despite the enormous team effort getting to the mountain and weeks of climbing it, when the avalanche conditions became too dangerous they abandoned their summit attempt. Griber explained, "There is always another day, another mountain to climb."

Event attendees browse the Teton County Search and Rescue booth during the Skinny Skis Avalanche Awareness Night held this December.

left: Jim Woodmency talks with Phil Leeds *(right)* and Jeff Crabtree *(center)* of Skinny Skis, with Chris Harder in the background.
right: Jay Pistono, Teton Pass ambassador, gives an enthusiastic explanation to Bob Comey of the Bridger-Teton Avalanche Forecast Center.

Skinny Skis Avalanche Awareness Night is a collaboration between Skinny Skis, a Jackson, Wyoming-based retailer of cross country and backcountry skis and outdoor equipment; Teton County Search and Rescue; and the BTAFC. This annual event, which in the past has featured such speakers as Jill Fredston and Bruce Tremper, provides an opportunity for long-time residents and newcomers to come together at the beginning of the season and visit with friends, get informed about snow conditions, have an opportunity to find out about or buy avalanche rescue equipment, and access information about local avalanche classes.

Sava Malachowski is the producer of SavaFilm in Wilson, Wyoming.

Shovel Performances Span Heaven and Hell

Story, photos, and diagrams by Manuel Genswein and Ragnhild Eide

The publication of the V-shaped snow conveyor excavation strategy triggered many questions concerning the quality and efficiency of the working tools – in particular, the avalanche shovel. The following study focused on avalanche shovels that can be carried in a normal-sized backpack. Specialized rescue shovels with large steel blades used occasionally by organized rescue have not been taken into consideration. Plastic shovels were also not studied since they usually break in cold temperatures and hard debris before the first buried subject can be excavated. There are even some shoveling tools available without a shaft. These have not been taken into account due to the inefficiencies of their mechanical and/or ergonomic design.

Under the conditions of this research, shovels were tested while applying correct shoveling techniques. All testers were shown how to cut blocks and specifically instructed not to break up debris by leveraging handles with a lot of force. All failures and observations were seen during regular use of the shovels in avalanche rescue, the application they are primarily designed and sold for.

In addition to testing and rating a selection of products currently available on the market, this research aims to provide a detailed overview on the many important characteristics and functions of a shovel. The resulting criteria may be used as an evaluation guide for future products.

The manufacturers of the tested products were asked to comment on the test result for their product, which may be read at www.bergundsteigen.at.

This project was carried out by the authors Manuel Genswein and Ragnhild Eide under the patronage of The Austrian Alpine Club.

A selection of *Life's A Beach* avalanche shovels, ready to build sand castles.

Avalanche Shovel Selection Criteria

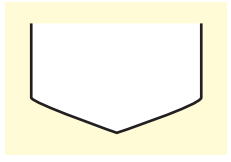
From all major manufacturers, only the one or two most promising (mechanically strong, ergonomic, lightweight) versions were selected for the test. Three each of the selected models were purchased in a regular mountain sports shop. In addition to a few heavier and larger versions weighing approximately 800 grams, we purposely selected a few lighter shovels in order to see if they can offer comparable properties / qualities as the larger versions. The lighter models were also an attractive choice for those who preferred plastic shovels.

Predominant Failure Patterns

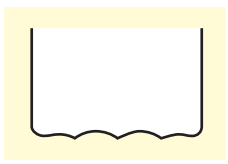
Most mechanical failures occurred while chopping blocks in hard debris. Blade deformations were often caused while jamming the shovel blade into the debris by stepping on the blade with a ski boot. When cutting into hard side walls, it was often not possible to cut into the debris by using the entire front of the blade. *(Refer to diagram "how to properly cut blocks in hard debris")* By using only the corner of the blade, the same applied force is concentrated in a smaller area and therefore more effective. However, in several models, the blade could not withstand this mechanical stress, which led to irreversible deformations.

Important Characteristics and Features

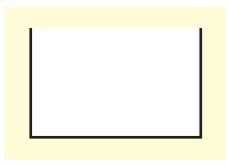
SHAPE OF THE BLADE—



A triangular-shaped blade is offered by a few manufacturers. Theoretically the concentrated point of attack is advantageous when chopping hard debris. Unfortunately practice shows that in hard debris the triangular shape creates an unstable position that forces the blade to twist sideways. If the material could withstand the concentrated stress at the tip, or enhance a sideways attack with the blade, one could theoretically see this shape as an advantage. In practice, however, it has been shown that applying force across the full width of the blade while chopping snow leads to more efficient snow removal.

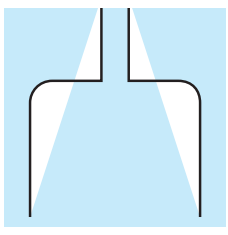


A serrated leading edge, with several exposed points of attack on a straight line, delivered the best cutting characteristics.



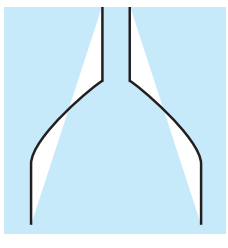
A straight front line of the blade provides a very stable leading edge of the shovel while chopping snow. The mechanical integrity of the main line of attack leads to the greatest blade durability.

In general, rounded tips offer good characteristics for cutting snow, although the rounded shape can lead to some instability.



BLADE DESIGN—

A flat top provides a good platform for stepping on while pushing on the shovel from the back in hard debris.



When the top of the blade slopes to the sides at an angle, the boot simply slides off, preventing any energy from being transferred from the foot to the shovel. This wastes energy and discourages the shoveler.

BLADE RADIUS—

Small radiuses in the shape of the blade will lead to more mechanical stress being concentrated in those specific zones of the blade. Therefore, small radiuses are more vulnerable to deformation and eventually cracking.

BLADE SIZE—

Small blade sizes take less energy to wield, but make snow chopping and transport less efficient. In contrast, large-sized blades can move a lot of snow quickly, but require a very strong person.

SHOVEL RATING CATEGORIES

HELLISH

☠ ***Shovels that break and damage your equipment.***
Shovels that belong in the *Hellish* category not only break, but also damage other equipment during regular use. Shovels with serious safety issues belong in this category as well.

☠ ***Shovels that are likely to break before the first subject has been excavated.***
Plastic shovels are often preferred for their light weight but are more likely to break in cold temperatures and on hard debris even before the first buried subject has been excavated. Furthermore, when plastic shovels do break, typically the entire tool becomes useless. Since there is no weight difference between plastic and the lightest metal shovels in the *All Mountain* category, plastic shovels should not even be considered.

LIFE'S A BEACH

☹ ***Shovels in this category allow you to excavate one or two buried subjects in hard avalanche snow, but are not designed to withstand the stress an avalanche shovel is exposed to without being damaged.***
After short use, these shovels show irreversible structural failures and need to be replaced. Considering the fact that the shovels of the *All Mountain* category are not more expensive – and some are actually cheaper – there is no justifiable reason to purchase a *Life's a Beach* shovel. These shovels will inevitably fail due to inferior properties of the metal.

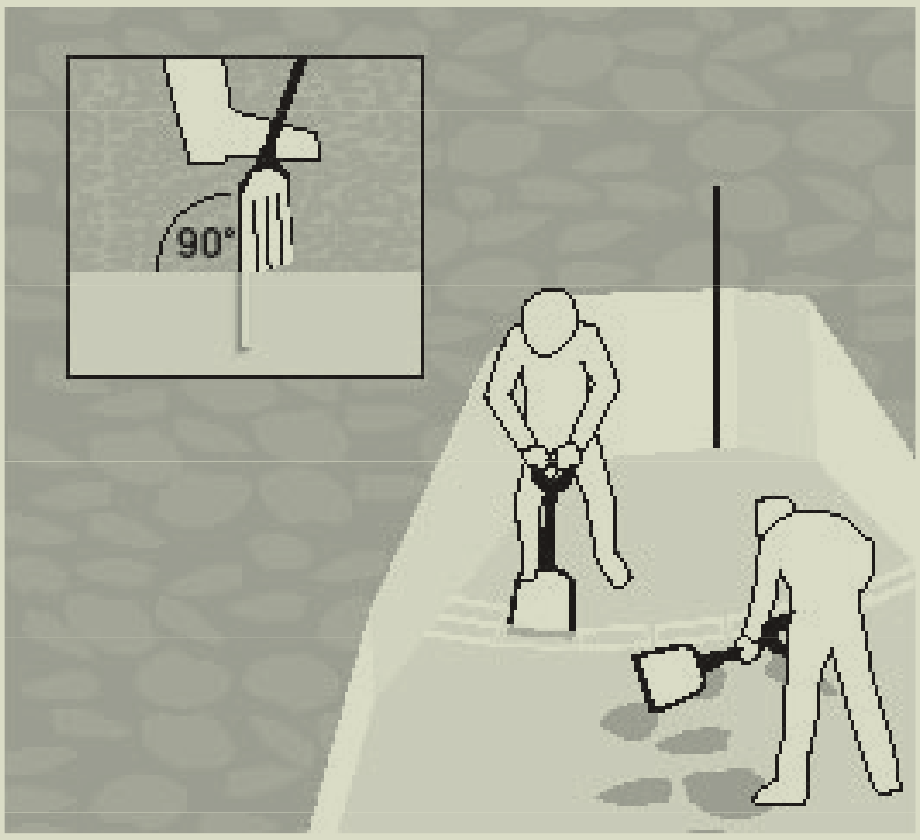
ALL MOUNTAIN

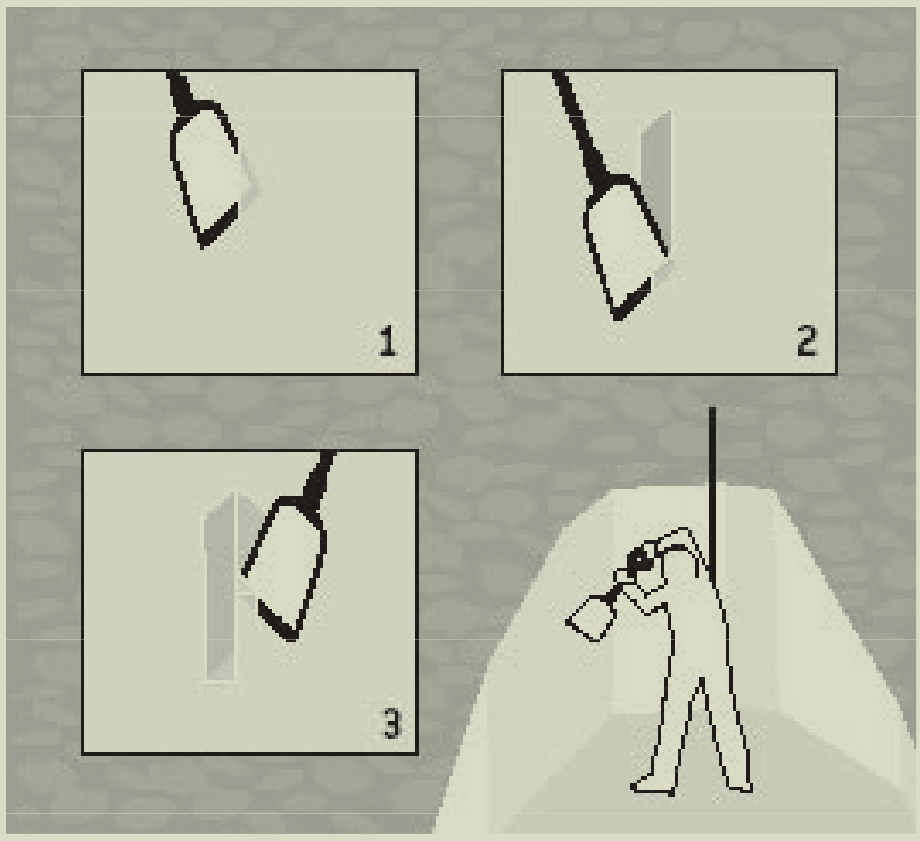
☺ ***All Mountain shovels are made for year-long use in avalanche rescue.***
These shovels are neither heavier nor more expensive than shovels from the *Life's a Beach* or *Hellish* categories. Due to the use of durable, heat-treated alloys, theses shovels do not suffer damage when chopping through hard debris.

HEAVENLY

❤ ***Unfortunately, the perfect shovel has not yet been constructed.***
See prototype of the solar-powered shovel with high-energy lithium batteries on next page…to be released in the near future.

CUTTING SNOW BLOCKS





CHOPPING BLOCKS: Rescuer facing toward the end of the V, shovel blade 90 degrees to the snow surface for optimal cutting. Segments should be narrow so that they can be broken away by tilting the shovel toward the rescuer's body.

WIDENING HARD SIDEWALLS: By concentrating the entire force to the corner of the shovel blade, even very hard side and front walls can be "attacked." Cut several triangular columns out and the intersecting snow will be easily removable.

All testers were instructed in the proper techniques for excavating avalanche victims, including how to cut blocks and move debris without leveraging shovel handles using undue force.

BLADE MATERIAL—

Only shovels with blades made of 6061 alloy with T6 heat treatment made it into the *All Mountain* category. Other manufacturers claim to work as well with specially treated alloy, but the tests did not prove the efficiency of alternative materials or heat treatments.

It is advised to be suspicious of shovels that do not clearly specify the use of 6061 and T6. For example, the Black Diamond R&D department explained to us in writing, "The mix that we use has taken much work and dedication in order to perfect. For this reason we do not share the specifics." Too bad. We do share with you that their top-of-the-line product ended up in the *Hellish* category.

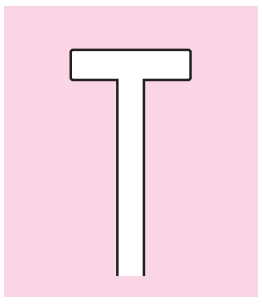
SCOOPING CHARACTERISTICS—

The more the cross section of the blade resembles a U-shape, the more reliably the snow will stay on the shovel while lifting or transporting snow.

BLADE-TO-SHAFT CONNECTION—

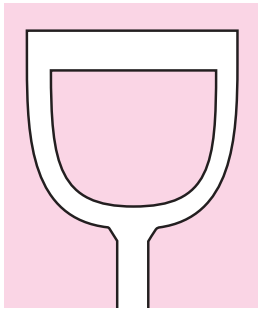
Round shafts offer less resistance while adjusting length, but are prone to rotating while adjusting, which then requires more time to insure proper alignment between the extension holes and alignment pins. Shafts with an assymmetrical cross section, such as oval or trapezoidally shaped shafts, exhibit more resistance while mounting, removing, or adjusting the length, but will not waste time aligning the push-pin with the extension hole.

HANDLE DESIGN—



T-shaped handles

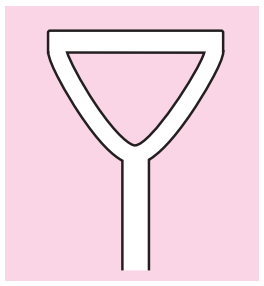
This is the least efficient and least ergonomic handle configuration. Newer versions of T-shaped handles with more rounding show fewer problems, except for rescuers with small hands where the entire handle is too big and does not allow a proper grip.



D-shaped Handles

This is the most comfortable grip, although a minimum depth and width must be determined for each person's hand.

left: D-handle with side walls provides an ergonomic grip.



left: D-handle without side walls is too small for most shovelers to operate with gloves on.

ADDITIONAL GRIP—

Some manufacturers supply an additional grip on the shaft of the shovel. The concept of this shaft grip is to provide more precision and stability while shoveling.

ANGLE OF THE BLADE COMPARED TO THE SHAFT—

The angle between the shaft and the blade is a compromise between efficiency while chopping and efficiency while transporting snow. Whereas the shaft and the blade should be in a straight line for chopping blocks, a more angled version is preferred while transporting snow in rowing motions.

ALTERNATIVE ANGLE BLADE – SHAFT —

Some models offer the possibility of pivoting the blade to be approximately at a right angle to the shaft, thereby transforming the shovel into a hoe. For certain applications, this can be advantageous. However, the versatility of this feature can compromise long-term durability and is not always ergonomically superior.

LENGTH OF THE SHAFT—

All testers complained continuously about the inefficiency and discomfort of short, non-telescoping shafts. Short shafts mandate an uncomfortable work position and dramatically reduce the effective range of motion. As soon as you use your shovel for what it is meant for – shoveling snow – you will not regret any extra weight a telescoping shaft adds. Telescoping shafts need sufficient overlap between the two segments in the extended state in order to provide enough mechanical stability.

CLOSURE OF THE SHAFT—

The opening of the shaft needs to be covered so that no snow may enter the shaft while shoveling. Snow entering the tubular shaft will lead to a malfunction of the locking mechanisms, and the compressed snow will melt into the interior of the backpack after use.

APPLICATION OF SHOVEL AS IMPROVISED EMERGENCY TOBOGGAN—

Shovel blades with mounting holes are useful to connect with the tips of the skis or the bindings for improvised terrestrial transport of a patient.

RESCUE INSTRUCTIONS—

Rescue instructions on the shovel blade make sense from an educational point of view, as the equipment is always with the owner and therefore offers a good opportunity to familiarize them with the basic rescue instructions. The print, however, should not lead to snow sticking to the blade.

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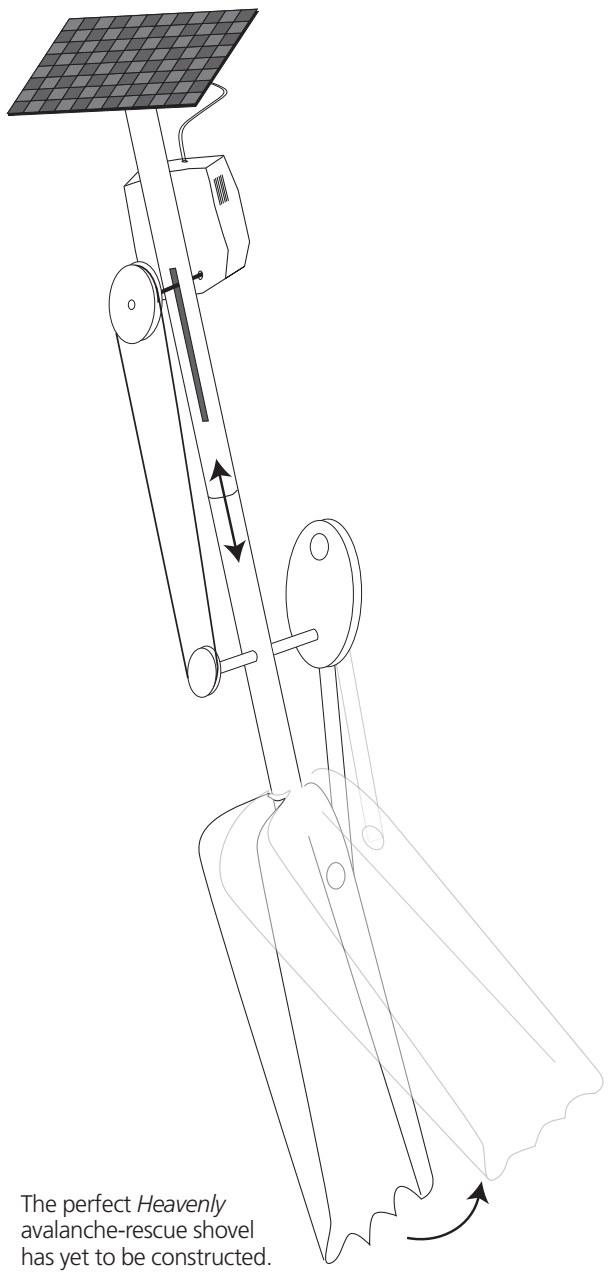


The perfect *Heavenly* avalanche-rescue shovel has yet to be constructed.

The shovel and the damage done: Several testers experienced severe damage to their ski boots, produced by the sharp edges and corners on top of Black Diamond's Transfer 7 shovel blade.

PERFORMANCE RATINGS

continued from previous page

☠ BLACK DIAMOND TRANSFER 7

Hellish

Sharp, Cutting Edge on the Top Side of the Blade: Like all smaller Black Diamond shovels, the Transfer 7 has a sharp edge on the top side of the blade. Since the blade design features a rounded top, shovelers must press their boot next to the shaft, right onto this cutting-edge feature. These shovels were removed from testing after the ski boots of three participants had been severely damaged by this sharp edge. The Vibram soles of the ski boots were severely damaged, and in one case even the rigid plastic shell of a Scarpa Denali boot was nearly destroyed.

Mechanical Characteristics and Stability: The Transfer 7 shovel cracked where the ramp angle of the blade starts to change toward the shaft of the shovel. The small radiuses on the upper end of the shovel blade cannot withstand the force applied to the shovel when cutting blocks and pushing the shovel with the ski boot into the snow, leading to severe deformations.

top: The Black Diamond blade broke at the starting point of the shaft holder.
bottom: The blade's material could not withstand the force to cut blocks, severely damaging the upper end.

Conclusion: In addition to cracking and deformation to the shovel itself during use, Black Diamond's largest and most rigid shovel caused extensive damage to plastic ski boots. Due to a rounded shape of the top of the blade, it is difficult for shovelers to step on it with boots, which makes cutting blocks harder. The trapezoidal shaft is strong with good surface structure on the metal. The T-grip has a good ergonomic shape, better than most T-grips, but the size is too large for a person with fairly small hands to utilize effectively.

In short order, the Pieps blade was so severely deformed and cracked that the shovel could no longer function.

☹ PIEPS PRO

Life's a Beach

Mechanical Characteristics and Stability: Unfortunately the Pieps Pro shovel broke before two holes of 2m burial depths could be excavated. The initial failure starts in the front center of the blade parallel to the company logo which acts as a weak spot. Even while examining this shovel in the shop, the blade clearly seemed far too soft to withstand an avalanche-rescue environment. This observation later held true during testing, as the sides of the blade bent outwards in short order during shoveling – effectively destroying the structural integrity of the blade.

Snow Cutting: The blade cuts snow nicely but is too weak to withstand the forces an avalanche shovel is subjected to.

Shaft and Extension of the Shaft: The T-grip was not the preferred shape of most of the participants. Pieps Pro has an assymmetrical shape for the locking knobs that allows the shovel to mate easily onto the shaft.

The additional grip on the shaft is strong and shredded gloves that didn't have durable surface material.

Conclusion: The Pieps Pro is by far the weakest and least recommended product in the *Life's a Beach* category. Unfortunately, this illustrates that some manufacturers do not appear to test their products in the real application environment before they are thrown on the market. In particular, safety equipment should be thoroughly tested by the manufacturers, as well in the hands of end users.

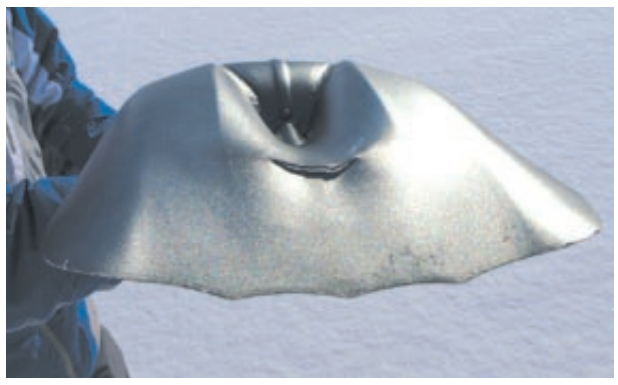
Stubai's locking bolts fell apart in different positions on several of the shovels tested, rendering them useless.

☹ STUBAI

Life's a Beach

Mechanical Characteristics and Stability: Rigid shaft, but some deformations of the shovel blade have occurred. Unfortunately, several of the locking pins on the shaft and in the handle broke, rendering the entire shovel useless. The locking pins are obviously weak in the connection between the bolt and the spring.

Conclusion: The small blade size of this shovel limits the amount of snow that can be moved per scoop. The overall stiffness is good for cutting blocks; however, removing the blade from the shaft was difficult and required a lot of force. The T-shaped handle felt uncomfortable.



Despite its tough moniker, the Ortovox Grizzly cracked under the pressure of field testing. The serrated front blade edge, however, was given high marks for excellent cutting characteristics.

☹ ORTOVOX GRIZZLY

Life's a Beach

Mechanical Characteristics and Stability: Unfortunately the Grizzly shovel did not live up to the strength implied by its name. The blade cracked where the ramp angle of the blade starts to change toward the shaft of the shovel, and the entire front of the shovel was heavily deformed. The large, flat platform on the upper end of the shovel is very effective when chopping blocks in the snow by stomping on the shovel with a boot.

Locking Mechanisms and Hoe Function: Attempts to lock the shovel in the two available positions weren't reliable, especially when the locking pin iced up. The shaft cannot be locked in the short length, which was particularly disappointing when working in close proximity to the buried subject. The hole which holds the locking bolt in place in the hoe working position quickly became ovalized, creating slop in the blade.

For general comments about the hoe function, see "Alternative angle blade – shaft" on page 17.

Snow Cutting: The serrated design of the leading edge of the shovel blade results in excellent cutting characteristics.

Conclusion: The concept of a shovel with an optional hoe position is promising, but many testers found this model tricky to handle while finding the proper locking positions. The lack of a short shaft working position is not optimal. The additional grip on the shaft is very aggressive even with gloves with a strong leather surface but still wore out remarkably quickly due to contact with the side of the ski boot when chopping snow.

The Ortovox Alaska's weak material could not hold up to digging and chopping blocks.

☹ ORTOVOX ALASKA D
Life's a Beach

Mechanical Characteristics and Stability: The blade of the Alaska D shovel deformed very easily. When pushing the blade into debris, it deformed dynamically and almost popped out again. The deformations quickly became permanent. There is too much play at all locking points (blade/shaft/extension).

The size of the blade allows movement of large amounts of snow per scoop and is not too big for a weaker shoveller.

Conclusion: The Alaska D has a very good D-shaped handle and a nice foam/rubber grip on the shaft. The only complaint about the additional grip material is that snow sticks to it, making it slippery to handle.

The Ortovox Alaska D was well liked by the testers, but unfortunately it is mechanically weak. This could potentially be a great shovel for avalanche rescue if manufactured with appropriate material.

During testing, the BCA's shaft bent near the blade attachment until it finally snapped off completely.

☹ BCA CHUGACH PRO EXT
Life's a Beach

Mechanical Characteristics and Stability: The big blade of the Chugach Pro showed little deformation, but the shaft slowly began to bend where it meets the blade and eventually broke. Even though the oval shaft is strong for levering; it was unable to handle the forces it is exposed to at the connection with its large blade.

Conclusion: Shovel blades of this size only make sense for particularly strong individuals. All other components, like the shaft, should be designed to withstand these forces. A shovel in this size targets a user group who would expect the lower shaft to be closed with a cap so that snow won't fill up the shaft.

The Mammut Expert simply folded up under pressure.

☹ MAMMUT EXPERT
Life's a Beach

Mechanical Characteristics and Stability: The blade of the Mammut shovel deformed very easily. This shovel was also used in the companion-rescue field test in 2008 and the V-shaped excavation field tests in 2007, and it has consistently displayed the same failure pattern with over 10 shovels. Some failures have occurred at the neck of the blade where the soldered back side broke.

Conclusion: Ergonomic handle, almost oversized and therefore rather big in packing size. Very weak blade.

This G3 model held up well during testing, showing only minor deformation to the top edge that did not affect shovel performance.

☺ G3 AVITECH D-GRIP
All Mountain

Mechanical Characteristics and Stability: The AviTech is manufactured with 6061 T6 alloy and withstood the tests without problems.

The shovel has a nice flat top for pushing the blade into hard avalanche snow with a boot. However, the radius is a bit too small towards the upper end, so some permanent minor deformations could be seen.

Conclusion: This proved to be a good sturdy avalanche-rescue tool. The D-grip handle is too small and not optimal in shape for rescuers with big hands or gloves. Top handle bar should be round for ergonomic glide while shoveling.

☺ VOILÉ TELEPRO T6
All Mountain

Mechanical Characteristics and Stability: All the features one would want are contained in this family of shovels. The Telepro T6 is manufactured with 6061 T6 alloy and withstood the rigors of testing without any problems. While being subjected to the same abuse as other shovels, Voilé blades were unaffected by destruction or deformities. The top of the blade was almost square, providing a good platform to step on, with excellent transfer of power. Though simple, the straight leading edge of the blade was reliable and durable. Finally, it comes with a telescoping shaft and a D-grip, the hands-down grip of choice for comfort among our testers.

Conclusion: This a good example of how an avalanche-rescue tool should perform: sturdy and ergonomic. A very good choice if you are not concerned that every single gram must count. For serious professional avalanche rescue and daily snow observation.

☺ VOILÉ XLM PRO
All Mountain

Mechanical Characteristics and Stability: The XLM Pro is manufactured with 6061 T6 alloy and withstood the tests without any problems.

This model has a smaller and thinner blade than the Telepro T6, but includes a telescoping shaft with an ergonomic D-handle.

Conclusion: A very good choice if you are looking for a sturdy, yet fairly lightweight, ergonomic shovel for touring. The weight is comparable to a heavier plastic shovel.

☺ VOILÉ XLM
All Mountain

Mechanical Characteristics and Stability: The XLM is manufactured with 6061 T6 alloy and withstood the tests without problems.

Compared to the Telepro T6, this model features a smaller, thinner blade and a very short shaft with a T-grip handle. Testers complained about shoveling discomfort with such a short shaft.

Conclusion: Sturdy and extremely lightweight. A good choice if weight is the most important criteria. This model's weight is comparable to the lightest weight plastic shovels available. Despite its weight, the shovel is very sturdy, yet sacrifices some ergonomics.

Declaration of neutrality: *All equipment rated in this study was purchased and paid for by the authors, and none of the involved parties are in any way involved in the manufacturing, sales, or promotion of any of the tested equipment.*

This research project also includes a section on avalanche probes; watch for the probe ratings in TAR 27/4.

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SHOVELS TESTED

	weight	packing length	short length	extended length	rating
BCA Chugach Pro Ext	1128g	59cm	88cm	109cm	☹
Black Diamond Transfer 7	780g	43cm	71cm	89cm	☠
G3 AviTECH D-Grip	775g	46cm	65cm	87cm	☺
Ortovox Alaska D	905g	50cm	78cm	97cm	☹
Ortovox Grizzly	838g	48cm	NA	87cm	☹
Pieps Pro	738g	46cm	72cm	99cm	☹
Stubai	775g	48cm	67cm	92cm	☹
Voilé Telepro T6	840g	50cm	79cm	99cm	☺
Voilé XLM Pro T6	665g	45cm	71cm	85cm	☺
Voilé XLM T6	520g	36cm	61cm	NA	☺

see rating categories on page 28

top: The 105 recoilless rifle in action – look closely to see the bullet in flight. *Photo courtesy Noel Peterson*
bottom: New Air out of Durango helping with spring warm-up shoots on Cement Fill. *Photo by Jerry Roberts*

SAN JUAN HISTORY, PART I

continued from pg 25

in high starting zones that didn't need the preset coordinates that artillery pieces required.

CDOT was building an outstanding avalanche-reduction program that evolved as time passed and experience was gained through many "shoots." Noel will tell you that they didn't really forecast avalanches, but had a pretty good idea that immediately after a storm was a safe bet on getting some of the paths to run. He said with a grin that in the early days they kept their results on a matchbook or a post in the shop before they became more sophisticated at recording the information on paper. Noel retired in 1988 after a distinguished career and was one of the true legends and heroes who worked the trenches of the CDOT avalanche program.

In the late '60s the Bureau of Reclamation, responsible for gathering water for a growing West, was out of options according to Peter Shelton's article, *Snow Science Hall of Fame* (TAR, Vol. 25, No. 2, December 2006). The Sierra Club had successfully stopped dam building on the Colorado River, and the filling Glen Canyon Dam would not be enough to satisfy the water needs of the seven states in the Colorado River Compact.

The Bureau of Reclamation came up with the idea of storing water in the form of snow in the San Juan Mountains of southwest Colorado and called it *Project Skywater*. The San Juans cover the same geographic area as the Swiss Alps and were already an important "water bank," according to Shelton. So if the snowpack could be enhanced from cloud seeding, then the big water users in developing areas such as Las Vegas, Phoenix, and the agriculture industry would be very pleased. Small mountain communities, however, weren't so sure about more snow in their already snow-choked mountain valleys and roads. Increased avalanche potential was a very big concern, and the citizens of Ouray and Silverton let their politicos know, who then passed it onto the Bureau of Reclamation.

Shelton continues, "So, in 1971, the Bureau funded a study by the University of Colorado's Institute of Arctic and Alpine Research (INSTAAR) to learn about the behavior of snow and avalanches. The San Juan Avalanche Project brought to Silverton, Colorado, an all-star team in the relative new world of American snow science." Many of those heavy hitters – some of whom have ascended to legendary status – helped spawn an avalanche-forecast program for CAIC/CDOT or stayed on to ski, teach, and later forecast avalanches for the highways of the San Juan. The rest of the INSTAAR team scattered to mountain ranges around the West. Much of what they are doing now saw its genesis in a decade of intense, high-spirited, and highly creative work at the top of the San Juan Range.

The San Juan Project was really the beginning of avalanche forecasting for CDOT. The researchers for INSTAAR worked well alongside of the CDOT avalanche-mitigation team led by Noel Peterson, and CDOT recognized the positive results of weather and avalanche prediction to aid in the shooting of the many paths that threatened Hwy 550. But a dozen years passed before that union became a reality.

See TAR 27/4 for Part 2 of Jerry Roberts' avalanche history of the San Juan mountains.

Jerry Roberts prowls Red Mountain Pass in a white CDOT truck, tracking the cast of usual suspects above and below the snow surface. His latest observation from the road has him "up to his ass in alligators" but still composing haiku.

JR in a snowpit at the El Indio mina, Chile.
Photo by Tim Lane