THE Avalanche REVIEW

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www.AmericanAvalancheAssociation.org

Jason West walks along the fracture line of an avalanche incident in Silver Fork, Big Cottonwood Canyon, Utah, that occurred November 14, 2006. Jason was completely buried in an avalanche he triggered but was quickly dug out by his partners in time to save his life. Here he returns to the scene the following day to investigate the accident.

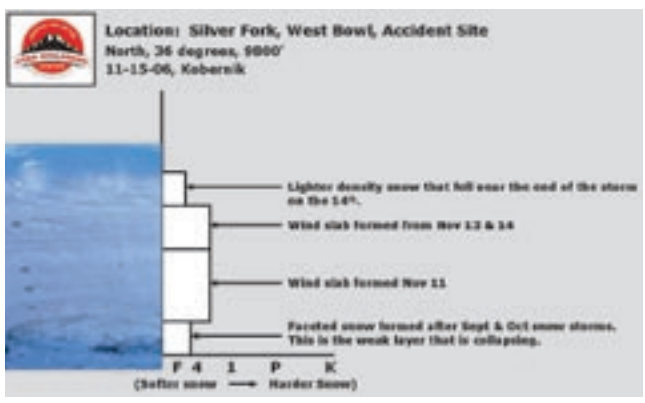
photo © Bruce Tremper
www.brucetremper.com

Avalanche Data— The avalanche is classified SS-AS-R4-D3-G. Rough measurements on a topographic map indicate this avalanche was around 2000' wide. It ran 600 vertical feet. The fracture line depth ranged from 14-36" and averaged around 28". The slope angle ranged from 35-40 degrees in steepness. The aspect ranged from northwest to northeast. It released at about 10,000' in elevation. A second avalanche released sympathetic to the original. It was around 100' wide, 30" deep, and ran around 500' vertical distance. It was on a northwest-facing slope. Faceted snow near the ground was the weak layer for both these avalanches. Depth of the debris averaged 3-4', but areas up to 6' deep were measured.

Weather History— The Wasatch range received some snow storms in September and October that were subject to weather conditions that promoted faceting of the crystals. This sugary type of snow was then covered up by a series of snow storms in early November that were accompanied by a number of windy days that produced a stiff wind slab on top of the faceted snow. Avalanching from this snow structure was observed during the weekend previous to this accident. The day of the accident, many professional snow workers as well as recreational users produced avalanches in this same snow structure.

Comments— All of the skiers involved had some formal avalanche training, but two of them had more training than the buried victim. They chose the West Bowl of Silver Fork because of its low-angle options which would be appropriate for the conditions that day. They performed some snow-stability tests on the way up from Alta. They noted some weakness within the new snow. They were also aware of faceted snow near the ground on northerly facing slopes. They did not experience any cracking or collapsing and successfully skied one run. This is when things started to go wrong. They decided to walk up a northerly facing slope to regain the ridge and then walk east on the ridge. It appears this deviated from the original plan of sticking to low-angle terrain. Perhaps since they successfully skied the run and did not see any cracking, collapsing, or other avalanches, this influenced their decision. Excitement about the new ski season could have also played a role. At least one member of the party had reservations about some of the decisions but did not speak up. Later when the group discussed the accident, the other two had reservations as well but there was not complete communication. This fits into the "no-leader category," where no one is in charge of making sure complete communication is occurring. Many accidents occur due to communication problems and no one is immune to making similar mistakes. It should be noted that this was a textbook example of a perfect rescue which was accomplished only because the touring party had the proper rescue gear and was trained in using it.

—from UAC accident report by Brett Kobernik



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

in this issue

She remembered the "old guys" talking about the winters when they did control work 20 or 30 days in a row. Avalanche control work was really a treat now, all the more so because they got to do it so rarely.

—James Sameth

Avalanche Forecasting in the Year 2017, p10

THE Avalanche REVIEW

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Please send submissions to:
Lynne Wolfe — Editor
PO Box 1135
Driggs, Idaho 83422
tel: (208) 709-4073
lwolfe@tetontel.com

Editorial Assistant:
Sue Miller

Advertising:
Jazz Russell
370 N 110 E
Driggs, ID 83422
tel: (208) 354-2524
fax: (208) 354-6500
jazz@FallLineDesign.com

Production:
Fall Line Design
76 N Main, Suite 208
Driggs, ID 83422
tel/fax: (208) 354-6500
karen@FallLineDesign.com

Business and Subscription Office:
Mark Mueller — AAA Executive Director
P.O.Box 2831
Pagosa Springs, CO 81147
tel: (970) 946-0822 / fax: (970) 731-2486
aaa@avalanche.org

american avalanche association AAA

The mission of the AAA is:

A. To provide information about snow and avalanches;
B. To represent the professional interests of the United States avalanche community;
C. To contribute toward high standards of professional competence and ethics for persons engaged in avalanche activities;
D. To exchange technical information and maintain communications among persons engaged in avalanche activities;
E. To promote and act as a resource base for public awareness programs about avalanche hazards and safety measures;
F. To promote research and development in avalanche safety.

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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.

Layout & Design: Karen Russell, Fall Line Design, (208) 354-6500, karen@FallLineDesign.com.

from the president

Change

In this day and age, life is truly all about change. And in the avalanche profession, change has been fast and furious. Technology accelerates just about everything we do or see. From backcountry tools to data collection and transfer to communications, our field is very different than even a few years ago. Attitudes and expectations have changed. The public looks for quicker ski area and road openings, easier access to bigger steeper lines and more radical remote terrain, even faster response when an accident does happen.

What has not changed is Mother Nature…wait a minute; I forgot global warming! The basics of why avalanches happen have not changed, but how we look at conditions and the conditions we are seeing have perhaps changed. Our terrain is even becoming altered by large wildfires and extensive beetle kill.

One of the American Avalanche Association's goals is to help avalanche workers share information and observations in a changing world and workplace. Recognizing change, managing change, and being proactive about coming changes is not only key for survival these days but helps to create a thriving community. Something I truly enjoy being a part of.

The Avalanche Review has established itself as one of the key vehicles for sharing information. ISSW and the biannual AAA professional development seminar have been joined by regional seminars in the Pacific Northwest, Colorado, and other areas. We are working to provide more and easier opportunities for professional avalanche workers to network and share information. *Avalanche Notes* and *Electronic Patrol Shack*, through avalanche.org, have seen use drop off dramatically. We'd like to encourage participation and revive both of these elements in one way or another. Let us know what you think. Any new ideas on how to do this? What would you like to see? The Governing Board is examining how to have an IT person on board in order to facilitate the Web site and provide members with more internet tools.

And you know all those increased expectations I mentioned earlier? Well I think we are doing an awfully good job meeting those expectations and better. When I look at the roster of AAA membership I see a lot of hard-working, ingenious, and fun-loving men and women. The role of AAA is to help keep you going.

Have a safe and snowy winter,
—Janet Kellum
Ketchum, Idaho
December 29, 2007

This BR 400+ Bombardier, pictured in *Hatcher Pass, Alaska* (TAR 26/2, page 15), was misidentified as a Pisten Bulley.

submissions

- Seen any good avalanches lately?
- Got some gossip for the other snow nerds?
- Developing new tools or ideas?
- Learn something from an accident investigation?
- Send photos of a crown, of avalanche workers plowing roads, throwing bombs, teaching classes, or digging holes in the snow.
- Pass on some industry news.
- Tell us about a particularly tricky spot of terrain.

Write it up; sent it to us.

The Avalanche Review is only as good as the material you send: articles, stories, queries, papers, photos. Submissions guidelines available upon request.

SUBMISSION DEADLINES

Vol. 26, Issue 4 . . . 02/15/08
Vol. 27, Issue 1 . . . 08/01/08

Lynne Wolfe, TAR editor
PO Box 1135
Driggs, Idaho 83422
lwolfe@tetontel.com
(208) 709-4073

mailbag

To the Editor: A Correction for TAR 26/2

A tiny bit of the critic in me compels me to explain to you that not all snow groomers are Pisten Bulleys. My machine and most here in Alaska use the Bombardier series, built in Canada. The machine of mine in the picture is a BR 400+ Bombardier. Others used are the Prinoth, the DMC/LMC, the Tucker – which has two sets of tracks and is articulated (bends in the middle), and of course the Pisten Bully, which is usually the most popular one for Nordic trails as it is normally only 8' wide, whereas the larger ones used in ski areas are usually higher horsepower and have asymmetrical tracks to give them more flotation and will groom a path 16' to 18' wide.

I could go on and on about the different machines and our individual preferences, cost factors, parts, availability, etc. I am a proponent of the Cummins engine, its dependability, and other attributes of the BR 400+.

—Dave Hendrickson

from the editor

Heart of the winter, 2008, Driggs, Idaho.

So far this has been a remarkable winter all over the western North American continent. We started with a drought: the editorial for TAR 26/2 contained a haiku hoping for snow and bemoaning the thin, cold snowpack around us. We got what we wanted – we have seen the sun only once or twice since Christmas. It continues to snow in the Tetons, but this thick blanket is underlain by delicate sandwiches of crusts and facets that have reacted poorly to the new loads. As of January 22 there have been 34 fatalities in North America and innumerable close calls and near-misses.

With that in mind, this issue of *The Avalanche Review* brings you several of my personal areas of interest for this year. I am trying to wrap my brain around the deep-slab problem, so you get to go there with me what may be a deep-slab year. How do we recognize and tiptoe around this seemingly unsolvable problem?

Dale Atkins' story, *Bloodletting, Water, Brazil Nuts, Swimming, and Dying in Avalanches* (TAR 25/4), started us talking about the physics and actions pertinent to being caught in a slab. In this issue, Karl Birkeland, Theo Meiners, and Perry Bartelt continue Dale's line of inquiry in an article that has provoked commentary even before it was printed *(page 12)*.

Also featured this issue, Manuel Genswein sheds more light on avalanche rescue through efficient digging techniques *(pages 20-21)*, and TAR delves into the complex decision-making process utilized in managing Sylvan Pass in Yellowstone National Park *(page 24)*. We also bring you an astonishing (fictional?) essay by Jim Sameth that won him a slot at the National Avalanche School *(page 10)*.

Finally, I want to put out a more personal and immediate call for submissions for TAR 26/4 and even further into the future for next year's TAR. If you have a story, a photo or series of photos, an experience or opinion, commentary on a TAR article or current event, please don't just *think* about writing an article: sit down and do it right now! I know it takes time and thought, but remember how much you gain from reading other folks' shared information and stories about close calls.

TAR 26/4 will focus on the wet-snow phenomenon; we'll have more articles from the Jackson Professional Development Seminar in October. Please bring us your experience or perspective on wet snow for the April issue. In addition, I'd love to see information from the Pacific Northwest, where your avalanche cycles have gone beyond your usual scope.

If you do write something for us, please make it timely. Get it to me by the deadline (February 15 for 26/4; August 1 for 27/1) so I can work with you to make it even better. If you are late with a promised article, we won't have the time to make your story as good as it can be. And if you are sending photos, make sure you provide the highest resolution possible, and don't forget to include the name of the photographer along with all the "Ws" of the photo's background: who, what, where, why, when, and how. Since many of us tend toward ADD, a great photo can really help us understand and relate to the topic at hand.

That's all from the trenches.
Stay on top, everybody,
—Lynne Wolfe

South Columbia Avalanche Forecast

Date Issued: Monday, December 10, 2007 at 5:00 PM

Valid Until: Wednesday, December 12, 2007

Forecast of avalanche danger

	Tuesday	Wednesday
Alpine	MODERATE	MODERATE
Treeline	MODERATE	MODERATE
Below Treeline	MODERATE	MODERATE

Forecast of Avalanche Danger: The Canadian Avalanche Centre is participating in the Staying Alive night at Kicking Horse Mountain Resort Thursday night. Be there.

Travel Advisory Boys and girls, this is a tough forecast to write. Many people are dropping into serious terrain left and right. Sending hard. Senior avalanche professionals and guides are surprised with the aggressive lines people are skiing or riding and getting away with. These aren't old crusty guys wagging a finger at you, but rather ski solders from a decade gone by, marinated with experiences that make most of us cringe and pay attention. The bottom line: A weak layer buried on November 24th is now 60-100cm deep, asleep and waiting for somebody to step on its tail. Will that be you? In many places at treeline, a hard rain crust is masking the layer, which is lower in the snowpack. Remember that masks always disguise. If you hit the right spot and an avalanche releases on this layer, it may pop big and your chances of walking away are not good. The avalanche danger scale doesn't capture the essence of current conditions well. The chance of triggering a slide isn't very high, but the consequence is grim due to its size and character. This is not the same Moderate you are used to. This Moderate means if you are pushing it in complex terrain and trigger an avalanche its wrath may be dire.

Avalanche Activity Here is the catch; avalanche activity from our limited group of observers is dwindling. Beware of the dragon.

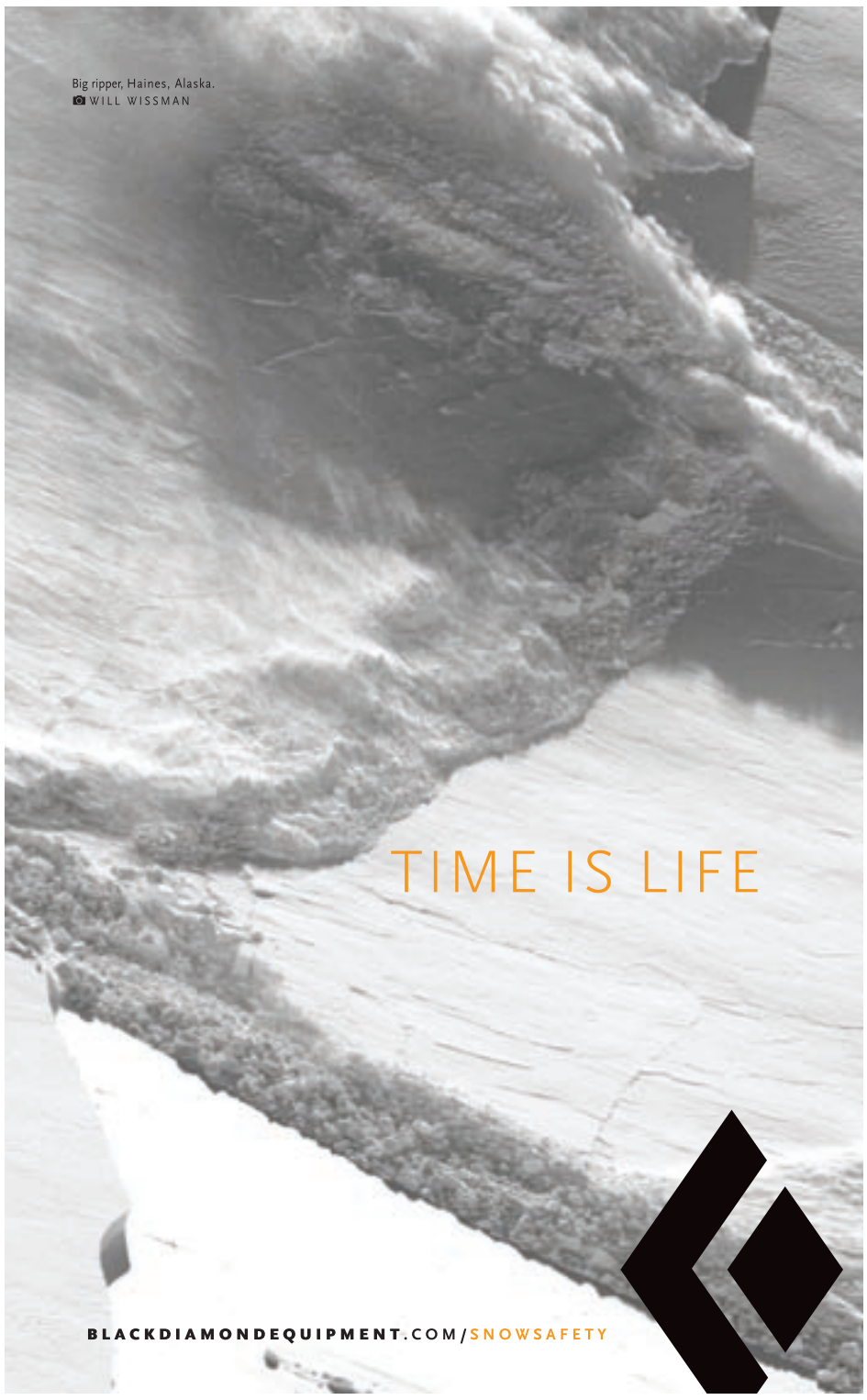
Snowpack 20-30 cm of unconsolidated faceted snow overlies the Dec 4/5th rain crust. Below is the Dec 2, surface hoar layer. Buried approximately 45-100cm deep is the Nov 24th surface hoar, facet, crust interfaces.

Weather A weak system is expected on Tuesday evening. At most 5-10cm with -10 temps. On Wednesday an upper ridge rebuilds causing a mix of sun and cloud.

Issued by:Greg Johnson

This CAC forecast for the South Columbia from December 10, 2007, from Greg Johnson is an extraordinarily well-written example of how to keep the public tuned in to the easily-ignored and ongoing hazard of the deep-slab problem. Thanks to Greg for allowing us to reprint his forecast.

—For more on the topic of deep slabs, see our series of stories beginning on page 14.



metamorphism

Mike Bartholow, his wife Kristen Chamberlain, and their son Owen of Summit County, CO, wish the TAR readership Happy Holidays. Mike is due to succeed Andy Gleason as secretary of the AAA as of the spring board meeting in April.

aaa news

Call for AAA Award Nominations

The American Avalanche Association will present its awards at the 2008 Whistler ISSW, which will be held September 21-27, 2008

The 2008 ISSW at Whistler isn't that far off. So it's not unreasonable for AAA members to start thinking about whether they would like to nominate someone for an award. Normally, the AAA has a general membership meeting at the ISSW and part of that meeting is the awards presentations.

There are three major awards that the AAA annually awards. The first is ***Honorary Membership,*** which is the highest award the AAA bestows. The second is the ***Bernie Kingery Award,*** which is awarded for dedicated professional practice. And the third is the ***Honorary Fellowship Award;*** this is to recognize individuals who have contributed significantly to the quality and success of snow-avalanche-related programs in countries other that the U.S.

Besides the three major awards, the AAA also awards ***Special Service Awards*** in recognition of specific and outstanding achievement in the service of North American snow-avalanche activity.

If you are interested in nominating someone for an award, please check out the awards section on the AAA Web site. You can contact me via the e-mail link on the awards page: www.americanavalancheassociation.org/awards.html.

—Halsted Morris, AAA Awards Committee Chairman

So you want to be a rescue dog when you grow up? *photo by Paul Phillipson*

ATTN: Educators!

The AAA education committee is now developing Level 3 avalanche course guidelines. Our goal is to have a working document this spring. If you have thoughts, opinions, or ideas about what Level 3 avalanche courses should look like, who they should cater to, or who should teach them, we want your input. AAA has worked hard to develop comprehensive guidelines for Level 1 and 2 courses. We are proud to continue the focus on the next level of courses.

Contact us with your input at edcomm@avalanche.org, snosaw@wildblue.net, or sarahlovessnow@mac.com.

—Sarah Carpenter and Brad Sawtell
Education committee co-chairs

AAA Memorial List
REMEMBERING OUR PAST

Story by Halsted Morris

At the spring 2007 board of directors meeting, I volunteered to take Denny Hogan's place as the AAA Awards committee chairman. At first I thought I would be just administering the awards program.

When I received Denny's files (which had been handed down to him from Rod Newcomb and then from John Montagne), I found a small note that just said, "avalanche workers killed…" But there was no attached list of names to go with the note. This note reminded me that regarding the AAA Web site, Steve Conger had once said at a board meeting that AAA should have a memorial list of avalanche workers killed. But like many other things, the idea got forgotten in the daily rush.

The idea of a memorial list started to tug at my curiosity. My relaxed summer plans were soon taken up with rereading the *Snowy Torrents* volumes and trading e-mails with a number of the more historically knowledgeable members of the American avalanche community. In my e-mail exchanges with various folks a criterion for being included on this list was slowly developed. This criterion was later approved at the fall 2007 AAA board of directors meeting. It reads as follows:

> The victim must have been engaged in either a professional or in a volunteer capacity while "on the clock," in snow-safety and or avalanche-rescue work, at the time that they were killed.

It has also been suggested that this memorial list might be a suitable ISSW 2008 poster presentation. If there is someone whom I have missed that you feel should be on the list, please send me details: names, date of accident, location, occupation, type of accident, etc. Anything you can supply would be greatly appreciated. And any photos of these individuals would also be equally appreciated. Please contact me via e-mail; I can be e-mailed via the link off the AAA Awards page at www.americanavalancheassociation.org/awards.html.

I'd like to thank the following individuals for their help and assistance with gathering this information: Dale Atkins, Don Bachman, John Brennan, Steve Conger, Bill Glude, Ethan Greene, Rob Hunker, Janet Kellam, Spencer Logan, Mark Mueller, Gary Murphy, Ray Mumford, Ian McCammon, Rod Newcomb, Blase Reardon, Doug Richmond, Jerry Roberts, Don Sharaf, Scott Toepfer, Knox Williams, Bill Williamson, and Evan Woods.

Halsted Morris is Awards Chair on the AAA board, He is a frequent contributor to TAR and patiently puts up with a demanding editor who continues to misspell his name. He has been heard saying that, "True love is much easier to find with a helicopter.

NAME, OCCUPATION, DATE	LOCATION
Adam Fraiser, Hwy Technician, 3/31/44	Loveland Pass, CO
Avalanche accident - while plowing	
George Beaton, Hwy Technician, 5/26/53	Glacier NP, MT
Going to the Sun Hwy opening	
William Whitsord, Hwy Technician, 5/26/53	Glacier NP, MT
Going to the Sun Hwy opening	
Wayne Whitlock, CDOT Hwy Technician, 4/08/57	Berthoud Pass, CO
Disney Slide	
Tony Deane, Rescuer/Ski Patroller, 3/09/58	Snow Basin, UT
Avalanche accident	
Richard Pittman, Ski Patroller, 3/12/64	Snow King, WY
Avalanche accident	
Lawrence H. Allen, Snow Ranger, 3/29/64	Snow Basin, UT
Avalanche accident	
Carolyn Laffoon, Ski Patroller, 2/18/67	Skyline,ID
Avalanche accident while in training class	
John Johnson, Ski Patroller, 2/18/67	Skyline,ID
Avalanche accident while in training class	
Earl Gentry, Ski Patroller, 11/25/67	Arapahoe Basin, CO
Avalanche accident while on sweep at the end of the day	
Robert F. Miller, CDOT Hwy Technician, 3/02/70	Red Mountain Pass, CO
Avalanche accident - cat operator clearing avalanche debris	
Tom Simpson, Snowcat Ski Guide, 3/16/71	Aspen Mountain, CO
Avalanche accident	
Marvin R. Critton, Ski Patroller, 12/13/73	Mammoth Mountain, CA
Explosives Accident	
Duane Gifford, Hwy Technician, 2/07/74	Thane Hwy, AK
Avalanche accident - loader operator clearing slide	
Peter Horridge, Ski Patrol Candidate, 11/23/74	Arapahoe Basin, CO
Avalanche accident - ski packing	
Tyler Hammond, Hwy Technician, 2/09/78	Helms Creek, CA
Avalanche accident - operator moving avalanche debris from path	
Terry Kishbaugh, CDOT Hwy Technician, 2/10/78	Red Mountain Pass, CO
Avalanche accident - rotary operator clearing slide debris	
George Morris, County Road Operator, 2/10/78	Twin Lakes, CA
Avalanche accident - watching slides swept into lake, drowned	
William F. Unsoeld, Climbing Guide, 3/04/79	Mt. Rainer NP, WA
Avalanche accident	
Roberto Gasperl, Ski Patroller, 3/31/81	Snowmass Ski Area, CO
Avalanche accident	
Albert Dow, Rescuer, 1/25/82	Mt. Washington, NH
Avalanche accident - while on S&R mission	
Bernie Kingery, Ski Patroller/Mtn Mgr, 3/31/82	Alpine Meadows, CA
Avalanche accident	
Jeffery "Jake" Smith, Trail Crew, 3/31/82	Alpine Meadows, CA
Avalanche accident	
Gary Pheister, Avalauncher gunner, 12/22/82	Helms Creek, CA
Avalauncher accident	
Douglas Wiens, Avalauncher gunner, 12/22/82	Helms Creek, CA
Avalauncher accident	
Charles Marvin, Avalauncher gunner, 12/22/82	Helms Creek, CA
Avalauncher accident	
Steven Forsythe, Avalauncher gunner, 12/22/82	Helms Creek, CA
Avalauncher accident	
David Stutzman, Ski Patroller, 12/24/82	Big Sky, MT
Avalanche accident	
Mickey Johnston, Ski Patroller, 12/18/83	Copper Mountain Ski Area, CO
Avalanche accident	
Chris Kessler, Ski Patroller, 3/31/84	Aspen, CO, Highlands Bowl
Avalanche control accident	
Craig Soddy, Ski Patroller, 3/31/84	Aspen, CO, Highlands Bowl
Avalanche control accident	
Tom Snyder, Ski Patroller, 3/31/84	Aspen, CO, Highlands Bowl
Avalanche control accident	
Paul Driscoll, Ski Patroller, 12/02/85	Jackson Hole Mountain Resort, WY
Avalanche accident	
Kim Momb, Heli-ski Guide, 2/04/86	Selkirk Mountains, Canada
Avalanche accident	
Tommy Raymer, Ski Patroller, 2/17/86	Jackson Hole Mountain Resort, WY
Avalanche accident	
Ian Kraabel, Climbing Guide, 8/03/86	Mt. Baker, WA
Avalanche accident	
Jefferson Wong, Ski Patroller, 2/19/89	Mount Hood Meadows
Avalanche accident - was fixing a rope in a terrain trap area	
Mark Yates, Avalanche Forecaster, 2/12/92	La Sal Mountains, UT
Avalanche accident	
Eddie Imel, CDOT Hwy Technician, 3/05/92	Red Mountain Pass, CO
Avalanche accident - stalled plow: one killed, one survived	
Steve Burchett, Ski Patroller, 12/17/94	Mission Ridge, WA
Avalanche accident - while ski cutting	
Roger Evans, Snow Ranger, 2/94	Alpine Meadows, CA
106mm recoilless rifle accident	
Bruce Hance, NPS Hwy Technician, 6/14/95	Tioga Pass, Yosemite NP, CA
Avalanche accident - operator killed during spring opening	
Jeff Brewer, Ski Patroller, 2/02/96	Solitude Ski Area, UT
Avalanche control accident	
Jim Otteson, Heli-ski Guide, 2/10/96	Paradise Peak, ID
Avalanche accident	
Erika Pankow, Ski Patroller, 12/25/96	Big Sky Ski Area, MT
Explosives accident	
Kerry Brookman, Alaska RRD Operator, 2/01/00	Seward Hwy (Bird Flats), AK
Avalanche accident - bulldozer operator, clearing debris	
Jeffery Nissman, USFS employee, 12/2/04	Portage, AK
Avalanche accident - roof avalanche	

Fall AAA Board Meeting Notes

Summarized by Bill Glude

The Board met October 4, 2007 in Jackson, Wyoming. Following are the highlights not covered in other articles.

President's Remarks, Janet Kellam

Janet commends Don Sharaf and Ian McCammon on their fine job of organizing and teaching the AvPro course; she was impressed.

Janet thanks all for comments on the proposed federal OSHA explosives rules last summer. The OSHA proposal threatened to add another layer of bureaucracy on avalanche explosive use and reflected a distinct lack of understanding of our needs. The proposal was eventually quashed by National Rifle Association lobby because of their concerns with regulation of gunpowder.

Treasurer's Report, Bill Glude

We are at our usual financial level for this time of year, with just under $29,000 in the operating account. We are balancing income and expenses, providing a good range of member services, and staying within our budget.

The endowment account has nearly $39,500 in it, and the National Avalanche Center account is balanced at close to zero, with some $900 allocated to cover AAA administration fees.

As we add member benefits like updating our Web-based services, work on federal avalanche legislation, AvPro instructor training, insurance, and providing more continuing education events in the next few years, we may need a dues increase. The Board is seeking member feedback on how a $5 or $10 increase would affect them. **(Members: please send your ideas and feedback to Mark Muellller at aaa@avalanche.org).**

Our major income categories in round figures for the fiscal year breakdown as dues $24,800; *The Avalanche Review* (TAR) advertising $15,000; donations $12,600; the professionals' course (now AvPro) $8,000; SWAG observations guidelines $7,700; and merchandise $4,300. All other income categories are less than $2,000 each.

Our major expenses are executive director $18,000; TAR design $6,700; ISSW 2010 seed donation $6,500; TAR editor $6,200; AvPro instructors $6,100; TAR printing and mailing $5,100; SWAG production $3,600; AvPro course insurance $3,500; merchandise $3,100; AvPro coordinator $3,000; executive director travel $2,400; TAR advertising manager $2,300; membership directory printing and postage $2,200; and Web page design $2,000. All other expense categories are less than $2,000 each.

SWAG brought in a net income of about $4,000; merchandise brought in $1,200; and the AvPro course lost about $4,900. TAR appears to have lost roughly $5,000 if only advertising revenue is considered as TAR income, but because TAR subscriptions account for a major portion of our nearly $25,000 in dues, TAR produces a strong net gain.

Executive Director's Report, Mark Mueller

Total membership is 977, with 424 Professional Members and 110 Member Affiliates, including new members approved at this meeting.

We will print more SWAG books but will limit the order. A revised second edition is anticipated next fall or winter with new international snow classification, at least one updated formula, a new danger scale, and some new tests. Forecasters have met to work on a US-Canadian joint manual but it is at least two years away.

We decided to quantity price SWAG at $12 per copy for orders of 10 or more. The small quantity price is $20.

International postage on *The Avalanche Review* has increased sharply. We subsidize these subscriptions as outreach, but we charge $5 for a roughly $15 value. The rate is set for this year but we may need an increase next year. We will decide at the spring meeting, and are seeking feedback from international subscribers.

We are pursuing an online database management service to handle subscriptions and mailing lists. Subscribers would log in to update their own information. We are also considering an electronic membership directory. **What do members think? Would these changes be useful?**

New Chairs, Board Action

Member Affiliate Representative Rick Gruben was approved to replace Halsted Morris.

Co-chairs Sarah Carpenter and Brad Sawtell were approved to replace Michael Jackson and Don Sharaf for the Education Committee.

Jamie Yount was approved as the new Intermountain South Section Representative.

Committee Reports, Education

Don Sharaf reported on the AvPro professionals' course. All courses to date have been taught by Don and Ian McCammon. Their goals are that the course be both sustainable and consistent. We need to develop a larger instructor pool and need instructor training guidelines.

AvPro is logistically difficult to organize. It typically involves several resorts, multiple backcountry areas, and a number of guest instructors. We need to limit the venues to simplify the logistics. Little Cottonwood Canyon in Utah and Southwest Montana have both worked well. The Sierra, perhaps Mammoth Mountain, is a likely future locale. Colorado – perhaps Telluride – would be good. We would like a Northwest and an Alaskan venue.

A day off was added to the schedule. Students needed a day to rest, explore the area, and practice skills. The instructors needed time to evaluate fieldbooks and give feedback.

Students requested more backcountry time and less in-bounds time. Most students to date are professionals – primarily in ski area operations – with a couple advanced recreationists.

The American Mountain Guides Association (AMGA) is considering AvPro for their guide training requirement. Don is confident that AvPro graduates are at a suitable level to qualify, but AMGA approval may take several years.

The Board approved course fees of $1100 for AAA members, $1200 for nonmembers.

Course insurance is about $3400 per year. We could run a second course without increasing that cost, but are not yet quite ready to run more than one a year.

AvPro scholarships funded from an ISSW donation are available. The application is on the AAA Web site. Four scholarships at $500 each will be awarded per year for AAA Member Affiliate or Professional Members.

New Avalanche Course Guidelines, Janet Kellam

The guidelines were circulated widely. There was not too much comment. The Education Committee fine-tuned some wording this fall.

Course providers using the Avalanche Skills Advancement Workshop – a refresher or bridge course between Levels 1 and 2 – report that it is working well for them.

Continuing Education, Janet Kellam

Craig Sterbenz notes that funds from an annual CIL/Orion donation to AAA education can be used for regional continuing education events.

Membership, Stuart Thompson

We approved 13 new Professional Members and eight new Member Affiliates.

Our new member application tracking process is working well. Blase Reardon will draft up a simpler combined application form and guidelines that emphasizes deadlines more prominently.

Publications, TAR, Lynne Wolfe

Advertising is covering our costs for 28 pages with color. Our new ad manager is Jazz Russell. We are using better paper, and the editorial staff is unchanged.

We are working on guidelines for submissions, including ethics rules for articles with commercial ties.

Research, HP Marshall

Jerry Casson, working with Howard Conway, applied for a graduate student grant studying crystal type, fall rate, initial density, densification, and shear strength. We approved $1,500 for shear frames and force gages, snow densification apparatus, and snow kits.

Bolars Matson applied for an undergraduate grant studying near surface faceting, spatial variation of near surface gradients, and radiation recrystallization. We approved $500 toward thermistors.

Follow up on methodology for Ron Simenhois' extended column research project from last year has been good.

We require that AAA gets credit and that we expect a TAR article and/or ISSW presentation/poster from all projects we fund.

Awards, Halsted Morris

Halsted has compiled a draft list of 48 avalanche workers killed in the line of duty. It is being adjusted as new information becomes available. Workers must have been engaged in professional or volunteer avalanche work on the clock when they were killed. He will post the list on the AAA Web site and do an ISSW poster on it.

Award nominations are welcome. *(see Call For AAA Award Nominations on page 4)*

Section Representatives and Committee Reports

Kyle Taylor, Eastern Section, says they have about nine pro members and they want to do an avalanche awareness day that will pull in rescue groups, ski patrols, backcountry users, and others.

Carl Skustad, Alaska Section, says Dave Hendrickson is still working on a possible Alaskan ISSW for 2012. Alyeska Ski Resort is under new ownership, and greatly expanded backcountry access is likely.

Lel Tone, Ethics Committee, reports no issues this year.

Rick Grubin, newly approved Member Affiliate Representative, is working on recruitment and retention of Member Affiliates, the education guidelines, and continuing education.

John Brennan, Colorado Section Representative, is recruiting members and working on continuing education events like the Colorado Avalanche Information Center's annual Colorado Snow and Avalanche Workshop (CSAW).

Gary Murphy, Sierra Section Representative, says it is his eighth year for *Avalanche Notes*, and more contributions are needed. They can be submitted online. Alpine Meadows was bought by JMA, a big land development company in San Francisco. Larry Heywood and others worked on Cal OSHA regulations.

Old Business, Board Liability Insurance

We are making progress on getting this.

New Business, Business Supporter Memberships

Other nonprofits like the American Alpine Club and the Appalachian Mountain Club generate significant income from corporate members. We approve the program as outlined in TAR 26/ 2.

New Business, Merchandise

We are reviving the online store. Lel Tone is spearheading the effort.

New Business, Regional Continuing Education, Janet Kellam

We are encouraging and supporting regional avalanche education events as partnerships between AAA and other organizations who share our goals, like Colorado's CSAW and the new Northwest Snow and Avalanche Symposium (NSAS) event, as well as the continuing education seminar we have in conjunction with our Board and Annual Meetings in non-ISSW years.

New Business, Legislation, Don Bachman

A federal avalanche bill sponsored by Mark Udall (CO) and Don Young (AK) has broad support and hopefully will be heard in the House Operations and House Resources Committees this fall. Don Bachman will coordinate those who want to support the bill. Don notes that it is politically essential that the bill be funded with new money, not funds taken from the already-pinched Forest Service.

New Business, AAA Web Site

We are updating the Moonstone Library of articles from TAR and technical articles, and want to add an event calendar and possibly set up an e-directory. We will put a help wanted ad in TAR for a computer nerd to help us do these things.

New Business, ISSW 2008

We need help with a venue for the AAA meeting at the upcoming Whistler ISSW.

Next Board Meeting

The date is set for Ketchum, Idaho, April 19, 2008.

what's new

CAA Update: HARD-WON SUCCESSES

Story by Mary Clayton

Well-structured and consistent training has always been one of the strengths of Canada's avalanche community, and the CAA's Industry Training Program (ITP, formerly known as the CAA Training School or CAATS) has developed curriculum that has been emulated and exported around the world. However, we haven't achieved this asset without some missteps. Some courses have failed, and some have taken a number of tries before we got them right. Two of our programs that have had difficulties in the past enjoyed a well-deserved success in late 2007, resulting in grateful students and instructors excited and inspired by their achievement.

The first was a weather course, designed specifically for winter forecasting. We ran two introductory courses and one advanced course in October and November of 2007. A good grasp of weather is a tremendous asset in avalanche forecasting, and the need for a reliable and effective course had been long identified. However, as we all know, meteorology is a vastly complicated subject that can quickly become an overwhelming mess of models and graphs, leaving the students more confused than enlightened.

This weather course was in the hands of Ken Wylie and Uwe Gramann. Ken is the Lead Content and Curriculum Developer for the CAA's eTraining project (the subject of a whole other column). In addition to being an IFMGA guide, Ken has a strong background in outdoor education. Uwe (pronounced oo-vay) is a professional meteorologist with strong communication skills and a contagious passion for weather.

Together, these two created a lesson plan based on a real-life scenario—a time period during the winter of 2006-07 where a surface-hoar layer developed over much of BC. Ken and Uwe reconstructed those few weeks meteorologically, linking the weather patterns to the changes in the snowpack and the resulting avalanche cycle. This creative approach has struck a chord, and the feedback from students was some of the most positive the CAA has ever received, which is saying something.

The second success we're celebrating is a CAA Level 1 course for snowmobilers, which ran in early December of 2007. Again, this is a course we have long seen a need for but have not been able to pull off. Unlike the weather course, this Level 1 course didn't need to be created anew. It has a strong foundation, based on a proven curriculum. The modifications for the sledding audience are significant, but achievable. The missing link, however, was the students.

The sledding community in western Canada had been requesting a course for a number of years. We had tried to answer that request, but always, when push came to shove, the enrollment was never there. It has taken a number of factors to drop into place before this community was willing to make the commitment. Most important of those factors was a recent organization of backcountry snowmobile operators, called the BC Commercial Snowmobile Operators Association (BCCSOA). This association now requires snowmobile guides operating in avalanche terrain to have CAA training. It seems the tide may have turned.

Of course, it takes more than students to make a course succeed, and again, our instructor team was key to this accomplishment. Randy Stevens has been a professional-level avalanche instructor for a more than two decades. Along with that wealth of experience and knowledge, he's also an accomplished sledder (a skill he says he had to develop in order to access more skiing). The other member of the team is Amber Wood, one of the new breed of sled-based ITP instructors. Amber is also the General Manager of the BCCSOA and one of the driving forces behind better organization among sledder operators.

The CAA is incredibly fortunate to have exceptional bench strength in our instructor pool—individuals with a wide diversity of talents united by common training and pride in their work. Both of these recent educational successes owe a debt to the creativity and passion of our instructors. Credit is also due to Ian Tomm, the CAA's operational manager, who consistently shows leadership and vision with the Industry Training Program.

If you're interested, the weather course will be held again this coming spring, close to the date of the CAA's annual general meeting in early May. Of course, you're always invited to attend our AGM as well—it's a great time! Have a safe, wonderful winter.

Mary Clayton is the Communications Director, Canadian Avalanche Association & Canadian Avalanche Centre. For more information she can be reached at mclayton@avalanche.ca, or through the CAA/ CAC Web site www.avalanche.ca.

A Cheap and Easy Det Cord Roller

Story and photo by Paul Phillipson

Time: 0830 on a powder day, after a significant storm.

Area management wants the ski area open as soon as possible, but a huge cornice needs to be shot, and you need to string out 100m of detonation cord in a trunk line to connect your charges.

You hand the end of the det cord to your partner, then, while holding one of your poles upside down, put the spool over the tip of the pole and start to ski out to the last shot point, feeling like a circus performer spinning a plate on a stick.

Of course, with the deep snow and little slope to give you momentum, you need to use your poles (oh, that's right; you now have only one to use). The reel of cord then decides to spin off your makeshift reel, with the det cord coiling up in knots at your feet. Hasn't everyone been there at one time?

An old aluminum ski pole with a good strap, two fender washers, and a hairpin clip is all the materials you need to craft up a handy det cord roller. Cost: less than $2.

Here's a simple, cheap solution to avoiding this FUBAR. Go to the ski area rental shop and find a broken spun-aluminum ski pole with a good strap. Cut it off with a tubing cutter to leave 8", then drill a 1/8" hole 3/4' from the cut end. Get two 3/4" fender washers and a hairpin clip from the hardware store and assemble your new det cord roller.

You can hold it by the handle or clip the strap to your pack and just ski out to the end of the line. Simple, patroller-proof, and at a cost of less than $2, within anyone's budget.

Paul Phillipson is a patroller and avalanche control technician at Mt. Rose Ski Area near Reno, NV. He came all the way to Jackson Hole for the Professional Development Seminar in October, where he promised to contribute to TAR.

Bridger Bowl Hosts Snow Science Day

Story by Peter Carse

Patrollers from ski areas around SW Montana gathered in the base lodge at Bridger Bowl on Nov 12, 2007, for a free all-day event organized by Bridger Patrol Director Fay Johnson.

As increasing winds tumbled semi trucks on I-90 and fanned large grass fires in neighboring counties, 150 avalanche professionals from Big Sky, Moonlight Basin, Yellowstone Club, Red Lodge, and Bridger Bowl met to consider cooler, calmer vibes from an all-star cast of local presenters.

Ron Johnson refreshed us all on the basics of slab avalanches, as well as rescue-shoveling strategies. Erich Peitzsch presented recent research on wet slabs, Chris Shelley shared a view of Moonlight Basin's avalanche program, and Scott Savage outlined a case history of a post-control release at Big Sky. Doug Richmond presented an explosives-safety review including NSAA/OSHA guidelines, and Chris Hyle talked about the choices of explosives products currently available for avalanche hazard-reduction work.

We heard from the always-energetic Karl Birkeland on a couple of topics. Karl encouraged us to continue to make an attempt to include a fracture propagation test in our pits, either an ECT or Canadian propagation test. These tests seem less vulnerable to spatial variability concerns than our standard column tests, as well as dramatically reducing the occurrence of false-stable results from our snow-study pits. On the topic of what to do if caught in an avalanche, Karl presented material that involved input from Perry Bartelt (Switzerland), and Theo Meiners (Alaska) *(see Avalanche Survival Strategies on page 12)*. One take-home message from this presentation was that Tom Kimbrough wasn't just making it all up when he so enthusiastically advised us to "fight like hell" in the now-classic video *Think Like an Avalanche*.

One final discussion became, in this writer's opinion, most thought provoking in the context of the evolving relationships between mind and snow (aka the "human factor"): the wisdom that we should be using the appropriate equipment when traveling in avalanche terrain. Beyond the basic transceiver, probe, and shovel, the premise is that "appropriate equipment" may include a helmet, body armor such as kneepads, and more: an avalung and air-bag flotation system.

Consider this: it really wasn't all that long ago when common sense kept people from venturing into known avalanche terrain – it was presumed to be dangerous! In recent decades we have been very busy with intense snow study and education, with the goal of reducing avalanche incidents, but

Karl Birkeland presents new and useful information to 150 SW Montana avalanche professionals. *photo by Doug Richmond*

with arguably mixed results as far as injuries/fatalities are concerned. Are we really that far off from clearing those troublesome trauma-inducing trees or other obstructions from our favorite avalanche paths, then dropping in during the height of storm with our appropriate equipment? Due to financial considerations, my ski buddies and I are investigating the viability of the "chicken on a string." With this equipment, the chicken may flutter to the surface during turbulent flows, and our partners can follow the string to the nose ring of the buried person!

In all seriousness, the gathering at Bridger was keenly appreciated by all attendees. There was a real feeling that we were meeting as members of a functional family, tuning up our avalanche senses in preparation for another safe and fun ski season in the land of cold smoke.

Peter Carse learned how to crawl through the snow in northern Vermont, and this led to a career of ski patrolling in the west starting in the early '80s. Most recently, his obsession with avalanche initiation is facilitated by working with the Bridger Bowl Patrol in Bozeman, MT.

GEAR REVIEW:
Black Diamond Women's Guide Gloves

Review by Lynne Wolfe

I got a pair of these burly gloves to review for Black Diamond, and they came at just the right time, as the weather turned arctic. These are not the gloves to wear while hiking up the bootpack, in fact, while hiking anywhere. These are the gloves you put on for going downhill fast when it is really cold, whether in the backcountry or at the ski area. They have a wool liner and an articulated shell that can actually grip my pole without me straining to bend hard leather. The wool liner was initially too puffy and I had to stuff my fat paws into a ladies large, but after a bit of wear they molded to my hands and kept me oh-so-warm. A long gauntlet with one-handed draw cords covers the cuff of your jacket easily, a plus when you don't want to fiddle around or have any skin showing on those coldest days.

Final score: A+ for their niche. At $154 retail, you are paying for the assurance of warm hands.

Juneau Urban Avalanche Advisories Canceled

At the last minute, the city and borough of Juneau, Alaska, refused to fund more than one-third of the cost of the Southeast Alaska Avalanche Center's community-based nonprofit service, leading to its cancellation. Director Bill Glude notes, "The entire program would have cost the equivalent of one $5.20 burger per person per year to save lives in a town that is spending millions on a new parking garage, swimming pool, and cruise-ship dock." The Center is still providing its full range of educational services and continuing to work for state and federal forecast funding.

Ortovox Search Training System Sets Standard for Beacon Search Practice

Ortovox USA has introduced the most advanced and user-friendly system for avalanche beacon search training. For ski patrols, guide services, heli operators, military trainers, and backcountry-oriented retail shops, the Ortovox Search Training System (STS) offers significant technological improvements over existing training systems:

- The STS is completely wireless, which reduces set-up time to about ten minutes and eliminates the aggravating tendency of wired systems to become unplugged when the snowpack shifts.
- The STS control unit can control up to five buried transmitting units, remotely turning any of them on and off, permitting multiple searchers to use the same area without digging up and relocating transmitters.
- The Ortovox STS system is compatible with the RECCO reflector system.

There are two models of the STS system: one with three transmitters and an MSRP of $1650 and a five-transmitter model for $2250. The three-transmitter model can be upgraded for $425 per additional transmitter.

Both versions of the STS are available immediately and can be ordered through any Ortovox dealer, or direct at 603.746.3176. For more details, visit www.ortovox.com.

media

Foreward from the author, Jim Sameth:

I've worked at Alpental, a ski area located just outside Seattle, Washington, since 1980. Virtually all of Alpental is exposed to high avalanche hazard, requiring significant control work. On a typical control day, we use about 400 pounds of explosives. Last season our total use was just under 11,000 pounds. Reporting requirements have becoming increasingly stringent, requiring a great deal of time to fulfill. In addition, regulations regarding our storage facility were recently reinterpreted in a way that would have made operation of the ski area impossible, requiring additional time spent on negotiating a variance. While Alpental may require greater-than-average avalanche control work, our dependence on the use of explosives in a way not widely understood by regulators is shared by many other ski areas throughout the country. I believe it essential that we work together to educate regulators regarding our needs in this area, to ensure that regulations are promulgated and applied in a way that is workable for us. This essay is a peek at what life for us may be like if we do not.

Snowbird ski patrollers Eric Fields and Ralph Whatley prepare to fire the 105 howitzer at the Superior and Monte Cristo start zones above Little Cottonwood Canyon.

photo © Bruce Tremper
www.brucetremper.com

Avalanche Forecasting and Control Work in the Year 2017

The Effect of Ever-Increasing Government Regulation and Accuracy of Forecasting

Tuesday, January 3, 2017

Katie woke to the nagging buzz of her alarm clock, repeating itself every 5 seconds. She rolled out of bed on the third repetition and walked the five steps to her clock to shut it off-just far enough away to make it unlikely-or at least less likely-that she'd close her eyes for "just another minute and end up missing the cutoff. She looked at the clock. Three-thirty: still time enough to check the weather update, complete today's application for Final Approval, and download the authorization code that would unlock the explosives cache. If everything went smoothly, they'd be able to start control work by 6:00. Good thing, she thought, remembering that today was the first day of ski school this season, and there'd be 250 busloads of kids waiting to get on the lifts at 9:00.

Grinding coffee beans for her first cup of the day, Katie thought about how things had changed over the 22 years she'd been patrolling at Aspental. Well, a few things hadn't changed much. Getting up early: maybe a little earlier now, because of the extra "paperwork" (or whatever you call filling out forms on line, she thought). But back when she'd started, you got up early to look outside and see how much new snow there was on the stake, and if there were six inches or more, you started making phone calls. The first call would be to Chuck, the Forest Service ranger. Chuck lived on the mountain himself, but didn't move too fast, and would hold everything up if he didn't get his 4:00 am wake-up call. Then moving down the list, she'd call the whole crew. Some would sound cranky, but nobody really minded hearing it was dumping snow and there was going to be control work. Others wanted to chat about how much snow had fallen, what the wind had done, and what they might expect to find on the mountain. It often took well over an hour to make all the calls. Now all it took was a mouse click to start the automated call system. Instead, she got up early to fill out forms.

With coffee cup in hand, she savored the aroma – another thing that hadn't changed. Besides the anticipation of new snow, this is what made getting up at this ungodly hour tolerable, she thought as she made her way to her computer.

But many things had changed, and a lot of them not for the better. They say people have always yearned for "the good old days," she thought, but it really seemed like the last ten years – and especially the last two – had seen far more change than what she remembered from the first thirty-some years of her life. For one thing, global warming wasn't something anyone debated any longer. Katie remembered when the subject first became popular. She had been concerned about it early on, unlike some of the others she worked with, who had been more skeptical. But they all loved skiing, and no one doubted any longer that the seasons were getting shorter. Even when she'd started patrolling, it had seemed like there was less snow than when she'd been a kid in ski school herself, and she remembered the "old guys" talking about the winters when they did control work 20 or 30 days in a row. Avalanche control work was really a treat now, all the more so because they got to do it so rarely.

On the other hand, weather forecasting had really improved, changing completely when Moore had announced his new forecasting model three years ago. And a good thing too, she thought, because without accurate forecasting, there's no way they'd be able to do control work at all. By the time they'd jumped through all the hoops to get approval, there'd be no need-not only would the hazard have subsided, most of the runs would be virtually snow free!

That's what I'm talking about – Katie said outloud, mildly startling Betsy, her 5-year-old avi rescue dog. Padding past the window looking out on her snow plot, she'd just flipped on the outside light, and was struck once again with how lucky she was to live a 10 minute walk from what she considered to be the best ski area on the planet. She sat down at her computer and called up the current update. It was helpful that it was all done automatically now – both the long-range forecasts and the five-minute updates were always immediately available. And she continued to marvel at the fact that for the last two years, the two had always been identical! Still, out of habit and a mild distrust of technology, Katie continued to clean her 24-hour stake every morning. Based on what she saw this morning, control work would not have been likely: there was barely three inches on the stake, and only a few flakes drifted past her window. The long-range forecast, however, told a different story.

Katie opened the current update. The blizzard that the long-range forecast had called for was still predicted: three inches of snow an hour for the next three hours, beginning in about 15 minutes.

"Yeah, right," she would have thought just a few years ago. "The 'mountain liars' have got it wrong again." But the "Moore Model" had changed that. Now, the long range forecast always matched the updates, which always matched what actually happened, without exception. So she clicked the "Notify Bros" button, setting up an automated call to each of the patrollers for the time he or she had requested.

Katie began filling out the online DHS forms for final authorization. She remembered when the Department of Homeland Security had been created, back in 2001, right after the terrorist attacks. She remembered someone (was it the President?) saying something like, "The world will never be the same." Whoever it was probably wasn't thinking of avalanche control work, but if he had been, he couldn't have been more right. Having to keep better track of the explosives we used wasn't so bad, she thought, in fact, we probably did need to be a little more careful. But each year, the rules got more and more onerous. Was it five years ago when we finally had to hire a full-time administrator just to fill out the forms? And of course, it was impossible to get someone on the patrol to do that, and it was impossible to get anyone they had hired to get up at 3:00 am to fill out the "Final Approval" form, so it had become Katie's job.

She looked at the time: 4:00 am. It was going to be close. Even though the information required would be the same as the information entered on the "Preliminary

Essay Wins Scholarship

With this essay, James Sameth won a scholarship to attend the 20th National Avalanche School. This was the first annual scholarship to the National Avalanche School offered by High Angle. High Angle is the United States distributor of Gazex, a remote-controlled avalanche-release system using a combination of oxygen and propane rather than explosives.

The second annual Phase I National Avalanche School scholarship sponsored by High Angle will accept applications starting August 1, 2008; closing date is October 1, 2008. The scholarship is offered through the American Avalanche Association and the judging is done by NSAA. A 2000-word essay about the future of avalanche forecasting and control work is the required topic of the essay. More details will be available in TAR 26/4 (April 2007) or TAR 27/1 (Sept 2007) or e-mail highangle@charter.net.

Approval" form, it now had to be re-entered. For some reason, there was no way to import the previously entered information. How many times had she complained to the patrol director about this ridiculous waste of time? He'd been sympathetic, and said he'd spent three hours on the phone trying reach someone at DHS about getting this changed. The best he'd been able to do was leave a message with the "Interim Assistant Regional Administrator" (she thought that's what he'd said), and gotten an e-mail back saying something like that "for security reasons" the process couldn't be changed. So the "Final Approval" form had to be filled out by hand. Besides all the weather data, she had to type in the name of each patroller who would be handling explosives, the number charges and caps and fuses they expected to use, which avalanche paths they expected to control, and on and on. Twenty-seven screens in total. Even typing as fast as she could, she knew it would take nearly an hour and a half. It all seemed so wasteful, and not just the time: how many unnecessary shots got thrown in order to make the "Actual" report match the "Final Approval" form? And worse, how many hazards were left uncontrolled because they hadn't been included in the preliminary application? Well, they'd at least pretty much eliminated that problem by including every path on every route in each application. So in the end, the new regulations hadn't actually increased avalanche hazard (Aspental hadn't had an avalanche-related in-area injury or death in its 50 years of operation), but they had certainly made control work less efficient and more cumbersome.

At 5:30, Katie completed the online form, looked it over one last time, and clicked the "Submit" button. Final approval usually issued within 15 minutes, if she hadn't missed anything and if there were no system glitches. Since implementation of the current system two years ago, they'd had to delay control work three times and missed it once altogether because of glitches, keeping the area closed all day. A scary thought, she mused, when you consider that the system was implemented by the agency charged with protecting us from terrorist attack. Still, she wondered what would have happened without Moore Model forecasting – some ski areas might not have had much trouble, but at Aspental, where virtually all runs were in potential slide paths, operation under the current rules would be impossible without accurate long-range forecasting.

Katie dressed, ate some breakfast and made a second cup of coffee. At 5:45 she sat back down at her computer. No approval. She allowed herself to worry a bit-what if she'd made a mistake in filling out the form? But then she heard the alert "ding" and opened the DHS Final Approval Notification: "Final approval of your Preliminary Application of October 5, 2016, was issued on January 3, 2017 at 0545. Your authorization code will be effective to access your explosives cache between 0600 and 0630 today only. Click 'Continue' to download your authorization code to your access key."

After downloading the authorization code, Katie put on her coat, finished her coffee, and headed out the door with Betsy. Snow was falling hard now, exciting her about the work ahead and erasing lingering resentment about the sleep she'd missed filling out forms for a bureaucracy that required application for avalanche control work no less than 90 days in advance.

Jim Sameth tried to quit law school in 1980 to work full-time as a pro-patroller at Alpental on Snoqualmie Pass, Washington. Either God or his mother intervened, and 1980-81 was a drought year, with the area open for less than a month. Jim took the hint and finished school, and has been pulled between two professions ever since. He worked full time at Alpental for most of the 1980s and part time through 2005. For the past two winters, he's managed to once again work full time at Alpental, while practicing law as general counsel for a Japanese software company. He lives in Issaquah, Washington, about 45 minutes from Snoqualmie Pass (and occasionally at the patrol station at the top of Denny Mountain). He attended the 2007 National Avalanche School to add an academic perspective to 27 years of experience doing in-area avalanche control work and backcountry observation (and the promise of an extra 10 cents an hour). He can be reached at jim@sameth.com

White Book the Movie

Review by Jamie Yount

White Book is a new avalanche-education movie sponsored by RECCO with footage from Teton Gravity Research. The goal of *White Book the Movie* is to motivate skiers and riders who want to play in the mountains to get educated about avalanches. The movie is entertaining to watch with excellent ski and snowboard footage from the TGR archives. Several well-known riders from the ski film industry narrate the major points in the film and there is a large collection of avalanche footage to drive home the message. The film also covers a selection of basic avalanche education topics including red flags, terrain, equipment, and simple field tests. While none of these subjects are described in detail, a good selection of red flag observations like recent avalanche activity, cracking and whumphing, wind loading, and rapid warming provide excellent basic skills to new backcountry users.

A unique portion of the film is directed towards the large number of riders who go into the backcountry just to build kickers in avalanche terrain. Scenes of new school freestyle riding reach out to a new generation of backcountry enthusiasts. I know I have different goals in the backcountry so addressing this new user group was educational for me as well. To quote from the film "A lot of my buddies just go out and build kickers with 38º landings not even realizing they're in avalanche terrain." Every year I see more kickers in the backcountry with landings in obvious avalanche terrain. Two years ago I witnessed a skier-triggered avalanche on a landing zone in a path that was the site of an avalanche fatality in 2003.

White Book the Movie is a great educational tool that is entertaining but with an important underlying message to get educated about avalanches and take an avalanche class. I see the movie as a great addition to the film collection of outdoor gear shops across the country that will reach out to a new generation of backcountry skiers and riders.

From Dale Atkins: *I just got a note from Rick Grubin (AAA member affiliate rep) about the DVD:*

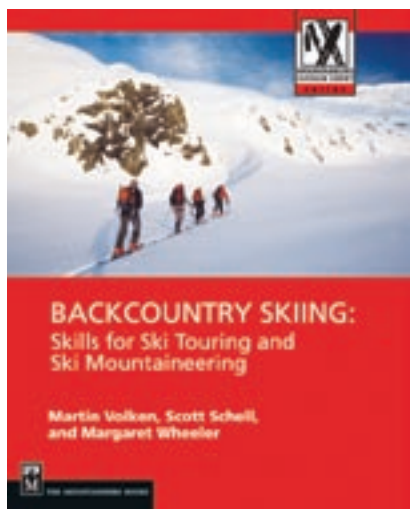
"...gave a copy of *White Book* DVD to my stepdaughter at Western State; she shared/showed it around her dorm. HUGE HIT! Got quite a bit of 'thanks' and such feedback and enough interest for their outdoor program to run another avy L1 (AIARE thru CB Mtn Guides, $105 for students) this academic year."

DVDs are available at no charge from RECCO. Contact: Dale Atkins, dale.atkins@recco.com, 303-579-7292.

Jamie Yount is the AAA Intermountain South Rep and the WYDOT forecaster for Teton Pass and Teton County, WY. He finds it hard to say no to an insistent TAR editor.

Backcountry Skiing: Skills for Ski Touring and Ski Mountaineering

Review by Lynne Wolfe



This shiny red book came out in late 2007 and looks to be a very up-to-date reference for, as it says in the title, ski touring and ski mountaineering.

The authors move from gear to avalanche decision-making, from ski anchors to a variety of rescue techniques, all in a carefully considered manner. Their collective experience is evident in the text, but either through judicious editing or a strong desire to present many sides of the sport, they are able to give the reader pros and cons of various techniques or pieces of gear in the context of what is appropriate to different situations without coming across as overly opinionated.

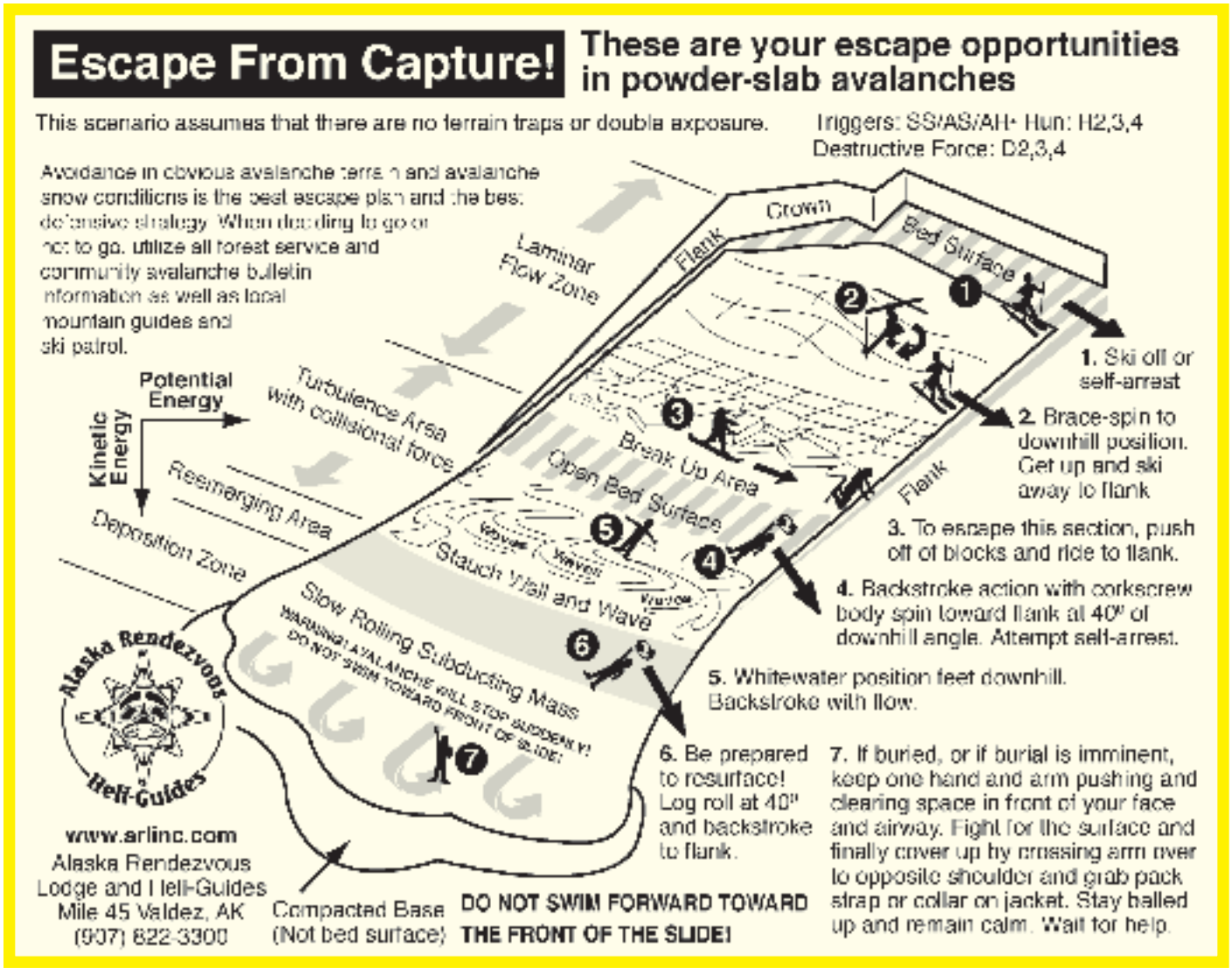
As an avalanche educator and TAR editor, my favorite chapter is titled *Decision-making in Avalanche Terrain*. Their material is state of the art, incorporating heuristics (McCammon, TAR vol 22, no 2 & 3) and the recent trend in avalanche education of stressing field communication. The authors emphasize the importance of balancing experience and training with appropriate risk tolerance, using the AIARE framework of the DMF, or Decision-Making Framework. I like this framework – an excellent structure that balances internal and external factors over time. I did find this chapter, as well as much of the avalanche curricula chapter, to be quite AIARE-heavy. I might have suggested including a broader perspective here; many other avalanche schools and curricula offer top-notch avalanche courses. In the US, our diversity is our treasure. But any book that insists that "it's important never to use travel techniques to justify otherwise inappropriate terrain-selection decisions," has its focus in the right direction, regardless of the sources.

Further into the decision-making chapter, the red flag values from the classic avalanche triangle are reprised. Even as a modern avalanche educator I think these have tremendous value to all levels of expertise. I would have liked to see a reference to more of the rule-based decision-making tools. We are introduced to Werner Munter's method of parsing time and terrain and how that translates to the STOP decision-making process, but I am a big fan of the simplicity of the ALPTRUTH method myself.

Further on in the book topics range from an overview of backcountry-skiing techniques to navigation and even a not-so-brief tutorial on kick turns. I hope no one ever actually has to learn how to kick turn from a book, no matter how well written and illustrated the directions and photos.

It is nice to see a section that emphasizes Leave No Trace along with ski anchors. Furthermore, I was curious how they would treat setting a skin track, and was pleased to see an initial emphasis that a good skin track involves both skill and art that take time and attention to translating theory into practice in order to becoming truly adept. The rescue section includes transceiver search, strategic shoveling, and crevasse rescue as well; all are thorough and seem accurate without being verbose.

In conclusion, this would be an excellent text for any ski-mountaineering course (I plan to use it for my Prescott College spring Ski Mountaineering class), a good reference for those planning a tour on the Haute Route, or a vital tool for any ski-guide aspirant. Even you old ski-touring salts might learn a trick or two.



Note from Karl Birkeland:

Dale Atkins' and Marty Radwin's presentations at the seminar in Jackson Hole got me thinking about survival strategies for people caught in avalanches. Clearly there are many things we do not know. I was curious about what we did know about granular flow, swimming, and surviving avalanches. I started by calling granular-flow expert Michel Louge from Cornell, and he gave me some valuable insights, but admitted that we don't really know if swimming in an avalanche is helpful, but we also cannot say that it is not helpful. In fact, there may be some times when swimming – or rather struggling – could be beneficial. I next contacted Perry Bartelt from the Swiss Federal Institute and he helped me to better understand avalanche dynamics and how surviving an avalanche might well depend on what part of the avalanche you are in. About that same time Theo Meiners, who runs Alaska Rendezvous Guides Heliski, sent me a hand-drawn picture (left) of how to survive an avalanche based on his experiences and the experiences of many of the people he knew. Theo's drawing showed different strategies for different parts of the avalanche. Interestingly, several parallels existed between Perry's theories and Theo's experiences. It was a perfect example of merging of theory and practice, and from it came this short article.

Avalanche Survival Strategies for Different Parts of a Flowing Avalanche:
MERGING THEORY AND PRACTICE TO INCREASE YOUR ODDS

Story by Karl Birkeland, Perry Bartelt, and Theo Meiners

Avalanche survival is currently a hot discussion topic among many avalanche professionals. Dale Atkins' recent comments that swimming may lead to dying in avalanches received wide media coverage, and his article in *The Avalanche Review* (Atkins, 2007) gave the avalanche community something to chew on. Was the long-established dogma of swimming in avalanches actually wrong? Has the avalanche community been misleading the public for many years about how to best survive an avalanche?

Of course, the best way to survive an avalanche is to not get caught. However, once you are caught, what is the best survival strategy? Dale brought out several interesting points, the most important of which is that many avalanche victims are found with their hands well away from their faces. This suggests they were unable to create an air pocket, which is critically important for surviving under the snow for any length of time. Dale suggests that the process of "swimming" does not allow people to get their hands in front of their faces quickly enough as the avalanches come to a stop. The idea that avalanches stop quickly is well established in our understanding of avalanche dynamics, and we need to emphasize to the public that people must to try to get an air pocket well before the avalanche comes to a stop.

However, other parts of Dale's message do not resonate for many. Once knocked off our feet, are we really better off simply trying to guard our airway for the entire ride? Or, are there things we can do to increase our chances of survival?

A PRACTICAL VIEW

Alaska's Chugach Range has served as a testing ground for guiding heli skiers in extreme terrain. Guiding the area has been a learning process resulting in no small number of avalanche involvements, and the survivors have swapped stories and devised optimal survival strategies. Though every avalanche is different, and each avalanche may require a different approach, some common strategies have emerged. These have been compiled by Theo Meiners *(see illustration above)* and are discussed below.

These guidelines apply to SS/AS or AR/D2,3,4 and R2,3,4 avalanches without secondary exposure or terrain traps. Field observations show similar flow patterns for many avalanches. Failure/release is followed by laminar flow, then as the stauchwall appears there is a violently turbulent zone as the sliding snow and blocks roll over the stauchwall. The snow then exits this turbulent zone, flows as a mostly laminar flow (depending on the terrain over which it is traveling), and begins its deposition phase. The head of the slide continues to subduct as it compacts and entrains the snow on slope while rolling forward. Depending on where you are in the slide, there are different possibilities for escape off the avalanche before you have to go full ride. The strategies are:

1. Ski or board away fast.
2. Self arrest on bed surface.
3. If knocked downhill with skis /snowboard still on, use your skis as brace and spin on hip/bed surface to get skis downhill (like a kayaker using a paddle) and stand and ski away (even if you are in a lot of snow this method works in initial phase).
4. If ejected from skis use backstroke/logroll combination to fight for flank and self arrest on to flank or bed surface. The main thing to do is to fight. Any resistance at all will slow your progress as slide accelerates away from you.
5. If you are in an area of turbulence, do your best to go with the flow. Maintain whitewater position with feet downhill. After going through the turbulent area you may emerge before the deposition area. Assist the currents of the avalanche with backstroke action once you are through the turbulent area. Continue to try to backstroke and logroll to get to the flanks and self arrest.
6. Do whatever you can to avoid head of slide as it is subducting and will pull you down and under the slide. Absolutely do not swim forward of head if you can help it.
7. Use essential equipment for surviving/escaping capture. This includes a helmet to help prevent a head shot and the resulting confusion, an Avalung to maintain breathing and to keep you from gagging (thereby helping to prevent panic), the usual transceiver/probe/shovel combination, and of course trusted partners. Never say die, and never go Gumby – you have a lot to teach others from this experience!

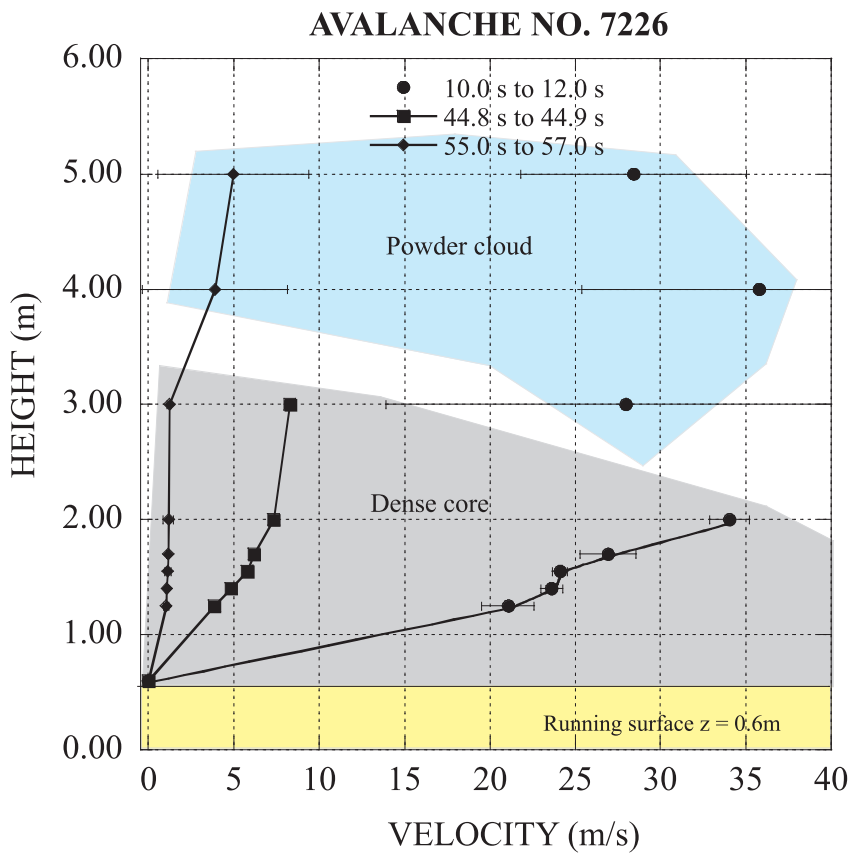
A THEORETICAL VIEW

Recent research is leading to an improved understanding of avalanches in motion. Much of this research is focused on better understanding avalanche runout, but it can also help us devise appropriate survival strategies for avalanches. Like the experience-based answers provided above, theory about avalanche motion also suggests that the best survival strategy in an avalanche depends – at least in part – on where in the avalanche you happen to be. Our discussion focuses on what we know about the flow in the different parts of the avalanche, and how you can use that knowledge to increase your odds of surviving an avalanche if you are caught.

Much of our theoretical understanding of avalanche dynamics has been derived from full-scale experiments recently performed at the Swiss Vallée de la Sionne test site (Amman, 1999). Actual measurements of

avalanche velocity clearly support the division of an avalanche into turbulent and laminar flow regions, as depicted by Theo *(previous page)*. Consider the figure below showing the distribution of avalanche velocity in a medium-sized mixed flowing/powder avalanche which spontaneously released after a heavy snowfall period in 2005 *(Avalanche No. 7226)*. The velocity profiles (the distribution of velocity over the avalanche height) are depicted at different times starting after the leading edge of the avalanche has passed the sensors. In this particular measurement, the velocities 10s after the leading edge has passed are still quite high at over 30m/s (67mph). Thirty seconds later, in the tail of the avalanche, the flow velocity has decreased to less than 10m/s (22mph). Wait another 10 seconds and the avalanche tail has basically stopped.

These velocity measurements provide useful insights into the flow behavior of avalanches and possible survival strategies. For example, in the turbulent front zone, the velocities at the top surface are much larger than the velocities at the bottom. This is the dangerous subducting zone. In this zone, velocity fluctuations and random flow patterns exist. A skier caught in this region will be probably be taken by the rolling motion of the avalanche. Because the velocity gradients (the difference in velocity as a function of height) are large, it is unlikely that any swimming strategies will be helpful as the tremendous shear forces (several tons per square meter) will prevent the avalanche victim from making any useful or concentrated movement. Clearly, this is the part of the avalanche we would like to avoid, if at all possible.



At the tail of the avalanche, the situation appears much better. The measurements reveal that an avalanche stops at the tail. As the avalanche elongates, mass is withdrawn from the front and deposits even on steep slopes. The avalanche essentially "runs out." The velocity gradients and fluctuations at the tail are much smaller than at the front *(for more technical details, see Bartelt et al., 2007)*. An avalanche victim caught at the tail, or who manages to work their way back to this part of the avalanche, has a fighting chance. They clearly should do everything in their power to arrest on the bed surface or reach the flanks of the flow.

What determines the size of the turbulent and laminar regions of an avalanche? Quite simply it is the amount of snow, or mass of the avalanche. Avalanches with larger release zones, or avalanches that can entrain the snowcover and therefore continually grow, will easily generate dangerous turbulent fronts. These monsters simply have more potential energy that they can convert to velocity and turbulent motions, and will have proportionally smaller tail regions. Conversely, smaller avalanches will have a proportionally larger tail and this will cause them to stop more quickly.

MERGING THEORY AND PRACTICE

Merging theory and practice can sometimes be messy business. However, in this case clear parallels exist between our scientific understanding about avalanche dynamics gathered from sophisticated instrumentation and the knowledge that some practitioners have gathered through experiencing avalanches from the inside looking out. First, avalanches consist of several parts and what you can do to increase your odds of surviving the slide depends – at least in part – on what part of the avalanche you are in. Second, practice tells us that we should do whatever we can to try to let as much snow go by us as possible, whether that is skiing to a side of the avalanche where less snow is releasing, digging into the bed surface, or climbing uphill over blocks. Doing this helps to put us in what an avalanche dynamics specialist would call the "tail" of the avalanche, and theory suggests that this is a much more manageable – and survivable – place to take a ride. Third, practice tells us that being at the head of the avalanche is bad news. Here we are likely to get sucked under and thrashed around violently. This rather unpleasant observation is also borne out by data collected from moving avalanches which shows that the leading edge of the avalanche

Continued on page 27 ➡

Probers from Wasatch Backcountry Rescue in Mineral Fork, December 12, 2004

photo © Bruce Tremper, www.brucetremper.com

Avalanche Pros Debate "Swimming" in Slides

Story by Angus M. Thuermer, Jr.

An avalanche professional sparked a debate at a seminar Saturday when he challenged the long-held notion that "swimming" helps a victim escape from a snow slide.

While swimming has been touted as a survival technique since 1864, the premise on which it is based is wrong, said Dale Atkins, a noted avalanche forecaster and author from Colorado. The oft-promoted technique advises those caught in a slide to act as if in a stream, to stroke and kick toward the surface or to one side of the flow.

But swimming keeps a victim's hands away from his or her face where they should be positioned to create an air pocket when a slide stops, Atkins told a group of about 300 professionals. He made his comments Saturday at a Jackson seminar sponsored by the American Avalanche Association and Forest Service National Avalanche Center.

Another expert, Martin Radwin, challenged Atkins and urged people to continue to fight to stay on the surface of the snow.

"It's really an honor to rebut him," Radwin said. Atkins' theories are on the "lowest rung of the evidence-based ladder," Radwin said.

The premise on which swimming is based is that avalanches flow like water and hence a victim in a slide would benefit from acting as if he or she were in a stream, Atkins said. In fact, avalanches are "granular flows" that behave both like a liquid and a solid, he said.

In granular flows, large particles rise to the top, Atkins said. In avalanches, a human body would be a large particle, so the tendency is for it to come to the surface, swimming or not.

Atkins used the cocktail party bowl of mixed nuts as an example. Shake it and the large Brazil nuts come to the top.

Also, water is more than three times denser than avalanche snow, Atkins said. A human body, which is buoyant in water, is anything but in avalanche snow, he said.

Getting buried may simply be bad luck – having nothing to do with swimming motions, he said. But people who swim put themselves at risk of not having an air pocket when the avalanche slows and if their arms are pinned away from their faces, Atkins said.

Avalanches slow and stop very quickly – much faster than most people realize or can react to, Atkins continued. In its last stages of motion – during the time avalanche victims are traditionally taught to stop swimming, cover their face and thrust a hand toward the surface – the avalanche has ceased flowing like a liquid and moves like a solid mass, Atkins said.

Victims dug out alive report stopping almost instantly – too fast to react – he said. Consequently, those who swim are in peril of being buried without an air pocket, air being a key element to survival under the snow.

"If avalanched, do not swim," Atkins told the group. "It does not work; leads to dying."

Those caught in an avalanche should think "hands in front of face," he said. They still should try to follow an escape route and grab a tree and fight to get out of the flow, perhaps by rolling, Atkins said.

An audience member immediately criticized Atkins for his opposition to swimming.

"There's no data to support that," one said. "I do not think it's appropriate to say swimming leads to dying."

Atkins agreed more work needs to be done. "I hope someone down the road will make science out of this," he said.

In his rebuttal presentation that promoted swimming, Radwin agreed the success of swimming is unknown. He called it struggling for one's life.

"I want to optimize my ability," to stay on the surface, he said. Arm waving and kicking makes one a larger particle and increases the chance a victim would come to the top, like the Brazil nut, Radwin said.

He urged backcountry skiers to wear helmets to reduce the chance of trauma in an avalanche and to grab the opposite shoulder strap of a pack with one hand to protect the face and a possibly create air pocket upon burial.

Then "fight like hell with three limbs," he said.

One audience member said survival practices might best be tailored to where one is in an avalanche, both in terms of time and location in the slide and slide zone. He said it might be appropriate, for example, to swim at the start of or top of a slide, but that when an avalanche accelerates, it would be time to cover up.

This article first appeared in the Jackson Hole News&Guide and is reprinted by permission of the author: Angus M. Thuermer, Jr., co-editor Jackson Hole News&Guide, (307) 733-2047 ext. 119, angus@jhnewsandguide.com

DEEP-SLAB INSTABILITY: Characterizing the Phenomena

Story by Bob Comey and Chris McCollister

Since 1974 the Jackson Hole Mountain Resort (JHMR) and the Bridger-Teton National Forest Avalanche Center (BTAC) have recorded daily meteorological and avalanche observations and have recently compiled this information into electronic databases. The meteorological data was obtained from automated weather stations and snow-study plots. The avalanche events occurred at the ski resort and in the backcountry.

These historical databases are comprised of 5,256 daily records that span 33 seasons. A simple search of this data identified 18,831 avalanche events. The vast majority (17,390) were dry-snow slab avalanches.

ALL AVALANCHES BY TYPE

Total Avalanche Events = 18,831
Dry-Snow Avalanches = 18,220
16,482 = Soft Slabs
908 = Hard Slabs
830 = Loose Snow
Wet-Snow Avalanches = 581
156 = Wet Slabs
425 = Wet Loose
Not Type Designated = 30

Avalanche Size by Type

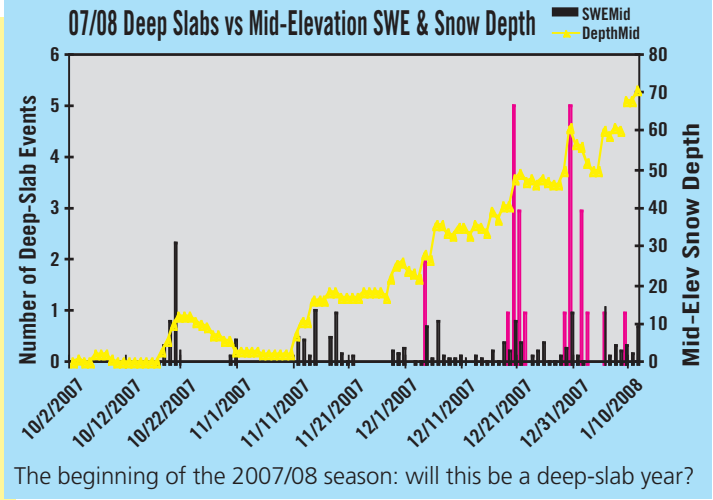
Graphs 1-2 show avalanche size distribution (relative to the avalanche path) for loose-snow, soft-slab, hard-slab, and wet-slab avalanches. There were no Class IV or V loose-snow avalanches. None of the loose-snow avalanches were deeper than 36". Loose-snow avalanches in this database were shallow and small relative to the size of the avalanche path.

The distribution of the size of the soft-slab avalanches spans all five classes with the vast majority falling in the Class II and I categories. Many of the avalanches in this database occurred at the ski resort where daily avalanche-hazard-reduction efforts are conducted.

The distribution of the size of the hard- and wet-slab avalanches clearly show a trend towards larger events with the majority of the hard-slab avalanches being Class II or III slides and proportionally more Class IV and V events.

SLAB-TYPE PERCENTAGES BY DEPTH

All Slabs (17,548)
Hard Slabs (593).....3.60%
Wet Slabs (86).....0.50%
Soft Slabs (16,482).....95.90%
Deep Slabs > 44" (800)
Hard Slabs (272).....34.00%
Wet Slabs (14).....1.75%
Soft Slabs (514).....64.25%
Deeper Slabs > 54" (333)
Hard Slabs (128).....38.00%
Wet Slabs (7).....2.10%
Soft Slabs (514).....59.00%



The beginning of the 2007/08 season: will this be a deep-slab year?

Deep-Slab Avalanche Characteristics

For this study all 800 avalanches in the database with crown depths greater than 44" were the subject of further analyses. A graph of the size distribution of these avalanches shows they are generally large with the majority being Class IV, III, or V events *(graph 3)*.

When a graph of the occurrence of all avalanche types by month is compared with the occurrence by month of the deep-slab avalanches, it is apparent that these deep-slab avalanches tend to occur earlier in the season *(graphs 4-5)*.

When we examined the percentage of slab type (hard, wet, or soft) with respect to the depth of the slab, we found that deeper slabs are more likely to be harder *(see table above)*.

Explosives triggered the majority of these deep slabs. However, many released spontaneously, and humans triggered a significant number *(graph 6)*. As one might expect, most of the deep slabs in the backcountry released spontaneously.

Deep Slab Avalanche Occurrence

Deep-slab avalanches showed a large variation in seasonal occurrence. On average there were 25 deep-slab events per season. During the 1977/78 season there were only four deep-slab avalanches. There were 60 deep slabs during the 1995/96 and 2000/01 seasons.

The work presented so far involved simple filtering of an historical database of avalanche events. Complex data searches that related historical weather data to these avalanche events were performed to gain further insight regarding deep-slab avalanche cycles. The historical weather database contains nearly continuous temperature, wind, snowfall, snow moisture, snow depth, snow settlement, snow surface, snow structure, volume of snow available for transport, and many other observations from multiple locations for the past 33 seasons.

Graphs that display daily snowdepths, daily snow-water equivalent measurements, and a per day count of deep-slab avalanche events over the course of each season were created. An analysis of these graphs identified approximately 60 deep-slab avalanche cycles during the past 33 seasons. Some of these deep-slab avalanche cycles occurred on persistent weak layers, and others occurred during prolonged periods of rapid loading when persistent weak layers did not exist.

Graph 7 depicts the latter case when a record extended storm cycle in December-January 1996/97produced many deep-slab avalanches in a snowpack with no persistent weak layers.

Graph 8 depicts the former case when deep slab avalanches during the 2000/01 season occurred on a persistent weak layer over the course on the entire season.

Graphs 9 and 10 from the 1997/98 and 1998/99 seasons depict well-defined deep-slab-avalanche cycles that occurred on weak layers that formed during extended dry periods.

Summary of Findings

In this database deep-slab avalanche are generally larger, harder, and occur earlier in the season than other avalanche types. They can release spontaneously or be triggered by explosives or humans on skis, snowboards, or snowmobiles.

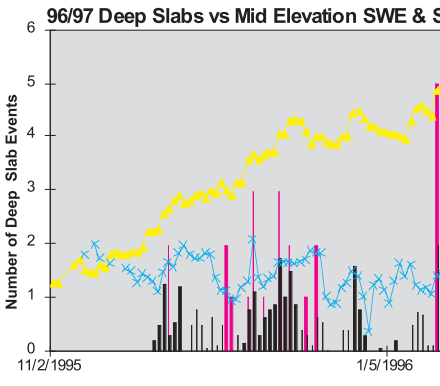
There was a large variation in the seasonal occurrence of the number of deep-slab events. Cycles of deep-slab avalanches can occur on a persistent weak layer or in response to extended periods of loading if weak layers are not present.

Further Studies

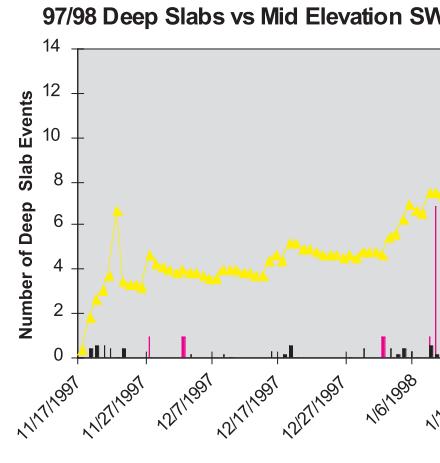
Additional analyses are planned on the 60 deep-slab avalanche cycles identified. These efforts will attempt to quantify load rates and durations necessary to release deep-slab avalanches and snow settlement rates observed to regain stability.

Bob Comey is lead forecaster for the Bridger-Teton National Forest Avalanche Forecast Center. He is happy to be done with the data-inputting process so that now he can ski powder or look more closely at the data patterns. He enjoys avalanche porn just as much as we do at TAR.

Chris McCollister is also a BTAC forecaster. A broken toe caused him to miss too much of the January deep-powder phenomena. His most recent article for TAR involved GIS use at Jackson Hole Mountain Resort.

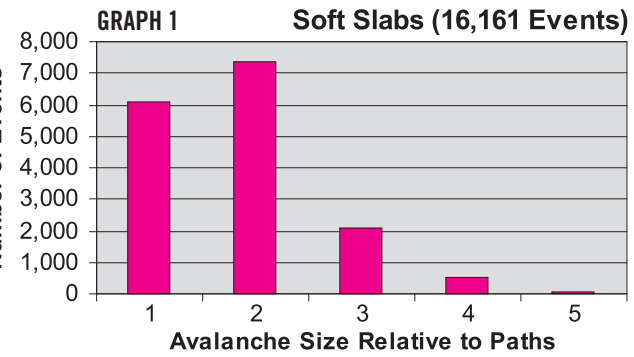


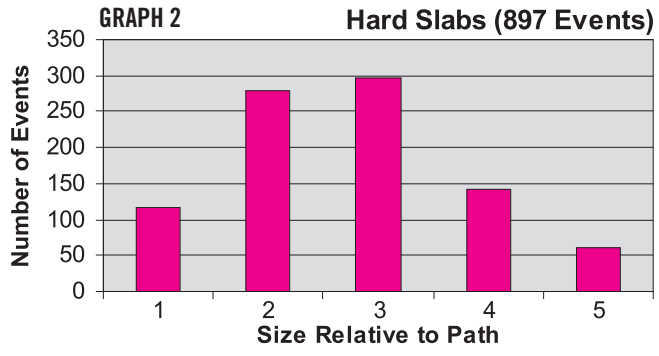
GRAPH 9

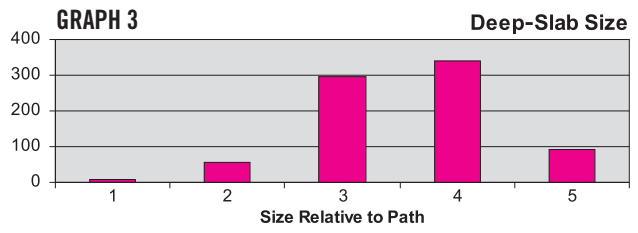


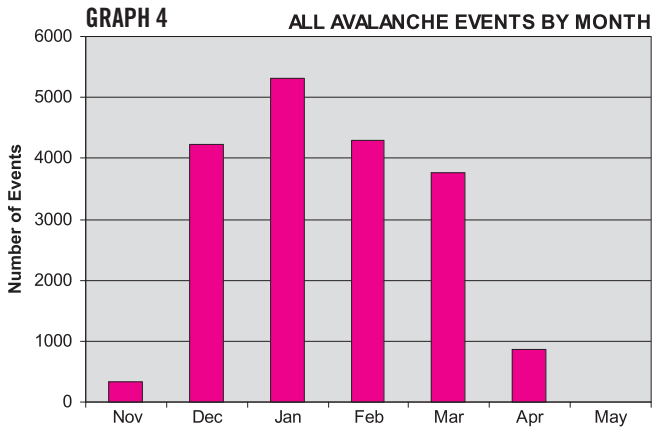
Number of Events
Number of Events
Number of Events

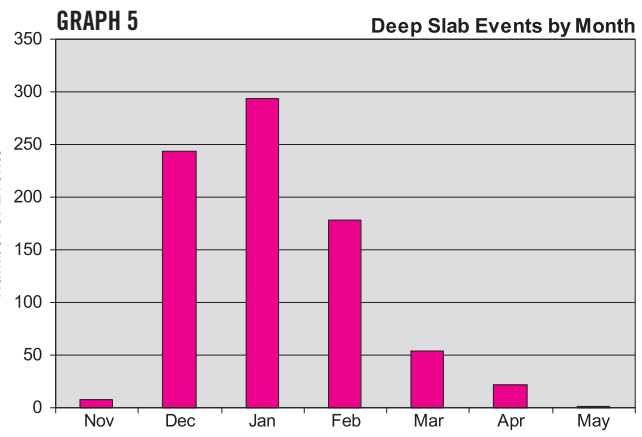
This large avalanche was triggered by the Jackson Hole Mountain Resort ski patrol with 30# of explosives in a kiddie sled sent over the edge of Rendezvous Mountain's North Ridge. The 11' crown can be seen in the upper left corner of the photos. The avalanche went on a facet layer formed during a long, cold, dry period around Thanksgiving 2007 (see *07/08 Deep Slabs* in blue inset box at left). *photos by Jim Springer*

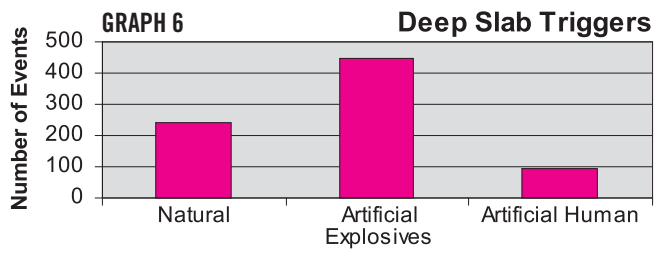


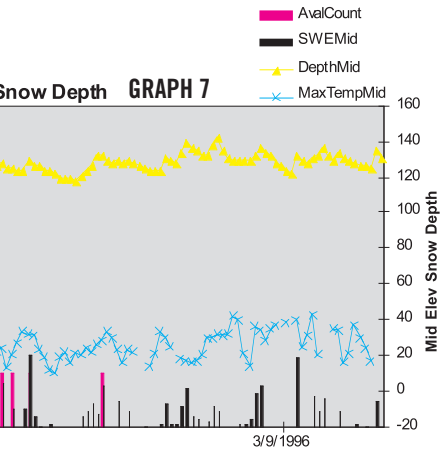


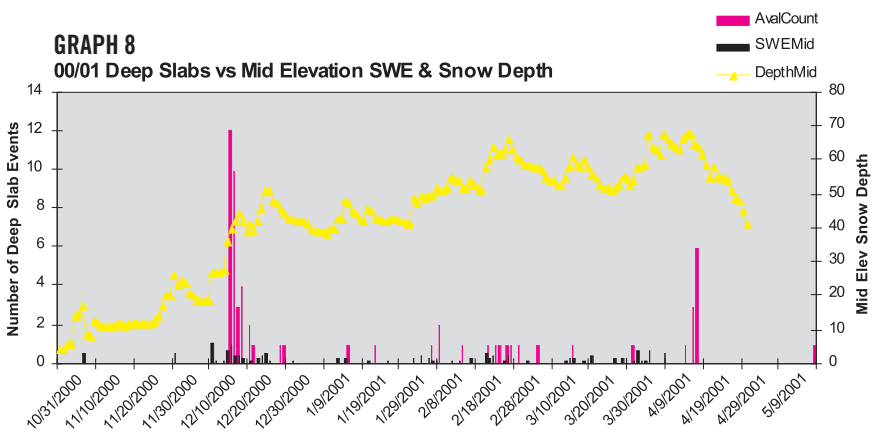


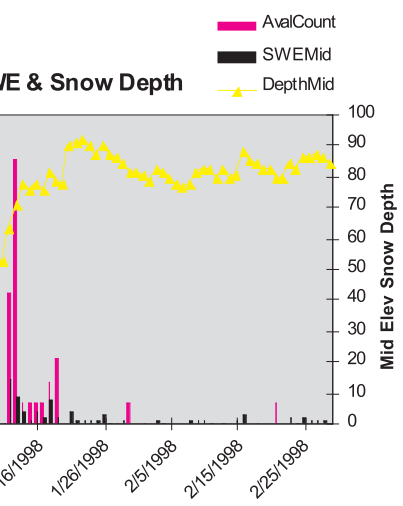


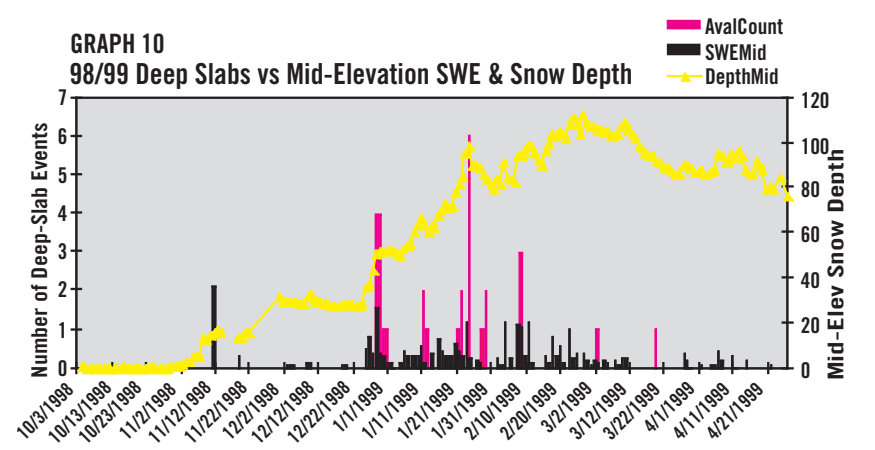












Deep-Slab Discussion from the Jackson Professional Development Seminar

Summarized by Sue Miller

Deep-Slab Avalanches was a stimulating topic at this fall's AAA Professional Development Seminar in Jackson, WY. Dave Gauthier and Bob Comey gave presentations on these phenomena, followed by a discussion period.

Dave Gauthier's talk, entitled *Deep-Slab Forecasting in Canada*, included two interesting characteristics of deep slabs in the Columbia Mountains. The initial snow sequence in early season seems to be an important factor in years with deep-slab cycles. Early season snow events cover most of the terrain irregularities, and then there is a November rain event sufficient to form a good crust. New, cold snow falls on the freezing crust, and with the latent heat exchange, facets are formed. Thus a persistent weak layer is set up near the bottom of the snowpack.

Dave tells us that none of his material was original; he was reporting mostly on the research by Jamieson, Geldsetzer, and Stethem from 2001 and from talking to experienced forecasters. He tells us that the Glacier Park forecaster, Bruce McMahon, has also identified a pattern of the timing of release. On clear cool sunny days, when the sun leaves the slope and there is rapid cooling, deep-slab avalanches often occur. Predictors of when natural deep-slab releases are possible include the early season set up mentioned above, previous avalanches in the last two to three days, snowfall for three or more days, warming during the past four to five days, and snowpack properties including a shear-frame stability index and hardness differences between the facet layer and the crust.

Deep-Slab Forecasting at Jackson Hole Mountain Resort, by Bob Comey and Chris McCollister, studied a dataset of 800 deep-slab avalanches. Deep-slab avalanches were found to be generally larger, harder, and occurring earlier in the season than other avalanche types. While there was an average of 25 deep-slab avalanches per year, there was a large variation in the seasonal occurrence of the number of deep-slab events. Cycles of deep-slab avalanches were found to occur in years with a persistent weak layer or in response to extended periods of loading if weak layers were not present. (see *Deep-Slab Instability: Characterizing the Phenomena*, left)

Discussion about deep-slab avalanches ensued; here are a few of the topics:

Why do deep slabs release late in the day after the sun leaves the slope? Does this have to do with rapid cooling, or with a lag time related to all day warming?

Studies by McClung suggest that sun does not warm the snowpack much below 30cm or so. Deformation from wet snow on top refreezing may be influential. It may also be that triggering takes place in shallow spots where temperature effects are greater.

How should backcountry users treat a deep-instability problem?

Having an awareness of the potential for deep-slab releases and adding more factors of safety are good tools. As with other unfamiliar conditions, you really have to back off and not stick your neck out.

How does one define a deep slab: measure the average depth, the maximum depth, etc?

For the Jackson Hole study, deep slabs were defined rather arbitrarily as being 44" or greater in depth. Dale Atkins noted that in Colorado, deep slabs were defined as being greater than 3'. Forecasters are more concerned with deep slabs as being in old layers rather than being a specific depth.

Sue Miller is a long-time Teton guide and eagle researcher. She currently runs the winter program for the Jackson Hole Mountain Guides.

Deep-Slab Instability

Story by Dale Atkins and Knox Williams

Goal Post, on the backside of Cody Bowl's Powder 8 face, went as a natural avalanche during a storm cycle December 31, 2007. Failure initiated in facets near the rocks on the left of the photo and extended into the thick slab in the foreground. The bed surface was a thin zip crust from November 11 and 12; the weak layer was light-density snow on the crust.
photo by Eric Henderson

"Deep-slab instability still lurks...beware, these slabs may inspire false confidence luring backcountry travelers further out onto slopes before releasing large areas..."

—typical CAIC daily avalanche bulletin

As a user of the CAIC daily avalanche bulletins, you no doubt have read or heard us mention deep-slab instability and the potential for big avalanches. But just what is deep-slab instability? Why is it so difficult to assess? Why is it so deadly? And what can you do about it?

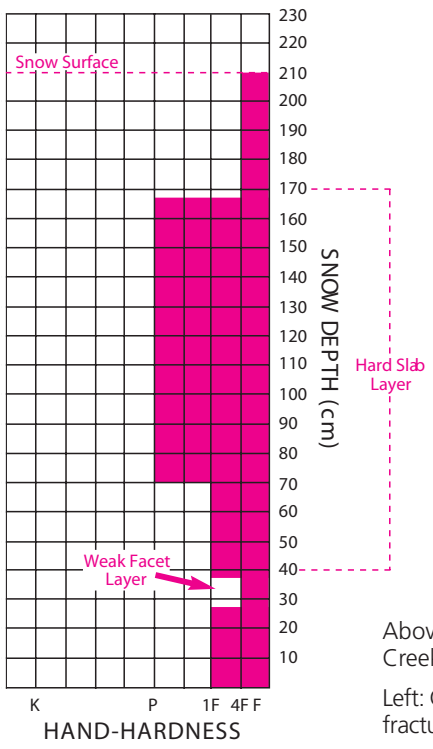
To answer these questions we put our heads together to compare experiences with different winters, weather patterns, and snowpacks; we reviewed past accidents for common themes; and we checked a few avalanche books, but not too surprisingly found there is very little information about deep-slab instability. In this short article we will summarize the facts of deep-slab instabilities, what you can look for, and what you can do about it.

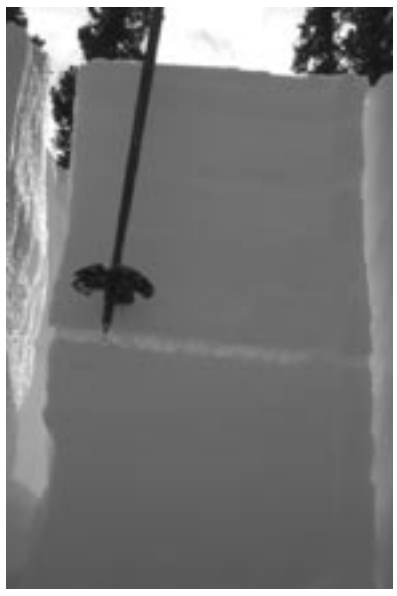
Deep instability simply refers to weaknesses in old snow layers, and deep-slab avalanches are those that break into old snow layers. We know from work done primarily by the Swiss Federal Institute of Snow and Avalanches in Davos, that the deeper the weak layer, the less stress a person exerts on the layer. In fact, a person's weight has little additional effect on weak layers buried deeper than about one meter. Knowing this, we decided to look at Colorado avalanche accidents involving deep releases. We defined a *deep release* as any slab avalanche with a fracture line greater than three feet. Conversely any release equal to three feet or less is a *shallow release*. We ended up with a sample of 239 human-triggered slab avalanches where we know the type of avalanche and the fracture-line (crown face) depth and width. On average, 25% of avalanche accidents involve deep releases in Colorado and other western states. Let's take a look at the facts of deep instabilities and deep-slab avalanches.

FACT 1: Deep instability often involves hard-slab avalanches.

Hard slab by definition is a cohesive slab layer having a density greater than 300kg/m3. Skis barely cut into it. On the hand-hardness test, it is usually pencil hard. It is usually formed when strong winds redeposit snow. *(see figure at right)*

Hard-slab avalanches are nasty and unpredictable beasts, and in Colorado our high elevations and strong winds mean widespread hard slab conditions. In fact in Colorado 59% of avalanches deeper than three feet involved hard slabs, whereas only 11 of 175 (6%) avalanches three feet or less were hard slabs.





Above: Buried surface hoar layer near Wolf Creek Pass. *photo by Tom McKelvy*

Left: Cumberland Pass, Colorado, fatal avalanche fracture-line profile, February 6, 1999

FACT 2: The snowpack appears to be very strong and able to withstand lots of weight.

There is no doubt that hard slab is strong snow- because of its high density that results from the close packing of very small grains. Generally speaking, the thicker the slab, the stiffer and stronger the slab. Thick hard slabs often conceal their trap from the unwary backcountry traveler with an illusion of stability, and it is stability, not strength, that is the important characteristic. These slabs can be very strong but are only as stable as the weak layer below. Failure and fracture start first in the weak layer, not the slab. In Colorado deep slab avalanches catch an average of two people per avalanche compared to 1.7 people for less deep avalanches. Why? See Fact 4.

FACT 3: The weak layer is days, weeks, or even months old.

Persistent weak layers are the usual problem layer in deep-slab avalanches. These layers are composed of relatively large and cohesionless grains that are slow to change shape or gain strength. These snow grains include depth hoar and facets, along with surface hoar crystals. These weak layers often form during a prolonged period of fair and mild weather when a strong temperature gradient dominates the snowpack. It is often during these same periods when the three Cs—clear, calm, and cold—create weak surface hoar on the snow surface. Additional snows eventually bury these weak layers *(see photo above)*, and it is not uncommon for a persistent weak layer to produce avalanches a month or two later.

Persistent weak layers are especially troublesome because even though they gain strength over time and sometimes can support considerable loads, when fractures do occur they can propagate long distances. A persistent weak layer is analogous to a line of closely spaced dominoes standing on end. Both are strong in compression and can support much weight; however, both are weak in shear. When one domino topples and falls into its neighbor it can trigger a cascade of toppling dominoes. Once a fracture starts in the weak layer, it may propagate long distances through the layer.

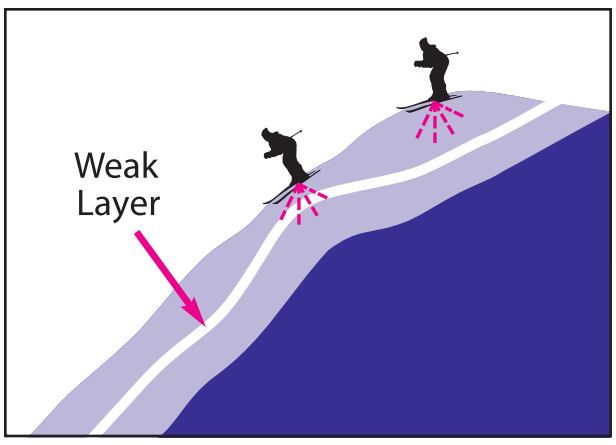
FACT 4: Deep slabs release above you.

Usually the stronger the slab, the farther fractures propagate, and therefore the bigger the avalanche. There is even more bad news: these avalanches fracture higher above or farther away from the trigger point—your position. *(See Figure 3)* The result is that deep-slab releases are harder to escape from. Soft and shallow slabs more often break at or near your feet, giving you a slightly better chance to escape (but any avalanche once set in motion is difficult to escape). In Colorado the width of the average fracture line for a shallow release is about 260 feet; however, the width for a deep release is about double that at 540 feet across.

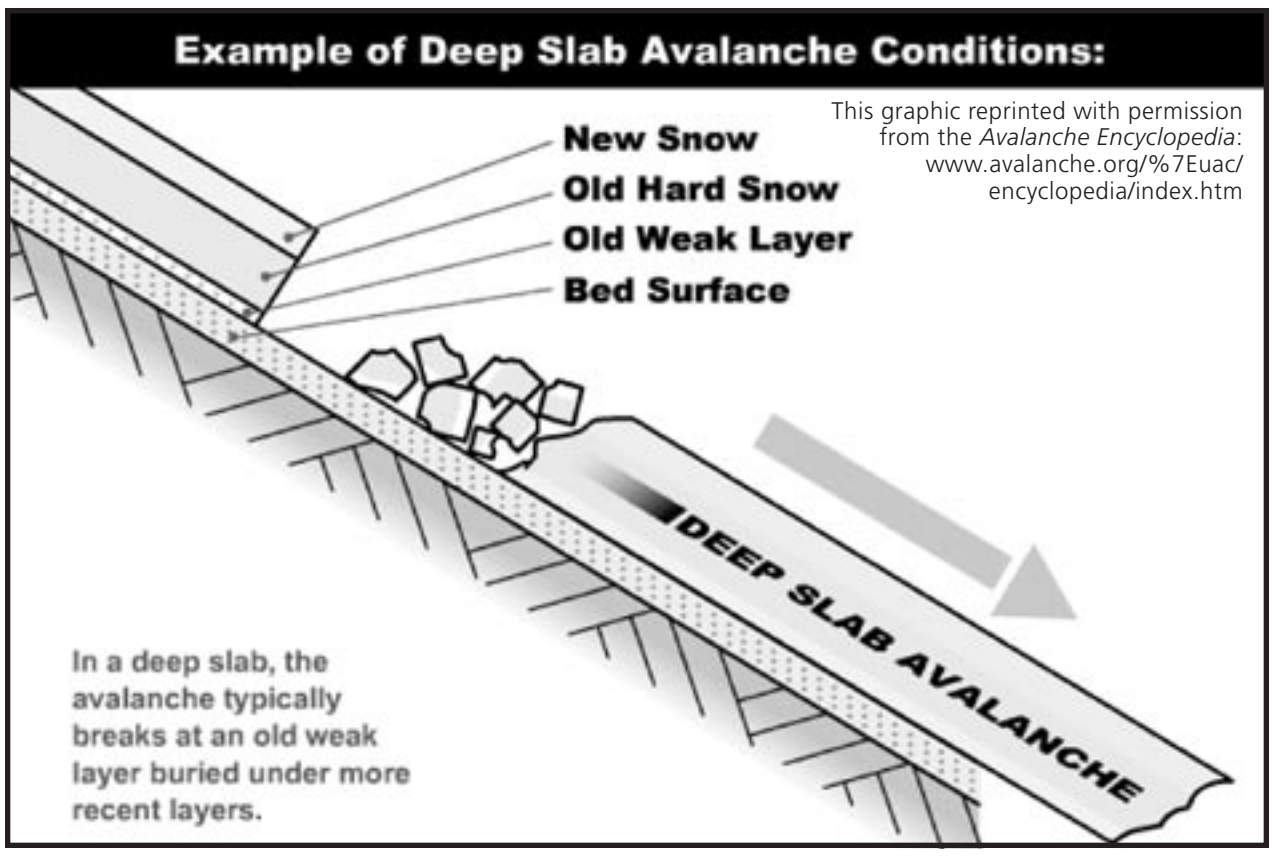
FACT 5: Deep slabs are triggered where the slab is thin.

This fact is key to understanding human-triggered deep-slab avalanches. Though our records tell of human-triggered avalanches up to 12' deep, it is essential to recognize that the fracture line did not occur underfoot. The victim triggered the avalanche from a thinner spot where their body weight could affect the weak layer. *(Figures 4 & 5)* Once fracture occurs, cracks are driven by high energy and quickly propagate into the deep slab areas. A person exerts

A large slab avalanche near Red Mountain Pass triggered by backcountry skiers while standing on the ridge far to the right of the avalanche. The skiers felt the shallow snow collapse beneath them and watched cracks shoot out and release the avalanche. The fracture line or crown face ranges from 2 to 8' deep. November 30, 2004. *photo by Messmore Kendall*



The additional stress of a skier can affect a weak layer where the slab is shallow.



nearly two times the force on a layer one-half meter (50 cm) deep compared to the same layer buried one meter down, and nearly four times the force compared to the same layer buried two meters. It is not uncommon to see a skier or snowboarder cut across a large pillow of wind-drifted snow only to see the fractures shoot out as the rider reaches the edge or bottom of the drift. The same happens but with all too often tragic results when a skier crosses the thin spot of a large slab and sets an entire slope into motion. The problem for all of us in the backcountry is, of course, that we do not know where the slab may be thin.

FACT 6: Snow pits and stability tests like the Rutschblock and Compression Test can be misleading.

Snowpits are a great way to learn about snow and avalanches, but snowpits can be deceptive because they only reveal information from one point in the snow cover. Snowpits can also be misleading when diggers interpret the wrong layers. Many backcountry travelers tend to focus on the strong snow layers instead of weak layers. Another common mistake is to dig in areas of deep deposition where the weak layer is far below the snow surface. When the weak layer is buried more than a meter down it is difficult to assess the weakness.

Stability tests can also be misleading when assessing deepslab instability. Because the weak layer is deep and often old, stability tests often score in the moderate to high (stable) range for two reasons. First, because the weak layer is deep, the thick slab attenuates the applied stress, reducing its affect on the weak layers. Second, it is easy to unknowingly dig in the wrong spot, where the weak layer is deep or is strong. With time, the super-weak zones in the weak layer will get smaller and slopes become less sensitive to triggers. This explains why we tend to see more frequent but smaller avalanches during a storm. But as the days pass we see fewer but larger avalanches. As the super-weak zones shrink you are also less likely to dig in the right spot to encounter the weakest snow, so stability scores may be high. This can give false confidence and a perception the snow is more stable than it really is.

FACT 7: Deep-slab avalanches produce large forces and crushing weight.

The middle of a roiling and crushing avalanche is a bad place to be, and this is especially true of deep-slab avalanches. In nature when it comes to gravity-enhanced events, bigger and heavier is almost always faster and more powerful and this is especially true with deep-slab avalanches. Certainly a deep-slab avalanche implies more snow, but also the density of that slab will likely be greater, resulting in an even more massive avalanche. The power of a deep slab avalanche is best viewed from afar.

What Should You Be Alert To?

Deep-slab avalanches are ornery and unpredictable. These avalanches are not only deeper but also wider than shallow releases, and thus more dangerous. Even worse, while the first skier or snowmobiler might trigger it, it is more likely that the 5th, 10th, or even 20th traveler will hit the weakest spot and cause the avalanche. During times of deep-slab instability it is easy to be lulled onto steep slopes because they seem stable. To avoid this trap, here are some points of which to be aware:

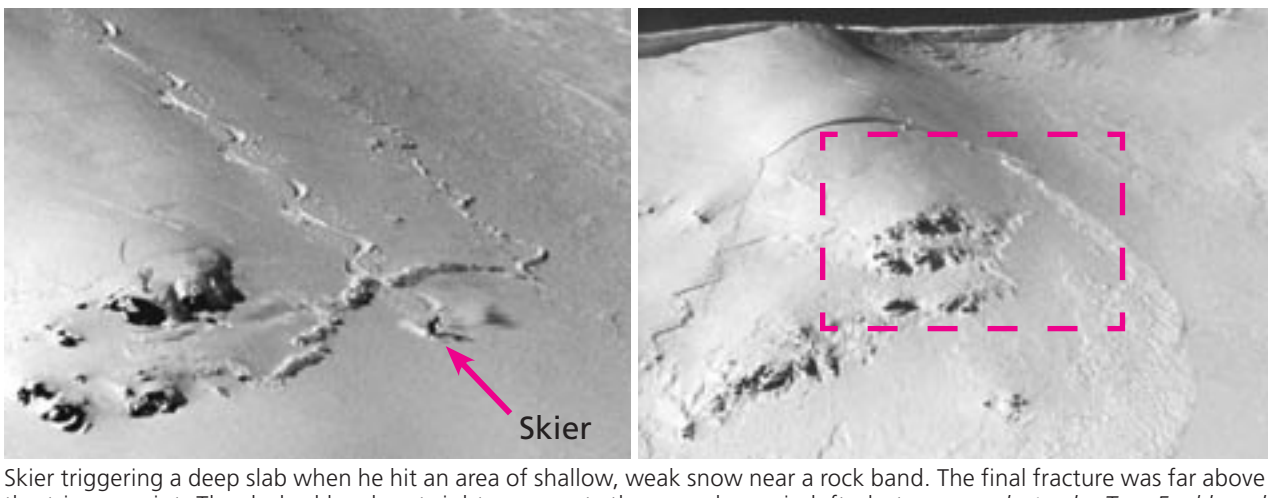
- Avoid hard slabs on steep slopes. Hard slabs are notoriously unpredictable and best left alone. Hollow drum-like sounds are the most obvious clue to unstable conditions.
- Dig snow pits in spots of shallower snow and/or where the slab is thin. This makes it easier to test the weak layer because the applied force in a Rutschblock or compression test will easily reach the weak layer. Stability tests performed at the top of slopes are less reliable than tests done along the edge and lower on the slope. Of course this can create the interesting dilemma of how much risk you're willing to take to get good data. If you are concerned about the snow, but unwilling to take risks to collect that information, we suggest you find a different, less-steep route.
- In snowpits, look for and test persistent weak layers, such as a thick layer of depth hoar or a thin layer of buried surface hoar. A dangerous combination is a persistent weak layer sitting on top of a crust (e.g., melt-freeze, sun, or rain crust).
- On steep slopes, be leery of the edges of pillows on winddrifted slopes. At the top of a pillow or drift the snow will be deep, and you will find lots of strong snow between you and the weak layer. Where the drift tapers lower on the slope, less slab separates you from the weak layer, and you could more easily trigger an avalanche.
- Generally winters with low snowfall or winters with periods of prolonged dry spells – and occasional periods of strong wind – are best known for creating persistent weak layers and deep-slab instabilities.

What Should You Do About It?

Uncertainty is the operative word when dealing with deepslab instabilities, and the backcountry traveler who assumes stable conditions may be in for a rude and painful surprise. Your first task is to learn as much as you can about current conditions. On a broad scale, the CAIC hotlines and emails will relay information that we have received on hard slabs or deep-slab instability. On a small scale-like the slope you want to be on-it is up to you to get data through observations, snow pits, and stability tests. Use the tips listed above in "What Should You Be Alert To?"

Your second task is to apply the habits of safe backcountry travel to the max-habits such as one at a time, don't bunch up, travel the edge not the center of slopes, don't cross beneath steep slopes, etc. You know the drill.

These tasks are your "due diligence," and they will lessen your uncertainty. But there is an unavoidable bottom line: When deep-slab instabilities lurk the only way to stay safe is to avoid steep slopes. This answer might sound like a "coveryour- you-know-what"-type response, especially when you watch people rip turns on steep slopes, or listen to your friends tell of their latest powder adventure. However, if you tackle steep slopes with deep instabilities your safety does not rely on skill, technique, or equipment; it relies on luck. Luck is something we would prefer to rely on in the casinos and not in the mountains!



Skier triggering a deep slab when he hit an area of shallow, weak snow near a rock band. The final fracture was far above the trigger point. The dashed border at right represents the area shown in left photo. *photos by Tom Fankhanel*

This article first appeared in The Beacon, Winter 2005 (Vol 9, No 2) and is reprinted by permission of the authors:

Knox Williams is the former director of the Colorado Avalanche Information Center. He can often be found these days forecasting or consulting for the Northwest Avalanche Center.

Dale Atkins is also a former CAIC forecaster who is the US delegate to IKAR, the International Council on Alpine Rescue. He now works for RECCO and can be found pondering the position of brazil nuts in a dish. His recent article on "To Swim or Not to Swim" (TAR 25/4) has spawned a large amount of thought, discussion, and potential research into avalanche physics.

education

Northwest Snow and Avalanche Seminar: NSAS 2007

Story by Steve Barnett

NSAS: An ASAP Event

Story by Michael Jackson

The Alpine Safety Awareness Program (ASAP) is a community-based nonprofit that uses local resources to teach alpine safety skills to children and adults throughout the mountain communities. We aim to save lives and reduce injuries by proactively increasing alpine safety awareness. Since 1999 we have reached more than 30,000 students and adults through our programs. Our goal is to make safety a habit among all winter outdoor enthusiasts.

ASAP is currently working with the Friends of the Northwest Weather and Avalanche Center and the Washington State Snowmobile Association in developing a Snowmobile Education Initiative as well as a Youth Advisory Board (YAB) to assist ski areas in a collaborative effort to address industry safety issues from a different perspective. *(see stories about both projects on next page)*

The YAB is working with Stevens Pass in an advisory role, and they are also spearheading a Alpine Safety Awareness Day to coincide with the NSAA Safety Week in January.

The Northwest Snow and Avalanche Summit (NSAS) is a direct result of my involvement as co-chair of the AAA Education Committee. The AAA Governing Board was looking to expand professional development opportunities for their membership, and ASAP was looking to expand our educational efforts to the Professionals in the Northwest. I saw this as an opportunity to collaborate with our Friends group, AIARE, and the AAA. I approached the ASAP Board with the idea of hosting NSAS, and an idea became reality. I called in every favor owed to me, and created some new debts of my own to attract top-tier speakers. The result was a seminar that was interesting, thought-provoking, and relevant to both professionals and recreationists.

Organizer and ASAP founder Michael Jackson, AIARE executive director Tom Murphy, and Ian Tomm of the CAA smile for the camera. *photo by Don Svela*

The future of NSAS lies in the ability to offer a day-long event that can continue to challenge professionals as well as provide useful information to the general public. Look for next year's agenda to be a balance of recent research as well as anecdotal presentations delivered by a mix of nationally known and well-respected professionals and nonprofessionals alike.

Michael Jackson has been the Executive Director of ASAP since 1999. He currently is responsible for curriculum development, training volunteers, and directing the community avalanche education courses.

"I feel like Tony Soprano speaking to a law-enforcement convention," began Sky Sjue in his presentation to the 250+ at the Northwest Snow and Avalanche Summit in Seattle. He admitted he had never taken an avy class, but had plenty to say about how he made decisions to ski or not ski large, steep, and remote mountains in the Cascades. The young ski mountaineer joined avalanche pros, mountain guides, heli guides, and patrollers who presented their experience, research, and thought.

ASAP's idea was to mix the motivated public and the professionals in one place, early in the season. An attendee could gain knowledge that would be hard to come by without long study or hard experience; knowledge that would have practical use during the coming season. Further benefits would come from mixing the speakers, not all of whom knew each other. It was also notable that this was a collaboration between sponsors AAA and AIARE – hopefully a taste of things to come.

Gary Brill talked about his own surprising number of close calls. Margaret Wheeler, of Pro Guiding, discussed the effect of testosterone and estrogen (in effect) on decision-making. Patty Morrison, ski patroller for Stevens Pass, outlined her research about the actual pattern of winds through the peaks, ridges, and passes near Stevens Pass (not at all like the prevailing wind). That fit well with Colin Zacharias' talk about regional variation in avy danger. Craig Wilbour gave a presentation on the difficulty of keeping the cross-state highways open in avalanche cycles. Larry Goldie, chief guide for North Cascade Heliski, gave a detailed analysis of the death of a young snowmobiler last winter, one who had taken an avy course from him. This was the darkest presentation but it felt appropriate to keep a bit of reality present. It was a struggle to follow the thought processes that turned clear warnings into an invitation to disaster. Steve Christie of BCA brought up the difficult subject of multiple burials. A lot of effort has gone into the design of transceivers that can better handle this situation, but the statistics for multiple burial accidents are dismal and not likely to change anytime soon.

Sky's talk about go and no-go decisions in ski mountaineering surprised and entertained the crowd. Sky has done bold descents of some of the North Cascades biggest and most remote peaks, and his survival is tribute to his good judgment. We expected a good talk, but no one at ASAP knew about his wicked sense of humor. He's already selling t-shirts with his "ski sickness" graphics.

The panel – Ian Tomm, Sara Carpenter, and Tom Murphy – discussed avalanche education with the audience *(see story next page)*. What were the differences between avy education in Canada and the US? How could high standards be enforced?

The room at the Seattle Mountaineers was filled beyond capacity (a few sneaked in) so evidently there was plenty of interest among backcountry skiers, boarders, and (a few) snowmobilers. Considering their increasing representation in accident statistics and their need (as a group) for more training, we would like to have more snowmobilers attend. That will be an objective for next year.

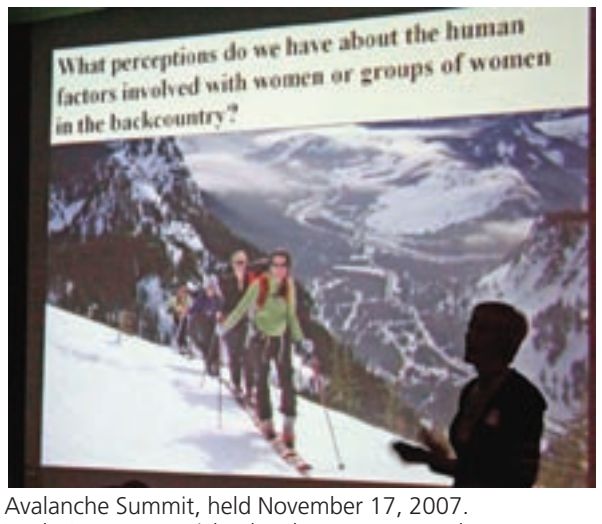
BCA and RECCO both had tables to demonstrate their wares and were happy with the size and interest of the audience. Other companies have already expressed their desire to be sponsors next year.

Problems? Coffee consumption was too high. We'd better make it lower quality coffee next time. Time was short. There were a lot of presentations and the panel was a little squeezed for time. We'll give it a clear mid-day slot next year, and try hard to be disciplined about apportioning time.

Still, the fact that the room stayed full through the whole exhausting day of serious presentations shows that there is a real demand and a real need for this kind of education.

The entire recorded seminar will be available on DVD at cost. Check out our Web site at www.alpine safety.org.

Steve Barnett has been skiing and climbing throughout North and South America as well as the European continent for over 40 years. Some people may think they wrote the book on teleskiing, but Steve really did – twice. The first is entitled "Cross Country Downhill" and the second, "Greatest Ski Tours In North America." When not touring with partners half his age, Steve can be found fighting the good fight as an ASAP board member.



upper left: An attentive crowd at the Northwest Snow and Avalanche Summit, held November 17, 2007.
upper right: The education panel *(left to right)*: Ian Tomm, Sarah Carpenter, Michael Jackson, Tom Murphy.
lower left: Steve Christie of BCA presents recent research on multiple burials, as NSAS MC Rich Marriott looks on.
lower right: Margaret Wheeler discusses women in the backcountry. *Watch for her article on that topic in TAR 26/4.*

NSAS Education Panel

Story by Sarah Carpenter • Photos by Don Svela

The panel discussion on avalanche education was an appreciated addition to the NSAS day. We had Ian Tomm from the CAA, Colin Zacharias from the CAA and AIARE, Tom Murphy, executive director of AIARE, and myself – Sarah Carpenter, co-chair of the A3 education committee.

The panel fielded questions in regards to differences between Canadian and U.S. avalanche courses, avalanche awareness courses and time frames, as well as standards vs. guidelines and enforceability of these in the U.S.. U.S. avalanche education is a different animal than Canadian avalanche education. We are a large number of educators teaching in a variety of climates, to a variety of audiences. We all have different styles and emphases, but if we're going to be successful and reputable, we should all be teaching to the same guidelines and end goals, hence the A3 avalanche education guidelines.

What I walked away with at the end of the day was that we have a lot to learn from each other here in the U.S., a lot to learn from the Canadians and their education system, and a need to all be on the same page to ensure consistent, high quality avalanche education.

If these comments ring true to you, consider participating in the A3 education committee's creation of Level 3 avalanche course guidelines. Give us your thoughts and ideas. Contact us with ideas, ways, and means to improve and maintain high standards of avalanche education in the U.S.. ❄

ASAP Avalanche-Awareness Instructor Training Program for Snowmobilers

Statistically, the snowmobile population suffers the highest percentage of avalanche fatalities in the United States. Here in the Northwest, the snowmobile community has no formal avalanche-awareness program in place to train their membership.

There is a definite need in the snowmobile community for formal avalanche-awareness program to properly educate their members as to the hazards of winter travel in avalanche terrain. The Friends of the Avalanche Center (FOAC) has as part of their mission, "to provide public education and awareness about avalanches and avalanche safety." By partnering with The Alpine Safety Awareness Program (ASAP) in the research, development, and implementation of a snowmobile-specific awareness program, both the FOAC and the snowmobile community would be meeting the needs of their membership.

Taught by club members to club members, systemic change could be made in the behavior of sledders due to the long-term friendships and familial connections that are critical to the social fabric of this recreational community.

With funding from FOAC, ASAP will develop a snowmobile avalanche-awareness training program. The program will be based on an already existing snowmobile avalanche-awareness presentation that has been very well received by the snowmobile community over the past three years.

ASAP would also research other resources available throughout the country for snowmobile education. The Washington State Snowmobile Association (WSSA) would then recruit potential instructors through their e-mail list and club newsletters. The Northwest Weather and Avalanche Center (NWAC) and the FOAC could also post notices on their Web sites to recruit instructors.

Aspirant instructors would then participate in a two-day training to become proficient in the delivery of the curriculum. Successful participants would be issued a certificate of completion stating they have successfully completed all necessary coursework to become a snowmobile awareness instructor. Shops and clubs could then schedule these trained instructors to come and deliver the program.

Instructors could be paid a fixed wage, and any funds above the cost of the program delivery could be donated back to the FOAC and WSSA Education Committee. Using this format, further trainings could be delivered at no additional development costs aside from the course manuals. ❄

Snowmobilers travel through avalanche terrain on Sylvan Pass in Yellowstone National Park *(see story on page 24).* *photo by Jim Peaco*

ALPINE SAFETY AWARENESS PROGRAM

ASAP Youth Advisory Board

Purpose:
To involve area youth in an advisory role on ski are safety concerns.

Goal:
Have students be part of the solution to the problems they identify.

Benefits:
Students — By identifying safety concerns and developing action plans, area youth will be an active part of their safety on the hill, and not just passive recipients of safety lectures by parents and Mountain personnel.

Ski Area — Ski areas will benefit directly from the unique perspective that the youth will bring to the safety process. More importantly, they will benefit from the new partnership between the youth and mountain safety personnel. Given the chance, students will consistently make good decisions if they feel their opinions are respected and that they are being listened to.

Who would make up the Student Advisory Board?
How often would they meet?
One volunteer representative from each area middle and high school. The middle school youth would be paired with high school students in teams of two, fostering an atmosphere of mentorship between the two age groups. Students would meet three times a year, once in the preseason, once in season, and once late season, to discuss concerns and make recommendations to the Alpine Safety Awareness Program. The format would be a questionnaire, with sample questions below.

1. What do you identify as your primary safety concerns in the ski area?
2. Do you feel they are being presently being adequately addressed?
3. If not, what would you like to see as additions or alternatives?

Why would students want to volunteer for this Advisory Board?
For a few reasons:

1. They would have a say in the direction of their winter passion.
2. It would be prestigious, with youth being rewarded for their efforts with pro deals and more.
3. They would be looked to by their friends as leaders by their actions. The time commitment is minimal, and the benefits of being involved in a proactive educational opportunity such as this program have already attracted the attention of a number of students I have contacted. ❄

Using the V-shaped conveyer-belt approach, coordinated shovelers transport snow centrally downhill (far left). Experienced rescuers adapt shoveling technique to suit individual strengths, such as coordinated sideways snow transport (center). After first visual contact with a buried victim (above), the front team continues to work together.

V-Shaped Conveyor-Belt Approach to Snow Transport

Story by Manuel Genswein and Ragnhild Eide • Photos courtesy Manuel Genswein

To excavate an avalanche victim takes by far the greatest amount of time during a rescue.

When considering the flow between beacon search and transport of victim, the gap between a successful hit with the probe and care for the air pocket constitutes a missing link in the otherwise tremendously well-structured knowledge on rescue. Development of the "V-shaped conveyor-belt approach to snow transport" started in 2004 and was tested quantitatively in the spring of 2007 during a large field test. During this test the uncoordinated approach to shoveling was measured as well.

The environment during the test

A site near the field laboratory of the Norwegian Geotechnical Institute in western Norway was chosen. A spring snowpack with high density and hardness proved to be a realistic simulation of dense avalanche debris.

The "victims" were two bags normally used to carry firewood, sewn together and filled with straw. The texture of those bags closely resembled the stickiness of ski clothing to snow, therefore making it necessary for the rescuers to completely remove all snow before being able to transport the victims. In order to avoid a loosening of the debris around the victims, great care was taken to dig small shafts during burial. In addition, the snow around the victims has been left to re-freeze on the surface during one night. The next day the snow around the victims was stomped down layer by layer. The day after – therefore after three days – the victims were ready to be rescued.

Three different burial depths were used (1m, 2m and 3m) in 2 different slope angles (flat = 0-5 degrees, steep = 20-25 degrees).

Choice of rescuers

All "rescuers" were chosen carefully. With ages between 19 and 39, they represented the age group that statistically most often becomes avalanche victims. Men and women from three different countries were chosen; the ensuing language challenges simulated to a certain degree the communication problems that often occur between rescuers who speak the same language with increased stress levels during a real incident. The call for volunteers read: "four-day avalanche course free of charge, including food, including active participation in a two-day digging experiment."

The digging experiment

In order to eliminate exhaustion as cause for potential mistakes, the digging experiments were spread over four days. After digging for a short while, the rescuers were assigned a less physically challenging learning module, after which another section of work with the shovel was completed.

Collection of data

The hole's depth increase was measured every 30 seconds. After every excavation the hole and excavated volume were carefully measured. The time measurements included first visual contact with the victim, head (airway) access time, first visual of the full body, lifting of the victim, and positioning the victim outside the burial site. Documentation included high-definition pictures as well as real-time video. An instructional video is available.

Challenges for an efficient and careful excavation

During companion rescue a single probe is normally used to locate the victim; this can result in little knowledge about the positioning of the body. On one hand a quick approach to the airway is necessary; on the other hand a certain amount of snow needs to be transported to facilitate efficient removal of the mass of snow. Furthermore, rescuers should be positioned so that the buried subject and possible air pocket are not endangered. The V-shaped conveyor-belt approach to snow transport is the answer to this challenge.

How to work efficiently over a long period of time

One major requirement of an effective rescue is to maintain the efficiency of the rescuers at a constant level. So the question was: Why do rescuers get exhausted so quickly when they apply uncoordinated shoveling? We wanted to avoid having the rescuers fatigue easily when shoveling as this results in longer breaks and therefore an undesired slowdown of active resources. We noted that rescuers achieve rapid exhaustion due to holding an ergonomically challenging position over a long period of time. In response, we found that clockwise rotation of rescuers every four minutes in the V-shaped conveyor belt method avoided this early exhaustion. The idea of job rotation has been used in industrial production for a long time.

An additional challenge to efficiency is the method of snow transport. Vertical lifting of snow constitutes one of the least efficient methods – despite maximum use of strength, snow still does not get transferred away from the victim. The bigger the lift with the shovel, the bigger the amount of snow that can fall off the shovel. A paddling motion, with which the rotation of the whole body can be utilized as opposed to just using the arms, is much more efficient and results in a bigger mass of snow to be transported (measured in liters / rescuers / minute). Methods that suggest steps be dug for snow transport or methods suggesting kneeling or sitting positions are just as inefficient.

Size of the V and required number of rescuers

The size of the "V" can be deduced from the burial depth known by probing. In a flat debris field (0-5 degrees), the required length of the V equals double the burial depth. On a steep slope (20-25 degrees), the length of the V equals the burial depth. Values in-between can be guessed. The width of the V at its open end always equals burial depth.

As a general rule, one rescuer can cover 80cm of the V's height. If a victim is buried 2m on a flat area, 2x2m = 4m / 80cm = 5 is the perfect number of rescuers. It's up to the rescuers where to position themselves within their sector of V height.

Companion rescuers have shown difficulty shoveling with the same efficiency on both their right and the left sides. Therefore the working position may be individually adapted to the current working situation in the V and the best position to cut or transport snow, as well as the personal, body-specific preference of the rescuer.

Correct handling of the avalanche shovel

All rescuers were taught the correct way to use the shovel (i.e., cut blocks).

Observations considering uncoordinated shoveling

Statistics and video analysis clearly show how often rescuers stepped all over the top of the buried victim as well as got in each other's way, resulting in diminished efficiency for excavation.

Onset of fatigue was rapid, and work was interrupted for everyone while exchanging a shoveler. With increasing burial depth, not all rescuers could be utilized.

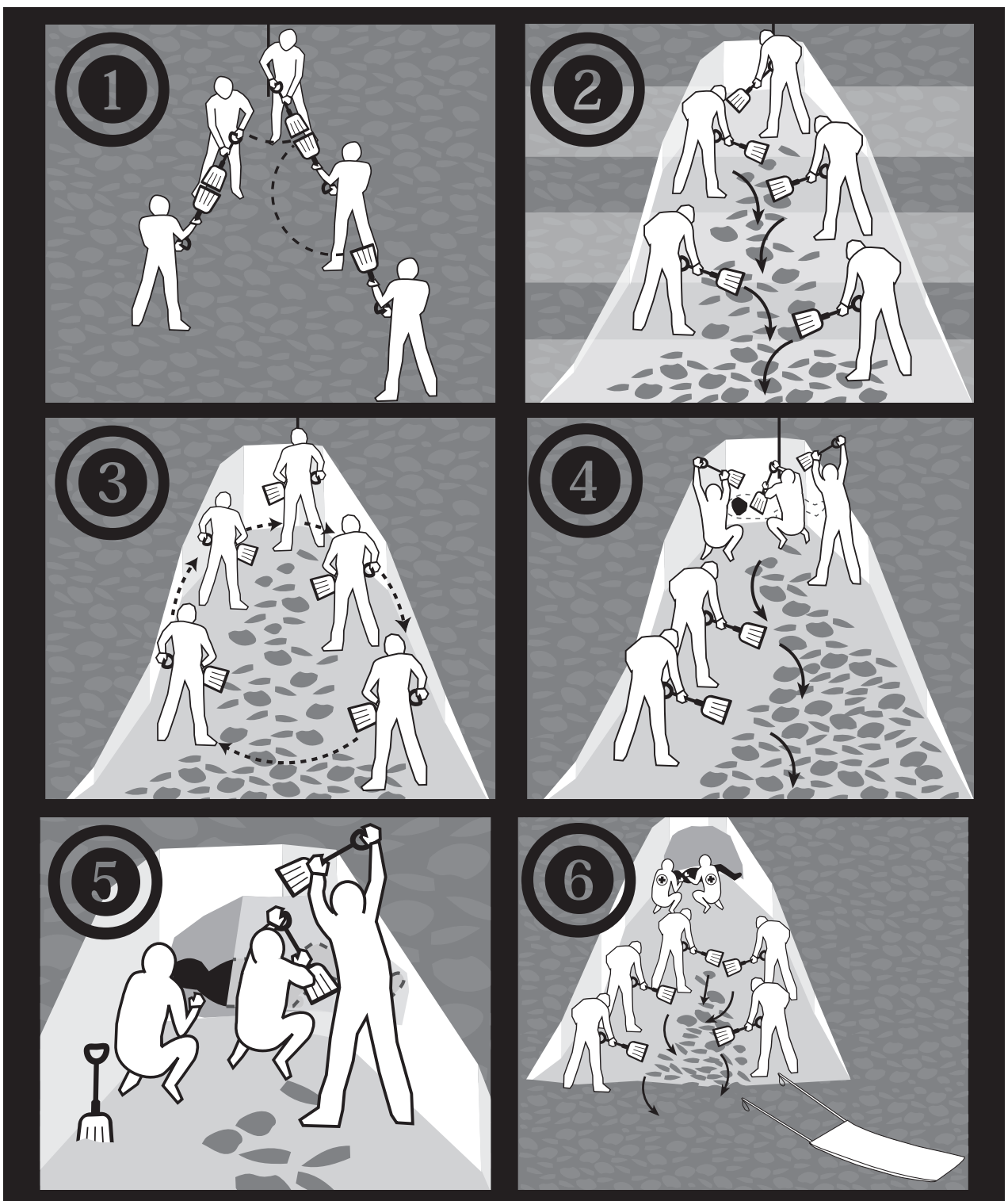
Using the V-shaped conveyor belt approach to snow transport

Rescuers form a V whereupon the two front shovelers are a distance of one shovel length apart; the rest are distanced two shovel lengths from each other. This positioning – which can be assumed quickly – enables everyone to work without disturbing each other while offering an optimal length of motion in the snow conveyor for each person. The primary job of each person is to move the snow from their segment onward to the next section behind them. Once there is no snow to transport, blocks should be cut to increase depth. The person closest to the probe only cuts blocks. The second person starts the transport of the blocks; the person might still have enough time to cut a few blocks as well. The further back in the V, the more work is used to transport the snow and less is used to gain depth. This results in a sloping plane, gaining more depth towards the buried victim. Due to the right length of the V, it is ensured that the critical angle of 25-26 degrees is not surpassed, therefore avoiding snow to fall back into the pit. Rotation of rescuers

By contrast, uncoordinated shoveling results in rescuers working centrally around the probe, repeatedly stepping on the victim in the process (above).Lack of a coordinated approach leads to inefficient use of rescuers (center), and once a victim is found, the steps out of the hole are too high, there is no exit ramp, and gentle transport of the patient is almost impossible (right).

is initiated by the front person. A four-minute cycle has been found to be the optimal balance between getting used to the new position and onset of fatigue. A greater gain in depth was measured during the first two minutes of the rotation, as opposed to the last two minutes. The psychological effect, resulting in increased motivation when expecting the rotation, was rated as very important. Of course, those four minutes don't have to be measured exactly. At the latest, the rotation should be made upon the first sign of fatigue by any of the rescuers.

Digging continues in this way until the buried victim is first seen. That's when the last rotation is made. Two rescuers should be on top of the V. Those two will work directly and carefully near the victim, therefore decreasing the amount of snow available to feed the capacity of the snow conveyor. To compensate for this decrease, the person behind the first two rescuers should aggressively cut out the sidewalls in order to make more space for the two front rescuers and to adapt the tip of the V to the real orientation of the buried subject. During this phase the first sign of a cave can be observed, as it does not make sense to take out the entire height of the front and sidewalls. The reason for stopping further rotation after first visual contact with the victim is the challenge of passing on the positioning of the victim in a timely manner from the front person to the next. Furthermore it would be psychologically challenging for a conscious victim to have to adapt to a different rescuer every few minutes.



V-SHAPED CONVEYOR-BELT APPROACH— 1) Positioning of rescuers: quick measurement of distance between shovelers. 2) Working in sectors on the snow conveyor belt: snow is transported with paddling motions. 3) Clockwise rotation is initiated by the front person: job rotation maintains a high level of motivation and minimizes early fatigue. 4) Buried victim is first seen: more rescuers are needed at the front, and the snow conveyor belt only need be kept partially running. 5) Careful work near the buried victim while some shovelers aggressively cut the side walls to adapt the tip of the V to the real position of the victim. 6) Interface to organized rescue: more space shoveled only after medical treatment of victim has started. All graphics ©Genswein /Eide

During this phase, more rescuers are used at the tip of the V. The V does not need to be fully maintained anymore. Often it is sufficient to keep only one side of the V open and to use the free space as an additional depository for snow.

Interface to organized rescue

Once organized rescuers appear on the scene, they often require additional space for first aid and transport of victim. While this request is well founded, it should not, however, result in wasting time to gain access to the victim's airway. Therefore the V-shaped conveyor belt approach to snow transport should be used for all user groups until commencement of first aid.

At that time the diggers can step back a couple of meters, and while keeping the V formation they can start transporting the snow further away to create more space – unless they are needed for more pressing tasks.

Basic method: additional optimization through micro-management within the V

The V-shaped conveyor belt approach to snow transport constitutes a fast, efficient, and careful excavation method of avalanche victims. Experienced rescuers may adapt the base method to suit each individual rescue situation by micro-management.

The avalanche shovel

This test was not conducted to systematically test avalanche shovels. However, valuable observations were made regarding different models of shovels. All rescuers received detailed instructions in the correct use of each shovel. Not one single shovel failed due to incorrect use. Plastic shovels serve the purpose of merely "having a shovel" but usually fail before reaching the first meter of depth. Light metal-alloy shovels need to be hardened by a metallurgical or temperature process, as the majority of those metal-alloy shovels from prominent manufacturers were seriously bent after little use. The front edge cannot end in a triangle with one exposed tip, since that will bend and deform the entire blade after continued stress. Collapsible handles have a clear advantage because of the increased length of the shaft, but the two parts must sufficiently overlap in the extended state. By creating a second hole this doubling can be increased. A D-shaped (curved) grip proved to be superior to a T-shaped grip. The Voilé Extreme proved to be a very sturdy and ergonomic working tool.

THANKS— We would like to thank our participants for their extraordinary efforts. A further thanks goes to Krister Kristensen of NGI for providing us with a very affordable work environment at the modern field station.

The results of the study will be presented in Whistler, Canada, during ISSW 2008, www.issw2008.com.

Manuel Genswein is an independent avalanche instructor. He has taught courses for 15 years in over 20 countries. He can be reached at manuel@genswein.com.

Ragnhild Eide has been working as a NF mountain guide in Norway since 1997. Since 2005 she has, together with Manuel Genswein, been part of the development of the V-shaped snow-conveyor technique for excavating avalanche victims.

A SNOW-DENSITY NOMOGRAM

Never make another mistake while calculating snow density

Story by Ian McCammon

I'm pretty sure no one ever died in an avalanche because they screwed up a snow-density calculation. Which is a good thing, because I've made my share of mistakes in doing what, in theory, should be simple arithmetic.

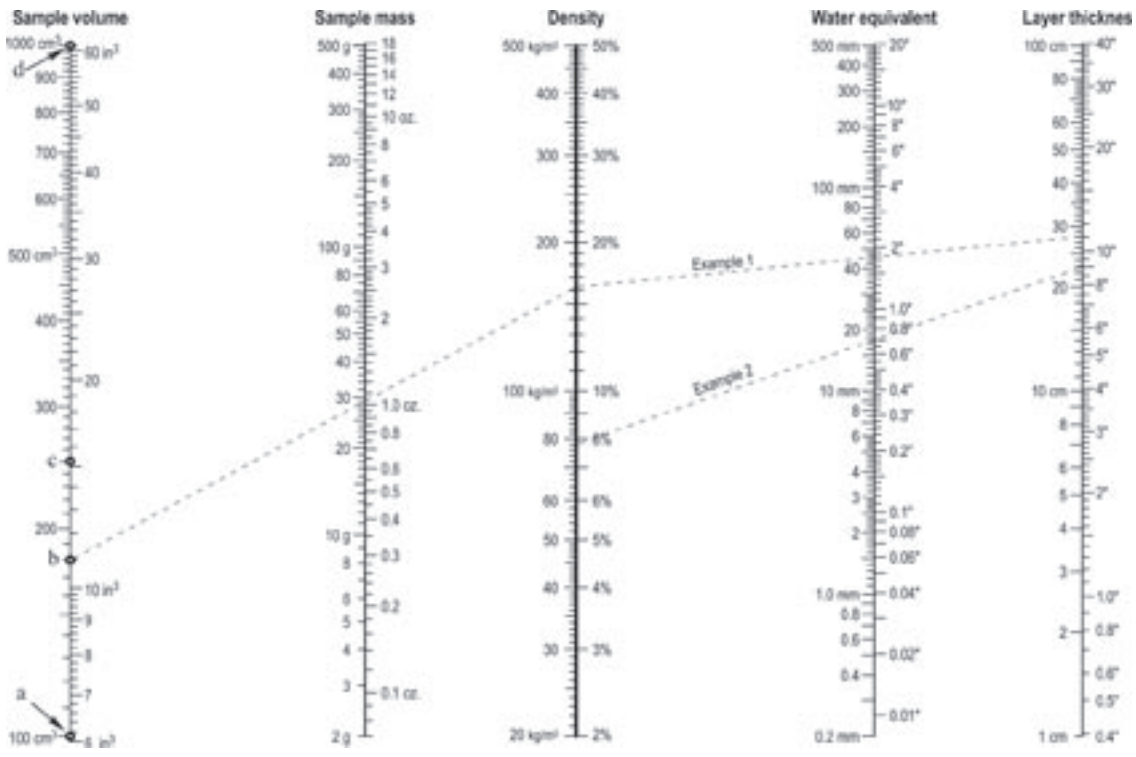
Apparently I'm not alone. At a recent training for aspiring snow professionals, one instructor gave a great explanation of why snow professionals communicate new snowfall in water weight. Heads nodded in agreement that snow density was a reasonable and important quantity to measure and track.

Then came the snow-density calculation exercise. The few mathy folks in the class dove right in, but most of the students struggled with the formulas and unit conversions. What should have been a two-minute exercise stretched into 10, and by the end it was clear that most folks would rather ski breakable crust than tackle snow-density calculations again. Almost palpable was the dawning realization that until each student mastered them, density calculations would haunt their snow careers like an unpaid debt.

The experience made me wonder if there wasn't another path to snow density enlightenment, an ancient path grown faint under an onslaught of cheap calculators and slick spreadsheet software. Way back when slide rules were cool, people used paper charts called nomograms to simplify arithmetic drudgery. Each nomogram is basically a graphical computer for solving a particular formula. To use one, you simply draw a straight line through two values that you know. Where the line intersects the third scale is the value you are looking for. Simple. No calculator, no algebra, no pesky unit conversions, no software. Heck, you could even use a nomogram while wearing mittens. Perfect for us snow folks.

It turns out that making a nomogram from scratch takes a little work, but the secrets can be had for the price of an out-of-print classic like *Elements of Nomography* by Douglass and Adams (McGraw-Hill, 1947) and a quick review of matrix algebra (details that are thankfully invisible to the user). I designed the nomogram shown above to solve the two most common snow-density calculations encountered by snow professionals: snow density from the weight of a snow sample (left half) and snow density from water equivalent of a snow layer (right half).

To use the nomogram, choose the half of the chart (left or right) that solves your problem. Locate the values that you know on the two relevant scales and connect them with a straight line that extends to the density scale. Where the line intersects the scale is your answer. Unit conversions are built into the scales, so even folks who start out with raw data in inches and ounces can remain blissfully calculator-free.



Example 1: Water equivalent of a snow layer

Using your El Cheapo snow-density kit *(see story below)*, you collect a sample that weighs 29 grams from a snow layer 28cm thick. What is the density and water equivalent of the snow layer?

The El Cheapo sampler has a volume of 180cm^3, marked as "b" on the Sample Volume scale. A line drawn through 180cm^3 and 29g (Sample Mass scale) intersects the Density scale at about 160kg/m3 or 16% water. That's the layer density. Now, draw a second line from this point to 28cm on the Layer Thickness scale. This second line intersects the Water Equivalent scale at about 45mm, which is the water equivalent of the layer you just sampled. Cool, huh?

Example 2: Density of new snowfall

You just received 9" of new snow that contains 0.7" of water. What's the density of the new snow?

A line drawn from 9" on the Layer Thickness scale through 0.7" on the Water Equivalent scale crosses the Density scale at about 80kg/m^3, or 8% density. Should be good skiing!

NOMOGRAM TIPS:

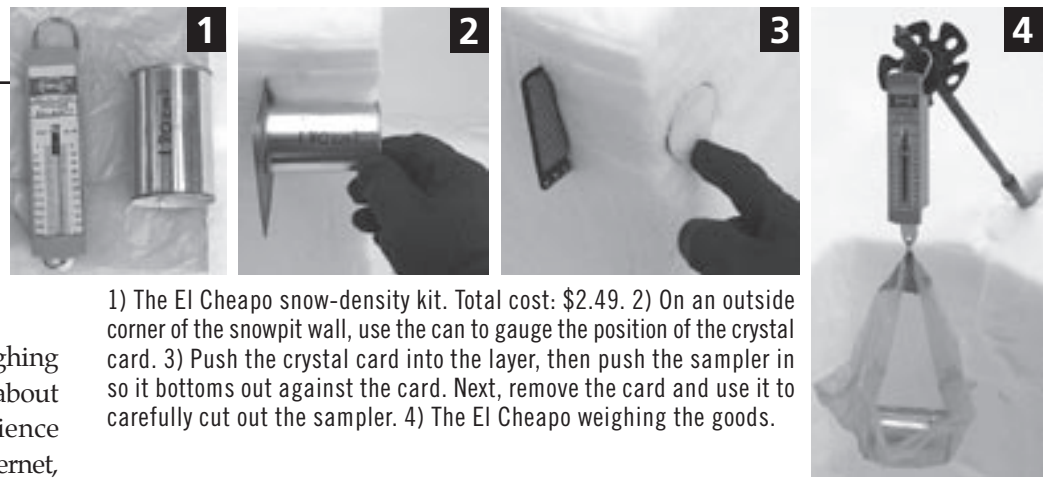
1. The volume axis is marked with values for common density cutters: a) Winter Engineering sampling tube (100cm^3), b) El Cheapo 6 oz tomato paste can (180cm^3), c) Snowmetrics Rip 2 cutter (250cm^3), and d) Snowmetrics Rip 1 cutter (1000cm^3). If your sampler has a different volume, just look it up on the scale.
2. If you are careful with your lines, nomogram accuracy will be sufficient for most density calculations. Remember that the variables aren't all that precise to begin with (new snow, for example, is only recorded to the nearest cm), so students can avoid the false-precision trap that sometimes snares users of pocket calculators (density to three decimal places is definitely overkill!).
3. Although the examples above solve for specific variables, you can use the nomogram to solve for any variable when you know the other two. No more algebra errors!

A final benefit of using a nomogram is that it can help students quickly develop an intuitive feel for what densities are reasonable for a given situation. And once students understand that, they are well on their way to mastering snow density. Happy calculating!

Snow Density for Cheapskates

Build your own kit for less than 3 bucks

Story and photos by Ian McCammon



1) The El Cheapo snow-density kit. Total cost: $2.49. 2) On an outside corner of the snowpit wall, use the can to gauge the position of the crystal card. 3) Push the crystal card into the layer, then push the sampler in so it bottoms out against the card. Next, remove the card and use it to carefully cut out the sampler. 4) The El Cheapo weighing the goods.

I'm a big believer in hands-on avalanche education. So I've never been happy when the only exposure that advanced students get to collecting snow-density samples consists of watching somebody else do it. But with density kits pushing $100 or more, it gets pricey to provide students the practice they need to get the hang of this advanced skill.

Enter the El Cheapo snow-density kit. Ideal for students and budget-minded snow-science enthusiasts, this kit keeps costs down so everyone can experience the joy of collecting their very own snow-density data.

The heart of the El Cheapo is a humble 6oz tomato-paste can. I like Hunt's brand because of the non-stick can lining, the smooth sides, and the superior taste in sauces. Remove both ends using a smooth-edge can opener. Now remove the label and write the volume (180cm^3) on the can with a permanent marker. If you use a different type of can, you can calculate the volume using the formula $V = \pi hr2$, where r is half the can diameter and h is the can height. Cost: 69 cents.

Find a cheap and durable weighing scale that measures up to 200g (about 10oz). You can find these at science education supply stores. On the internet, search under "spring scale." I like the Parco® 200g spring scale from Indigo instruments (www.indigo.com) because it stores nicely inside the can, and you can't beat the price. Remove any weighing hooks from the scale, and thread a short string through the scale armature. Tape the string to a small plastic bag, and you're ready to go *(fig 1)*. Cost: $1.80

HOW-TO

1. Dig a snowpit and identify the layers to be sampled – layers must be thick enough (5cm or more) to accommodate the sampler. Form an outside corner on the pit face by digging a vertical chimney or by doing an isolated column test.
2. Zero out (tare) your weighing scale – drop the empty sampling can into the bag, and adjust the scale until it reads zero. If you can't get it to read zero, adjust it to a round number like 10 or 20g. This is the number you'll subtract from the measured weight to get the true weight of the snow sample.
3. Start with the layer closest to the surface. Hold the sampling can horizontally with one edge even with the outside corner on the pit face. Slide a crystal card behind the sampler, and leave it in place *(fig 2)*.
4. Push the sampler horizontally into the layer until it hits the crystal card *(fig 3)*. Remove the crystal card, and use it to carefully cut out the sampler. Clean off any stray snow sticking to the outside of the can, and make sure the ends of the sample are flat.
5. Drop the can into the weighing bag *(fig 4)*. The weight you measure (minus the tare weight you set) is the weight of the snow sample. Find density and water equivalent from the snow-density nomogram. Continue for the other layers of interest.

TIPS

- Let the sampling tube cool in the shade for a few minutes before use to avoid icing.
- A spritz of Elmer's Slide-All or WD40 on the inside of the can facilitates sample removal.
- If you have wet layers, sample them last to avoid snow sticking to the sampler.

A caveat: The El Cheapo is great for students and others who want a quick estimate of snow density. If you need high-precision density data, spring for a high-quality density kit.

Ian McCammon is an avalanche researcher and certified instructor who is always looking for easier ways to do things. He welcomes your questions and comments at ian@snowpit.com.

Systematic Approach to Avalanche Rescue:
Too Pedantic or the Key to Success?

Story by Manuel Genswein

Despite the assumption of a connection between a systematic approach and its effect on efficiency during avalanche rescue, a statistical proof based on clear measurements has been missing. The following abbreviation of a text published during ISSW 2004 (*An Analysis of the Efficiency of Avalanche Victim Search and its Contributing Factors*, Genswein, Bezzola, Whelan, Proceedings ISSW 2004 Jackson Hole) explains tests that quantitatively evaluate the connection between a systematic approach and its effect on efficiency during avalanche rescue.

A series of tests with over 120 mountain guides shows not only the importance of a systematic approach, but also gives valuable insight into personal self-evaluation of individual guides during the span of their professional career.

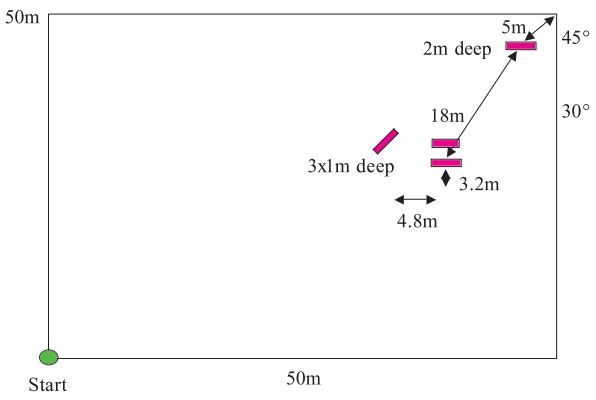
Goal of the test was to provide participating guides with an opportunity to test their skills during a highly structured and near-real environment and then compare the results with their peers.

The test proved to have a very high learning value and was followed by a short discussion of each individual weakness and subsequent lesson learned. By constantly linking the test with a customized individual learning experience, the motivation of participants was kept at a high level throughout the test.

Criteria— The rescue scenario had to test the following criteria reliably and independently from each other:

CRITERIA	Systematic search	Systematic search for multiple burials	Balance between search speed & search accuracy	Systematic pinpointing on deep burials
Adequate size of search area	●		●	
Separation of multiple burials & deep burials		●	●	●
Median burial depth within multiple burials		●		
Deep burial with single victim				●

Using the above criteria, the following scenario was developed:



To ensure an efficient test, the test sites were equipped with remote-controlled (wireless) search targets with probe detection. The majority of participants used digital/analog dual-antenna transceivers; some used single-antenna analog devices.

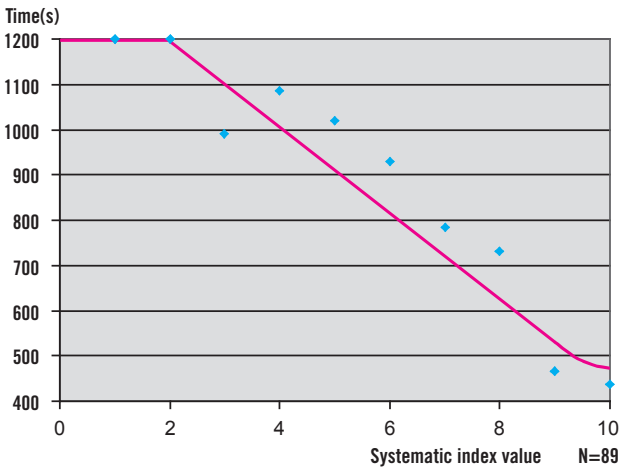
Rating System — The performance and systematic approach had to be quantified in order to ensure proper analysis and comparison of the results.

On one hand, the search times for all four victims (time until probe hit – number of victims not known to rescuers) as well as the remaining time for transceiver search on the debris field had to be measured. On the other hand, the key criteria had to be measured similarly to evaluation marks on school exams. The resulting Systematic Index provides the following data (higher points = more efficient approach).

1.0 Systematic search of area
1.5 Recognizing a multi-burial situation with numeric estimate of the amount of buried subjects
1.5 Systematic use of micro-grid system for multiple burials
2.0 Pinpointing
2.0 Good ratio of search speed to search accuracy
1.0 Probing
1.0 General behavior
10.0 Total

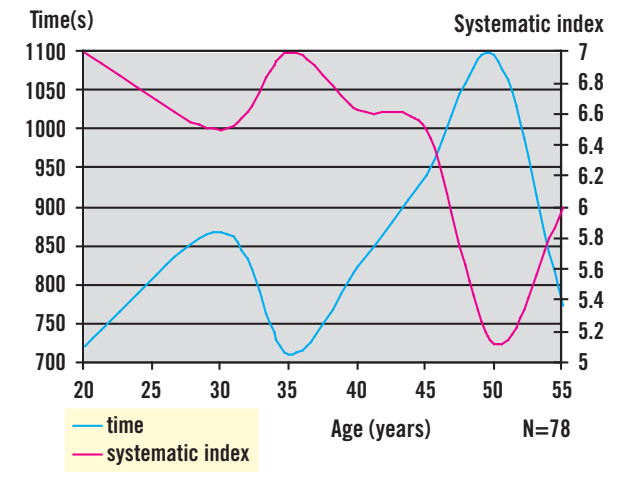
Rated points where broken down to 1/4. For instance, if a subject showed adequate speed during signal (primary) search but did not dramatically reduce speed during pinpointing, only one of two points was received for *good ratio of search speed to search accuracy*. If a subject did not use a systematic pattern for the probe search (such as spiral probing), 1/2 point was deducted. If a subject dramatically reduced speed during probing, 1/4 point was deducted. The same applied to subjects who did not probe at a right angle to the snow surface (therefore reducing the efficient recovery of a deep burial). *Note: before conducting the test, all participants where familiarized and trained (during different course modules) in the correct use of different search methods.*

Questionnaire— Prior to and after the exercise, participants answered questions where they were required to rate themselves as to their competency in avalanche rescue.



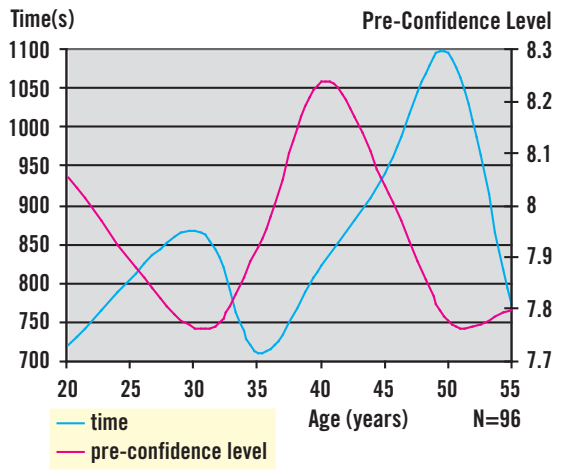
Results— The results proved without doubt a clear connection between shorter search times and a systematic approach. Rescuers with fast search times showed a high systematic index; those with slow search times showed a lower systematic index. The curve flattens at 20 minutes since the test was stopped at that time. The flattening of the curve towards the lower end shows that a further reduction of search time was not reached by a higher systematic index but by an increase of speed. An interesting point to note was that some of the rescuers with the shortest search times often displayed a moderate search speed compared with rescuers that showed a high search speed but a longer search time. Therefore, the objectivity of this test was not weakened by a different physical fitness level of participants.

The systematic index shows an opposing value to the search time during its life span.



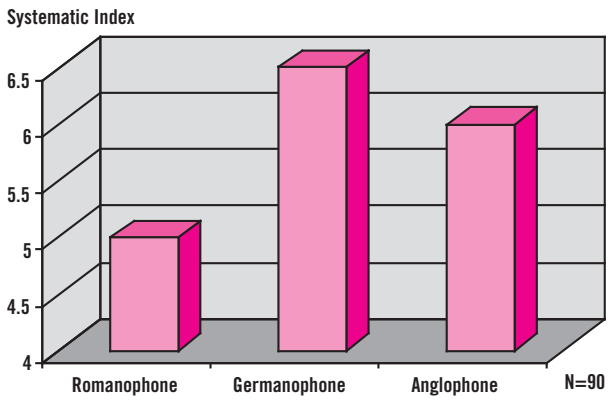
The self evaluation of participants was strongly dependent on their age, which seemed to influence their willingness to accept new knowledge. A period of an overestimation of one's ability was followed by a reduction of performance, which resulted in higher search times. Older participants have a more realistic self-evaluation, know their strengths as generalists, and are better able to evaluate, accept, and use suggestions in specialized areas like avalanche rescue. This results in lower search times.

Due to lack of sufficient female participation, no statistically relevant result can be provided in regard to gender-specific performance. What became obvious when examining the self rating of confidence among



the female participants, however, is that they were less prone to overestimating their ability. The shortest overall search time was recorded by a female participant.

Thanks to a very multi-national composition of participants, a comparison between the linguistic origin/mentality and the statistical average of the systematic index could be made.



An important part for participants proved to be the opportunity to test their skills against the skills of their peers. Especially in the relatively competitive environment of mountain professionals, a high degree of motivation can be achieved through measuring the difference between reality and requirement. It is important though to avoid public embarrassment. The additional pressure of embarrassing oneself in front of one's peers is counter-productive and not conducive to a highly motivated learning environment amongst this individualistic group of people. Therefore all results must be coded. Each participant received a code number which enabled identification of personal results on the performance chart.

Conclusions— A systematic approach is the key to success. The search for avalanche victims becomes less challenging if one is ready to accept and strictly apply the different rules of the search systems.

An important part of a search system for avalanche rescue is its capability to be dynamically adapted to accident-specific characteristics (terrain, size of debris, etc.). Search systems that utilize fixed assumptions for search-strip width, burial depth, minimum and maximum distance between buried subjects, and other fixed parameters are doomed and will fail in a real search.

A good ratio (balance) between search speed and search accuracy poses a challenge even for experienced rescuers and is vital for a quick overall search time. Somebody moving too slow when still at a considerable distance from the buried subject will lose precious time, whereas moving too fast while pinpointing will result in longer probe time or, in the worst case, a run over (skip) of a buried subject.

Pinpointing within the last meters must be done with a systematic crossing of lines whereby the maximum for signal strength and minimum for distance must be surpassed each time. The transceiver is held close to the snow surface while pinpointing. The probe must be used in a right angle to the snow surface while moving in a spiral-like pattern. Once the probe search has been decided upon, this method must be kept for at least several circles before returning to the transceiver search in case no result has been achieved with the probe. An efficient use of the probe is only possible by using both hands.

Manuel Genswein is an independent avalanche instructor. He offers a wide variety of primarily rescue-based products and services that range from digging and searching tutorials and training to navigation with GPS to helicopter-based rescue. Contact: manuel@genswein.com.

crown profiles

Sylvan Pass and Operational Risk Management Assessment

Story by Molly Loomis

SYLVAN PASS STATISTICS—

Average Starting Zone Elevation: 9,096'
Average Slope Angle: 38 degrees
Average Slide Path Length: 1,160'
Average Vertical Drop: 613'
Distance from Cody: 63 miles
Number of Slides Triggered in a Big Year: 120-130
Number of Slides Triggered in a Minimal Year: 60-80

Snowmobiles take advantage of recent avalanche mitigation on Sylvan Pass. Note the plowed debris piles on the uphill side of the road. *photo by Jim Peaco; inset picture from Google Earth*

Deep in Wyoming's Absaroka mountains is Sylvan Pass, a 5,000' section of road whose winter management is at the root of a contentious debate between Yellowstone National Park (YNP); citizens of Cody, Wyoming; snowmachiners; environmentalists; and avalanche professionals. Many say the pass and the control work needed to keep it open is too dangerous. When compared to other avalanche-hazard-reduction programs, the operation is at the same standard of safety. So the underlying question is: does the risk offset the gain?

Ski areas and interstates in America have similar avalanche-hazard-reduction programs, but they accept the risk for multi-million-dollar commerce. Sylvan Pass, on the other hand, averages just eight snowmobiles a day. Even at the maximum set by the current EIS *Record of Decision*, only 30 snowmobiles per day are allowed on the pass.

Others say the use of explosives inside a national park is outside the park's mission, and still others allege that avalanche hazard is being used as a scapegoat to ban snowmachines. Regardless of the argument, the situation is delicate and complicated by possible lawsuits, a shrinking park budget, differences in risk tolerance and avalanche-assessment experience between park officials and those on the ground, and the threat of lost income to nearby communities.

In an effort to accurately and objectively assess Sylvan Pass' avalanche risk to the public and to snow-safety personnel, the National Park Service (NPS) utilized a risk-assessment and information-gathering tool the United States Coast Guard (USCG) has been using for over two decades called Organizational Risk Management Assessment (ORMA). ORMA is a process that may be taken beyond Sylvan Pass and could prove to be a viable tool for backcountry enthusiasts and avalanche professionals alike in determining and rating risk factors of particular situations.

Sylvan Pass Background and History

The route over Sylvan Pass, once frequented by Buffalo Bill, travels under 20 separate slide paths along a distance of 5,000'. On average, the pass receives 350" of snow each year. During the winter, high winds can scour the area or cause dangerous wind slabs to form.

In 1973 avalanche-control work formally began on Sylvan Pass in response to increased use of the park during the winter months. By the 1980s the 75mm recoilless rifles originally used for control were replaced by a 105mm howitzer. In 2004, aerial dispensing of explosives using a helicopter was introduced to supplement the howitzer. But by 2006, enough concern had generated about the potential of howitzer duds *(see caption next page)* and the risks park personnel faced accessing the howitzer platform as well as rock fall, cornice drops, avalanches, shrapnel, and severe weather.

As a result, helicopters contracted out of Bozeman, Montana, took over as the sole means of avalanche control for the 2006/07 season. The move was criticized by many avalanche professionals as overly expensive, but the real issue seemed to be delay in performing an avalanche-hazard-reduction mission due to poor flight weather. Forecasters couldn't "move snow" at the most opportunistic time, and the road was closed for multiple days waiting for flight weather – a situation Cody citizens found unacceptable. While entailing different but comparable risks as howitzers, helicopter use was significantly less effective because of their inability to fly in stormy conditions – the window viewed as the most effective for performing control work.

Since avalanche-control work began on the pass in 1973, one fatality has occurred. In the midst of a storm in 1994, YNP ranger Robert E. Mahn died from injuries sustained from driving his snowmachine off the road en route to forecast avalanche hazard on Sylvan Pass.

Bob Comey, lead avalanche forecaster for the Jackson Hole Mountain Resort and Bridger Teton National Forest, was contracted by YNP to perform an independent risk assessment of control work on Sylvan Pass, and he estimated winter traffic on the pass during the 2006/07 season to be 12 snowmachines per day and one snowcoach every three to four days.

Meanwhile, pressure from conservationists regarding snowmachine use in YNP, a shrinking budget, OSHA's identification of Sylvan Pass as a hazardous work environment, and growing concern from park officials over employee safety in all areas of Yellowstone thrust operations on Sylvan Pass under the microscope. In 2007 Mike Snyder, NPS Intermountain Regional Director, ordered an assessment of the options and risks associated with keeping Sylvan Pass open in winter. The results, to be presented to Snyder and YNP Superintendent Suzanne Lewis, would assist the two in creating the park's future winter-use plan. Billy Shott, NPS Branch Chief of Law Enforcement and Ranger Activities in the Intermountain Region, was given the task of facilitating the information gathering and risk-assessment process.

ORMA: Operational Risk Management Assessment

A panel comprised of avalanche experts, some unaffiliated with YNP and some YNP maintenance and operations personnel, met in August of 2007 to discuss options for the future of Sylvan Pass with the goal of ranking these options in order of riskiness.

The tool Shott brought to the table was the ORMA, a process born from an USCG accident when a guardsman and an individual he was attempting to rescue lost their lives as a ship overturned on a rescue mission. As a result of the fatalities, the USCG was determined to find a more systematic yet efficient approach to assessing risk – easy enough to understand and utilize that guardsman of all ranks would be able to share in the common vocabulary and system. ORMA was the result – a processes that according to USCG literature "does not tell you what to do; it gives you an accurate assessment of ALL risks and asks the question, 'What is acceptable to you?'" The core principles underlying the ORMA are as follows:

- **Accept no unnecessary risk.**
- **Accept risk when benefits outweigh costs.**
- **Anticipate and manage risks by planning.**
- **Make risk decisions at the right level.**

While the first principle, *accept no unnecessary risk*, may seem unrealistic to those of us who ski in 38-degree terrain or choose to go out on a red-light day, Shott explains "It's not about going to bed with your helmet on; the organization has to accept some level of risk. It's about establishing what's necessary risk and what's not and defining what tips the scale in one direction or the other."

This sentiment is further emphasized by USCG philosophy stated in the ORMA manual, "Taking calculated risks is essential for an organization to grow and capitalize on its capabilities."

Military jargon like *mission* and *operation* aside; the ORMA steps are similar in many ways to other popular outdoor decision-making strategies:

1) Define Mission
2) Identify Hazards
3) Assess Risks
4) Identify Options
5) Evaluate Risk vs. Gain
6) Execute Decision
7) Supervise and Watch for Changes.

Steps 3 (Assess Risks), 4 (Identify Options), and 5 (Evaluate risk vs. gain) is where the process differs from other popular models by incorporating a comprehensive structure for evaluating risk on multiple levels. Although the system (described below) may look confusing at first, converts to the system like YNP ranger and former Sylvan Pass forecaster Michael Keator are convinced and say use of the system becomes easier with time.

Keator has begun incorporating the ORMA into winter survival classes he teaches in the park. "I call it

a 30-second plan," he says, alluding to the amount of time it takes to run through the ORMA once the user is familiar with it. "They can come up with a good plan that identifies the risks and mitigating actions necessary to evaluate if there is an acceptable risk".

Once the risks (Step 3) and options (Step 4) are identified, they are run through a risk versus gain assessment tool (Step 5). Depending on the type of mission, the GAR (Green Amber Red) or the SPE (Severity, Probability, Risk) method may be more appropriate.

RED (High Risk)	80
AMBER (Caution)	60
GREEN (Low Risk)	35
	0

GAR: Green Amber Red

The GAR, an abbreviation for "Green Amber Red," is most useful prior to embarking on a mission for assessing the risks of that particular mission. Eight different components are evaluated for their risk factor on a scale of 1-10 with 10 being the most risky:

1. **Supervision—** How much experience does the supervisor have and what level of supervision is occurring?
2. **Planning—** What is the quantity, quality, and clarity of your information, and do you have adequate time to utilize that information in your planning?
3. **Contingency Resources—** What pre-determined resources might be relied on for backup if the situation becomes overwhelming? Are those resources available, reliable, and appropriate to the scale of the mission?
4. **Communication—** Communication considerations focus on both interpersonal dynamics and technological logistics.
5. **Team Selection—** What are the qualifications and experience of your team members and any backup teams?
6. **Team Fitness—** Team-fitness considerations include mental and physical health – including such factors as ability to withstand environment challenges and sleep-deprivation – and how those factors might affect the team member's performance.
7. **Environment—** What are the environmental factors affecting your team and equipment's performance?
8. **Incident Complexity—** What is the amount of time required to perform the job and thereby be exposed to hazard? What is the complexity of the task, and for how long will the environmental conditions remain stable?

The eight scores are then tallied, and based on the total, the option is placed on a green to amber to red continuum from zero to 80. Theoretically the riskiest option will have the highest score, while the option with the least amount of hazard will have the lowest score.

SUPERVISION			
PLANNING			
CONTINGENCY RESOURCES			
COMMUNICATION			
TEAM SELECTION			
TEAM FITNESS			
ENVIRONMENT			
INCIDENT COMPLEXITY			
TOTAL			

Sample Risk-Calculation Worksheet

Considering that the GAR is most typically utilized in a mission-planning capacity (and you could define the term *mission planning* as the pre-tour fuel up at the coffee shop with your ski buddies), the advantage of such pre-mission assessment is that factors diagnosed as risky can often either be waited out or changed.

For example, before embarking on a tour into "yellow" terrain on a day denoted as having high avalanche hazard, you realize you've forgotten your shovel, thereby warranting a very low score in the *Environment* category. You can either change your situation by delaying your tour until you have a shovel and/or change your tour plans to terrain where the risk of a slide is little to none.

"It allows you to identify and explore hazards," says Comey, relating it to a backcountry-ski expedition with a group of friends. "If everybody understood it and did it a few times, you could use it just like that." The GAR also pulls in more concrete ways of analyzing human factors such as experience, fitness, physical and mental state, equipment, and communication.

Shott, who conducts ORMA trainings, recalls several people confessing to him after trainings, "'You know my gut feeling was we were doing something wrong, but I never knew what to say to my boss.' With the ORMA we're giving people tools to articulate with."

Shott found that the common vocabulary the ORMA provides has been of particular use for the Sylvan Pass panel, as at the onset the various participants were utilizing multiple terminologies. "By the end of the workshop," Shott says, "all of a sudden people were talking the same language. [The ORMA] creates a simple way to quantify and understand the risks involved."

SPE: Severity, Probability, Risk

SPE, which stands for "Severity, Probability, and Risk," is an other risk-assessment tool which tends to focus more on being in the midst of the action versus anticipating it as with the GAR. The definitions of each component are as follows:

1. **Severity—** The potential loss or the consequences of a mishap.
2. **Probability—** The likelihood that with the amount of exposure time a given mission occurs an accident with the anticipated consequences may occur.
3. **Risk—** The amount of time, quantity of people and equipment involved that will be exposed to the hazard.

SEVERITY x PROBABILITY = RISK

The operation or option in question is then evaluated on a ? scale with its level of riskiness and corresponding action classified as:

PROBABILITY	ACTION
Slight	Possibly Acceptable
Possible	Attention Needed
Substantial	Correction Required
High	Immediate Correction
Very High	Discontinue

If multiple options are being debated, these can be ranked by their level of risk. Shott suggests that the SPE process comes in particularly handy when searching for a conclusion about grey areas whose risk level hasn't become clear through the GAR.

Inclusion of the ORMA in Professional and Personal Decision-Making

While the ORMA is certainly not a panacea for making decisions in avalanche terrain (no single system is), it does provide an interesting tool to add to our decision-making toolboxes, and with more investigation it may be utilized more often by the avalanche community. Currently the NPS is working to integrate this system into more of its operations.

One drawback described by Don Bachman, a Sylvan Pass panel member, avalanche consultant, forecaster, and control specialist, is that he sees the ORMA as an incomplete tool for the recreationist. "You can't use it if you're making a decision for touring where there are other options. You'd have to take the other option."

Neither system leaves much room for historical information. For instance, some may feel there should be a way to denote less risk if assessing options between a slide path that has only slid once in the last 15 years versus a slide path that goes regularly. However, while this level of risk may be tolerable in personal pursuits, many view professional decisions differently. "I don't think incident complexity gains anything from a good track record," says Bachmann, referring to one of the evaluating categories. "It's just a matter of time before someone could be killed on Sylvan Pass."

Although the SPE and GAR may be used for assessing programs, some feel that both processes work best when assessing a particular moment in

Continued on page 28 ➡

Dave Hill (at left, without a hat on, as usual) works on heating up a gun in a snowstorm in preparation for an avalanche hazard-reduction session on Sylvan Pass. *photo courtesy National Park Service*

The question of duds on Sylvan Pass had garnered much attention and concern when, in 2004, a YNP official unfamiliar with the avalanche program publicly referred to 300 unrecovered duds on the pass. In reality, the number is unknown because prior to the use of the 105mm howitzer no dud records were kept. Since the introduction of the 105mm howitzer in the late 1990s there have been eight duds, two of which have been recovered: one was detonated in place on the mountain by an EOD Team, and the other was detonated by the US military on the road at Sylvan Pass after it rolled off the mountain and landed on the road while it was open to the public. Since their introduction to YNP in the 1980s, eight to nine duds are at large on the pass.

While Bob Comey remains neutral as to how Sylvan Pass should be managed, he does offer the warning, "This should be of real concern to the avalanche community. If people who are not avalanche professionals are making blatant misrepresentations of fact, and that becomes accepted, avy professionals could seriously suffer in their credibility."

Prior to snowplowing the road each spring for motorized traffic, a metal detector is used to search for duds. During the winter, guides versed in the identification and management of duds accompany all motorized travelers. While explosives used by helicopters have an electronic locating chip (RECCO), their dud record on the pass is a higher percentage than that of howitzers: 1.7% as compared to 5%. (The 105mm howitzer dud record is 0.5%.)

Snow Observations from the Silverton Backcountry: 12/17/07

Story by Doug Krause

Since the first of the December we have received around 75" of snow at 10,400' in Cement Creek with above-average water content. The skiing is very good; considerably more snow has fallen up high, and there have been transporting winds from the south through the west during most of the storm cycles. Failures to ground have occurred, primarily on NW aspects above 11,500' and confined to local features. The majority of avalanche activity has occurred at the interface between the first cycle and the second cycle or mid-storm during the second cycle. We are currently in our third cycle which has produced over a foot at 10,400' since last night.

Went for a ski today on King Solomon, NNW aspect from treeline at 11,600' to the upper Animas at 9,600'. On approach via road initially and then into the trees. No collapsing/cracking at all, anywhere, even on fat 38+° pockets near treeline. Saw some LS/SS-N-R4/D2-I from steep rockbands on NW aspects; W aspects in old paths among aspen groves seemed pretty bomber from brief cat holes and pole tests. HS: ~150cm with a nice hardness gradient and the snow a little moist at the bottom.

Encountered old SS-N-R4/D3-I? at treeline on flank of large path 36° aspect. 2-5'x300'x? probably ran Fri or Sat (Dec 14 or 15); went to dig crown profile and team short bus lost the only pencil, so obs are general. There was about 10" of new on the bed surface which was difficult to hold an edge on, and it probably failed in a wind-loaded area of ~40° then propagated out to adjacent 35° pitches. HS: 150-210cm. Bed surface was up to 100cm of K/P hard, well-bonded snow sitting on 5-20cm of P hardness depth hoar. Very difficult to produces failures within the bed-surface layer. There was a smooth hardness gradient from this layer to the surface pow. Had some Q2 failures above the bed surface in more recent snows but nothing impressive. Seems like this path may be a repeat performer this season.

Traversed over bed surface to gut of path at more NNW aspect and turned for about 200' vert of waist-deep, blower-over-the-head, face-shot San Juan pow, then cut into trees to the right and traversed to next path. Observed SS-N-R4/D3-I? in this main path with mid-thigh ski pen in new snow on old debris. This part was very good, then descended to the Animas. Some cracking on steep pitches closer to the creek, but nothing moved.

No snow bridge. Team short bus scouted a crossing, and the first contestant achieved mid-thigh boot pen in the upper Animas, was able to travel ~10' upstream and gain the far shore. Second contestant continued downstream, scouted new crossing, and encountered mid-calf boot pen but made a rapid clean crossing and ascended 45° bank of HS: 150cm willows to the bike path. Returned to TH at Arrastra Gulch and departed on quest for beer. Good day. Pray for snow.

Doug Krause is a backcountry skier, Silverton resident and avalanche professional. He realizes that this flash of stability in the San Juan continental snowpack is a gift not to be counted on for the future.

Top: Doug Krause flashes a couloir. *photo by Steve Mead*
Bottom: Expedition member Steve Mead crosses the Animas on the way back to the car and the bar. *photo by Doug Krause*

Top: This picture of the avalanche area was taken from the south rim of Spearhead Glacier looking north to the Corona Bowl bootpack and entrance. One skier is bootpacking to the top of Corona Bowl (the entrance to the bowl is behind the ridge). Bottom Left: A view of the runout. Bottom Right: A view of the crown.

Whistler/ Blackcomb Small Avalanche

Story and photos by Lee Lau

This shows a small avalanche (size 1 at most) triggered by a group of skiers on a traverse to a popular backcountry run named Corona Bowl off the Blackcomb ski area. There were five skiers in the group. As the traverse is either flat or slightly downhill with only one bootpack at the end of the traverse, the group travelled on skis with no skins. This is an area that sees a lot of traffic by a large variety of users and is readily accessed from ski-area boundaries.

This incident occurred on December 7, 2007 – a bluebird day. Winds were light. Temperatures approximately minus 10 degrees C. The major recent weather incident was a Pineapple Express warm wet front coming through the area on December 3 which deposited a lot of moist snow above 1900m and brought freezing rain at lower elevations. The Pineapple's first wave had spiked freezing levels even higher, so there was a melt-freeze crust present at even the Corona Bowl area (approx 2200m elevation).

There was no significant amount of new snow after that event. A minor Arctic high locked in good weather in the area for a few days after, bringing moderate NE winds. The traverse is windward, and there appears to have been wind-transported snow on the traverse.

There were no injuries, and no equipment was lost. Two skiers at the rear of the party were caught and skied out of the debris. Fortunately the runout zone of the slide is a flat bench. There are rocky outcrops below the traverse that the party had already crossed safely.

I went to take a look at the slide path and had the following notes: SE aspect. Crown about 10cm on 44-degree slope. Failed on w/s. Cross-loaded slope. Not a clean shear on the stauchwall. Buried facets about 10-20cm down. Ran about 50m.

Lee Lau is an enthusiastic recreational backcountry skier who tours mainly in the southwest British Columbia area with frequent trips to the interior of BC and the Canadian Rockies.

Sink or Swim; Heads or Tails

Story by Dr. Martin Radwin

At our recent point-counterpoint discussion during the Jackson Hole AAA educational seminar whether or not to swim if caught in an avalanche, Dale Atkins and I presented opposing views on the virtues of each approach to this important, long-held dogma. Dale's opinion regarding the danger of swimming, by potentially not having a hand available for creating a life-saving air pocket when the avalanche flow unexpectedly stops and rapidly sets, is well taken. I strongly commend him for challenging conventional thought and opening our minds to a radically different approach to that which has been taught for decades. If we didn't ask these kinds of questions, science would stagnate into unbridled acceptance.

However, I argued that swimming, or in reality struggling and fighting to achieve self-arrest on the surface or flanks of the avalanche, is the correct strategy for survival, if not basic instinct. I recall taking a "fall for life" after hitting a submerged stump and releasing from both skis, falling forward into a steep chute with a stand of trees at the bottom. No thought was involved for me to fight with every ounce of strength to try to arrest the fall and swing my legs in front to protect my head from trauma. It was all instinctive. Could we really teach potential avalanche victims in a panic situation not to fight but rather flight and concentrate only on achieving an air pocket?

I further suggested that this fighting action with limbs flailing in battle with the forces involved might actually operate to effectively increase the size of the victim, enhancing upward separation during laminar flow by the principle of inverse segregation. However, neither Dale nor I had any substantial evidence to support our positions except for unproven theories. So how do we answer this intriguing question scientifically?

A scientific approach to this question ideally requires prospective, evidence-based, controlled study. However, when this is not possible as in the case of human research in potentially lethal trials, we must instead rely on theory, expert opinion, experience, and modeling to reach a consensus. In this regard, Karl Birkeland, in his article beginning on page 12, has taken the lead by initiating a dialogue with experts in the realm of avalanche dynamics and experienced practitioners to help dissect out any commonalities between the theories of bench researchers and evolving practices in the field.

Karl's investigations reveal some interesting similarities between practice and theory, but answers to complex questions don't come easily. Survival strategies may differ depending upon where in the avalanche anatomy one is caught. In laminar flow, swimming and fighting might have a beneficial arresting and surfacing effect favoring placement into the "tail" of the avalanche where velocities are slower. In contrast, in the "head" or leading turbulent zones, fighting may be futile due to high velocities and subduction making airway protection the preferred action. In addition, the size of the avalanche will dictate the relative proportions of head and tail regions thereby translating into success or failure of swimming and fighting.

Obviously, more research and investigation is needed, as no simple answers or consensus can be reached at this time. However, thanks to Dale and Karl, the train has left the station, and momentum is gaining to find an adequate answer.

Dr. Radwin attended The University of New York Stony Brook where he received a Bachelors degree in Biology. The lure of the mountains and a love of snow led him to the Green Mountains of Vermont for medical school at The University of Vermont. Internal Medicine residency and Gastroenterology fellowship was served in the Tufts University hospital system in Boston. He subsequently practiced in Concord, Massachusetts for 11 years before heading for the larger mountains of Utah to further pursue an interest in snow and avalanche science. Over the last 10 years, his activity in avalanche burial physiology research has resulted in multiple publications and has led to international recognition. He is a Professional Member of the American Avalanche Association and has presented papers at several International Snow Science Workshops. He presently practices at Granger Medical Clinic in Salt Lake City. As a winter enthusiast, he spends much time skiing and enjoys teaching wilderness medicine, rescue, and survival, having previously served as Medical Advisor and active member of the Weber County Sheriff Search and Rescue Team.

SNOWKITERS:
A New User Group Enters Avalanche Terrain

Story by Max Forgensi

In mid-November, I was contacted by Brian Schenck, co-owner of Windzup, to speak at the inaugural Snowkite Summit. The venue: the Manti-Skyline, one of our forecasting zones. The Manti-Skyline is a large piece of earth: 50 miles of terrain stretch north to south and 20 miles east to west, which makes forecasting and educating multiple user groups difficult at best. Brian made our job easier. He came to us with concerns on how to keep an exploding sport safe. Recognizing that kite technology and increased skill levels were pushing snowkiters into avalanche terrain, Brian wanted an early start on the education front.

Bisecting the Skyline is State Highway 31, the highest maintained highway in Utah. Avalanche starting zones can be found 50 feet from the road. Snowkiters can use this high-elevation starting point to their advantage. Unobstructed (and consistent) winds and long-ridge lines make the Skyline a world-class snowkite destination.

Snowkiters have various backgrounds and venues in which they can play in or on. In the summer, lakes and oceans can be used as playgrounds. In the winter, frozen lakes from New York to California are places people can use to kite. Snowkiting in avalanche terrain is definitely an option. With the right wind direction and skills, users can climb slopes fast, and I mean real fast…traversing a mile of terrain in a few minutes. In the past three years, I have seen people in this burgeoning sport do things that I thought were pretty impossible – 300' of hangtime, anyone? One major concern of the industry is unfamiliarity with avalanche danger. A snowkiter from Buffalo, New York, would probably be clueless on the dangers of riding in avalanche terrain.

On December 8, 2007, over 50 minds representing the core of North American snowkiting gathered to discuss avalanche-education issues. From over 20 states and two countries were dozens of retailers, snowkite schools, and instructors. Not to mention representatives from *Kiteboarding*, *Kiteworld* and *Drift* magazines. Kite-mountaineer Andrew McLean and backcountry pioneers Noah Poritz and Ken Lucas were on hand as well.

Many topics were brought up regarding safely mitigating hazard in avalanche terrain. This is not a complete list of the dangers, but of topics brought up by the group attending the discussion.

photo courtesy Windzup

1. **Terrain Traps:** Even small terrain features can be dangerous – especially gullies that snowkite users find themselves in.
2. **Alpha Angles:** Recognizing where historic avalanche run-out zones terminate. This was brought up in regards to cross-country travel in remote locations.
3. **Windward vs. Leeward:** Non-prevailing wind days. Usually, with prevailing winds, snowkiters are on the windward sides of slopes and ridges and out of the major hazard. When the winds change, they are able to recreate on the leeward hazard: the wind-loaded side of a ridge or under an overhanging cornice.
4. **Avalanche Myths:** How a kiter could outrun an avalanche. The reality of an air-blast from an avalanche and its consequences.
5. **Slope Steepness:** Understanding that slopes greater than 35 degrees are where avalanches usually occur.

Overall, it was great to talk to a group of stewards in a snowsport growing in popularity. In speaking with some of the people in attendance, there have only been a few reported cases of snowkiters actually starting avalanches. It is great to know that the snowkite community is starting the educational process early with their user group. Snowkite retailers were discussing which avalanche rescue gear to sell and how to get kiters basic avalanche education. For us in the avalanche world, be prepared for a new user group on the block. If you haven't used the wind to travel over snow, it is a powerful tool to put in your tool box, not to mention tons of fun!

Max Forgensi works as an avalanche forecaster for the Utah Avalanche Center, Moab office. In the summertime, he is a wildland firefighter based out of Moab. He and his wife Erin are expecting a baby in early April and ask TAR readers to wish them luck.

INCREASE THE ODDS

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is where there are tremendous subducting forces and wildly turbulent flow patterns that make swimming either difficult or impossible. If you are getting thrashed around in this zone you might be best just trying to protect your airway if that is at all possible.

Of course, when we teach others about avalanches we don't want to focus on how to survive an avalanche. Instead, we need to emphasize the importance of not getting caught in an avalanche. Still, having a viable plan might save the life of a person who unintentionally does get caught in a slide. Clearly, each avalanche will be somewhat unique and different strategies might work in different avalanches. However, we believe that the strategies and ideas discussed in this article can form part of a useful plan for surviving avalanches.

REFERENCES

Amman, W.J. 1999. A new Swiss test site for avalanche experiements in the Vallée de la Sionne / Valais. *Cold Reg. Sci. Tech*. 30, 3-11.

Atkins, D. 2007. Bloodletting, water, Brazil nuts, swimming, and dying in avalanches. *The Avalanche Review* 25(4), 9-11.

Bartelt, P., O. Buser, and K. Platzer. 2007. Starving avalanches: Frictional mechanisms at the tails of finite sized mass movements, *Geophys. Res. Lett.* 34, L20407, doi:10.1029/2007GL031352.

Karl Birkeland is the avalanche scientist for the Forest Service National Avalanche Center, and is based in Bozeman, Montana. He's been trying to control, forecast, and study avalanches for the past 25 years. Karl enjoys mucking around in the snow in the winter when he isn't chasing his two young daughters around Bridger Bowl.

Perry Bartelt is head of the research unit "Snow avalanches, debris flows and rockfalls" at the Swiss Federal Institute for Snow and Avalanche Research (SLF). Although clearly a theoretician, Perry can and even enjoys writing computer models that actually work on real problems.

Theo Meiners is the owner and lead guide for Alaska Rendezvous Lodge and Heli-Guides, which he has operated for the past eight seasons. For the five seasons prior to that, he was a lead guide for Doug Coombs at Valdez Heli-Ski Guides. When it's too dark in Alaska he spends his time guiding at Jackson Hole Mountain Resort. Theo has been skiing and guiding in the Alaska's Chugach Range, Colorado's Elk Mountains, Wyoming's Teton Range, and the Andes in Chile. Without dummies to experiment with and with poor technical help, he and his colleagues have managed to blunder through many an experiment of merging science with practice as they passively and personally mitigate avalanche hazard.

SYLVAN PASS

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time, since factors such as *Environment* constantly fluctuate, so are difficult to generalize.

Just as the NPS has slightly tweaked the ORMA to meet their needs, Bachman and Shott suggest that the ORMA could further evolve to meet the needs of specific programs, rendering the process even more effective as ski patrollers will inevitably have different specific concerns and levels of risk tolerance than heli-ski guides, for instance.

The Future of Sylvan Pass

For the time being, Sylvan Pass remains open with the avalanche hazard mitigated with helicopters and howitzer. But the park's recently released *Record of Decision* states that YNP and Cody will negotiate through a mediator to identify how Sylvan Pass will be managed for winter use. If there is no agreement by June of 2008, then YNP will manage Sylvan Pass with forecasting only.

Considering that the August ORMA process – in which Bachman, Comey, and Keator participated with Billy Shott facilitating – placed full forecasting among the riskiest and least gainful of all the solutions, this would be a puzzling choice. "The risk assessment process had value. But it wasn't followed," says Bachman.

It is worthwhile noting that the risk ratings described in the August ORMA were specific to the particular moment in time when the panel took place. Since that August meeting convened, significant staffing changes have occurred, and two new forecasters with a depth of professional snow-safety experience in private industry have been added to the Sylvan Pass program. Though new to forecasting on Sylvan Pass specifically, their level of expertise should balance the risk inherent with any personnel transition. However, Comey, Bachman, and Keator all agree that the change in personnel does affect the ORMA ratings. *(see response to this issue at right)*

For the next six months the park will continue accepting comments on the *Record of Decision*. It is difficult to anticipate whether the park will adjust their proposed plans and sway to the socio-political pressures of local advocacy group Shut Out of Yellowstone, which is fighting to keep the park open; environmental concerns about the appropriateness of explosives and snowmachines in a national park; budget constraints; or employee safety.

One missing element is a very key NPS management policy titled *Management Policies* (2006 ISBN 0-16-076874-8) which on page two lists 10 "Underlying Principles" for preparing the document. The third principle states, "Ensure that conservation will be predominant when there is a conflict between the protection of resources and their use," and the other nine follow the same general theme.

Just as interesting as the decision-making process will be the evidence the park uses to justify any closures or changes in programming – the reasoning is apt to be as controversial as the decision itself.

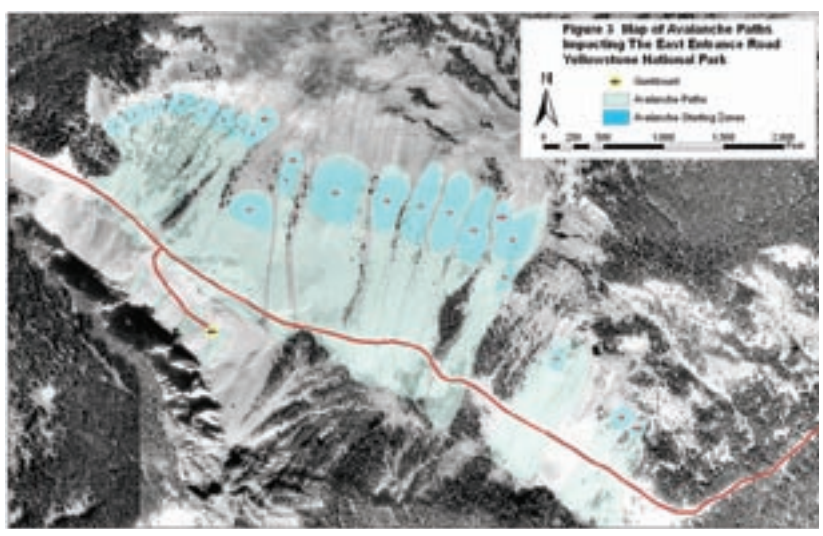
But putting environmental issues, employee safety, tax-payer rights to access public land, and NPS budgets aside, Bachman presents an important point: "Is this something we really want to engage in – an issue that involves fewer than 40 people a day – when we've got real serious issues just down the road at Teton Pass where over 4,000 people in cars are traveling daily?" He poses an important question which puts the issue of Sylvan Pass into an interesting context for avalanche professionals.

Sources

Comey, Bob PG. *Avalanche Hazards Assessment and Mitigation Report on Sylvan Pass*, Yellowstone National Park. 30, March 2007

Molly Loomis is a freelance writer who co-authored "Climbing Self Rescue: Improvising Solutions for Serious Situations" with her husband Andy Tyson. Molly is also an international mountain guide who works for Exum Mountain Guides in the summers. She lives in Teton Valley, Idaho, where she likes to garden, backcountry ski, and train her new puppy Kali.

Photographer Jim Peaco started working in YNP in 1980 having grown up in Illinois. He has a BS in geography from Illinois State University and has been the National Park Service photographer in Yellowstone since 1987. He met his wife on a backpacking trip in the Wind Rivers, and his 21-year-old daughter can out-hike him these days, but he can still out-ski her (for now). He enjoys ski touring in the mountains of NW Wyoming and SW Montana from his home in Cooke City, MT. Summers find Jim on canoe trips and at bluegrass festivals. He can be reached at Jim_Peaco@nps.gov



Sylvan Pass slide paths and starting zones. *image courtesy National Park Service*

From Maura Longden, Sylvan Pass snow-safety forecaster: The same people with the addition of two more are involved in the control work, so the risk is not increased in the control program. Adding a professional forecaster to the program should not drive up the risk significantly. Instead, the program benefits from this level of experience, building on the program established by previous forecasters in the park.

The additional forecasting expertise, implementation of an operational profile for Sylvan Pass operations, increased training for all Sylvan Pass personnel, and improved information dissemination have added to the overall safety of the program this season.

I appreciate the fact that the ORMA was completed with the involvement of private and government participants. It is a very useful tool to us who are involved in public and employee safety on Sylvan Pass.