THE Avalanche REVIEW

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www.AmericanAvalancheAssociation.org

Theo Meiners works the sharp end of stability evaluation, hunting for weak layers. In April of 2010 in Alaska's Chugach Range, surface hoar managed to survive and get buried on west aspects and more protected areas, but it was not to be found on this exposed, easterly facing slope. After hard compression test results with poor shear quality and an ECTN, Theo led his group down the slope without incident. The Wrangells provide stunning background topography. *Photo by Karl Birkeland*

The Effect of Changing Snowpack and Terrain Factors on ECT Results

Story by Ron Simenhois and Karl Birkeland

Since this issue of *The Avalanche Review* focuses on fracture, Lynne Wolfe asked us to summarize our work with the Extended Column Test (ECT). The ECT was designed to test not only what it takes to get a block to fail, but whether or not a fracture fully crosses the block. As such, we believe that the ECT gives us some information about snowpack fracture. However, we have to be careful in interpreting our results since the scale of the ECT is obviously much smaller than the scale of a fracture leading to an avalanche. In this short paper we will first put forth our definition of fracture, which is different than the snow community has been using, but which is consistent with the terminology of materials scientists. Then we briefly discuss some recent ECT research demonstrating how changing slab thickness, changing slope angle, increasing loading, and wetting the snow surface affect ECT results.

See story continued on page 22 ➡

The Avalanche Review
P.O. Box 2831
Pagosa Springs, CO 81147

in this issue

How would you feel if someone who didn't know much about skiing tried to teach you to ski safely in avalanche terrain? What would your response be if they made you feel like shredding steep powder slopes was stupid?

—Chris Lundy, *Shredders Teaching Sledders*, pg 17

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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 provide direction for, promote, and support avalanche education in the US;

F. To promote research and development in avalanche safety.

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

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from the president

Witches, Avalanches, and Our Association:

Community, Knowledge, and Professionalism

New AAA president Dale Atkins, December 26, 2010 at Loveland Basin, Colorado, checking out the patrol's handiwork from the day before. *Photo by Sam Atkins*

Early in the start of my avalanche career many snow cognoscenti spoke of "the science of snow and the art of avalanche forecasting." Today, avalanche prediction is an amalgamation of science and art, but it wasn't always that way. Centuries ago the craft of avalanches was often considered to be sinister and dark. In the middle of the 17th century ecclesiastic and secular courts in the alpine countries of Europe found women (and on rare occasions men) who practiced witchcraft and sorcery guilty of causing avalanches. The sentence for the condemned usually meant a very painful death.

Eventually rationality won out over superstition, in part thanks to the Scientific Revolution that started in the mid-1600s. This revolution also spawned the first professional societies, formed to advance their particular discipline by sharing information. Fast forward to today and that is what we – the American Avalanche Association – do. We seek to share information of snow and avalanches, and to promote the development of new knowledge.

Members of the American Avalanche Association have access to a community of peers and experts – now tallying more than 500 professional members – from whom we can learn and share. For the paid avalanche-aficionado, becoming a member of a professional society is an important step in furthering a career as an avalancheologist. For the unpaid professional, membership provides information and enlightenment that may be difficult or impossible to learn in other ways.

Professionalism plays a critical role to further this pursuit of knowledge and to spread information. Being a professional is not just about being paid, it is also about our expertise and specialized knowledge, and our high standards. As the American Avalanche Association advances, our professionalism will define us and determine who joins and who will listen to our message.

Perhaps our most simple goal might be to prove our effectiveness to our members. To be an effective organization requires that our members both demand action from and contribute to the organization. Just in the last few years, in my opinion, the American Avalanche Association has evolved from an organization that was supported by its members to an organization that supports our members. This is a huge achievement!

Our association is growing and changing and special; thanks is due to Janet and former board members who have positioned the American Avalanche Association to take advantage of the future. We – your new officers and I – thank you for your confidence and we look forward to building upon AAA's past to achieve new results and rewards. In the coming issues of TAR we will outline our goals and strategies, and solicit your inputs and actions. I invite you and your colleagues to enhance our community, knowledge, and professionalism.

—Dale Atkins, AAA president

from the editor

Another Teton powder day, living the life. *Photo by Sue Miller*

AAA Tracks Sledder Education, Fracture Mechanics

Heart of the winter: La Niña has brought us a strong base and a January thaw. Rain turns town grey, the roads to ice. We'll have a robust rain crust to track and puzzle over. TAR 29-3 is off to the printer in a flurry of avalanche courses and spring plans.

This issue of *The Avalanche Review* contains two powerful themes. The snowmobile avalanche education theme has a separate introduction on page 12, but you'll see that the final product, new AAA course guidelines for snowmobile avalanche courses, is a collaboration on the part of many individuals, each dedicated to the goal of helping riders make better decisions in the backcountry. If you plan on teaching courses to sledders, please use and critique these guidelines, see the adaptations created by sledders to better teach safe riding.

The other theme, CSI: Fracture Mechanics, begins on the cover with stalwart TAR contributors Karl Birkeland and Ron Simenhois's look at the ECT and how its results represent theory. Two front-line practitioners then bring us their perspectives: Peter Carvelli dissects the where and why of post-control releases while Don Sharaf once again cuts to the chase as he translates fracture research into what and how better understanding of the phenomenon of fracture affects our decision-making and our teaching.

Our two correspondents from ISSW – Doug Richmond, representing the "peanut butter and jelly" crowd, and Andy Gleason, representing the "snow geek" faction – give us snapshots and insights from five packed days back in September 2010. Andy's thorough report on more fracture mechanics topics shows how many smart people are examining the avalanche problem from many angles. Doug makes us laugh as always while reminding us that behind every "brainiac" is a platoon of ski patrollers and guides, wanting to know what's important to the infantry.

I'm already deep into production for TAR 29-4, the April issue, with a theme of human factor. We'll wrap some new research around old dilemmas, showcasing case studies of accidents by professionals and experienced backcountry travelers. If you have any experiences or insights around this theme and wish to contribute, please contact me right away; deadline is February 15.

—Lynne Wolfe

aaa news

2010 American Avalanche Association Awards

Story by Halsted Morris

The American Avalanche Association gives four awards every two years: Special Service Award, Honorary Fellowship Award, Kingery Award, and Honorary Membership. These awards are normally awarded at the general membership meeting, held at the 2010 ISSW. One award was actually awarded to billy barr (billy's trademark is his name in lower case) at the Rocky Mountain Biological Laboratory's annual meeting this past summer.

In the past the AAA has only awarded one Bernie Kingery and Honorary Membership each time. The AAA board of directors decided to recognize more then one person each time in the spirit of recognizing the veterans of the greatest generation while they can enjoy the recognition.

These citations were read at the general membership meeting along with the Honorary Membership citations for Dan Judd and Daniel "Howie" Howlett *(see TAR 29-2)*. Unfortunately, or fortunately – depending upon your point of view, the presenter's "roasting" comments to the award recipients are not included here. Sorry folks, you had to be there.

billy barr
Special Service Award

The American Avalanche Association bestowed the 2010 Special Service Award to billy barr of Gothic, Colorado. This award is in recognition of the "***specific and outstanding achievement in service of the North American snow avalanche community,***" though the establishment and maintenance of an avalanche and weather observation database which is unprecedented in its detail, longevity, and usefulness.

billy barr came to Gothic, Colorado, in 1972 as a research participant at the Rocky Mountain Biological Laboratory (RMBL) where he continues to live and work to this day. In 1975, winter caretaker Art Mears initiated collection of avalanche occurrence data which billy assumed recording in 1976, providing a continuous 36-year record through the 2009/10 winter season. The nearly 175 sample paths on surrounding National Forest lands range in vertical dimension from 600' to 3800' with an average of c. 1600'.

RMBL is an independent field station dedicated to research by students and scientists from dozens of universities across the nation. The weather data set provides valuable environmental baseline information to complement summer research and experiments in the multiple fields of natural sciences that are represented at RMBL. The avalanche data set has been utilized in several research projects.

The avalanche-occurrence database is unique in that over 99.9% of the observed avalanche occurrences are naturally occurring. The nearly 10,000 recorded natural avalanche events form a continuous record which is likely the only such long-term collection of this information in the world.

Nominated by Don Bachman, Art Mears, Art Judson, Karl Birkeland, and Dale Atkins.

Russ Johnson
Bernie Kingery Award

Russ has been an avalanche professional for over 25 years. His interest in snow and avalanches started in California when Mark Mueller hired him as a member of the Squaw Valley ski patrol in November 1985. Russ educated himself by attending the National Avalanche School, Norm Wilson's avalanche courses, ISSW conferences, and advanced forecasting seminars.

Squaw Valley's Patrol Director Bob Cushman and Assistant Director Curtis Crooks recognized Russ's interest in snow, weather, terrain, and snowpack, and

Bernie Kingery awardee Russ Johnson and his wife Lorraine pose with his hawg. *Photo by Kahlil Johnson*

his abilities to recognize avalanche hazards. Squaw had been without a formal avalanche forecaster. Russ proposed that they update and refine their avalanche-forecasting program. In 1991 Russ became Squaw Valley's first avalanche forecaster. His duties included weather, snowpack, and terrain observations as well as stability analysis identifying strengths and weakness in the snowpack and formulating an avalanche-hazard forecast for the starting zones of Squaw Valley's 26 avalanche-control routes.

His skill level improved through the years as he had a golden opportunities to observe and examine slabs shortly after they occur. During this time Russ was responsible for setting up and maintaining the three remote access weather stations as the base of Squaw, High Camp, and the Sierra Crest. This was a huge undertaking and took much time, energy, patience, and expertise. Russ also used this link to share information with other ski areas. To this day, these sites are used by Squaw Valley, Sierra Avalanche Center, backcountry users, the general public and the National Weather Service in Reno, Sacramento, and the Bay Area.

Russ became the primary trainer for explosive safety, avalanche safety, control procedures, and avalanche

Continued on next page ➡

AAA AWARDS

continued from previous page

rescue. He retired from Squaw Valley ski patrol after 19 years.

Russ did not confine his job duties to the patrol. He was called on for countless TV and radio interviews concerning avalanche safety and conducted community avalanche-awareness talks at the Tahoe Truckee School District. The Steep and Deep Clinic (a yearly avalanche awareness event at Squaw Valley) established by Bill Williamson was eventually taken on by Russ when Bill left.

Russ is a professional member of the American Avalanche Association and served as Sierra Section Representative from 1994 to 2002. He became the president of AAA, a post that he held from 2003 to 2006. Russ shared the governing board with mentors and co-workers and worked on projects such as Avalanche Education, *The Avalanche Review*, Membership, SWAG Observation Guidelines, Research, Awards and Data. The AAA has benefited from his dedication as he volunteered countless hours to the AAA board.

Russ is a dedicated professional engaged in the study of forecasting, control, and mitigation of snow avalanches. His avalanche-education talks are among the best. I have observed Russ teaching avalanche courses through the years, and students have told me that they have come away with a clearer understanding of safe winter travel. He worked as an instructor for Northwest Avalanche Institute with Paul Bauger and Mark Moore. He was a phase one and two instructor in the National Avalanche School in Incline, Nevada. He worked closely with Alpine Skills Institute, AIARE, and the Association of Professional Patrollers.

"Russ Johnson was one of the founding directors of the Sierra Avalanche Center, established in 2006," said Bob Moore, retired US Forest Service snow ranger/forecaster. "He was instrumental in organizing avalanche hazards and forecasting techniques for the avalanche center."

For the last two years Russ has been dedicated to the planning of ISSW 2010 at Squaw Valley.

The Bernie Kingery award honors individuals who have significantly contributed to the reduction of avalanche hazard through meritorious career accomplishment in safety and education. The award emphasizes the role of a dedicated field professional. Russ is recognized throughout the industry as a leader and forecaster in the avalanche field. He has become a mentor himself and created a great legacy for future forecasters. He is most deserving of this prestigious award.

Nominated by Gary Murphy, Curtis Crooks, Lel Tone, Jeff Goldstone, Janet Kellam, and Bill Williamson.

David Lovejoy, map-reading and route finding with student Chase Edwards in inclement conditions during a Prescott College course on Mt Shasta, yet another course that he designed and implemented. *Photo by Lynne Wolfe*

David Lovejoy
Bernie Kingery Award

David Lovejoy's contribution to avalanche research and education began in 1979 when he joined the outdoor education faculty at Prescott College. During his career he has taught and mentored close to 1000 students, many of whom are now professionals in the avalanche field. If you've met a Prescotteer on skis, then you've met someone David has influenced. Many of his Prescott graduates and mentees have gone on to join ski patrols, forecasting programs, heli-guide services, avalanche schools, and graduate programs throughout the country, including patrollers at Alta, Jackson Hole, Bridger Bowl, and Telluride as well as avalanche forecasters at the Gallatin, Idaho Panhandle, and Sawtooth National Forests and the CAIC. Even AAA feels David's influence with Lynne Wolfe counting him as an influential mentor.

David started Prescott's backcountry ski program in the early '80s and the Silverton avalanche-forecasting program in 1986 which continues to this day. I was one of four students in that inaugural class and was deeply influenced by the experience.

Besides teaching, David has done snow research on snow water loss due to evaporation and sublimation in a seasonal snowpack in Arizona and

AVALANCHE-COURSE PROVIDERS
Deadline extended for updating course listings on Avalanche.org

If you haven't been paying attention, your avalanche courses or school may be off the Avalanche.org site. All existing course providers were sent a personal email just prior to the 2010 ISSW in October, but some course providers still have not submitted their application or syllabi. Check your inbox: the message subject line is "Course Providers - Do Your Homework." If you want to remain on the Avalanche.org course listings section, the submission deadline was January 15, but if you act now, your course information may still be reinstated for this winter.

All information is posted on the AAA Web site education page:
www.americanavalancheassociation.org/edu_provider.php

As AAA awards committee chair Halsted Morris gives Mark Moore his Bernie Kingery award, Knox Williams treats the audience to few more stories to illuminate Mark's career. *Photo by Vicki Judd*

Ecuador where he also investigated near surface faceting. In 2005 David started the Kachina Peaks Avalanche Center in Flagstaff.

Throughout the decades he's worn the hats of teacher, student, and community organizer. Most importantly, David led by example and inspired us all. He is professional and empathetic, and for many of us he was the first person we knew who was an expert in the snow. His inspiration fueled all of us forward into our snow-related careers. Mark Rikkers put it best when he said, "Dave was instrumental in helping me realize my dream of becoming a smart backcountry skier, a professional avalanche forecaster, and a helicopter ski guide. And while I rarely see him these days, I'll always be thankful for that, and he'll always be a mentor and friend."

Nominated by Doug Chabot (citation written by Doug also), Lynne Wolfe, Angela Hawse, Ann Mellick, Andrew Ryan, and Joe St. Onge.

Mark Moore – October 2010
Honorary Membership

The American Avalanche Association is proud to present its highest award – Honorary Membership – to Mark Moore. Mark's career has spanned 38 years as a meteorologist, weather forecaster, avalanche forecaster, educator, and founding member and director of the Northwest Weather and Avalanche Center (NWAC).

Mark's interest in snow and skiing began early, learning to ski while his father was posted in Garmisch, Germany. Later as a student at the University of California San Diego, he was instrumental in forming the UCSD ski club and in organizing the Southern California Intercollegiate Ski Racing Association. Mark graduated from UCSD in 1969 with a degree in aerospace mechanical engineering and promptly moved to Mammoth Mountain to become a ski patroller, where he gained experience (and had his interest piqued) in avalanche safety, control, and rescue. On an exploratory trip to Aspen, he met his wife-to-be, Ginger, and his direction in life changed.

Mark and Ginger's next move was to Seattle, where he enrolled in grad school at the University of Washington to study under Ed LaChapelle. After earning his master's degree in atmospheric science, he continued to work with Ed as a post-graduate researcher. His studies included the structure of the maritime snowpack (hey, I could use a little help with this 20' snowpit!), alternative methods of avalanche control, and the Central Avalanche Hazards Forecasting program which began in 1975. This last program officially became NWAC in 1978; Mark is the bedrock upon which NWAC was built and has stood for 36 years.

Further accomplishments include:

1. The development, installation, and maintenance of the largest network of remote weather stations of any avalanche program in North America. Users access the data more than 10 million times a year.
2. Instructor at weather and avalanche schools from Alaska to Colorado, including the National Avalanche School.
3. Committee chairman of ISSW '98 in Sunriver, Oregon.
4. Committee chairman for unifying the US Avalanche Danger Scale in 1995. This accomplishment endured until recently, when the North American Avalanche Danger Scale was established.
5. Member of the working group on Observational Guidelines – the creator of SWAG.

A mere list of accomplishments only hints at the skills and character that Mark has shown in his professional career. He worked with, was influenced by, and had an influence on some of the luminaries in the snow and avalanche profession of the Northwest, including Rich Marriott, Sue Ferguson, and Ed LaChapelle. He has known when to criticize and when to praise. And when to forge ahead, stand pat, or yield. He has seldom yielded – his annual budget battles have been legendary – and Mark's stubborn-as-a-grease-stain trait has served NWAC well. Mark can be serious, of course, though that is not his mood of choice: Witness his turning his weather and avalanche forecasts into poetry! Quick with a smile and a laugh, Mark has been a long-time friend and colleague of many members of the American and Canadian Avalanche Associations and is most deserving of this Honorary Membership.

Nominated by Janet Kellam, Rich Marriott, Patty Morrison, Craig Sterbenz, Paul Baugher, Garth Ferber, Kenny Kramer, Roland Emetaz, and Knox Williams.

Halsted Morris currently serves as AAA Awards and Memorial Chair. AAA awards criteria and nomination process are listed on the AAA Web site.

Scott Kay Dies in Colorado Avalanche

Photo by Jason Lombard

Michael "Scott" Kay, patrol director at Wolf Creek Ski Area died in an avalanche while doing control work on November 22, 2010. He joined the patrol in 1995 and became director in 2002. Scott was 41 years old and a native Coloradan. After graduation from high school he joined the US Marine Corps, served six years, became a reconnaissance Marine, and was a veteran of the Persian Gulf War. He was not only an avid skier, but a skilled hunter, water skier, kayaker, and dirt biker. More than anything Scott was a devoted husband to his wife Chantelle and an amazing dad to his two young sons Nolan and Rhead. He was a fun-loving, hard-working individual who touched many in our community. Hundreds of friends attended his memorial service in Pagosa Springs.

metamorphism

The American Avalanche Association 2011 Membership Directory will only be available in an electronic version this year. This will help to save environmental resources and AAA's financial resources which can be directed toward other membership benefits. Watch for an announcement regarding availability on the AAA Web page and our Facebook page.

Congratulations to new AAA Certified Instructors: John Stimberis, Ellensburg, WA; Tom Thorn, Big Sky, MT.

AAA thanks the following members for contributing an additional donation in 2010 to further our efforts. Donations totaled $13,791 and amounted to 13% of our total income in our fiscal year 2009/10.

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Jeff Fowlds
Matt Kinney
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Scott Quirsfeld
Eric Deering
David Dellamora
Aaron Mainer
John Fitzgerald

Krister Kristensen: New AAA EU Rep

Krister's introduction to the avalanche world started in 1975 when he came from surveying in Sweden to Stryn in western Norway for a temporary job at the avalanche research field station of the Norwegian Geotechnical Institute. Admittedly, he had a couple of lucky strokes at this time, personally as well as professionally. First he got assigned to work with Dave McClung; when Dave began to lecture about strain softening in snow and Griffith fracture theory, Krister knew he was in for a steep learning curve whose importance would be at the center of his understanding of avalanches. When his boss Karstein Lied assigned Krister for another year to collect extreme runout data from historic avalanches in western Norway, he was hooked.

Attending the legendary 1979 Snow in Motion symposium in Fort Collins, CO, made lasting impressions on Krister of the US and North American avalanche community, which had a unique freshness and openness that was different from the more formal European culture.

A lot of water under the bridge since then. Here's a short summary:

- voluntary alpine and avalanche rescuer since 1980
- representative to avalanche commission of the International Commission for Alpine Rescue since 1986
- professional member of AAA since 1994
- initiator and steering committee member for the Norwegian avalanche conferences since 1994
- member of the European Working Group for Avalanche Forecasting services since 1995
- board member of the Norwegian IFMGA mountain guide association
- international board member of the first European ISSW in 2009
- sabbatical at Department of Natural Hazards and Alpine Timberline, Innsbruck, Austria in 2009

Krister currently works as senior engineer at Natural Hazards division of the Norwegian Geotechnical Institute (NGI) and runs the NGI-Stryn office. He is locally responsible for the field research station Fonnbu and Ryggfonn AVALAB full-scale test site. His main professional interests are hazard zoning, risk assessment and decision theory, avalanche education, and alpine rescue.

Krister feels that the invitation to become AAA region representative for Europe is both an honor and a challenge. Although not as centrally positioned in Norway as his predecessor Peter Høller in Innsbruck, he feels that the avalanche community is a truly international one. The AAA plays an important role in Europe, and TAR is widely read. Perspectives may differ between regions, for instance where the societal costs from avalanches are greatest, but we can only benefit from exchange of ideas and experiences. Krister aims to work toward this as AAA's European representative.

Contact Krister at: Krister.Kristensen@ngi.no

After an unusually warm September and October in south-central Alaska, 113" of snow fell on the unfrozen ground of Turnagain Pass during the first 12 days of November. While it was a great way to start the season, seemingly hundreds of glide cracks starting appearing and avalanching at will. The cycle went on for almost five weeks before mellowing out, but new glide cracks are appearing as I write this on December 14. The day of November 22 saw the highest concentration of glide avalanches when a six-day inversion broke and a freezing rain event coated mountainsides from Girdwood to Fairbanks.

Photo by Lisa Portune

News from the Chugach

Story by Lisa Portune

There are lots of changes to report up here in Girdwood, Alaska. After 10 years of directing the CNFAIC, Carl Skustad accepted a promotion and moved back to Minnesota to work on the Superior National Forest in Ely. I've heard that he's already sold his AT gear and bought an ice auger.

Matt Murphy has also moved on, accepting a job as an avalanche forecaster for Alaska Department of Transportation based out of Girdwood. We hope to drag him from his fancy DOT truck for a tour now and then. Both will be hugely missed, though thankfully for me, they're only a phone call away.

We recently hired two outstanding guys, Jon Gellings and Kevin Wright, as new forecasters. Kevin has been a ski patroller at Alyeska since 2002 and a NPS mountaineering ranger on Denali since 2007. Jon was our intern last year and is a recent graduate of Alaska Pacific University's Outdoor Studies program. Both bring a mountain of skill, energy, and new ideas to the program.

Lisa Portune is now lead forecaster for CNFAIC. In late-breaking news, Lisa Portune is moving to Sandpoint, ID, where her husband Sean got a wildlife job. Congratulations to Wasatch local Wendy Wagner as she becomes the newest new hire at the Chugach.

USAW host Craig Gordon gets ready to introduce Liam Fitzgerald's Snowbird history as the day starts to wind down.


USAW participants gather at the social, sharing stories with old and new friends alike.

what's new

Third Annual Utah Snow and Avalanche Workshop

Story by Craig Gordon

The Utah Avalanche Center and their nonprofit Friends organization hosted the third annual event in early November at The Depot in Salt Lake City. Kicking off the day, a closed-door professional development session featured an amazing list of guest speakers with presentations from Karl Birkeland, Ian McCammon, Titus Case, and Bob Comey to name a few. Morning topics geared toward avalanche professionals were safety oriented, ranging from communication pitfalls to an avalanche fatality in the work place and wrapped up with sidecountry avalanche issues. A catered lunch allowed everyone to socialize and catch up with old friends.

The afternoon was open to the public and centered on continuing education for advanced backcountry users. Bruce Tremper, Karl Birkland, and Liam Fitzgerald were among the lineup. Presentations included a summary of ISSW, followed by Brad White's review of the large avalanche at last year's Big Iron snowmobile event on Boulder Mountain in Canada. In addition, a recap of a close call as told by an avalanche survivor makes for a powerful testimony late in the day. Liam Fitzgerald wrapped up the seminar with a look back at the early days of avalanche control work at Snowbird.


The morning pros received a schweet shwag bag full o' goods.

Over a dozen vendors had their own area to display ski gear, new rescue technologies, and advances in avalanche control systems. Nearly 500 people attended the workshop and the day ended with a social sponsored by Uinta Brewing and the Friends of the Utah Avalanche Center. Huge thanks to all who support this event including the AAA, the National Avalanche Center, the Friends of the UAC, and all my awesome colleagues at the Utah Avalanche Center.

Craig Gordon is a forecaster for the UAC who doesn't mind taking his turn at the microphone.

New Binding on the Block

Story by David George

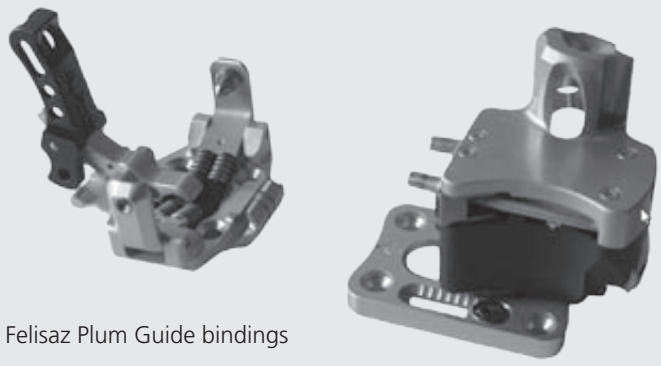
The Avalanche Review recently had the opportunity to visit the Felisaz production facility in the French Haute-Savoie. Felisaz have just released a new "tech" compliant ski touring binding which looks like being a serious competitor to Dynafit's dominance in this sector. Based in the Arve valley, which runs from Chamonix down to lake Geneva, the area has been a center for precision engineering since the 18th century. Today 65% of French production comes from the area.

Felisaz started making "tech" compatible race bindings six years ago, but the financial crises and its affects on manufacturing gave them the space to produce a touring binding. After a couple of years beta testing they have decided to go into mainstream production. The result is the Plum Guide.

In fact it is not just one binding but four different models. A standard version similar to the Dynafit Comfort with a heel turret for binding adjustment. The Plum is a well-finished, fully machined binding. There are four different holes in the turret so you can always engage a ski pole no matter how the heel piece is oriented: left or right handed. The binding also has a machined ski crampon holder – no more breakages on critical traverses! The binding weights in at 660 grams without screws.

A pro S model replaces the heel turret with a flat plate. The plate has a slot to allow rotation with a ski pole. This pro model saves 30 grams.

Both bindings have a lateral DIN release of 5 to 12 and frontal of 5 to 13, which is interesting if you are carrying


Felisaz Plum Guide bindings

a heavy touring pack on a multi-day trip. Finally the Guide XS and XXS have the same characteristics but with a DIN of 3 to 7, ideal for lighter skiers such as women and kids. The heel gives 3 cm of adjustment, around 4 to 5 mondo points.

The Plum has been tested and is compliant with the DIN/ISO standard 13992 covering alpine touring ski bindings and is expected to receive its full certification during the season after field trials. This is a first for a tech binding.

Felisaz is lining up a North American importer. Escape Route in Canada currently stock the binding (www.escaperoute.ca/) for $620 CND. Although the binding looks similar to a Dynafit TLT, it can be better compared to the FT 12 while saving around 170 grams and offering slightly higher DIN settings. It costs about $70 more than the FT12. Ski brakes for the Plum will be available next season.

Video review: ***www.youtube.com/watch?v=dyjbS3x2d6c***

David George is the French correspondent for The Avalanche Review. *He runs a Web site for French backcountry skiers: www.pistehors.com.*

Black Diamond AvaLung Recall

Black Diamond Equipment, Ltd, recently discovered that the intake tubing on certain 2010 AvaLung packs may crack under extremely cold temperatures. The company is working with the US Consumer Product Safety Commission and Health Canada in the process of obtaining final approval for a recall. The recall will pertain only to a limited manufacturing run of Black Diamond AvaLung packs produced in 2010, which can be identified by PO# and model combination found at the Black Diamond Web site: **www.blackdiamondequipment.com/en-us/about-us/company/recalls#avalung**

Any 2010 AvaLung pack that falls within the criteria above is potentially defective and should be immediately returned to Black Diamond for inspection and possible replacement (anticipated replacement time is March 2011). Once inspected, the returned/replaced AvaLung unit will bear a mark confirming that the product has been inspected/fixed.

Free Avalanche Weather Forecasting Learning Module Available Online

From Jim Woodmencey of MountainWeather in Jackson WY, comes an online learning module that was created through the COMET program as a training tool for military use forecasting for winter missions in mountainous areas such as Afghanistan. Below is the module site. You'll need to set up a login, but then you can view all modules. Access is free to the public after registration.

www.meted.ucar.edu/afwa/avalanche/

Pacific Northwest Happenin's

Industry Events Provide Food for Thought

Story by John Stimberis • Photos by Michael Jackson

We had a couple of great events in the Pacific Northwest this fall, both sponsored in part by the AAA. A blasters workshop was held over the Halloween weekend, followed by the Northwest Snow and Avalanche Summit the following weekend. Having just returned from the ISSW, this schedule made for a couple of very busy weeks, but what a great way to get the winter going – and with La Niña in the forecast, the excitement was already there.

Halloween is one of my favorite holidays and although I would have liked to travel to see my favorite band celebrate the weekend in Atlantic City, I remained in the Pacific Northwest to attend the Northwest Blasters Workshop, and I was not disappointed. I admit that having the event on my home turf of Snoqualmie Pass and being one of the presenters might sway my opinion, but I think the event was a real success. Kudos to all the presenters and to the two main organizers in particular: Bram Thrift and Chris Catlin.

This event was grassroots all the way. The presenters were eager attendees, and The Summit at Snoqualmie donated the meeting space, which included free lodging for those wishing to utilize the bunk rooms. The group even had a potluck dinner where the post-event conversations were likely as lively, if not more so, than the day's events. But that's the beauty of events like this: getting the region's professionals together to share knowledge, express opinions, and get to know one another before heading back to our winter jobs.

The workshop included a variety of topics, including fundamentals such as *Properties of Explosives*, *Types of Explosives*, *Blast Site Procedures*, and *Licensing and Documentation*. Overall we tend to use the same products, though the DOT crews use huge amounts of detonating cord and generally avoid emulsion-based explosives, mostly because they have reduced or eliminated hand control routes. *Forecasting* and *Highway Forecasting vs Ski Area Forecasting* was also discussed, providing some valuable insight into how the programs have similar goals yet different methods to achieve those goals.

Safety was an important topic throughout the workshop. The presentation on *Misfires and DUDs* was pertinent, especially coming from the Mt Hood program where they fire over 500 Howitzer rounds a year! The safety topic extended to great discussions about route safety and companion rescue – important items to be sure.

Along with the discussions about route safety and companion rescue came the discussion about blast site safety. This topic appears to be ever-growing and a point of genuine concern. More and more programs are attracting their share of early season and early morning hikers. These hikers are continuing to encroach on what was once a much simpler concern for the avalanche controller: blast site safety. I know when I got started doing avalanche control it was unheard of to have people hiking up the slopes early in the morning; now it is an ever-growing concern. This topic is a real powder keg with public lands issues and legitimate explosives and avalanche safety concerns going head to head. I certainly hope our industry and partner agencies are able to find a solution before too long.

The following weekend, on November 7, the Alpine Safety Awareness Program held the 4th Annual Northwest Snow and Avalanche Summit (NSAS). NSAS is billed as a professional development seminar for avalanche workers and a continuing education opportunity for recreationists. NSAS is intended for ski patrollers, forecasters, ski guides, and search and rescue teams, as well as for any number of other occupations that occur on and around snow. The day-long event was held at the REI store in Seattle and was again emceed by Steve Christie. Seven presenters comprised the lineup this year, and they all did a great job. The following is a recap, not necessarily in the order they appeared.

Avalanche centers, and the Northwest Weather and Avalanche Center (NWAC) in particular, were represented in two presentations, provided by our own Mark Moore and Garth Ferber. These guys both work for the NWAC and provided the type of information one might expect from avalanche centers: weather forecasts, avalanche statistics, and the state of avalanche centers across the US. Mark provided an outlook on the coming La Niña winter and a review of avalanche statistics related to ENSO events *(see Moore and Marriott's articles in TAR 29-2 for more information)*. Mark also provided an update about the NWAC Web page including the addition of the danger rose (www.nwac.us).

Garth Ferber presented an overview of a survey he conducted about US avalanche centers and related information. Garth and Doug Abromeit presented the survey information as a poster at the ISSW 2010. The presentation provided some interesting insights into the demands that avalanche centers face: limited staff and budgets, large forecast areas, and often grueling work schedules. If you don't already appreciate the women and men who work at these centers, please take a moment to review the paper in the 2010 ISSW proceedings.

NWAC forecaster and presenter Garth Ferber shoots the breeze with former forecaster Roland Emetaz at the NSAS in Seattle on November 8, 2010.

Dale Atkins discussed decision-making and how we process information.

We often rely on avalanche centers to aid in our decision-making, and the remainder of the NSAS topics related back to decision-making, either directly or indirectly. Dale Atkins provided a very interesting talk about decision-making: the how and why of what we do. I think for many, if not all, those attending, there's a certain "ah-ha" moment when we stop to think about how we think. Dale does an excellent job of putting together an engaging presentation that looks at how and why we make decisions and how we process information. I think we all like to believe we are in control of decisions and observations, and then pow! Dale gets you with some revelation about the inner workings of your psyche. Dale played the classic video clip of two groups of people passing a basketball back and forth and asked the audience to count the number of passes. Many in attendance expressed awe that they missed the man in the gorilla suit weaving his way through the group of basketball players.

Bruce Jamieson invited the audience to consider when to dig pits.

Moving along the theme of decision-making, we were treated to presentations about field observations by Bruce Jamieson and Colin Zacharius. Jamieson posed the question "*When to Dig?*" though it began as, "*To Dig or Not to Dig*." As one revered avalanche professional said to me after the presentation, "Blasphemy! We've always been taught to dig, dig, dig." He was being sarcastic, but the impact of Jamieson's talk was clear: we must reevaluate our long-held convictions. Jamieson's paper may be found in the 2010 ISSW proceedings.

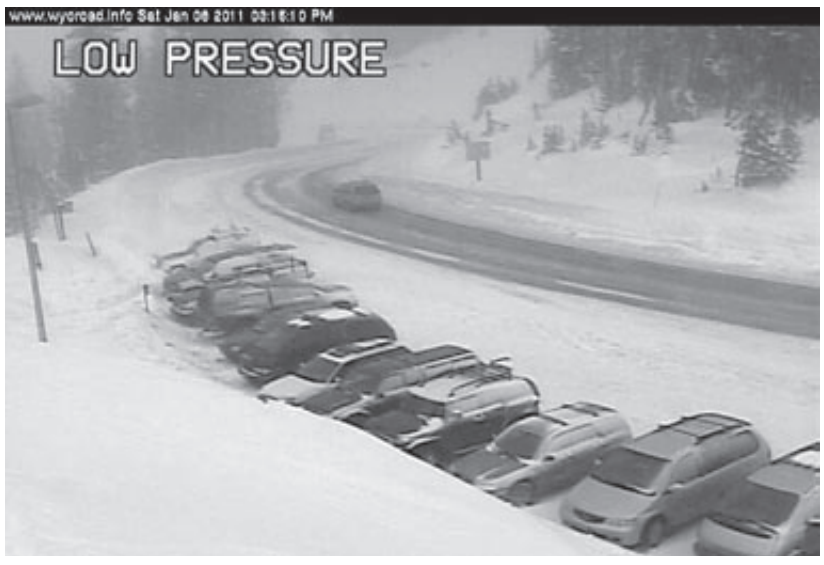
Colin Zacharius' talk looked at terrain and provided an insightful look at the nuance of terrain assessment. His talk is an excellent and an integral part of the AIARE level III course that Colin teaches. I found that Colin and Bruce's presentations both address the complexity of avalanche terrain decision-making, and they reinforced the idea that there's no snow stability "silver bullet."

Brad White related the near-miss incident on Boulder Mountain.

There were two case study presentations at the NSAS. I see case studies as a continuation of the decision-making process; decisions were made, and consequences were realized. The two case studies covered at the NSAS were Brad White's examination of the Boulder Mountain incident near Revelstoke, BC *(see story on page 16)*, and Dan Otter's review of his own avalanche accident on Kendall Peak, WA *(see TAR 29-4 for this story)*. Both cases were stories of major tragedy narrowly averted. Brad White provided a great overview of the avalanche that engulfed many snowmobilers at a non-sanctioned backcountry event. The Boulder Mountain accident had the potential to include numerous fatalities.

Dan Otter gave one of the more emotional accounts that I've seen. He was nervous in front of the large crowd and still has some deep feelings attached to the accident. He admitted as much, and the crowd responded with a round of applause, letting Dan know that he was among friends. Dan asked the audience to set their judgments aside as we are all capable of making mistakes. In spite of his personal misgivings, Dan provided a riveting account of his decision-making, the accident, and his subsequent recovery. The helmet-cam footage of the event only added to the reality that he conveyed. Information about this accident can be found at: http://tinyurl.com/2fg8t6f. I highly recommend a look.

John Stimberis is the new vice president for the American Avalanche Association. We welcome his energy and talents.



You'd be able to find a parking spot in these photos, but on weekends and powder days you'd be anxiously waiting your turn.

Screen shots from the WYDOT Web cam, Saturday, January 8, 2011, 3:14 pm

Don't Ruin Your Day on a Crowded Mountain Pass

Story by Dan Bennett

Approximately 20 years ago a group of dedicated backcountry skiers met one evening at a small ski shop in downtown Jackson, Wyoming, to ponder avalanche danger. They continued meeting each year at the start of winter, and eventually the gathering moved to a larger venue in a nearby log cabin. On December 2, 2010, a standing-room-only crowd estimated at 600 skiers, snowboarders, and snowmobilers of all skill levels packed the Grand Room at Snow King Resort for the 2010 edition of Avalanche Awareness Night. The resort co-hosted the event with Skinny Skis – the store where it all began.

The crowd swilled beer from plastic cups, shopped the latest backcountry gear at vendor booths, and eventually settled down for presentations from local and national avalanche experts. Skinny Skis co-owner Phil Leeds said $8500 was raised for Teton County Search and Rescue and the Bridger-Teton Avalanche Center from the $5 admission and the sale of raffle tickets. Avy night uniquely combines the safety message with the promotion of gear from manufacturers like Black Diamond, Ortovox, Backcountry Access, and Arc'teryx, Leeds said.

The vibe at the annual gathering is normally anticipation for a big snow winter. This year, however, there was little doubt. The din of chatter filling the room was a thousand tales of epic turns already earned thanks to an early season storm system that coated the mountains with a 50" base by Thanksgiving. With the winter solstice still weeks away, 130" of snowfall had been recorded. Most agreed this was deep revenge for the previous winter's El Niño-induced drought. Snowboarder Karen Colclough succinctly described to friends her backcountry run of the previous day: "Like butter," she said.

The bounty meant more than just well-covered rocks and stumps and fall face shots, some area ski resorts opened early; the Jackson Hole Mountain Resort operating all lifts on opening day for the first time. "The whole town is in a better mood," said Jim Woodmencey, weatherman, mountaineer, and avalanche night's master of ceremonies. Woodmencey credited the early snow to a strong La Niña effect. "But don't expect it to continue," he said. "Weather varies. Whether it's a La Niña or an El Niño year, avalanches don't care which." Good snow winters can occur in either environmental circumstance, he said. "By April," he optimistically predicted, "we should come out above average."

The socializing was occasionally punctuated by a loud whoosh of air inflating the pontoons of an avalanche airbag pack, one of the newer gear innovations being demonstrated. Retail price: about $700. "The jury's still out on this one," a reluctant consumer said. But Jackson Hole Mountain Resort this year equipped each ski patroller with airbag packs following the death last winter of Mark "Big Wally" Wolling, who was swept down a steep bowl and buried during avalanche hazard reduction efforts.

A cluster of ski buddies formed a circle around their beers and taunted shredder Patrick Nelson, accusing him of initiating the avalanche that closed Highway 22 for a day in late November. Nelson, who was not the culprit, was unprovoked. "I'm a firm believer that personal accountability is at stake anytime you cause an avalanche," he said.

The issue of human-triggered avalanches that could spill onto the highway, or worse – cause injury or fatality – was forefront on the evening's agenda. The Wyoming Department of Transportation (WYDOT) announced earlier that it might no longer plow parking areas on Teton Pass during storms, thus barring many skiers and riders from one of the nation's prime backcountry destinations on treasured powder days – a harsh solution to a growing problem.

Woodmencey commenced the speaker presentations with the question, "Who here has taken an avalanche course?" Roughly half the crowd raised a hand. "I would like to remind you that Avalanche Awareness Night is no substitute for taking a course," he said. "And don't take one from your boyfriend." Level one field courses by certified instructors teach the use of rescue probes and transceivers, pit digging to test for weak layers in the snow, and the best methods for safe backcountry travel. Sign-up sheets and course schedules were available from Exum and Jackson Hole Mountain Guides and the American Avalanche Institute, which along with the Jackson Hole Ski Club offered a junior level one course during Christmas break for kids and teenagers age 10-18. "It's good to get 'em learning while they're young," Woodmencey explained.

Participants witnessed the impressive coordination that has evolved between the various Jackson Hole agencies focused on avalanche safety. Speakers from the US Forest Service, the American Avalanche Institute, WYDOT, and the Bridger-Teton Avalanche Center unveiled the well-funded, behind-the-scene efforts that are made on behalf of winter recreationists.

A new video from local filmmaker Peter Pilafian was premiered: *More Than Meets the Eye: What You Don't Know Can Ruin Your Day*, produced for the Avalanche Center. The short film is designed to make backcountry travelers aware of how the daily forecast is produced and how it should be interpreted. It will be uploaded shortly to an expanded www.jhavalanche.org Web site, forecaster Mike Rheam said. He said that despite budget cuts everywhere, the Forest Service and Jackson Hole Mountain Resort have never wavered in their full support of the Avalanche Center. Rheam said the site now includes avalanche event mapping, snowpit information, and timely videos of actual snowpit tests. "This is not intended for run selection advice," he said. "Our forecasts give you the information you need to make good decisions, and you must supply the rest." Other interesting reading on the site is a century of Jackson Hole avalanche fatalities and the mistakes that led to many of them.

On the bright side, Don Carpenter of the American Avalanche Institute said the snowpack to date was relatively stable and lacked the weak, faceted base layers from sporadic autumn snows seen in previous years. Credit the largely right-side-up snowpack to consecutive storms in November followed by cold temperatures, he said. But the month also brought high winds that scoured some slopes while dangerously overloading others.

Jay Pistono has become a pillar of the ski community after a joint venture of the Forest Service and Friends of Pathways named him Ambassador of Teton Pass in 2005. The summit parking lot had become a junk show – cars double parked, bumpers jutted into the highway, dogs ran amuck. The same parking lot today has vehicles neatly arranged in a long, single arc and tightly flanked in 50 available spots. Even the waiting line for spaces to open is a more organized affair.

"People are really starting to cooperate because they don't want to lose this privilege," Pistono said. He also became an onsite source for weather and avalanche projections and the best places to ski, although he'd rather see people dig pits on the slopes they plan to run and rely less on general forecasts. Pistono had these recommendations for Teton Pass devotees:

- Obey the plow drivers when they are working.
- Help keep parking tight by getting ready behind your car.
- When hiking the highway back to the lot, hug the berm.
- Eliminate the term "hitchhiking" from your vernacular and replace it with "rideshare." If someone pulls over, be ready to load your gear and hop in.
- Control your pets and pick up the poop.

Pistono and Jamie Yount, WYDOT's avalanche technician, Teton County, WY, Search & Rescue team member, and Intermountain South representative to the AAA board, said plowing would continue in the parking areas as long as skiing and snowboarding is conducted responsibly and snowplows are accorded the right-of-way. "You wouldn't drop in on your buddy skiing below you, so don't drop in above the road," Yount urged.

Featured speaker, Scott Savage, an avalanche forecaster from Bozeman, Montana, spoke about decision-making in the backcountry. His pointers:

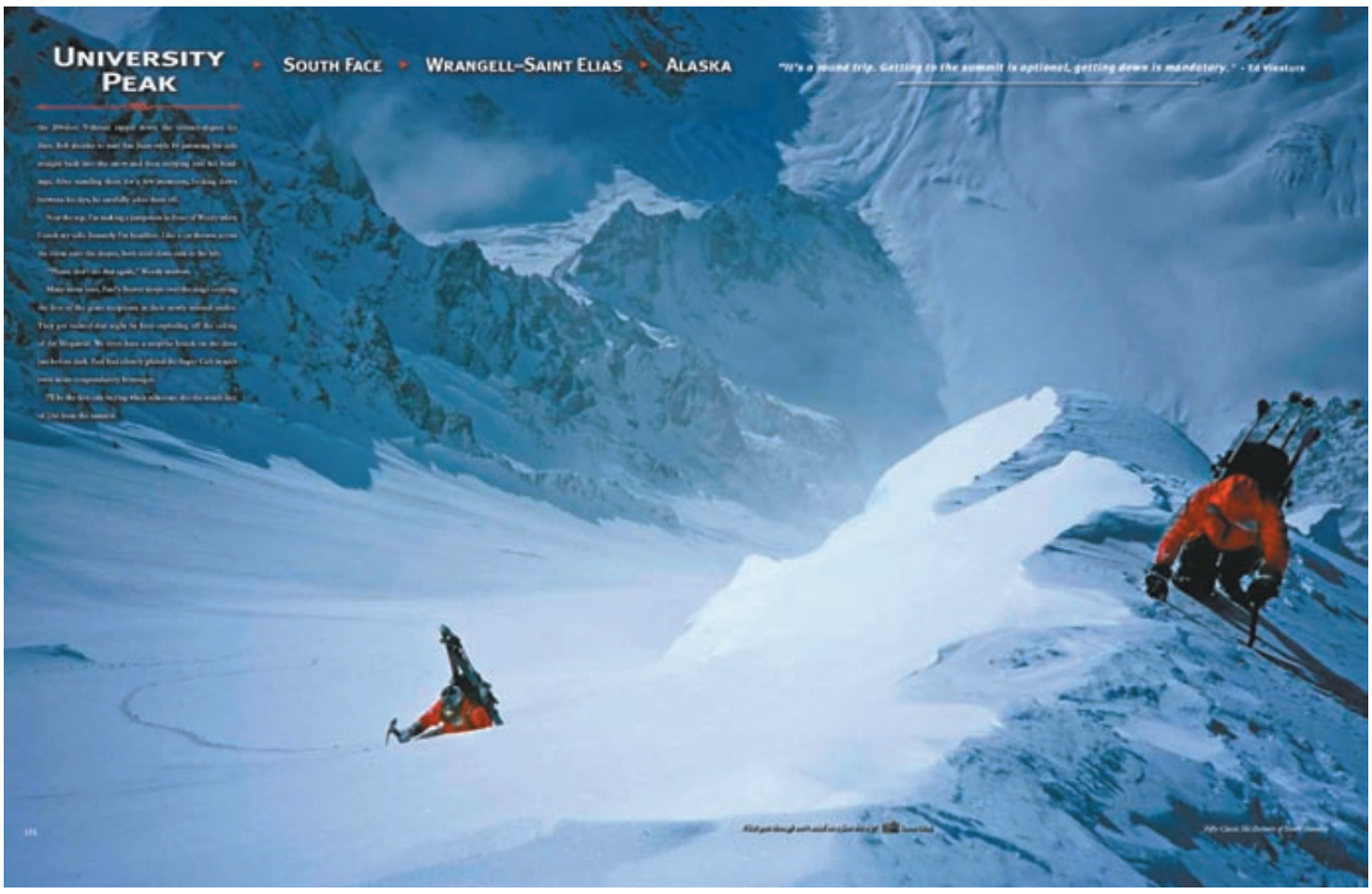
- During a storm is the worst time to ski; allow freshly fallen snow to settle.
- Experts and novices alike can pressure themselves into an unwise situation. Once we have committed to ski a slope, too often there is a reluctance to back off.
- Ski tracks on a slope are no indication of its stability.

Sava Malachowski, Search & Rescue volunteer and avy night organizer, said the night's primary purpose is to create a culture of safety awareness in the backcountry. "We want an individual to posses knowledge about the characteristics of snow, to practice safe habits, and be adept in the use of backcountry safety equipment. And we want that person to expect the same from his or her ski buddies."

Between speakers, Skinny Skis' employees raffled $7000 of sponsor-donated backcountry gear and clothing and the grand prize of an All-Mountain Ski Pass donated by Jackson Hole Mountain Resort. The booty, including parkas, goggles, and shovels, was either raffled or tossed into the crowd. A huge man who won a small woman's pink puffy sweater held it up for size and curtsied to the crowd. For their $20 investment in raffle tickets, Mike and Meagan Piker thought they had been skunked until they were awarded one of the final prizes: an avalanche transceiver capable of locating multiple victims.

"It's time to practice," Mike Piker said as the four-hour event concluded and everyone filtered into the icy parking lot.

Dan Bennett is a freelance writer and long-time resident of Jackson Hole. He is a mountain bike guide and enthusiastic telemark skier.



Book Review:

Fifty Classic Ski Descents of North America

Chris Davenport, Art Burrows, and Penn Newhard. Forward By Andrew McLean. Capitol Peak Publishing, 2010. Distributed by Wolverine Publishing. Hardcover. 201 Pages. $59.95.

Review by Kevin Grove

University Peak in the Wrangell-St Elias is only one of fifty. Stunning photos entice or amaze. Some of these destinations go right onto your bucket list; others are eye candy for the mere mortals.

What makes a ski descent classic in your eyes?

An aesthetic plum line on a remote summit? A narrow couloir splitting granite walls like an axe slicing through a block of wood? A steep face with big consequences? A mellow outing with good friends and many faceshots?

Ski mountaineers Chris Davenport, Art Burrows, and Penn Newhard set out to define the *Fifty Classic Ski Descents of North America* in their recent book from Capitol Peak Publishing. Admitting that classic ski descents are "Impossible to quantify to some extent and there-in lies the attraction," the authors take a valiant stab at defining 50 classics. To add depth and breadth to the project, the authors allow space for 16 contributors to share their most notable ski descents. The contributors, including Lou Dawson, Andrew McLean, and Kristoffer Erickson, are among the most prolific ski mountaineering adventurers.

The large coffee table book is similar in style to Davenport's first book, *Ski the 14ers*. The eye-catching, jaw dropping, mouth-watering photos alone make *Fifty Classic Ski Descents of North America* well worth the price of a day lift ticket. Who wants to ride lifts, anyway? Especially after thumbing through this book, readers will be enticed to experience the rugged and wild backcountry.

Route descriptions and perspectives from authors and contributors provide the proverbial icing on the cake. Pacific Northwest ski pioneer Lowell Skoog writes, "Ski mountaineering is a 'flow' experience, both in the sense that Mihaly Cziksentmihalyi defined it (a zen-like state attained while pursuing a challenge) and in a sense of moving through a beautiful landscape." Jimmy Chin, who skied from the summits of the Grand, Middle, and South Teton in a blazing 10 hours and 55 minutes adds, "The aesthetics of a line are important to me. I like beautiful lines." Greg Hill, closing in on skiing TWO MILLION, human-powered, vertical feet in one year, writes, "I look for somewhere I have never been. I like the dramatic beauty of a chute as it cleaves its way between the rocks but more so I love a large snowy face that sits precariously on a mountainside."

Many of the 50 classic descents are fairly well known, at least in the ski mountaineering community. A few classics, however, have remained out of the public eye. Pete Costain and Andy Zimet skied the Southwest Face of Mt Stimson, a beautiful giant in the heart of Montana's Glacier National Park. In addition to skiing a stunning line, the adventure also involved canoeing across the swollen Middle Fork of the Flathead River. Costain's descriptive account of the journey is one of the book's many highlights. Also memorable is Lorne Glick's report and photos from the South Face of University Peak in Alaska's Wrangell-Saint Elias. The authors add, "The massive South Face of University Peak is one of the crown jewels of North American ski mountaineering." Dramatic aerial photos by Ruedi Homberger transport you from your couch to these majestic Alaskan peaks. Big. Remote. Aesthetic. Wild. CLASSIC!

Anyone who enjoys skiing, the mountains, and stunning photography will enjoy this book as a coffee table piece. As a guidebook, however, this is primarily for well-seasoned ski mountaineers. The majority of the classic ski descents are on big, steep, and relatively remote faces. Cziksentmihalyi's explains in his book *Flow: The Psychology of Optimal Experience* (referenced by Lowell Skoog) that people find the flow state when their challenges match their skill set. The authors and contributors all have a high level of skill in the ski mountaineering arena, and therefore require challenging terrain to reach the 'flow' state. A classic descent in their eyes is relatively high up on the difficulty scale.

Many climbers are familiar with this book's predecessors in the climbing realm: the original, wildly popular, *50 Classic Climbs of North America*, by Allen Steck and Steve Roper written in 1979 and Mark Kroese's *50 Favorite Climbs* that came out in 2001. The 50 classic climbs have developed such a reputation over the years that they are often referred to as the 50 crowded climbs. I hope that this book does not turn these 50 classic ski lines into the feeding-frenzy line-up of folks waiting to drop into Corbet's. This is highly unlikely given the difficulty of the descents. Somehow I can't imagine such a line-up on Mount Robson's North Face, skied only once, by Ptor Spricenieks and Troy Jungen in 1995. Only time will tell, but the *Fifty Classic Ski Descents of North America* will undoubtedly inspire current and future generations of ski mountaineers to get out there, get after it, and experience the 'flow.' Will you be the first to ski them all?

Kevin Grove teaches science at Central Oregon Community College in Portland, OR. He indulges his passion for snow personally through ambitious road trips and professionally by including snow science in many of his classes.

Kevin Grove and his wife Molly enjoy a Christmas Eve powder day in the Tetons. *Photo by Lynne Wolfe*

education

Snowmobile Avalanche Education in the US

THE SEED OF THE PROJECT

Story by Jake Urban

Nearly a year ago Lynne Wolfe and I took on the challenge of compiling information for the development of guidelines for snowmobile avalanche education in the United States. We are nearing the completion of this task, which has included many emails, long phone conversations, and the editing of many documents. As part of this project, and as an Education Committee member, Lynne asked me to write up the committee's perspective on this project in the form of a short article. Instead, I am writing this from my own perspective. Developing the guidelines was a long process, writing this article has taken much less time. So here you go…

Snowmobilers practice a timed rescue drill in an avalanche awareness field course.
Photo courtesy Gallatin National Forest Avalanche Center

Almost two years ago the Education Review Committee was tasked by the American Avalanche Association (AAA) board of directors to review and compile new guidelines for avalanche education in the United States. After months of work, the AAA board immediately accepted the guidelines submitted by the Education Committee for use and publication. At the end of the project, however, there was still one large pink elephant in the room. Snowmobilers, the user group with the highest avalanche fatalities, had no guidelines for avalanche education in the United States. While there were islands of successful courses taught throughout the US, there was nothing that ensured continuity within that community of educators from one course to another.

At the spring AAA board meeting, April 2010, widespread groundswell due to a combination of events that included a spate of snowmobiler accidents in a tenuous snowpack – especially the Iron Mountain Showdown in British Columbia *(see story on page 16)*, avalanche educators who saw a need and a market, and an urgent request for the guidelines from American Institute for Avalanche Research and Education (AIARE), led the board to task the Education Committee to create snowmobile education guidelines.

When we got the word, I think we were all thinking the same thing: "Great! Here we are a bunch of skiers given the task of creating guidelines for a discipline that needs a completely different approach than the one we are familiar with."

The entire Education Review Committee agreed that the guidelines needed to come from the snowmobile community. Kirk Bachman, our committee co-chair summed it up well when he said, "Snowmobilers look at terrain and utilize it in a unique way, different from backcountry skiers and snowboarders. Their approach to education should come from the perspective of sledding too."

As an educator and snowmobiler myself, I had professional interest in the process the guidelines would take us through and with our newly appointed honorary committee member, Lynne Wolfe (she had personal motivation as TAR editor as well), we teamed up to find out what the community needed in terms of curriculum guidelines.

As we launched our fact-finding mission, we turned to the expertise of many of the individuals; small businesses; and state, national, and international avalanche centers that are currently providing successful snowmobile avalanche education programs. During the past year the numerous phone conversations, emails, and face-to-face meetings provided the basis for the development of the guidelines that we are about to submit to the AAA board. We are indebted to these individuals for their thoughtful and experience-based input and ideas, and feel they have represented the community well. These guidelines were a collaborative effort driven by these individuals. These guidelines not only represent the needs of the community, but also the growth of future educational offerings to snowmobilers. Just like our skier-based educational guidelines, this document needs to be revisited as the needs of the community change.

As we compiled ideas and practices, we noted that the Level 1 is currently not widely offered by snowmobile educators. In the future, however, many sledders may wish to pursue higher education after their basic or awareness course. Thus, by developing snowmobile guidelines for the Level 1, curriculum offerings and growth are encouraged. I look forward to being part of the development of L2 snowmobile guidelines when the community deems it necessary.

Jake Urban is a Jackson Hole-based outdoor educator who teaches for Central Wyoming College (CWC). Additionally, with his wife Marilynn, they co-own Jackson Hole Outdoor Leadership Institute through which they provide AIARE avalanche and SOLO wilderness medicine curriculum for CWC. When not instructing or skiing you can find Jake digging out his sled as he continues to refine his riding techniques. ❄

Help Us Refine The Tools & Guidelines

At the AAA board meeting last spring, I volunteered to push the snowmobile guidelines project toward completion. I had several motivations; the first was based on a cumulative number of snowmobile avalanche accidents over the last five years, culminating in the Boulder Mountain accident in British Columbia in March *(see story on page 16)*. From correspondence with Doug Chabot and Craig Gordon, I knew that several of the Forest Service Avalanche Centers were having good success educating their local riders, but coverage and curriculum were incomplete; sledders were still too regularly dying in avalanches that seemed eminently preventable from my perspective.

But how to reach these people? Education is an obvious reply, but a more complex achievement. We needed a consistent product in order to empower more educators. Now we have that product and I encourage any sledder avalanche educators to examine what they can do to help. Partnerships are key; looking at the success of the Gallatin and Sawtooth forecasters in the field, donations and connections with the local shops and clubs are crucial.

And I was motivated to get this vital material for the February issue of TAR. December seemed too early after our post-ISSW flurry of activity; we were busy finalizing the material discussed at a well-attended pre-ISSW meeting. But now it's ready. In this issue are some tools to choose from, take a selection of these guidelines, tricks, and tips and head out into the field to try them out, help us refine them for future instructors. Do let us know what works and what doesn't; these AAA course guidelines are a work in progress. We need more consistency with names and techniques for slope cuts and with hand signals in the field.

Finally, big thanks to my project partner Jake Urban, whose strong work ethic and dedication to clear communication helped make the guidelines and this wonderful variety of essays a product of many minds and hearts.

—Lynne Wolfe, editor, The Avalanche Review ❄

Recommendations for US Snowmobile Avalanche Education

American Avalanche Association

Program	Audience	Recommended Outcomes	Recommended Content	Recommended Prerequisites	Recommended Format	Recommended Performance Measures	Recommended Instructor Qualifications Student:Inst Ratio
Avalanche Awareness	Interested public.	Awareness of avalanche hazards.	General information about avalanche hazard, how to avoid it, and proper equipment for traveling in avalanche terrain.	None.	1-2 hr	None.	Knowledgeable and entertaining.
Introduction to Avalanches	Any winter backcountry user. May be adapted for groups like Public Safety, Search & Rescue, Snowmobilers, etc.	1) Recognize & avoid obvious avalanche hazard. 2) Understand and apply current avalanche advisory.	**A Brief Introduction to:** • Avalanche statistics and human factors • Avalanche terminology • Avalanche terrain • Snowpack and weather factors • Obvious clues and red flags • Avalanche bulletins • Simple decision tools (ALPTRUTh, FACETS, RYG Light, clear communication, etc. • Travel protocols • Companion recovery	None.	2-3 hr presentation	None.	Member Affiliate AAA or higher.
Introduction to Avalanches Field Course	Any winter backcountry user. May be adapted for groups like Public Safety, Search & Rescue, Snowmobilers, etc.	1) Recognize avalanche terrain and understand safe motorized travel protocols. 2) Understand how layered snow contributes to avalanching. 3) Understand basic companion rescue.	**Field Examples and Hands-On Training:** • Avalanche terrain, avalanche runout zones, and terrain traps • Basic route selection • Motorized travel protocols (one at a time, hand signals, manner in which you park, don't help stuck partner on slope) • Snowpack layering • Basic stability tests (performing safe slope cuts to identify instabilities, small column tests) • Current snowpack conditions and weather effects (bulletin) • Companion recovery including probing, shoveling, beacon use	None.	7 hrs field	Attendance and participation.	Primary Instructor: Member Affiliate AAA or higher. Exemplary riding skills & enthusiastic about riding. Assistant: sufficient personal experience. Maximum 7:1
Companion Rescue Clinic	Any winter backcountry user.	1) Wear and operate an avalanche beacon. 2) Perform a mock companion recovery including single and multiple burial search. 3) Understand challenges involving multiple rescuer and learn basic group management.	**Hands-On Training:** • Importance of beacon skills (burial time-survival statistics) • Beacon operation and search principles • Demonstration and practice of signal, coarse, fine, and pinpoint search • Rescue practice scenarios including group management, probing, and shoveling • Overview of first aid and emergency skills needed in actual rescues	None.	4 hrs field	Attendance and participation.	Sufficient personal experience. **format and teaching tips available* Maximum 8:1
Level 1: Avalanche Fundamentals	Current and aspiring backcountry travel companions.	1) Apply the current avalanche bulletin in tour planning and travel. 2) Recognize avalanche terrain and understand safe motorized travel protocols. 3) Interpret snow conditions and weather on different aspects and elevations in relation to slope stability. 4) Apply simple decision tools in avalanche terrain. 5) Conduct a mock companion recovery and understand basic group management.	**Avalanche Types and Anatomy** **Basic Slab Mechanics** **Terrain** •Terrain evaluation and route selection • Travel protocols and group communication, i.e., one at a time, don't help stuck partner on slope, manner in which one parks, pre-loading communication, hand signals, etc. • High-marking guidelines **Snowpack and Weather** •Mountain snowpack development leading to instability or stability •Field observations, tests, and judging instability • Perform safe slope cuts to identify instability • Use of avalanche and snowpit tools: inclinometer, compass, probe, saw • Introduce elementary pits with hand-hardness profiles, basic grain type symbols and stability tests. Expose to recording field notes. •Avalanche and snow climates **Decision-Support Tools** • Human factors and the need for systematic decision tools • Application and limitations of decision tools • Avalanche bulletins **Rescue** • Companion rescue including scene size up, organization, beacon use, probing • Recovery of victims not wearing beacons • Common mistakes in avalanche rescue • Single and multiple beacon search techniques • Role of first aid and emergency response in real avalanche rescues	No formal prerequisites. Strongly recommended: 1) Winter Travel and First Aid Skills 2) Introduction to Avalanches Program 3) Course provider's recommended reading	24 hours Minimum 60% field	Attendance and participation.	Primary or lead instructor: AAA Pro Member with exemplary riding skills and enthusiastic about riding. Assistants: AAA Member Affiliates. Continuing education within previous 4 years. Instructors must be excellent role models for the skills they teach. Preferred 5:1 Maximum 7:1

Zac's Tracks Education Suggestions

Lori and Randy Zacaruk teach Awareness and Level 1 AST curriculum to the recreational snowmobile community in Canada. Here are some of their suggestions concerning the delivery of educational programs to the snowmobile community:

General Thoughts:

- A personality and culture match is necessary. Instructors need to be able to connect with students on a personal and cultural level. For instance Lori mentions that most bilers would expect to see an instructor in a ball cap and button-down shirt, unlike a skier who might wear a knit hat and be dressed for the outdoors. The snowmobile community wouldn't wear their riding attire inside, so why would a skier? Making students feel as though they are with like-minded individuals creates trust.
- Education needs to be delivered by a trusted entity.
- Trust takes time, marketing, and money.

Parking Lot / Trailhead Considerations:

- Safe Travel: Discuss minimum spacing while on trail; review red flags.
- Group Management: Set defined goals in terms of "no joy riding."

On Trail Considerations:

- Instructor is always in the lead.
- Instructor's job is to keep the group together.
- Keep a good "wrench" and "digger" in back.
- Stop well past corners.
- Put an obvious identifiable color at the end of the line.
- Employ the buddy system.
- Pull over within one mile of starting for a "check in."
- Radios go at front and end of the group.
- When sending information, send it forward not back.
- Make decisions regarding broken down sleds before leaving the trailhead.
- When you pull over, have an objective and escape route. Never block anyone!
- Angle park.

Lori Zacaruk of Zac's Tracks begins a class at the trailhead by outlining safe travel and group management techniques. *Photo courtesy Zac's Tracks*

Teaching Techniques:

- Snowpits should be dug close by trailhead (spend no more than an hour).
- Dig one long pit so everyone can get in.
- Don't tempt riders with powder. Go where the terrain is better suited for teaching than riding.
- Use very simple avalanche terrain with good visibility of alpine terrain.
- Spoon feed information.
- Emphasize structure over tests.
- Review bulletin at the end of the day rather than the beginning. It's easier to apply bulletin to findings later, rather than while digging pit.
- Their mantra: Timing, Predictability, and Weather.

These pointers are based on Jake Urban's notes from phone conversations with the Zacaruks. ❄

Outside Cooke City, MT, rescuers search for the body of a missing snowmobiler. He was high marking on a slope littered with tracks when the slope avalanched. He was wearing a beacon, but forgot to turn it back on after eating lunch in town. *Photo courtesy Gallatin National Forest Avalanche Center*

Promoting Avalanche Awareness in the Snowmobile Capital of the World

Story by Doug Chabot

The Gallatin National Forest Avalanche Center (GNFAC) came to life during the winter of 1990/91, 21 years ago. Encompassing West Yellowstone, Montana, the self proclaimed "Snowmobile Capital of the World," and the extreme terrain around Cooke City, snowmobilers were a focus from the beginning. During that first year Karl Birkeland taught the first snowmobile avalanche awareness classes in southwest Montana, reaching 140 riders. Long tracks were reaching 121" and engines were topping out at 650cc – puny by today's standards. The next season Karl wrote an article for *The Avalanche Review* titled "Avalanches and Extreme Snowmobilers" *(see www.fsavalanche.org/NAC/techPages/articles/92_TAR_Av_Ext_Snowmo.pdf)* which identified the audience and outlined his educational approach to the rapidly growing population of snowmobilers. Since then the GNFAC has given 188 awareness lectures (one to two hours long) to 7151 riders. During the winter of 1992/93 Karl offered his first field session for snowmobilers. After securing a loan of two mountain sleds from our local snowmobile shop in 1999, our field sessions took off, especially as our riding skills improved. By the end of last winter we had taught a total of 39 field sessions to 1187 snowmobilers since Karl's first venture.

Snowmobile avalanche awareness has been a large part of our education program in the last 10 years. In 1999 there was a big void in education as avalanche centers and educators were trying to get a handle on the rising tide of snowmobiler fatalities. Most of us did not ride very well, almost none had access to mountain sleds, and all our education lectures contained an overabundance of skier pictures to illustrate avalanche fundamentals.

On the Gallatin we took hundreds of photos with our new sleds and put together a PowerPoint lecture specifically aimed at snowmobilers. Seeing the need for this type of education far beyond our borders, we burned 215 CDs and handed them out with an instructor handbook for free to anyone who wanted one: other avalanche centers, educators, schools, snowmobile clubs, etc. By having an open dialogue and sharing our education tools with all users we were able to give valuable avalanche education to thousands of riders across the country.

After flooding southwest Montana with awareness lectures, riders wanted more. They wanted to get in the field with us, so in 2000 we designed an Avalanche Awareness for Snowmobilers course: five hours of lectures followed by a day of riding in the field. This course was adopted in 2004/05 as the minimum standard of avalanche education for snowmobile guides on the Gallatin National Forest, the first requirement of this type in the nation. Every year the course evolves as we learn more about riders and their changing needs. More skiers with Level 1 and 2 certifications are becoming hard-core riders alongside younger athletic riders who are taking X Game moves into the big mountains. These changing demographics are forcing us to become better riders ourselves which is one of the funner aspects of the job.

COURSE STRUCTURE AND CONTENT

Our multi-day course is popular with at least three sessions a year: one in Bozeman and two in West Yellowstone. The Bozeman course has lectures on two weekday evenings with a weekend field day. In West Yellowstone we cover the same lectures in an afternoon with the next day dedicated to field sessions. All participants need a shovel and beacon and most have probes too. All riders need their own machine since we don't allow riding double – our experience has shown that this limits where we can go. Although we prefer a ratio of riders to instructor at 9:1 or less, we've been known to do 12:1 in a pinch. Regardless, each instructor has a tail-gun volunteer whose job is to sweep the trail and keep the group moving forward. Occasionally sleds break and have to be towed back to the parking lot.

One of the worries, especially on days when the avalanche danger is elevated, is that a sledder will peel away from the group to hit an adjacent hill. This behavior is not tolerated – we explain our expectations of students not playing that day; we expect them to closely follow the instructor. We take a hard line, talk about it often, and in our 11 years of teaching these classes we've never had an issue.

We go riding with the class. If there's a hill to highmark, we discuss how to go about it: how to gather information, make cuts, watch one another, and be safe. Our job is to give them the skills to snowmobile in the mountains safely, and we practice this in class. We dig pits too, but usually just to identify layers and show them how the snow shears. We practice with the Compression Test, but mostly concentrate on heightened observation skills: recent activity, collapsing, and cracking. And we hammer in ***The Big Three***:

1. Only ride a slope one at a time, and never go up to help your stuck buddy.
2. Recent avalanches equal instability.
3. Always carry rescue gear.

If riders never dug a snowpit but followed these rules, we would see a dramatic – over 50% – drop in avalanche fatalities overnight.

We spend half of our field day teaching beacons (single and multiple burials), strategic shoveling, and probing, and then we cap the afternoon with a dynamic rescue drill. Each group gets divided into two groups that set up complicated rescue scenarios for each other. This is the most powerful exercise

More skiers are becoming hard-core riders alongside young athletic riders taking X Game moves into the big mountains. These changing demographics are forcing us to become better riders ourselves which is one of the funner aspects of the job.

Two snowmobilers were riding Mt. Jefferson, MT, when it avalanched, killing a local rider under six feet of snow. The rescue was frantic and unorganized until a trained Gallatin National Forest Snow Ranger arrived on scene. Case studies about avalanches in familiar terrain for the audience are powerful teaching tools. *Photo courtesy Gallatin National Forest Avalanche Center*

we do all day. Students are blown away at how physically demanding rescue is and how beacon practice is crucial to being able to perform under pressure. This is always the highlight of the day since it dispels all their misconceptions about how easy a rescue is.

For the classroom portion we include five lectures, each an hour long: terrain, weather, snowpack, human factor, and rescue. The science is standard level one fare, but we concentrate on ***The Big Three***, since this is where lives will be saved. Calculating densities is cool, but knowing never to go up to help your stuck friend is critical.

Our lectures are laced with snowmobile accidents that we've investigated, each illustrating a particular point (i.e., you can trigger a slope from the bottom, facets are persistent weak layers, never leave the scene of an avalanche, carry rescue gear on your body, only one at a time on the slope, etc). Since these accidents occurred locally, many folks either know the victim, were part of the accident, or are intimate with the terrain. This is a powerful component of our lectures since we're showing real events on their home turf.

COSTS

All of our one- to two-hour avalanche awareness lectures are free. The multi-day course has a suggested donation of $30 for the entire course. This allows anyone to take it, no excuses. Most people pay, and many give us more than the suggested minimum. We raise funds from within the community to pay for the instructor's time. When we first started our numbers were small and the fee was subsidized by our fund-raising efforts. But as years go by and more people attend, the $30 entry fee covers the real costs associated with putting it on. We've found that the cheaper it is, the more people will attend and convince their riding partners to come too.

CONCLUSION

Although avalanche centers and educators across the nation are tackling snowmobile education locally, it's important for us all to move forward as a community. All regions have unique problems and strengths regarding snowmobiler education. Yet it's important to share our ideas, pictures, stories, and hard-learned lessons so we can move education forward in the US. Saving lives is our goal; everything else is secondary.

Doug's best riding advice came from a Polaris dealer the first time he stepped on a 154-800 RMK. He instructed, "Point it where you want to go, pin it, and don't let go. This sled is like a .357 Magnum, it'll kill you if you're not careful." As director of the GNFAC he graduated to a 2011 Yamaha Nytro MTX 162.

Thoughts on Snowmachine Avy Instruction

Story by Ryan Hutchins-Cabibi

General thoughts:

- The focus for the avy education community on the importance of sledders teaching these courses is right on. I had only been riding (out West) for about a year when I taught these courses, and that experience and ability to relate to the goals, desires, and culture of sledders was crucial to reaching them. In addition, having solid riding skills in a variety of conditions will increase the instructor's ability to access terrain, bond with students, and demonstrate techniques.
- The most interesting part of teaching to this population is the shift in our culture that we as educators need to embrace. I think as we make that shift, snowmobilers will welcome our education more and more. This means we need to learn to ride well and break down walls and stereotypes on all sides of the winter recreation community, then tailor our education to different populations.
- Snowmobilers want to know how to make decisions in avalanche terrain; clearly they love life and enjoy the outdoors. I think the challenges to getting them this education comes from our end: the more we can get snowmobilers to teach these courses, or become sledders ourselves, the more effective we'll be at saving lives.

More specific thoughts:

- I agree with the GNFAC's feedback for AAA guidelines.
- In the two courses I taught, I found that most riders had beacons but few, if any, had practiced with them. This was a highlight of these courses for participants.
- Lots of riders ride with their shovel attached to the sled somehow. Stressing the importance and reasons for having your rescue gear on you will be valuable on the courses.
- The use of video was highly effective with snowmobilers. There are tons of videos available on the Web that show snowmobile avalanche incidents and depict the vast terrain that riders can access. These videos add spice to a PowerPoint, and because they are shot by other riders, they are easy to relate to.
- The insight from Zac's paper on clothing choice was excellent and right on.
- The tests in the TAR article are a great start in mechanized stability tests. I am excited to see research on these tests that, hopefully, will prove that they are quantifiable.
- Chris Lundy's article, *Shredders Teaching Sledders*, is right on the money *(see page 17)*.
- It can be useful to point out the challenges and advantages of being on a sled versus other modes of travel. This can help encourage sledheads to get off and walk around, dig a quick pit, or even talk to other backcountry travelers to gain information. I also think the TAR article is correct that the amount of terrain a rider can cover in a day is a huge asset to the forecasting/backcountry community.
- One article discussed the challenges of getting manufacturer's and travel boards to push the importance of avy education because they don't want to scare customers. This is an interesting point. I think there are some companies out there that we should pursue for sponsoring awareness days and potentially even level one courses. KLIM would be a great company to work with, as they are securely rooted in mountain riding culture. Polaris is an American snowmobile company that has been involved in sponsoring or loaning sleds to avalanche centers for a number of years; I wonder if they would expand this support if approached? Video companies? It seams like TGR has made a small foray into some avy education, and I wonder if they would step up to do some more for snowmobilers? Getting the Slednecks production company on board would garner a lot of legitimacy in the snowmobile community. Could the AAA education committee take on the responsibility / task of developing these relationships?

In closing, I am very excited that we are looking at this stuff. I would love to continue to be involved and increase my involvement where appropriate. Let me know what I can do!

Ryan Hutchins-Cabibi is an outdoor educator who balances his love of wilderness with a healthy dose of motorsports. He grew up in New Hampshire where he spent winters skiing, snowboarding, and snowmobiling. Ryan is currently a program supervisor at NOLS Rocky Mountain where he begs to go on snowmobile food drops for winter courses. He teaches avalanche awareness and Level 1 courses to skiers and snowboarders and has taught snowmobile avy awareness courses for Fremont County SAR and local snowmobile groups in Wyoming. Ryan's best face shots come from leaning over and counter-steering a sled in fresh powder.


Big Iron Shoot

The Aftermath

Story and Photo by Brad White

IN THE DAYS leading up to the 2010 "Big Iron Shootout" snowmobile event at Boulder Mountain near Revelstoke, British Columbia, the chat rooms were full of discussion about the fact that the local snowmobile club had raised the groomed trail access fee from $20 to $25, partially to cover the anticipated cost of cleanup from the thousands of riders who attended previous years' events. Surprisingly, there was almost no talk about the fact that the Canadian Avalanche Center had issued an unprecedented fourth-in-a-row *Special Avalanche Warning* for the upcoming weekend. New snow and multiple, active, buried surface hoar layers had pushed the danger to High once again.

However, on the day of the event, only 270 riders showed up to race their modified sleds and see who could climb the highest, so the message about the dangerous conditions had reached most of the snowmobile community. March 13 was a wonderful sunny day, and with the fresh snow the riding conditions were excellent. After the more formal challenges of the day, which went off without a hitch, many of the riders had drifted over to the base of Turbo Hill, a well-known hill climbing test piece. Over 100 riders were parked on a sunny bench in the runout zone of the avalanche path beneath the hill while a few riders gunned their way to the top.

At around 3:30 pm, one rider was stuck on his sled on the slope, while another climbed over a thin rocky section near the top. It was likely he who triggered the avalanche. Within seconds, a seemingly perfect day had turned to terror and chaos. The size-three avalanche ran straight through the gallery of spectators. People were scrambling, trying to get their machines started, or just turning and running as the avalanche swept over them. It is estimated that over 60 people were involved in the avalanche, but the real numbers will never be known. What *is* known is that at the end of the day there were two fatalities, 31 injuries requiring hospital treatment, and countless more self-evacuated walking wounded.

That there were no more fatalities in an avalanche accident of this magnitude is a miracle, but also a credit to the bystanders who quickly went into rescue mode, and also the result of the quick mobilization of nearby heli-ski companies who responded and were able to effect an evacuation of over 100 people in the two hours before darkness.

There are stories of people being found alive who were not wearing beacons. In one instance a person was dug out of a hole, and suddenly a hand poked into the hole from the side and another person was rescued. The fact that most of the riders and survivors had beacons, shovels, and probes and immediately put them into action undoubtedly made for a less tragic outcome.

Immediately after the avalanche, the call got out for help. A nearby rider who witnessed the avalanche was able to get a call out on his two-way radio to Revelstoke Mountain Resort, and they notified Selkirk Tangiers Helicopter Skiing who began a complete call out of all the available avalanche rescue resources. At the same time, numerous SPOT devices were triggered and the RCMP also began a complete call out. Within one hour, 12 helicopters, 50 rescuers, and four dogs were responding. The lead guides from CMH and Selkirk took charge and began evacuating injured from the site. By 6 pm the only person left on the slide was a confirmed fatality and one RCMP team who were sweeping the trail and containing the scene.

Everyone who responded on the first day was convinced that there were going to be more fatalities uncovered with subsequent searching. The following day, a joint rescue response team led by Parks Canada came in and performed avalanche control to remove some residual avalanche danger and began with more transceiver and dog searching. Meanwhile, the RCMP had spent the entire night checking every vehicle, hotel room, and campsite in the community to determine if there were any other riders missing. By noon on the 14th, all the riders from the previous day were accounted for, and the searchers had not turned up any more victims. Still to come was the removal of over 45 damaged snowmobiles in the debris and the call for an inquiry into how a tragedy like this could have been allowed to happen.

There is no question that the riders in this incident had congregated in absolutely the worst place. Efforts at snowmobile avalanche accident reduction will need to address the approach to terrain by sledders. The speed of access, lack of communication between riders, and the nature of the terrain use while snowmobiling do not lend themselves to one-at-a-time exposure such as what is taught to skiers. However, there is room for better terrain recognition and avoidance skills that will ensure an incident like this does not happen again.

As far as follow up from the avalanche, the RCMP looked into it as far as criminal charges, but decided that no charges will be laid as it is public land and everyone was there of their own free will. The event is not a sanctioned or officially organized event but a loose group event that is talked up over the internet.

The coroner's recommendations from the inquiry into the 19 sledder fatalities in 2009 are slowly being implemented, but funding issues are always a problem. As far as I know there has been nothing official from the coroner regarding Boulder.

Brad White is a IFMGA mountain guide with over 25 years experience in the avalanche industry. He is employed by Parks Canada as a mountain safety programs specialist in Banff, Kootenay, and Yoho National Parks where he is responsible for public avalanche bulletins, forecasting, and avalanche control and mitigation on park highways. He lives in Banff, Canada, with his wife and two children, and spends much of his free time moonlighting as an avalanche educator, ski guide, and adventure photographer. ❄

SHREDDERS TEACHING SLEDDERS:

Tips and Guidelines for Snowmobile Avalanche Educators

Story by Chris Lundy

Recently, the AAA Education Committee began developing Guidelines for Snowmobile Avalanche Education in the US. While not dramatically different than the existing general guidelines, they will establish important criteria and outcomes for avalanche educators teaching snowmobilers. But as we all know, the curriculum alone does not make an effective class – it's all about the instructors.

Sean Wisner from the Alaska Avalanche Information Center has said, "It's more effective to make an avalanche instructor out of a rider than a rider out of an avalanche instructor." While this may be true, until we train more sledders to be avalanche educators, many of us coming from a skiing background will be pressed into service teaching avalanche safety to snowmobilers. US avalanche centers that have been teaching snowmobile-specific avalanche classes for the past 10, even 20, years have learned many lessons the hard way. Here are some tips so you don't have to play the fool like we did.

❶ First and foremost, put yourself in their shoes. How would you feel if someone who didn't know much about skiing tried to teach you to ski safely in avalanche terrain? What would your response be if they made you feel like shredding steep powder slopes was stupid?

❷ Enjoy riding. If you don't like to ride or have personal/ethical issues with snowmobiles, don't even think about teaching an avalanche class to sledders. Harsh, maybe, but you stand a good chance of doing more harm than good.

❸ Learn how to ride. Eventually this will stem from tip #2. While it's not impossible to be an effective instructor as a beginner rider, it sure is hard to gain credibility when you're getting stuck all the time or are afraid to leave the groomed track.

❹ No Patagonia. Period. Or other skier-oriented clothing for that matter. As a skier, would you respect someone who showed up looking like a motorhead or was wearing a shirt that said "Wilderness: Land of No Use?" The ethic that Patagonia represents has similar connotations to snowmobilers. Go get yourself a snowmobile getup and look the part.

❺ Learn tools and techniques that will be applicable to snowmobilers. Many safe travel, stability evaluation, and rescue methods that we teach skiers don't translate well to snowmobiling. In many cases, sledders have an advantage over self-propelled travelers – help them learn how to exploit these to increase their safety.

❻ Remove photos and videos of skiers from your PowerPoints and retool certain sections to be more applicable to snowmobilers. There are plenty of pictures and video of snowmobilers out there, but if you need some contact me or another avalanche center that teaches a lot of sledders. We're all happy to share.

❽ Learn the lingo, what the issues are in their sport, and what's cool and new. Never, ever call them 'biles. What are the hot new sleds this season? Many sledders like the new four strokes, but not because they pollute less – so don't act all excited about that.

See, not that hard. By becoming one of "them" you'll be more effective at the one goal everyone agrees on, no matter your background: saving lives. Careful, you might like it…

Chris Lundy is director of the Sawtooth National Forest Avalanche Center; he has a secret passion for sewing and a not-so-secret passion for being a motorhead. He and his wife Sara are rejoicing to have just moved into their owner-built house outside Stanley, Idaho. ❄

From: Sean Wisner
Subject: Snowmobile Avalanche Education

In terms of teaching techniques and group management what tricks (or stumbling blocks) would you pass on to other potential instructors in the field of snowmobile specific avalanche education?

We need to change the attitude of our current avalanche educators regarding snowmobile education. Simply stating that "they shouldn't ride in avalanche terrain" won't cut it anymore. Snowmobilers are here to stay and we need to educate them effectively. We need to create course materials that are truly snowmobile-specific, and are not riddled with photos of backcountry skiers slowly accessing a single run in a day. Snowmobilers are a different breed, and can access hundreds of miles of avalanche terrain in a single outing. The old paradigm of trying to include snowmobilers in a skier-specific course, having them snowshoe along with a group of skiers, simply does not work. These courses need to be taught on snowmobiles, by avid and competent snowmobilers, or we will continue to lose all credibility with the user group.

In terms of group management there are some obvious differences that need to be addressed. Communication techniques are vastly different, as we cannot chat while riding our machines without using expensive in-helmet radio communication systems. We need to practice hand signals and other non-verbal communication techniques that are agreed upon and standardized BEFORE the ride begins. We also need to stop frequently and turn the machines off to discuss changing conditions and route plans. Group management can be easily accomplished by avid snowmobilers, but will be ineffective if a novice snowmobiler attempts to teach the course.

In terms of standards, what do you think should be required of all snowmobile specific avalanche courses.

I believe that the standards for course progression in the US have already been set by the AAA, and we do not need to reinvent the wheel in this regard. For example, a level 1 course must be a minimum of 24 hours, must contain both classroom and field components, and has to include all of the pre-established topics with an emphasis on decision-making. We just need to modify the course materials to make them specific to snowmobiling.

In regards to field work, I believe that we need to standardize the way we teach slope testing with snowmobiles. Lori Zacaruk has done some great work on this, as has Mike Buck. We outlined the snowpack testing that we teach in our TAR article last Spring, which are all very similar to the tests that Lori teaches, but with different names for each test. I also believe that we need to standardize the communication techniques that snowmobilers use, as well as the travel techniques for riding in avalanche terrain.

Lastly, I believe that all snowmobile courses need to include components of companion rescue specific to both top-down rescue and bottom-up rescue, strategic shoveling, and effective probing. Most snowmobilers can use a transceiver these days, but many have not yet learned the subtleties of efficient shoveling and probing.

How much do you stress snowpack tests (CT, ECT)?

Level I: I usually show the students how to do compression tests, and discuss looking at layers in the snowpack, but realize that they will probably never stop on a ride to dig a pit. Therefore, I focus most of my energy and time on slope testing and identification of weak layers on representative slopes while riding the machine. Again, these tests cannot be adequately demonstrated by novice riders and need to be perfected before the class.

My main focus of Level I courses is avoidance, checking bulletins before heading into avalanche terrain, and following weather patterns throughout the season. It is all about making good decisions, and choosing terrain that is appropriate for the conditions.

Our Level II courses focus on more detailed snowpack testing, based on the AIARE curriculum, but we have not yet had enough interest from the riders to teach a Level II snowmobile-specific course. I believe that this will change as we get more riders through the level I program.

How much importance do you put on slope tests?

Slope testing with a snowmobile is an integral part of our level 1 program, and we spend a few hours in the field discussing these techniques. While the main focus of the program is decision-making terrain choices, we feel that the slope testing that can be performed while "on the fly" during the ride can identify weak layers and instabilities effectively. The information that is gathered from these slope tests will aid in the decision-making process, and may ultimately modify the plan for the day.

I hope that this information helps you. Let me know if you have any more questions or comments. Hopefully Mike Buck will also provide feedback to these questions as well, as his insights and educational background are integral to our programs.

Sean D Wisner, Executive Director, Alaska Avalanche Information Center, www.alaskasnow.org

Sean Wisner serves as the executive director, snowmobile and ski course instructor, and technical rescue coordinator for the Alaska Avalanche Information Center. Prior to his work with the AAIC, Sean worked as a high altitude mountain guide, helicopter and snowcat ski guide, whitewater raft guide, and snowmobile tour guide in Alaska. Sean lives in Valdez, Alaska with his wife and two children, and enjoys playing in the mountains and the sea whenever possible.

Sled Shed Awareness Course

Sample Course Outline by Michael Jackson

Introduction: Alpine Safety Awareness Program (ASAP) *5 minutes*

Purpose: To raise your awareness about common mistakes made in avalanche accidents and to provide some tools to avoid similar situations.

Statistically, avalanche accidents are the result of two primary factors:
1. Not recognizing OBVIOUS signs of HUMAN NATURE
2. Not recognizing OBVIOUS signs of MOTHER NATURE

Goal: To train you to recognize both OBVIOUS signs in our own nature and Mother Nature…and to make this recognition skill a HABIT.

HABITS: Your habits are what is going to save you or kill you.

GOOD HABITS when planning to ride in avalanche terrain:
1. Check the avalanche hotline: Gives you the chance to choose terrain appropriate to the hazard.
2. Safety gear: Five to Stay Alive
3. Plan options into your day: weather changes, snowpack changes, people change, you need to adapt. Options keep you from making bad decisions in the heat of the moment when you're tired, hungry, etc.

BAD HABITS – People don't make a habit of running red lights, do they? Why? Avalanche accidents are like running red lights: you might be able to get away with doing this once or twice, but eventually it will kill you or others.

Bad Habits: FACETS PowerPoint *15 minutes*

TRANSITION

Now that we have talked a little bit about HUMAN NATURE, let's look at MOTHER NATURE

Observable Clues: ALPTRUTh *20 minutes*

"Terrible Traverse" *30 minutes*

Break class into two groups. Assign each group either FACETS or ALPTRUTh and have them locate and discuss the various component. Discuss how human factors can trap you. Devise strategies to avoid them: communication, planning options, recognizing different risk acceptance levels, and choosing proper partners for the day's goals.

BREAK

Case Studies Small Groups, Handouts. Track FACETS/ ALPTRUTh in case studies. *60 minutes*

AVALANCHE BULLETIN: Teeter totter. Higher the hazard, lower the terrain angle. *15 minutes*

LUNCH

RESCUE: What to do if caught. *15 minutes*

PowerPoint Companion Rescue. *25 minutes*

Beacon Practice: Field Exercises

- Have participants get in circle. Show how each beacon is turned on/off, how you wear them.
- Demonstrate flux lines. On chart, on ground visible people walk in line.
- Range check/demonstrate proper beacon check. Do before you leave each time you go out.
- Have probe assembled before you search, probe as you approach fine search. Shoveling effectively, leave probe in, shovel downhill and into the slope.

TEACH THE FIVE TO BRING THEM BACK ALIVE

Demonstrate single beacon, multiple beacons, group rescue

CONCLUSION: Avalanche accidents are mostly avoidable , and if we pay attention to some OBVIOUS clues in Human Behavior (FACETS) and COMMUNICATE with our partners, we can put the odds in our favor. In addition, if we can recognize the OBSERVABLE CHARACTERISTICS in Mother Nature (ALPTRUTh) and place OPTIONS in our planning of the day, we can avoid making poor decisions that could come back to haunt us.

Take these new tools and practice with them… make them your newest GOOD HABIT!

Michael Jackson is the founder of ASAP, Alpine Safety Awareness Program, a community-based effort that uses local resources to teach alpine safety skills to children and adults throughout the Pacific Northwest. He also works countless hours every fall as the organizer of the Northwest Snow and Avalanche Summit (see article about this year's event on page 9).

Rock Stars & the Trickle-Down Effect

Story and Photo by Craig Gordon

Avalanche outreach for sledders is challenging. Let's face it – most forecasters and avalanche educators come from a strong ski background, where an ingrained culture developed many years ago continues across generations. Plus, our teaching tends to include a science-based approach. In the early days we did what most avalanche instructors did, we cloned an avalanche class for skiers and boarders and just added a few snowmobile photos, then wondered why no one listened. We found that sledders require a different approach: 1) make the classes shorter, 2) have more fun, 3) don't tell them how the clock works when they just want to know the time, and 4) don't show up on skis or show photos of skiers. You've got to be a sledder or at least learn to fake it, and 5) you need a rock star.

Star power. That's the ticket. Get community rock stars involved as a conduit to help spread the message. While some of us think we're the rock stars, the harsh truth is, most folks outside our "community" don't know us. Start with the low hanging fruit – the riders who already flock to us for info and classes. The hard job is getting people onboard who don't know us. Marketing 101. Find the rock stars.

I use a multi-pronged approach and it seems to have gained quite a bit of traction. First, like any other successful business model, you've got to get the movers and shakers involved. Invite the renowned as well as the local athletes to help as assistant instructors. I use this process whether I'm teaching sidecountry skiers and boarders at a Big Mountain Freeride Workshop or teaching snowmobilers during our Avy Essentials for Sledders. Of course it takes a lot of hard work to make the connections, spend time "selling" the program, and most of all, forming a bond. But the benefit becomes organic and the message spreads not only through the mouths of avalanche professionals, but also through the mouths of peer riders which gives the program a huge amount of street cred.

I know we're pretty spoiled here in Utah: great snow, great mountains, and an abundance of pro riders. It's kind of like what the North Shore of Hawaii is to surfing. And here in Utah we have team riders from film production companies like Boondockers – who do some of the most amazing things on sleds – on board to help us out. (Dan Gardiner, mastermind behind the Boondockers movies is on our Friends of the Utah Avalanche Center board). You may not have a production company in your own backyard, but no matter where you live, there are local riders everyone respects, and the sooner we start courting them, the sooner we can start saving lives.

Most of the sledders I deal with don't have the time nor patience for a three-day Level One class. They want enough information to feel confident about their terrain choices and not have to invest too much time and miss out on good riding. So, I try to strike a balance between the amount of avalanche information, both indoor and on the snow, with some fun, free-riding time. With sledders I think it's super important to allow 'em to go tear it up for a while and blow off a little steam. We limit our 11-hour basic, on-the-snow classes to 24 people, with a 4:1 student/instructor ratio and combine three hours of evening classroom work with eight hours in the field.

The typical field day starts off with the "Keys to the Kingdom" – learning how to use avy rescue gear. Like most groups, sledders quickly realize they're not quite as good with this stuff as they think they are. With the realization that rescue does not work very well comes the critical mind shift that must occur before you can go to the next step. Now, they are finally ready to listen to the lessons that will actually save lives, namely looking for obvious clues to instability, how to manage terrain, and safe travel ritual.

Dan Gardiner of Boondockers gives young Jack Dailey a flying lesson during last winter's Avy Essentials class.

For the second and third phases I call in the big guns. We break into two groups: one group geeks out with snowpits, stability evaluation, and recognizing safe terrain choices. Meanwhile the other group gets a riding lesson from Dan Gardiner and his posse. Dan blends safe travel techniques with the secret behind landing huge air, how to counter-steer a sled, body positioning, and throttle control. In addition, the riding group gets a "mock rescue" surprise thrown at them when they least expect it, which hopefully further reinforces that rescues don't work very well.

Meanwhile back in the pit, we talk about lessons that are applicable to sledders. A review of the winter's weather and how it applies to the current state of the snowpack gets people thinking about more than just the snow they're riding in. While most riders don't sense the same nuances as skiers, they understand how snow feels under their track. This is a huge breakthrough moment when sledders interpret avalanche conditions according to how it feels under their machine. Yes, they're just like non-motorized users, only utilizing a different snow vehicle. Since very few people, much less sledders, actually dig snowpits, we can't expect people to geek out on ECT or Saw Propagation tests. However, we still like to show them at least one snowpit and let them try the test for themselves. First, it allows riders to see for themselves how the snow reacts and that it's not rocket science. And second, it gives a lot of cred to what we do as avalanche professionals. A couple hours at each station and we rotate groups…always keeping people moving.

The day wraps up off the snow at a local sandwich shop with a review and debriefing along with some hot soup and coffee…all first rate of course. The riders are stoked. They've learned some tips that could save their life, they got to ride with their heroes, and they understand our world a little better.

It's easy to get discouraged because we knock ourselves out for a day to only teach 25 people, but we have to remember that each participant will teach perhaps 10 of their friends and each of their friends might teach 10 more. Like magic, these seeds spread through a community.

Craig Gordon is a skier who snowmobiles, or is he a sledder who skis? Either way, his enthusiasm for avalanche education has been a huge influence in the Wasatch with programs such as Avy Essentials for Snowmobilers *and the ground-breaking film* Know Before You Go. ❄

From: Mike Buck
Subject: Snowmobile Avalanche Education

Jacob, As Sean has said, thanks for all the work on this project. It would be fantastic to see some quality education delivered in a way that meets the needs of riders. For years now the avalanche education community has been missing the mark on snowmobile riders for a variety of reasons. The riding community is very diverse in its makeup, and that has made it very difficult to reach each group with the appropriate information. It would be like having a class with hard-core mountaineers, backcountry snowboarders, resort skiers, cross-country skiers, and a moms' snowshoe fitness group all in the same class. We need to target our classes with the appropriate level of information. It is absolutely essential that we recruit instructors respected in the riding community and train them to be avalanche instructors. Sean has made some excellent comments on your questions. I will attempt to add a few thoughts.

In terms of teaching techniques and group management what tricks (or stumbling blocks) would you pass on to other potential instructors in the field of snowmobile specific avalanche education?

As mentioned by Sean, a set series of hand signals are essential for managing the group. A preplan for stops should be made, roundup stops are used when the instructor needs to relay verbal instructional information so the riders are in close proximity to the instructor.

An initial "follow the leader" evaluation ride is essential so the skills of the riders can be accessed by the instructor. This is also a valuable warm-up for riders. The slope test evaluation techniques will be different depending on skill set of the riders.

Make sure all riders have a reliable machine to ride. Additional back-up riders are a must for potential breakdowns. A back-up plan for how breakdowns and instruction will be handled will save valuable time.

In terms of standards, what do you think should be required of all snowmobile specific avalanche courses.

I agree totally with Sean on this question. We have the standards for the courses. Some modifications in materials are needed.

We need communication, travel, and slope testing techniques but I am not sure that they should be called standards and I am not sure that they could be applied equally to all areas of the country. Sean's point on companion rescue should definitely be a standard.

How much do you stress snowpack tests (CT, ECT)?

We show snowpack tests and spend a fair amount of time doing them so that the "machine slope tests" make sense and can be cross referenced to what was observed in the pit. While doing these stability tests we stress the importance of exposure as we perfect our technique as much as possible. (Additionally I am a firm believer that route selection and safe zone selection are the most important things we teach.)

How much importance do you put on slope tests?

Slope tests are very important and the results are a very valuable tool for conducting a safe ride. As stated above, route selection and safe zone selection are the most important components of our field instruction It is absolutely essential to make it clear to students that enjoy climbing and high marking in the backcountry that it is possible to hit the sweet spot that could release a deep instability in the snowpack even when all indicators point to a stable day. In Alaska we have had several of these events that have injured and killed many riders. With this factor in mind we will often teach advanced riders who like to high mark how and where to select the best spot for their activity. This again emphasizes my earlier point about our audience. It is important that as avalanche educators we try to target our classes with the appropriate material for the students.

Mike Buck taught high school in Valdez, Alaska, from 1978 to 1998. He has been a river guide since 1982 and started riding snowmobiles in 1979. As a backcountry snowmobile guide since 1997, Mike has logged well over 50,000 miles in Alaska's backcountry. Mike is also the founder of Valdez Search and Rescue and continues to teach backcountry safety and avalanche programs around the state. ❄

Part of a guide's training is learning how to ski steep powder.

above & below: A toe-in landing and hover exit requires balance, timing, and communication. Here the guide must ensure that the guests exit gingerly and move quickly to a safe spot.

HELI-GUIDE TRAINING:
Opportunities for Snow Professionals in Utah & Alaska

Story and Photos by Mark Kelly

As a ski guide in Alaska I am always asked "Wow, is it always this amazing?" followed by "How can I do this for a living?" For the past eight seasons, H2O Heli Guides has been answering the second question by offering two American Mechanized Ski Guides courses: a level one and a level two. Both courses offer quality hands-on time with ski lifts, snowcats, and helicopters in a big-mountain environment.

So why might these courses be useful? Here's a few thoughts from my experience: ski patrol experience taught me to work in a team setting, learning radio protocols, and other professional skills. My work as a year-round guide teaching climbing in the summer made me familiar with the AMGA and helped round out my skill set. After some great training in demanding venues, a lot of hard work, and some time and experience, I became a certified ski mountaineering guide.

But I still had not received any training on how to work safely around the machines most commonly used to access ski terrain. I had no idea what a load manifest was, how to go about fueling, flight following,

It can be hard work to balance desire and uncertainty, especially with top-down guiding. Spectacular lines can have all kinds of hidden dragons.

preparing LZ/PZs, and was inexperienced with top-down guiding. When I talk to heli operators the common question is, "Do you have any blade time?" As a professional in my 30s, I was not interested in becoming a cook or office intern in exchange for an occasional run. I had a combination of skill and luck as H2O hired me as an AMGA guide to establish a ski mountaineering program. Upon seeing the professionalism I brought to the job, H2O asked me to take their existing guide school and bring up to the standard of the AMGA, CSGA, etc. I am currently the director of this program.

The AMSG level one is open to any applicant able to meet minimal prerequisites such as basic first aid training and advanced skiing ability. As ski areas begin to implement more mechanized options to access adjacent terrain, the need for patrollers with experience working around snowcats and helicopters is increasing. These courses offer an opportunity for anyone with an interest to explore this profession within a reasonable financial commitment. A wide variety of students, from a ski patroller wishing to become more of an asset to their mountain or an aspirant mechanized ski guide, can walk away with invaluable experience.

Alta Ski Area in Little Cottonwood Canyon, Utah, hosts the level one course. Level one is an introduction to mechanized mountain operations from lift self-evacuation to snowcat and helicopter operations. Participants will learn about assessing avalanche terrain and managing groups within it; advantages and limitations of ski lifts, snowcats, and helicopters; village and highway protection; and companion and organized rescue coordination. All of the skills learned during this course are important for aspiring guides as well as for patrollers, highway workers and avalanche-control specialists. Civilian participants are also encouraged to join and can gain as much as professionals from this one-week course. Economically priced, level one is really a great chance for a guided skiing adventure with some intense learning opportunities.

The second course in the AMSG progression is held in the Chugach Range of Alaska. While the level two course has slightly more stringent prerequisites, enrollment is open to anyone with a desire to explore the heli-ski profession. With a primary focus on helicopter access into big-mountain glaciated terrain, this course is intent on getting participants as much time in the guide's seat as possible. The course costs less than a week of heli skiing and includes an AIARE Level 2 course. An aspirant guide or patroller could look at AMSG level two as both training and an opportunity to gain experience in the complex big-mountain environment that the Chugach range offers, while under the tutelage of seasoned guides. Graduates of this course do not leave with the label "heli guide" but are potentially attractive prospects to a heli operator looking to hire new blood. After completing the AMSG L2, participants have the skills to work flight deck operations, to tail guide as necessary, and have begun to build the time experience required of an Alaska heli-ski guide.

Mark Kelly is an AMGA ski mountaineering guide, AIARE L 1&2 instructor and H2O heli ski guide. Mission statement: The American Mechanized Guides program strives to provide comprehensive training opportunities for on-snow mechanized mountain professionals.

Back to the wind and facing the ship: come on in!

Different Ways for Different Days

How to manage four common types of instability

Story by Chris Lundy

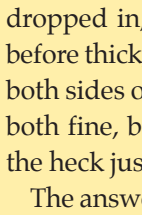
This article first appeared in Backcountry Magazine, *November 2010.*

As we drove to the trailhead, the words of the avy report mingled with caffeine from the morning's cup of joe. "Four inches of new snow…moderate to strong winds… persistent facet layer one to two feet below the surface, but recently unreactive." We assumed that new snow instability and wind loading were the biggest hazards that day.

Later, while skinning along a ridge, hand shears revealed that the new snow was bonding well. Kicking cornices and stomping on wind slabs didn't release anything. As a final precaution, I ski cut the slope to a safe spot. But when my partner dropped in, I heard her yell "slide," just before thick, fast-moving debris ripped by both sides of my island of safety. We were both fine, but still I asked myself, "What the heck just happened?"

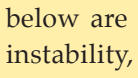
The answer was in the buried facet layer that we had ignored. Four inches of new snow combined with wind loading made it "reactive" again. Because we believed storm snow and wind loading were the primary instabilities, we used tools specific to those problems such as hand pits and slope cuts. Unfortunately, these tools are not effective for persistent weak layers and failed to reveal the *true* instability. Had we been thinking more critically about persistent buried snowpack weaknesses, we would have dug numerous pits and used more conservative decision-making.

The danger rating provided by your local avalanche center is definitely important, but be sure to focus on the *types* of instability they identify as possible hazards. Then, choose appropriate evaluation and hazard management tools that work effectively for those particular instabilities. Outlined below are four common types of snow instability, and the ways in which you should begin to approach them.



Persistent Weak Layers
Recognition Difficulty: *High*
Management Difficulty: *High*

Tricky to identify, unpredictable to manage, and often producing large, powerful slides, persistent buried weak layers—more than any other type of instability—kill skiers. Signs of instability can be subtle, making it tantalizingly easy to convince yourself conditions are stable. When a persistent instability exists you will see clues if you look hard enough. Read the avalanche report, and follow the local snowpack history throughout the winter. Facet, depth hoar, and surface hoar layers vary tremendously across a slope, so snowpit results depend on whether they hit a strong spot or a weak one. You can never dig too many pits, and one poor result is far more significant than five good ones—never ignore even one sign of poor stability. Uncertainty and dire consequences necessitate extra conservative decision-making and route selection.



Wet Snow
Recognition Difficulty: *Low*
Management Difficulty: *Low*

When the sun's beating down or the temps are above freezing, melt-water can turn the snow into a Slurpee, sluffing off steep slopes. Identifying wet snow instabilities is best done before you go skiing. Will it be warm and sunny? Will the surface freeze overnight? Plan to be off your route before conditions become dangerously wet; sometimes, this dictates a painfully early start. Surface mush deeper than about eight inches, or punching through bottomless junk are sure signs you've overstayed your welcome. With surface slush, ski cuts can initiate sluffs that will clean off your route. If the wet snow instability seems deeper—indicated by unsupportable surface conditions or collapsing—retreat via the coolest, lowest-angle slopes possible.

New Snow Instability
Recognition Difficulty: *Medium*
Management Difficulty: *Medium*

Sometimes new snow adheres poorly to the old snow surface, or a weakness forms within the new accumulation. New snow instability is a concern if you are storm skiing or there was significant recent snowfall. Fortunately, new snow instability shows up easily during snowpit tests and quick hand shears. As the slope angle increases, so does the risk of triggering a slide, so pay special attention to slope convexities. Ski cuts and cornice drops are effective tools for managing new snow instability because it's typically more widely reactive than fickle, hit-or-miss persistent weak layers.

Wind Loading
Recognition Difficulty: *Low*
Management Difficulty: *Medium/High*

You can easily identify fresh wind loading by looking for fat, rounded drifts or chalky, firm slabs. Though relatively simple to recognize, wind loaded slopes can be notoriously tricky to evaluate. Snowpits aren't much help because wind creates tremendous variability in the snowpack—you could get inconsistent results just meters away. While ski cuts and cornice drops tend to be effective tools for softer wind slabs, as slabs get harder, so, too, does the task of releasing them safely. Often, your best bet is "identify and avoid" rather than "seek and destroy." Because most wind loading occurs near ridge crests, a good option is to find a more sheltered or lower angled entrance or run.

Chris Lundy is director of the Sawtooth National Forest Avalanche Center; he has a secret passion for sewing and a not-so-secret passion for being a motorhead. He and his wife Sara are rejoicing to have just moved into their owner-built house outside Stanley, Idaho.

snow science

CSI: FRACTURE MECHANICS

Investigating the who, what, when, where, and why – a series of articles that examine propagation

Ron Simenhois performs yet another ECT in his research. A strong work ethic leads to robust results.
Photo by Karl Birkeland

SNOWPACK, TERRAIN, AND ECT RESULTS

continued from cover

Defining Fracture

Before discussing fracture, we need to agree on some basic terminology. The snow community has long used terms like fracture propagation and fracture propagation propensity. However, this terminology is not consistent with that of materials scientists. In their terminology, fracture is not a thing but is rather a process. The thing we are talking about is a crack, while fracture is the process of expanding or propagating the crack. Thus, talking about fracture propagation doesn't make sense because – by definition – fracture is crack propagation. Thinking about fracture using this new vocabulary won't be easy, especially for those of us who have written articles using the old terminology (for an example of how we've misused these terms, check out *(Simenhois and Birkeland 2009)*). However, using terminology consistent with materials science is important since it allows us to better communicate and share ideas with scientists working with other materials. Therefore we will use the above definitions in this article.

Changing Slab Thickness

At the 2008 ISSW we presented results on the effect of changing slab thickness on ECT results *(Simenhois and Birkeland 2008a)*. In 52 pits we did a set of side-by-side ECTs where we first loaded the column at the end where the slab was thick and then at the end where the slab was thin. The snowpack on all our tested slopes was capable of sustaining fracture over considerable distance, as evidenced by recent avalanche activity (33 of the 52 pits) or by standard ECTP results. In 20 pits the slab thickness above the weak layer changed naturally within a column width and in the other 32 pits where the slab thickness above the weak layer was consistent, we reshaped the slab above the weak layer with a snow saw. Change in slab depth across the column varied from 12 cm to 50 cm, with an average change of 30 cm. In all 52 pits in our dataset fractures that initiated under the thin part of the slab always advanced along the weak layer to the thicker end of the column. However, fractures that initiated under the thick slab consistently arrested before crossing the entire column to the thinner side.

Our limited data and field observations show that sizable slope-scale fractures are also often more likely to advance from areas with thinner slabs toward areas of the slope where slab above weak layer is thick, than in the other direction. We know of cases where explosives large enough to create large cracks in the weak layer did not trigger avalanches when placed in thicker areas of the slab, while smaller loads placed in thinner areas released the entire slope. Though our dataset does not contain cases where fractures propagated from under thick slab toward a thinner slab, it would be wrong to assume that fractures initiating under thicker slab areas will not propagate toward areas of thinner slabs. We and many others have observed slopes fracture from thicker slab areas toward thinner slab areas under some conditions. Further, it is also possible that under some conditions that we haven't observed yet, fractures in our propagation tests may come to an arrest when propagating from thin to thick areas.

See Simenhois and Birkeland, 2008 for more information at www.fsavalanche.org/NAC/techPages/articles/08_ISSW_Simenhois_ChangeSlabDpth.pdf

Changing Slope Angle

At the 2010 ISSW we presented a study on the effect of changing slope angle on ECT results *(Birkeland et al. 2010)*. For this study we collected four datasets from three different slopes with slope angles ranging from 7° to 44°. The snowpack structure was reasonably similar for all four of our datasets, with a 25-40 cm slab overlying surface hoar. In all cases, the number of shovel taps required for weak layer fracture remained reasonably constant or increased slightly, with increasing slope angle. Our results provide strong evidence that ECT triggering of persistent snowpack weak layers such as surface hoar does not vary, or increases slightly, as slope angle increases. Though counter intuitive to most of us, our results are consistent with the anticrack model for weak layer fracture *(Heierli et al. 2008; Heierli et al. 2010a, 2010b)*.

From a practical perspective, our results show that, as long as the snow structure remains reasonably consistent in space, observers can conduct dependable tests on persistent weak layers such as surface hoar in gentler, safer terrain before committing themselves to more exposed areas. Of course, it is still critically important for observers to carefully assess whether or not the snowpack structure in that lower angled terrain is sufficiently similar to the snowpack structure on the surrounding steeper slopes. The bottom line for avalanche practitioners is that being able to conduct at least some initial tests in safer locations has the potential to greatly increase the safety of stability assessments.

See Birkeland et al., 2010 and Heierli et al., 2010b for more information at www.fsavalanche.org/NAC/techPages/articles/10_ISSW_ECT_SlopeAng.pdf and www.fsavalanche.org/NAC/techPages/articles/10_ISSW_Heierli_etal.pdf

Increased Loading

At the 2010 ISSW we presented a study on the effect of increased loading on ECT results *(Simenhois and Birkeland 2010)*. We collected data from before and after 11 different loading events in Colorado utilizing 50 pits on 45 different slopes that we specifically targeted for being on the verge of instability before the loading event. In each pit we collected two ECTs before and after each loading event. In 64% of the tests results changed from ECTN before the snow loading event to ECTP afterwards, while in 12% our results were ECTP both before and after the loading, and in remaining 24% of the cases (12 pits) results were ECTN before and after the loading event. Thus, although it does not hold in all cases, increased loading generally increases the probability the fracture will completely cross the ECT. Two case studies from southeast Alaska confirm these conclusions.

The technique used for some of this work involved placing additional blocks of snow on an ECT before testing it. Further refinement this technique, along with additional data collection, might allow us to develop a rough test that will give an estimate of the load required for cracks to begin to freely propagate along the weak layer.

See Simenhois and Birkeland (2010) for more information at www.fsavalanche.org/NAC/techPages/articles/10_ISSW_Simenhois_ECT_loading.pdf

Surface Warming / Setting

Avalanche workers have consumed many pints of beer while discussing the possible role of warming in changing the avalanche potential. At the 2008 ISSW we presented some data showing changes in ECT results when warm temperatures had caused the snow surface to become wet *(Simenhois and Birkeland 2008b)*. During four relatively warm days we collected data from 28 pits in different locations around Copper Mountain, Colorado. We especially targeted slopes on the verge of instability. We conducted a variety of Extended Column tests, tracking changes in ECT and modified ECT results during the day. The weak layer was buried near surface facets.

In all four datasets, fractures crossed the entire columns after the snow surface became wet in the afternoon while in the same pits in the morning when the snow surface was frozen those fractures arrested before the end of the column. In addition we witnessed

two cases where slopes tested with explosives or skiers early in the morning did not release, but later avalanched when the snow surface become wet. A possible reason for these results is that increased deformation in the slab near the surface increases the strain rate down to the weak layer, thereby decreasing the propensity for fracture arrest *(Schweizer and Jamieson, 2010)*. However, the snow structure must already be close to critical. In our data, ECT results in three pits (more than 10% of our data) were ECTN in the morning and in the afternoon.

See Simenhois and Birkeland (2008b) for more information at www.fsavalanche.org/NAC/techPages/articles/08_ISSW_Simenhois_SurfWarm.pdf

Conclusions

Our recent work shows that many factors affect ECT results. We have not definitively shown that these same factors affect the slope scale fractures resulting in avalanche release, so be careful about extrapolating our results out to the slope scale. However, a few field observations suggest that some of our observations might hold for avalanche slopes, such as the increased propensity for fractures to both initiate and propagate from thinner to thicker areas of the slab.

Acknowledgments

Many thanks to Joachim Heierli for numerous discussions that helped us better understand fracture, fracture mechanics terminology, and the physical processes that occur during an ECT test. Thanks also to Alec van Herwijnen for his help in clarifying the wording in our fracture definition.

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Ron Simenhois just moved his entire family to Juneau, AK, where he forecasts for the Kensington Mine and thinks about snow. His work on the ECT has given the practitioners among us an incredibly useful tool for assessing propagation propensity.

Karl Birkeland is not only the avalanche scientist for the National Avalanche Center, he is also a perennial cheerleader for The Avalanche Review. His clear eye and ongoing support are greatly appreciated. ❄

RANDOM SHOT PLACEMENT:
An Alternative Technique for Risk-Reduction Explosive Use

Story by Peter Carvelli

In western Colorado an effective snow-safety program spans the winter season, beginning with the first snowfalls. At Aspen Highlands we begin with weather and snowpack observations, moving into bootpacking and Strategic Application of Explosives (SAE) when appropriate depths are reached. Bootpacking and SAE disrupt layering of initial storms, thus greatly enhancing stability *(Carvelli ,2008)*. As soon as bootpacking and SAE are completed on a given slope, skiers are applied to increase strength through compaction AND to further layer disruption with each succeeding storm. Generally, after a storm, risk-reduction routes are completed prior to the introduction of skiers. This industry standard procedure traditionally utilizes explosives delivered to start zones followed by ski cutting each slope. During the season, large ANFO explosive charges are applied to select slopes at select intervals to further test ongoing stability. With the advent of spring conditions, ski runs may be closed as strong solar input and warming air temperatures combine to moisten and weaken the snow cover through bond erosion and other factors, which may be reopened as refreezing occurs.

As we all know, the Colorado snow cover is a product of a continental climate. The early season metamorphism of the snow cover provides a faceted basal layer to work with every year. The clear period between storms throughout the season produces surface facets for the next storm to fall on. Persistent weak layers (PWLs) exist throughout a Colorado snow cover. PWLs plus loading equal INSTABILITY. Absolute instability presents a readily solvable problem in ski areas. Conditional instability is a more difficult problem, and one we are employed to manage. Conditional instability brings uncertainty into the picture. This paper introduces a technique to reduce uncertainty: random shot placement.

Traditional storm risk reduction usually involves targeting start zones with a few shots followed by ski cutting, then opening to public. This has worked well for the industry over the years. However, many of us have experienced or know of so-called "post-control releases" on recently opened ski slopes. This may imply that our technique is incomplete.

Current avalanche fracture theory *(J Heierli, 2008)* states that an avalanche can occur when two conditions are met:

Condition 1

A crack, caused by stress on a flaw in a weak layer, must grow to a critical size, from which it will self propagate two dimensionally in all directions through the weak layer until stopped by a change in weak-layer boundary conditions. Once a crack begins to self propagate, and the slab is detached from the weak layer and has met a size condition of at least 100m2, condition one is met.

Condition 2

The frictional force between the two crack faces must be overcome. This force is determined by slope angle, slab mass, and weak layer grain geometry. When friction is overcome, condition two is met and an avalanche can occur. The stress on a flaw can be caused by new or wind transported snow, a skier, or an explosive pressure wave. Our understanding of the avalanche process, while improving, is also incomplete. In light of this fact, it makes sense to do all we can within reason to reduce uncertainty in our risk-reduction work.

Explosives can be used to accomplish four things:

- **To elicit avalanches.**
- **To test a slope for instability.**
- **To establish an array of deformation-resistant pillars of snow which may inhibit crack propagation.**
- **To disrupt layering of the snow cover.**

TRADITIONAL STORM SNOW RISK-REDUCTION TECHNIQUE

Generally speaking, the traditional risk-reduction technique for storm snow usually involves placement of a few 2-lb explosives in a given start zone, followed by ski cutting. If these tests prove uneventful, the slope is opened to public. The benefits of this technique are timely openings, low cost, and hands-on experience with current conditions.

In order to use this technique most effectively, snow-safety personnel must be familiar with their route(s), understand the concept of "sweet spots," and have a good bit of experience.

Often, a snow-safety team will have only one or a few routes they are familiar with, and they may run the same route for a season or many seasons. While familiarity with a route is desirable and necessary, it may lead to complacency, and it may result in explosive placements that are unvaried and ski cuts made from here to there every time.

Costs associated with this type of risk-reduction work are minimal, usually consisting of explosive cost, (currently about $20 per 2-lb round), protective gear costs (hearing protection), training costs, and wages. Explosive use with this technique is generally limited to a few shots placed high in the start zone, keeping costs down.

RANDOM SHOT PLACEMENT

The random technique is not new, but an enhancement of traditional methods developed to reduce uncertainty over time. The random shot technique differs from the traditional technique in two respects, which are:

- **The increased use of explosives.**
- **Intentionally varied placements of the additional shots, particularly in the lower portions of the path.**

The technique itself consists of the following steps:

❶ **Observe conditions prior to the weather event.**

❷ **Observe current conditions, i.e., HN, wind speed and direction, loading, temps, weather forecast, etc.**

❸ **Make a stability forecast and risk-reduction plan and consider plans B and C.**

❹ **Begin routes for the day in less hazardous areas when possible in order to verify conditions and stability forecast.**

❺ **As information becomes available, tweak the plan as necessary.**

❻ **Assign a greater number of shots to each team than the minimum, to be used randomly throughout the route. This addition may be two or five, or more or less, and is determined by the forecaster and/or the risk-reduction team, depending on path history for the season, demands of the day, HN and loading, near-future weather forecasts, and "intuition and experience."**

After making what could be considered the traditional shot placements, the additional shots may be utilized randomly throughout the path. Maybe one higher than usual, or in this corner, or on that bench, or as far down as can be thrown. Maybe above the convexity, maybe below. Maybe at mid-

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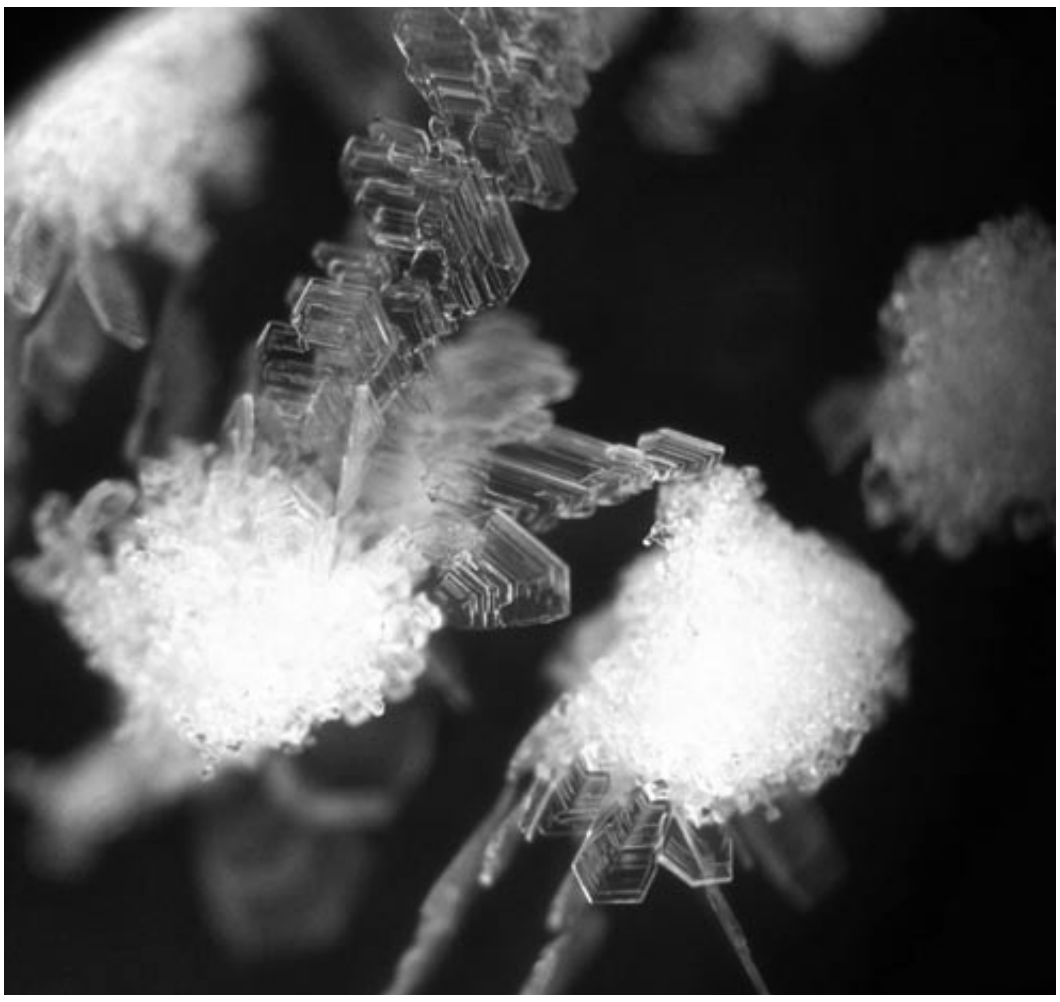

Surface hoar growing on rimed new snow in the Wasatch, December 7, 2010. UAC forecaster Brett Kobernik and soon-to-be Chugach forecaster Wendy Wagner tell TAR that taking these photos was a multiple "snow-gasm" experience!! Each grain we came across was better then the last.

RANDOM SHOT PLACEMENT

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path, maybe at the bottom of the path. Maybe one or perhaps three in a given area. Key here is randomness and more shots. During the route, the team may elect to throw all shots from the top, or to utilize some shot down in while ski cutting from a safe spot. Perhaps one ski cutter makes the usual cuts while another varies his or her ski cuts.

It is important to emphasize that the random parts of the route are a redundancy in addition to the traditional method!

❼ **Complete risk-reduction routes, ski powder, open terrain to public.**

❽ **Document routes, shot placements, and results.**

❾ **Repeat as necessary.**

This random technique was developed to meet several needs:

Need #1 Not all patrollers are equally experienced or trained, meaning that sometimes a less experienced patroller may lead a route he isn't fully trained on. This can happen when a patrol experiences a large turnover, or when many of the more experienced folks are on exchange or in Mexico, or when we're in the third day of a big cycle. The forecaster can't place every shot, or describe exactly where it should go, so more shots in more places is a reasonable way to get the job done in a timely fashion.

Need #2 Although there have been recent advances in avalanche fracture mechanics, we still cannot see into the snow cover. It is not possible to visualize the perfect shot placement. Random shot technique can, over time, deliver explosives to a wider selection of potential weak areas in a given snow cover, thereby reducing risk.

Need #3 While not everyone will agree, at Aspen Highlands we believe that shot craters play a key role in blocking propagation pathways, as they are very resistant to deformation. These resistance points are an important part of our overall strategy of layer disruption and destruction. Storm periods are an ideal time to build these deformation-resistant pillars throughout the snow cover vertically.

The benefits of such a technique are obvious. It allows for more areas in a given path to be tested for instability (sampled). It produces pillars of deformation-resistant snow that may block crack propagation in the future. It increases forecast confidence. It decreases risk. It decreases uncertainty. It allows more patrollers more opportunity to gain experience.

There are some drawbacks to this technique. Cost is one drawback. It is our best estimate that this technique will increase explosives costs by 20- 25%, determined of course by how many additional shots one wants to put out there. While this technique should decrease overall risk by some similar percentage, it may increase some short-term risk if risk-reduction teams fail to adhere to safety protocols, or substitute the technique for full attention during the route. It allows less experienced personnel to take on jobs that may be beyond their ability level. And as with all techniques, it is possible to become complacent. Overall, we feel the benefits of this technique far outweigh the costs, and the short-term risk.

We've been using this technique for three seasons here at Aspen Highlands, not a long period of time, but a good start. So with a short history, it is difficult to make definitive statements about its effectiveness.

The technique fits in well with our snow-safety philosophy. We believe it works well to further reduce risk. It provides larger sampled areas in the near term, and over time it thoroughly tests a given path. It produces pillars of deformation-resistant snow. It provides more experience for more patrollers. It may reduce the probability of post-control releases through its ability to sample or test larger areas of the start zones. It increases confidence in forecasts, and it provides redundancy – which is necessary when working with uncertainty.

POST-CONTROL RELEASES

Let's finish with a discussion about post-control release (PCR). As mentioned, random shot placement may reduce the probability of PCRs. What are PCRs? They are avalanches that, in a ski resort, are unintentionally released after a slope has been subjected to storm-snow, risk-reduction routes.

The use of the term "control route" is misleading. Do we really control anything with our efforts? No, we reduce risk. Control implies certainty; certainty implies zero risk; zero risk means absolute safety. We know that through our efforts the ski resorts have had great success at reducing risk to an acceptable level. We also know that risk has not been, nor ever will be, reduced to zero. What we cannot know is how close we come how often to a PCR.

So what are we accomplishing with risk-reduction routes, and – more importantly – what are we not accomplishing?

When we toss shots and ski cut a slope, we are sampling for instability. Sampling, not thoroughly testing. We are also trying to exploit flaws in the snow cover in order to release avalanches prior to introducing guests to the slope. When we introduce those skiers, we are trying to destroy any lingering flaws and thoroughly disrupt layering of the new snow and old.

Going back to old-school avalanche theory *(Gubler, 1991)*, a 2-lb shot on the snow will test an area around the shot of about 300m2. A ski cut likely tests a 2-meter-wide strip of the slope as the ski cutter moves. That leaves a lot of area untested, or conversely, samples just a small portion of the slope. As thorough testing would be time consuming, costly, and not leave a lot of powder snow, sampling is reasonable. Sampling likely flaw zones (sweet spots, convexities, etc.) increases the probability of either exploiting flaws or of safely opening a slope.

However, flaws at the layer boundaries do exist, and it is possible that a skier could exploit a flaw in an area that has been sampled and opened. If the two avalanche-release conditions are met, an avalanche could occur. Quite often, as an area is skied, weak layer boundary barriers develop dynamically, and preclude condition one as the new snow is manipulated. Flaws are exploited; shear plane fractures develop but are arrested before reaching a critical size. This is the stabilizing process in action, accomplished by our guests. Very occasionally, that shear plane fracture will reach critical size, friction will be overcome, and a PCR will occur. This comes about not because of a failure in our risk-reduction work, but because it is not possible to test a slope completely given current methodology. Conditions can change rapidly. Perhaps the slope that was good to go at 0930 isn't opened until 1100, after another 15 mm of SWE fell on it, creating more flaws or exploiting existing ones. Flaws can migrate over time or develop or disappear altogether.

PCRs appear more likely to occur during the early season or during initial slope openings. This may be due to the existence of more undisturbed and untested layers in the early season snow-cover configuration. Or not. Who really knows? This brings us back to our old friend *uncertainty*.

In our world, uncertainty is a fact of everyday life. There are as many ways to deal with it as there are route runners. This way, random shot placement is just another method that may reduce uncertainty to an acceptable level through more thorough sampling and redundancy.

As always, have fun, ski safe, love all.

Peter Carvelli is a long time ski patroller at Aspen Highlands. He can be reached for further discussion at pcarvelli@aspensnowmass.com

SO WHAT?

How does an understanding of avalanche mechanics benefit ME?

Story by Don Sharaf

In the beginning of snow stability assessment, there was stress and strength. The beauty of the system was that it was relatively easy to understand how stress can be added to the equation. You could increase the weight with snowfall, wind deposition, travelers, and explosives; or you could decrease the strength of the system by dissolving the bonds (warm air temperatures, solar radiation, phase changes, etc.). Unfortunately, our stability test scores that we used to assess the stress/strength balance were all across the map (spatial variability) and we surmised that the stress-strength model is overly simplistic.

Research into fracture mechanics of other materials, showed that there is a lot more involved in material failure AND fracture than just a balance between stress versus strength. If that larger picture weren't the case, then many of our engineered structures and conveyances would never fail given tenfold safety margins incorporated into their designs. But material failure continues to plague engineered structures (and snow), and that is because the stress versus strength is only part of the problem. "Structure and Energy" became the battle cry of the Y Generation in new-school avalanche mechanics classes. Eyebrows went up, ah-ha's were muttered, and people started understanding why there could be so much spatial variability in snow strength. More importantly, practitioners started using tools such as shear quality, fracture character, and structural characteristics ("lemons," "yellow flags," threshold sum variables) to assess likelihood of triggering. With more tools, practitioners could take a bit more of the guesswork, or intuition, out of slope assessment.

Four to five years ago, Ron Simenhois (and Karl Birkeland) developed the Extended Column Test (ECT), for the same reason that Dave Gauthier (and Bruce Jamieson) developed the Propagation Saw Test (PST). These new tests were designed to address "propagation propensity," an inclusive expression of the snowpack's structure and energy state (within the weak layer). Propagation propensity is now a focus of research in avalanche mechanics and appears to be getting closer to the heart of avalanche release and propagation.

Pan to ISSW 2010, and we see that we have returned to the inquisition of how fractures propagate. Is it the old "shear fracture" within the weak layer model that has been in *The Avalanche Handbook* since the first edition? Is it the collapse-driven fracture of the "anti-crack" *(first introduced to avalanche practitioners by Joachim Heierli at ISSW 2006)* or is some mixed-mode fracture? The bigger questions for "meatball" practitioners everywhere is, "Does it really matter?" For me, the short answer is "somewhat." I do believe that as the scientific community comes to really understand avalanche release, we will be able to develop field tests that will more accurately assess a slope's stability state. What follows is my understanding of the current "understanding" of avalanche release and how I apply it to my travels in avalanche terrain.

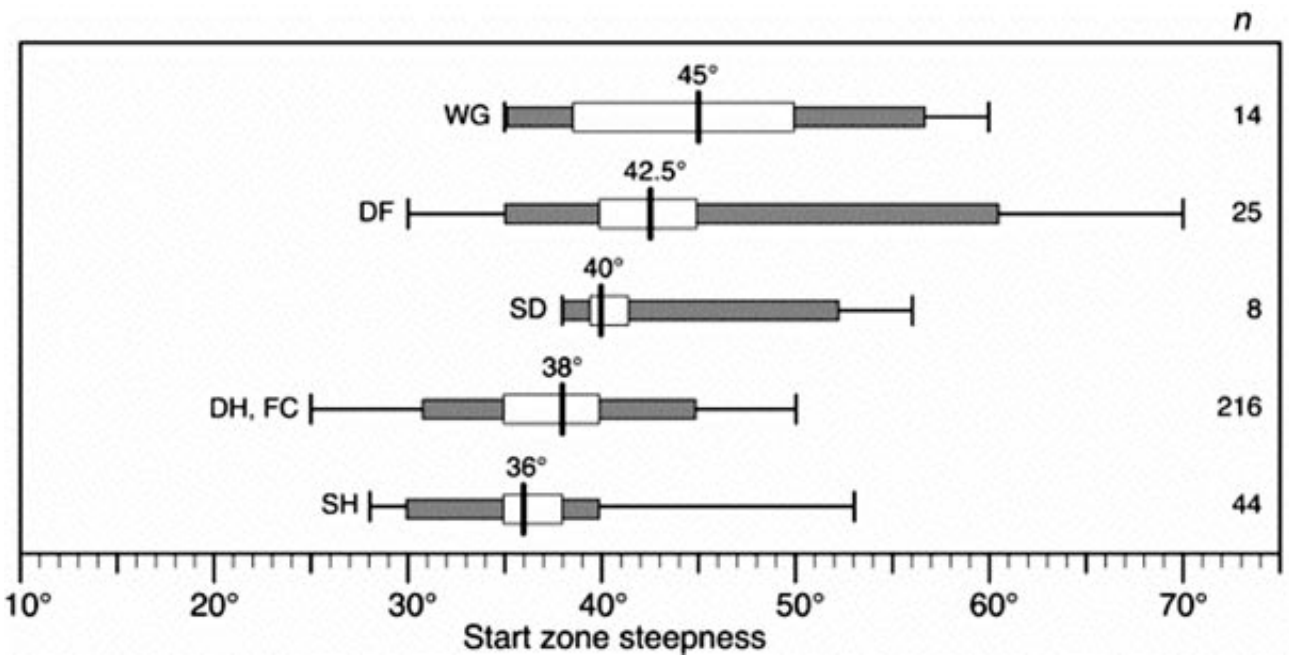
"What is the recipe for an avalanche?"

How many avalanche educators have uttered this sentence? Slab, weak layer, and bed surface – simple as that. How do you know if your ingredients are ripe? Well, you have to know if your oven is hot enough (slope angle). Some ingredients cook at "lower temperatures" (surface hoar is notorious for releasing on the lower end of the bell curve of slope angles) while some need "450∞" (storm snow instabilities, wet snow). Extending the cooking analogy even further: Do you need to be on "hot" slopes to assess the propagation propensity of higher slope angles? Anti-crack theory and some research data suggest that it takes "slightly less" force to initiate fracture on higher angle slopes than it does on lower angle slopes. That was manifested as higher ECT scores as one progressed up slope in a study by Birkeland, et al. This information is perplexing to me. It is nice to think that we can assess committing avalanche terrain from lower angle/safer terrain that is adjacent to steeper start zones. The reality still exists that higher slope angles are often closer to being ready to avalanche. If they haven't avalanched yet (naturally), then they may not need much of a trigger (especially if they are "fresh"). The longer the snowpack has been cooking, the tougher those slopes may be to trigger. In other words it will take far more work to initiate failure, but once the failure progresses to fracture, it may propagate more widely than in the fresher, softer slabs.

Enough history. I have had stimulating conversations with many practitioners and several scientists about fracture propagation via the mixed-mode, anti-crack model and the shear stress model and am walking away with the feeling that both sides are talking, but they aren't necessarily fully hearing one another. One says that collapse is driving the process, while the other says "collapse is the caboose of the propagation train." From my perspective, avalanche release is a complicated process that involves more than material failure, more than fracture propagation, but also involves that oft-neglected interaction with the bed surface (residual friction between the bed surface and the weak layer). In other words, we're working with only some of the ingredients for a slab avalanche.

The authors of anti-crack research acknowledge that they are strictly addressing crack propagation and not directly addressing avalanche release. That is a key point. If ECT test scores and propagation propensity act somewhat independently of slope angle, yet avalanches are very slope-angle dependent for the given bed surface, weak layer, and slab combination, I think that illustrates the limits of our stability tests – and the limitations of our understanding of avalanche release in general. Field research for the anti-crack model thus far has been focused on collapsible weak layers, and for the most part has been focused on surface hoar exclusively. The intent is to test less collapsible weak layers (storm instabilities, hardness breaks during wind deposition, etc), but seeing the variation between slope angles for different weak layer types makes me think that there must be more going on in avalanche release than meets the eye with either fracture model.

So what good does a more inclusive, yet somewhat skeptical, view of avalanche mechanics do for me as a forecaster? I can see the crowd getting restless, so I'll put my thoughts into sound bites:



START-ZONE STEEPNESS for different weak layer types (SH=Surface Hoar; DH,FC=Depth Hoar,Faceted Crystals; SD=Stellar Dendrites; DF=Decomposed and Fragmented crystals; WG= Wet Grains).

Caution: some of the data sets are small (n=number of data points), and the data is from avalanche accidents and may not accurately portray naturally triggered avalanches. *Graphic courtesy Ian McCammon*

- A holistic view of fracture propagation (incorporating both models) helps to explain those situations where large avalanches are occurring. Specifically when there is greater than average continuity in the slab (considering the slab as the messenger for fracture propagation). Simply put, the more spatial UNIFORMITY of the slab and the weak layer, the greater the propagation potential. Not just a good hindsight tool, but a good forecasting tool as well.

- Anti-crack theory helps to explain remote triggering of avalanches from low-angle/flat terrain. The shear stress model does not work for any weak layer when the angle is too low. Understanding the slab's role as a "communicator" for propagation particularly with collapsible weak layers (often persistent WLs) illustrates another red-flag situation for forecasting.

- Clearly all weak layers do not behave the same. As the research develops we are gaining an understanding of why this is the case. Bottom line: avalanche character (weak layer type) influences the mechanics of avalanche release. Choosing stability tests that best assess the weak layer and slab type will provide better information than if no thought was given to the nature of the instability.

- Looking at the stiffness and the contiguousness (spatial uniformity) of the slab has a direct impact on propagation propensity. Is there a point where the slabs become too stiff for the bending moment to propagate in the slab? When are slabs too soft for propagation? Good things to ponder as forecasters.

- As always, viewing the stability situation conservatively and with a healthy dose of humility is the best approach. When all the science is done take it back to the predictability/detectability of the weak layer and its subsequent manageability *(See "Different Ways for Different Days" on page 21).*

If snow is the question, terrain is the answer… always.

—Drew Hardesty,
from one of his UAFC advisories this season

Contrary to Don's article earlier this season he takes full credit for any misunderstandings, misconceptions, and fallacies that he leaves with the reader. Don Sharaf acknowledges the following people for poor sleep, grinding teeth, and a general discomfort when discussing avalanche mechanics: Scotty Savage, Karl Birkeland, Ron Simenhois, Joachim Heierli, and Ian McCammon. Without them his life would be blissfully ignorant, but a lot less rich. Thank you! ❄

Huge Slide in Rattlesnake Canyon

Story and Photos by Toby Weed

We experienced a large natural cycle at the end of 2010 in the Logan area. Among the many large slides was a particularly huge one in Rattlesnake Canyon in the Wellsville Mountain Wilderness. I brought the level 1 class up to it for a field session on January 9 and went up to take more photos yesterday.

Starting up the main part of the glacier-like debris field *(above)*. The friction scoured the gully wall part way up the long snaking debris flow *(right)*.

Repeater avalanches will be likely in the Logan area. The shallow snow on the bed surfaces of many of the already active local slide paths is super weak and sitting on a very solid, smooth, and slippery bed surface.

This is looking down at the lower run-out and the long, snaking gully toe from high above *(below)*.

http://utahavalanchecenter.org/observation_rattlesnake_canyon_1112011
http://utahavalanchecenter.org/observation_rattlesnake_canyon_182011

An avalanche triggered with explosives at Loveland Ski Area in Colorado. The crown face was 60 to 120 cm deep and involved about 30% of the start zone. The conditions in the track were not especially conducive for a long runout. We would classify this avalanche as R2D2. *Photo by Dale Atkins*

ACCURATELY ASSESSING AVALANCHE SIZE:
The Ins and Outs of the R- and D-Scales

Story by Karl Birkeland and Ethan Greene

Assessing avalanche size can be like telling a fish story. To one person the fish is the monster of the deep that almost dragged the boat over, while to another person that same fish was a minnow. However, with avalanches an accurate and unbiased assessment is critically important to improve communication between avalanche workers and also to maintain consistency in our databases. Although most observers do a great job of assessing avalanche size, we have noticed an unfortunate increase in the incorrect use of avalanche size, especially the relative (or R-) scale. Descriptions of the size scales are included in SWAG *(Greene et al., 2010)*, but we are writing this short article to try to help clarify the use of each of the size scales, and to discuss how they complement each other.

The R-Scale

The R-scale, or relative-size scale, has served as the standard size classification in the United States since at least the start of the Westwide Avalanche Network data in 1968. At its core, the scale is a simple estimate of the size, based on volume, of an avalanche relative to the path in which it occurs. Sizes range from R1 (very small relative to path) to R5 (maximum or major, relative to path). When estimating the relative size of an avalanche, remember that you are trying to compare the current avalanche with the largest avalanche that path could produce. The size is not just the proportion of the start zone that released. The R size is a function of the depth and width of the slide, as well as the conditions in the track. For example, an R5 slide would run far past where you would normally expect. For paths ending below treeline, an R5 (major or maximum, relative to the path) avalanche would remove a significant amount of timber. Likewise, an R4 slide (large, relative to the path) would generally run full track and might also take out a few large trees. A slide where the whole start zone releases but the crown face is only a foot deep is unlikely to be an R4 or R5 slide unless the conditions in the track are such that a large volume of snow ends up at the end of the runout zone.

The D-Scale

The D-scale, or destructive-size scale, has been the standard size classification in Canada for many years. When the first version of SWAG was released in 2004 the working group decided that using both scales would be the most complete way to describe avalanche size, so the D-scale was added to US guidelines. The D-scale is an assessment of the destructive potential of an avalanche. Sizes range from D1 (relatively harmless to people) to D5 (could gouge the landscape, largest snow avalanche known). A D4 avalanche could destroy a railway car, large truck, several buildings, or a substantial amount of forest. The description of the potential damage produced by avalanches in each size category is a very useful tool for classifying an avalanche in the field. It also helps all of us select similar categories and thereby maintain consistency between operations and regions. With the D-scale, half sizes are sometimes reported. The scale also provides the typical mass (which increases exponentially) and typical path length for each D-size, though these can occasionally vary quite a bit from avalanche to avalanche.

Combining The Scales: Why Use Both?

Classifying avalanche size resulted in numerous discussions for the SWAG working group. In the end, we decided that using both scales gives operations flexibility and provides the most complete picture of avalanche activity. Note that both scales are qualitative assessments of avalanche size. As such, they are useful if you are communicating recent avalanche activity within or between operations or if you are looking back and assessing historical cycles. However, the utility of the scales is only as good as the consistency between observers, past and present. While we can use the categorical values of the scales in some statistical analyses, saying a specific avalanche was an R3D4 is closer to saying the water was warm than it was 16.8 ∞C. This is true for both scales since numbers associated with the categories are simply estimates meant to give each level some context.

A slab avalanche triggered by two snowmobilers in northern Colorado. The slide involved about 70% of the start zone, but stopped well inside the boundaries of the runout zone. We would classify the avalanche as an R3D2.5. *Photo by Spencer Logan*

Each scale has its advantages. The R-scale is especially useful for forecasting if the forecaster is not familiar with the particular avalanche path, and it can also give a hint of the current avalanche character *(Atkins, 2004)*. For example, a report of an R4 avalanche would tell a forecaster that avalanches are running deep, propagating far, or both. On the other hand, the advantage of the D-scale is that it tells us the destructive potential of a particular avalanche. This is critically important for engineering applications and it may be easier for avalanche workers to visualize the destructive potential of a particular avalanche rather than its size relative to the path.

Utilizing the strengths of both scales can be valuable for avalanche forecasting operations. Imagine you are forecasting for a mountain range. You know you have a buried layer of faceted grains and the next snow storm is rolling into your area from the north. An observer on the north end of the range reports three natural avalanches, and two of them are R4s. As the storm progresses through your mountain range, you know there is the potential for more avalanches to release that are large with respect to the path. If there are big paths in the central and southern portions of your mountain range, these are going to be dangerous

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Ski and avalanche history is rich in Squaw Valley, from tales of Monty Atwater and the 1960 Olympics to the more recent achievements of Russ Johnson and his hardworking ISSW crew in 2010. *Photo by Craig Sterbenz*

ISSW 2010: More Merging of Theory & Practice in Squaw Valley

Story by Doug Richmond

The International Snow Science Workshop returned to Squaw Valley, California, in October 2010 for a reprise of the 1986 ISSW. This one was just as good, with lots of great input from practitioners and more news of progress on the scientific frontier from the brainiacs. The conference was masterfully run by Russ Johnson and a host of others, who kept things rolling through five days of presentations, parties, and camaraderie.

Attendance was phenomenal: over 900 of us, including impressive contingents from several foreign countries. The Europeans were there in force, despite having hosted their own similar conference in fall 2009. Thanks to everyone who traveled long distances to bring us your expertise and friendship!

The following are just a few references you might want to look at. Check out the proceedings CD. You can search it for these authors or for subjects of interest to you.

Avalanche Initiation

The DaisyBell was there. They rocked the place one day at lunch time by hanging it from a crane outside the conference center.

We still haven't seen the development of the portable hexagonal resonator or some other whizbang improvement over the big shock wave. But people are working on better understanding of slab response to outside forces. I was listed as a coauthor on an explosives investigation by MSU folks (Tichota and others). I was just the blaster, but apparently we characterized the "periodic oscillatory response of the snow slab during the explosive events." How far out can we be from developing cool new ways of oscillating those slabs?

Fracture mechanics

Understanding how slabs fail is key to developing those new ways to start avalanches, and there are lots of interesting papers from this ISSW addressing the subject.

Borstad and McClung are working on numerical modeling of fracture propagation in slabs. They use complicated sounding codes like " smeared rotation crack model," and they assured us that "more realistic models related to avalanches are within reach."

Schweizer and others from Davos discussed their work on weak layer fracture energy and its relationship to slab stiffness.

The Montana State University cold room engineers (Walters and others) showed us high-tech movies of shear failures. Borstad and McClung had some good movies too. They showed deflection and slab failure using peppercorns in pit walls during PSTs.

Heierli and others said, "We find that fracture is propagated by a stable, kink-shaped wave traveling with sub-shear velocity through the snowpack." They discussed "fracture energy" and a "super-critical crack."

Bruce Jamieson (Gauthier and Jamieson) gave a clear and interesting talk on the complicated subject of fracture propagation involving a collapsing weak layer.

I'm not saying I understood all this stuff, and I'm with Borstad when he quotes Malcolm Mellor: "No material displays the bewildering complexities of snow." But I'm behind you guys all the way. Keep it up. Maybe we could have a mid-winter mini-conference on this stuff at some hot springs resort?

Stability Tests

Ron Simenhois continued his tireless efforts to refine stability test methods and to interpret results. Two of the five papers he coauthored deal with this quest. One paper discusses the effect of slope angle on test results and looks at whether we can test in safer, lower-angle places to evaluate nearby slide paths. Another paper uses ECT and PST "to track changes in the snowpack's ability to propagate fracture before and after loading events."

The Norwegians (Brattlien and Ellevold) introduced "The SLAB Test." It is similar to the Rutchblock test but with just your boots on a 30x60 cm column with no backside cut. It appears to mainly deal with hard-slab conditions and maybe should be called "The HARDSLAB Test."

Transceivers

The transceiver folks gave us interesting talks about third antenna technologies and effective range testing methods. Bruce Edgerly (BCA/Tracker) discussed his continued efforts on digging strategies. Although these various vendors are competing fiercely in a limited market, their efforts seemed to be more objective than we've seen in the past, and they are all obviously dedicated to bringing us the best tools they can.

Snowpack Imaging

Progress continues toward the development of stability goggles, with which the practitioner will be able to cruise around viewing snowpack stratigraphy. The brainiac pioneers are working on:

- infrasound microphones and FMCW radar *(Meier and Lussi; Marshall and others)*
- upward-looking ground-penetrating radar *(Heilig and others)*
- fully radiometric thermal imaging *(Brusseau and others)*
- thermal photography *(Shea and Jamieson – great talk Cora)*
- near-infrared photography *(Smith and Jamieson; Bair)*
- fiber optic temperature sensing *(Worndl and others)*

Practitioner Papers

Peter Hoeller gives a very good history lesson in his paper on practical knowledge about avalanches. His two-page reference list goes back to 1916.

Two French guys (Escande and Letang) wrote a nice paper discussing risk assessment and decision-making for scientists and practitioners. They succinctly clarify the challenge in their abstract with: "The main goal is always to make the right decision using the available information with all its imperfections and uncertainty."

The Norwegian highway folks (Farestveit and Skutlaberg) discussed their work experimenting with DaisyBell and a Wysen Tower that holds 12 charges of 5 kg each.

Craig Wilbour gave an entertaining and insightful summary of Washington Highways work past and present.

The New Zealand folks (Conway and others) were back with more awesome photos and video from their work on the Milford Road.

Simenhois and Savage discussed their work on compiling and sharing lessons from professional avalanche incidents and near misses as a learning tool. Read their paper. They want your input.

Scotty Savage also wrote about a post-control release at Big Sky, Montana. Read this one if you think you are good at hard-slab stability evaluation. This hard slab was likely triggered by one of the several skiers on the slope. It ran on a buried weak layer after the run had seen an estimated 2000 skier passes.

Karen Sahn wrote a detailed description of the Aspen Highlands aggressive bootpacking program that involves an army of locals working for lift tickets.

The Italians (Segor and others) showed how they make room for the next round of avalanches above a highway by using snowcats to build halfpipes on old debris that has maxed out defense structures.

Mike Rheam and Bob Comey gave a synopsis of the Mark Wolling tragedy at Jackson Hole and highlighted the hazards of early season avalanche work.

Other

Ben Hatchett discussed the complex meteorology of the big storm that fooled weathermen when it hit Bozeman in November 2009.

Bruce Edgerly discussed tapping into social media like Internet forums, blogs, YouTube, and Facebook to capture data on otherwise unreported avalanche incidents.

Lawyer John Fagan (no paper, just abstract; you had to be there) gave a very good picture of a hypothetical in-bounds avalanche death scenario, with lots of good points for patrollers. He made the obvious statement: "Forecasting is hard. Hindcasting is easy." He recommends avalanche-risk wording in releases, and he said that weather and avalanche records are key defense tools.

Several papers address human behavior, risk taking, decision-making, and how these affect avalanche education strategies. David Sweet, in his "evolutionary psychology and cognitive biology" abstract, says, "It would seem that some risky behavior is impervious to conscious learning." Doug Chabot illustrated this in his analysis of sidecountry behavior south of Bridger Bowl.

One Stinker

One guy, Bob Uttl, used our forum as a personal soapbox to once again air his dislike of Haegeli and McCammon's Avaluator Accident Prevention Card. In his inappropriate, quasi-statistical rant of no value to ISSW, he accuses these aces of unethical, reckless behavior, apparently because of a perceived lack of data sharing.

Papers committee: I can see how you got duped by the misleading abstract. The rest of them were great. Alaska: don't get fooled again.

Ian and Pascal: Let it roll off. Keep up all the great efforts that have helped so many of us understand human behavior and avalanches better.

In Memoriam

Finally, Halsted Morris presented the AAA Memorial List of 51 US avalanche workers killed in the line of duty from 1944 to 2010. Read those names and honor their memory by appreciating the risks, challenges, and rewards of avalanche field work. Keep it safe out there. Keep learning, and come share your knowledge at the next ISSW in Anchorage, Alaska in 2012.

Doug Richmond is a ski patroller at Bridger Bowl, Montana. He's one of those guys who sits down in front and asks a lot of questions.

ISSW participants take a hike at Squaw during one of the field trips, heading up the ridge toward the top of KT-22. *Photo by John Stimberis*

ISSW 2010:
The Snow Geek Perspective

Story by Andy Gleason

Here is a highly selective, randomly distributed, non-normalized review of some of the talks at ISSW 2010 in Squaw Valley, California, this year. The setting was ample for all the snow geeks, patrollers, and other snow aficionados to fit into the lecture hall at Squaw Creek Resort. While not as plush as most of us (in our luxury patrol shacks and cold labs) are used to, we made do with Squaw Creek facilities for the largest attended ISSW yet.

Monday's highlights included the new use of thermal photography for looking at the snowpack. I really enjoyed the juxtaposition of Eeva Latuoso's talk with Cora Shea's talk and the different approaches to snow science from the practitioner to the scientist. Eeva and her team began using infrared thermography in snowpits and presented the usefulness and limitations of the new tool. Cora introduced her work with thermographic video that promises to link detailed temperature measurements with various snowpack properties. Thermal imaging is in its infancy for avalanche research and appears to be a promising tool for understanding the snowpack.

There was a strong showing from Montana State University this year as they presented research from their new cutting edge cold lab pioneered by Ed Adams. Andrew Slaughter presented his research that may be able to predict the formation of near surface facets using meteorological instruments. We in the snow community should be grateful that Dan Miller is using his exceptional brain power to study snow. He presented his model of explosive

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ISSW 2010:
Thoughts on the Rescue Presentations

Story by Randy Spence, Moonlight Basin, MT

1. **If you are caught in an avalanche and carried any distance, you are in deep shit.**
2. **If you get buried, you have less than a 50/50 chance of survival.**
3. **Trauma is as big a concern as burial.**
4. **AvaLungs and ABS systems are some help but by no means a magic bullet.**
5. **Good shoveling techniques are as important or even more important than good beacon skills.**
6. **Avoidance, good decision-making and excellent route-finding skills beat good rescue techniques and snow knowledge hands down.**

The free beer socials were a great time to catch up with old and new friends. Free beer, good friends, and Tahoe in the fall; it can't get much better than that. See anyone you know in this photo? *Photo by Craig Sterbenz*

ISSW SNOW GEEK

continued from previous page

use on the snowpack and demonstrated how shear stress concentrates on top of the shallow weak layers. He showed that a shear stress wave lags behind the explosive shock wave which may have an effect on the effectiveness of the charge.

We saw the use of high-speed photography and particle-tracking software to measure strain in the snowpack used more extensively by a number of folks to examine the mechanical properties of the snowpack. Davis Walters combined optical analysis with a load actuator to observe the deformation around weak layers. So far he has seen that the weak layer experiences the most deformation with the slab above and below showing very little strain which suggests rigid body displacement of the slab.

Chris Borstad used high-speed photography to measure results from the propagation saw test (PST). He found that collapse of the weak layer occurs after the fracture has propagated within the weak layer. He also noted that strain energy in the bending slab is not fully recoverable. Alec van Herwijen from the SLF in Switzerland used particle tracking software and a standard digital camera to look at the PST and the changes in mechanical energy prior to fracture propagation. He says he can measure these parameters with his method: elastic modulus, weak layer fracture energy, amount of collapse of the weak layer, and the coefficient of friction at the weak layer. This of course makes us snow geeks melt our pit walls with glee as these parameters have previously been difficult and time consuming to measure in the lab.

We had an excellent international turnout this year with talks from all over the world representing at least 12 countries. Our friends from Japan showed how water pooling at the bottom of the snowpack affects full-depth avalanches. Pavel Chernous' talk from Russia showed a novel approach to pulling shear frames with a constant force with a bucket being filled with anti-freeze on a cable with a pulley attached to the shear frame. While the SLAB test from Norway raises an interesting point about the significance of slab tensile strength in avalanche initiation in maritime snowpacks, their study had too few data points to reach a significant conclusion. We heard from scientists in Italy, led by Barbara Frigo, who are looking into the effects of explosives using geophysical techniques such as radar and seismic surveys. We got to see some always exciting footage from Milford Road in New Zealand. They placed charges systematically to show the spatial variability of weak zones between storm events.

Chris Pielmeier from the SLF showed us data from Switzerland and Colorado in a study that compared the Snow Micro Pen (SMP) data to rutschblock and Extended Column Test (ECT) results. She feels confident that the rutschblock has about an 8-meter resolution from her data. This is consistent with previous spatial variability studies; go more than about 8 meters from your pit and the snowpack could be significantly different. It is always sobering to be reminded of this with good data.

ISSW participants stand above KT-22 at the top of Eagle's Nest, renamed McConkey's run in honor of the untimely death of local skier Shane McConkey. *Photo by John Stimberis*

One presenter tried to dis the excellent work that Pascal Haegeli and Ian McCammon have done. It pisses me off when people who claim to be scientists don't understand the difference between correlation and causation.

Iain Stewart made an excellent point in his talk on listening to your gut. Using information gleaned from the InfoEx, he noted that the most experienced guides make intuitive decisions, and the least experienced guides made analytical decisions.

Karl Birkeland gave an interesting talk that showed that the number of taps required to initiate fracture that propagates across the entire column in an Extended Column Test did not change significantly as the slope angle increased *(see this issue's cover story)*. The results were striking for a buried surface hoar layer, but it would be interesting to see the same study for a variety of weak layers. This caused an answer session wherein some people confused fracture propagation with fracture initiation or stability. This could have implications for the field practitioner as one could conduct the ECT test in lower-angle terrain and get the same information on fracture propagation as on steeper terrain. It is important to make the distinction that stability results may vary on differing slope angles if the weak layer is not a reactive surface hoar layer.

Pascal Haegeli gave us some insight into decision-making with his talk based on the experience of mountain guides. What stuck in my mind was that the presence of a weak layer or easy shear is important, but the absence of one is not important.

I woke up on Tuesday morning with glitter on my arms and on the pillow. No, there were no late night liaisons I couldn't remember; some of the Divas had prepped for the Diva night in our room and the surplus of glitter was like a layer of gaudy surface hoar sprinkled through our hotel room. Yes there was some evidence of instability that morning.

I enjoyed Ingrid Reiweger's talk on how snow fails. She was basically looking for a crack without propagation. She used an apparatus that can vary loading rates and avoid moments in the weak layer. A moment at the weak layer would be equivalent to doing a shovel shear test on an isolated column that bends the column instead of causing shear at the weak layer. She found that strain concentrates at the weak layer even with very soft slabs above the weak layer. With low loading rates, the cracks healed themselves. This supports the transient weak zone model. She also noted that initiation of cracks is easier on steep slopes but not propagation of cracks.

Dave Gauthier gave us insight into the critical length of weak zones which he said are related to the length of the en-echelon block size that occur during slab fracture. The lengths are dependent on slope angle.

Joachim Heierli continued the discussion of the ECT tests on varying slope angles that Karl Birkeland talked about earlier in the week. He investigated how the direction of an applied force and the penetration depth of skis influence the chances of triggering a weak layer. Using the principles of the mixed-mode anti-cracking model he found that there is the same risk of triggering the weak layer uphill as it is downhill. Perhaps this is why sometimes during ski cuts the slabs breaks above your cut and sometimes below. This is a classic example of something I learned from Karl many years ago: science quantifies our observations of the obvious.

I think some of the best exchange of ideas at ISSW occurs during the poster sessions when you can really get to know the person conducting the study and ask your questions in a low-key environment. I think the concurrent beer session always help to lubricate the flow of knowledge. There were so many great posters this year that I fear I can't do even a small percentage of them justice.

We saw more use of near-infrared (NIR) photography to characterize the snowpack from a number of folks who are now using NIR as a tool to compare other field methods for stability studies and grain type analysis. Researchers around Europe are using infrasound monitoring to detect avalanche release, and they seem to be having the same problems that we have seen over here for the last decade or so. The use of LiDAR to identify trim lines by Chris McCollister was an interesting use of a technology that I think the snow-research community will use more frequently (if the funding continues). It is always interesting to learn about the various experimental avalanche sites from around the world and see what new expensive equipment they have destroyed in the last few years.

I am always amazed at all the insightful and innovative studies that snow enthusiasts from around the world produce every two years. Snow is an incredibly complex medium with properties that vary with the slightest change in temperature, crystal type, and structure. We are fortunate to have such a dedicated group of nivophiles expanding our understanding of one of the most complex and entertaining materials on the planet.

Emily Wen, her new husband Rich Marriott, (they were married at ISSW in Davos last year) Craig Sterbenz, and Mark Moore, friends from a prior millennium, ham it up for Dede Sterbenz behind the camera at ISSW. *Photo by Dede Sterbenz*

The Avalanche Review *appreciates Andy Gleason's willingness to be volunteered to write this year's "ISSW from the snow geek's perspective" story.*

Youth Avalanche Education Programs in the Pacific Northwest

Story by Ken Turner

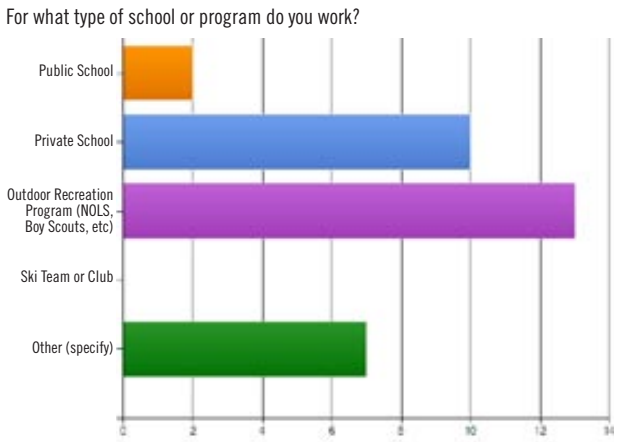
With the rising popularity of winter snow sports, more and more teens (and younger kids) are venturing out into the backcountry, sometimes into avalanche terrain. Friends of the Northwest Weather and Avalanche Center (FOAC) seeks to determine what current youth avalanche education is being conducted by both public and private schools as well as ski clubs, assorted outdoor recreation programs, and guide services in the Pacific Northwest. FOAC supported this research to:

- Identify schools and programs that offer winter sports activities to their K-12 students and determine if they also offer youth avalanche education (YAE).
- Survey educators for what is working in their avalanche curriculum and what is missing.
- Make recommendations on how to strengthen youth avalanche education programs and how FOAC can support this process.

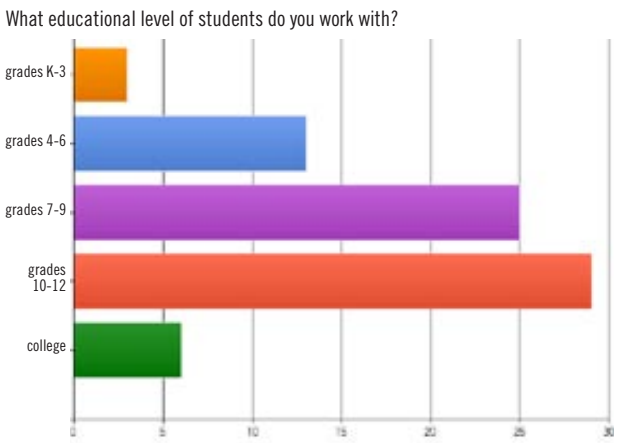
Based on Northwest Weather and Avalanche Center's (NWAC) coverage, outdoor educators in the diamond-shaped range encompassing (north-south) Bellingham to Portland, Oregon, and Port Angeles to Wenatchee (west-east) were identified and interviewed. A majority of the research time was spent locating teachers of public and private schools who run outdoor education programs, as well as outdoor recreation program coordinators in both the private to nonprofit sector. Often, public and private schools were searched for online in the Seattle and Portland areas, then called to see if they had a ski or outdoor recreation program. Other contacts were found through fellow educators, colleagues of friends, and contacts of FOAC. At the same time, this researcher was constructing an online survey with about 16 questions, constantly testing the survey with FOAC education members.

After several weeks of searching for contacts, a spreadsheet of some 62 possible contacts was created with names, phone numbers, emails, and school/business Web sites. After paring down that list to workable email accounts, 49 public and private school teachers and outdoor educators were identified and sent a survey created using Survey Monkey (www.surveymonkey.com).

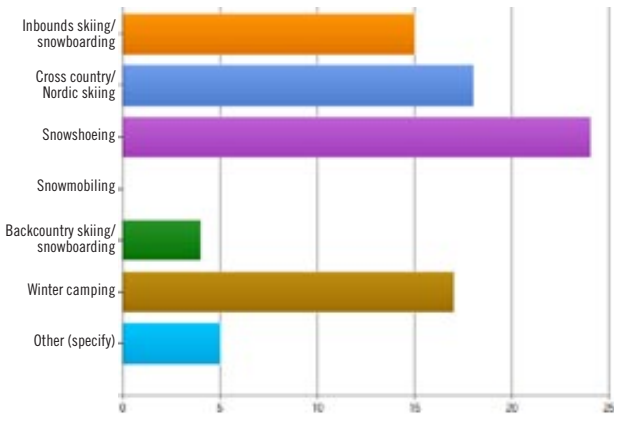
NWAC coverage area



Graph 1: Types of programs participants work for



Graph 2: Grades served



Graph 3: Winter activities offered to youth

Graph 4: Importance of youth avalanche education subjects

Most of the participants run outdoor programs outside of schools, while the private schools made up the next biggest block. *(see Graph 1 – Note: "other" is actually made up of four outdoor recreation programs, two avalanche providers, and one snowboard program.)*

The research was aimed mostly at 8-12 grades (upper middle school to high school) and most of the participants focus on youth in those age levels. *(see Graph 2)*

For program activities, Nordic skiing, snow camping, and snowshoeing were the most popular activities offered to youth in these programs. *(see Graph 3 – Note: 3 of the 5 other with non-winter mountaineering courses in avalanche terrain)*

Other important quantitative data gleaned from this research includes:

- 48% of participants are offered some type of YAE.
- Of those offering YAE, 86% instruct in-house versus utilizing outside experts.
- 82% present and create their own curriculum (instead of using AIARE or other).

When the 48% of participants who offer YAE were asked about their program strengthens, common qualitative themes include:

- Student interest in material, especially hands-on sessions.
- Cross cultural connections and customized-to-fit outdoor trips.

When they were asked what is missing in their YAE, common responses included:

- More class time and equipment.
- Experts to assist.

When the 52% of participants who do not offer YAE were asked what barriers prevent this type of education, common qualitative themes include:

- not enough time, resources, or funding
- not comfortable with material

When participants were asked to quantitatively rate subject importance of YAE material, the top three scorers included *(see Graph 4)*:

1. Presenters focused on youth.
2. Field sessions with beacons, etc.
3. More avalanche training for self.

Common qualitative responses for what any youth avalanche education must include:

- Independent decision-making skills and general common sense.
- Respect for terrain and dangerous conditions.
- Understand that even with beacon and gear, they are NOT invincible.

CONCLUSION AND RECOMMENDATIONS

Through analysis of participants comments and similar programs that are presently in use with the Canadian Avalanche Centre, this research recommends four suggestions for FOAC to support youth education.

1. Construct Beacon/Avalanche Tool Box

Currently, Canadian Avalanche Centre has several beacon boxes that they mail to schools to use for transceiver practice. FOAC could create several beacon boxes for use for schools and outdoor programs; these beacons could be used anywhere – on snow or grassy athletic field – including several transceivers and a couple shovels and probes.

2. Develop FOAC-supported instructor pool

There are successful programs already teaching YAE in the Pacific Northwest, including David Pettigrew Foundation and Alpine Safety Awareness Program (ASAP); better coordination might help clarify who is teaching to which schools and programs. These instructors might be brought into the umbrella of FOAC, equipped with a standard avalanche awareness presentation and labs for students.

3. Avalanche 1 Certification for Educators and Outdoor Program Coordinators

An avalanche 1 certification class could be aimed at both school teachers and outdoor program coordinators, and run through a local college/university for teacher clock hours and college credit. Participants would also receive FOAC's avalanche awareness curriculum in the expectation that they can teach their students the material.

4. Develop a youth/teen-focused avalanche awareness curriculum

FOAC is planning to pilot a youth avalanche awareness presentation for the 2010/11 season in five to 10 schools. Presentation will be roughly 60-90 minutes, including a 30-minute slideshow and two to three experiential labs/activities.

ACKNOWLEDGEMENTS

Without the support of John Comminskey, Matt Schonwald, and Friends of Northwest Weather and Avalanche Center, this research would have been virtually impossible. I would like to thank Michael Jackson of ASAP and Bridget Daughney of CAC for their views and wisdom in avalanche education, as well as SPART and AIS for ISSW 2010 conference funding. This was the first time I used Survey Monkey, and I recommend its services for gathering data and analyzing results.

Ken Turner is an avid backcountry and Nordic skier in Washington State, where he ski patrols at Snoqualmie Pass and was on the Vancouver 2010 Olympic medical team. He also instructs environmental science and outdoor education classes at four local colleges in the Puget Sound area. His research in youth education was supported through a grant from Friends of the Northwest Weather and Avalanche Center and presented at the International Snow Science Workshop 2010.

AVALANCHE SIZE SCALES

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and destructive avalanches. Like we say in all of our avalanche awareness classes, recent activity is the best predictor of further activity. Large avalanches in small paths are likely to be good predictors of large avalanches in large paths with similar snow conditions.

In contrast, hearing about a D4 avalanche makes all of us pay attention. However, a forecaster has to know the particulars of the path to extrapolate the D size to other areas. For example, a D3 avalanche could be a small avalanche involving only new snow in a large avalanche path, or it could be a large, deep slab avalanche in a small path. In short, neither scale gives the complete story by itself, so using both scales is advantageous. For US avalanche operations, keeping the R-scale is especially important because it provides consistency with other data collected for many years. However, the US was not the first to use both scales. The operation at Canada's Rogers Pass has been using an avalanche classification system that includes both an absolute and relative size for many years *(McMahon, pers. comm., 2009)*. They document avalanche size with a D scale size and a qualifier of Large, Medium, or Small, which describes the size of the avalanche with respect to the path. Thus, they might describe a specific avalanche as a "Small D3" or a "Large D2."

Conclusion

As a community, we need to do our best to accurately and consistently estimate avalanche size. Having a good understanding of the R- and D-scales can help us to do that. However, the most effective tool for improving size estimates is good mentoring from experienced avalanche workers. Those folks have likely seen a multitude of conditions and a wide variety of avalanche sizes in both relative and destructive terms, and that gives them the perspective to better assess the size of various avalanches. Accurate size assessments are important for communicating between and within various avalanche operations and for maintaining useful long-term avalanche databases.

An avalanche triggered with explosives in the Wasatch Mountains of Utah. The crown face encompassed almost all of the start zone, and the slide ran full track and destroyed a few large trees at the toe of the path. We would classify the avalanche as R4D4. *Photo by Craig Gordon*

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Karl Birkeland (left) is an avalanche scientist with the USDA Forest Service National Avalanche Center, and Ethan Greene (right) is the director of the Colorado Avalanche Information Center. Karl and Ethan first worked together during the 1990/91 season when Ethan, an undergraduate at Montana State University, helped Karl out as an intern during the first year of operation of the Gallatin National Forest Avalanche Center. That first year the GNFAC was a one-employee, two-intern operation run (no kidding!) out of the office supply closet at the forest. Photos by Kelly Elder.