THE Avalanche REVIEW

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Making Tracks in Snowmachiner Education

Hill climbing, the sport of roaring powerful snowmachines up steep mountainsides, is now made possible even on the stock machines sold by the thousands throughout the Intermountain West. As snowmachine technology outpaces riders' avalanche awareness, increasing numbers of recreational riders travel into avalanche terrain completely unaware of their peril. Until avalanche education reaches this at-risk population, more and more snowmachiners will simply not be returning from their backcountry outings.

Photo by Toby Weed

Each year I'm involved it becomes more apparent. If you are going to provide avalanche programs to snowmobilers, you have to be sincere and credible. If you feel strongly that snowmobiles do not belong on public lands, don't even try to run classes. Now this doesn't mean you can't have some differences of opinion, but if you constantly make derogatory comments about Budweiser-drinking, good ol' boy snowmobilers, you need to find someone else to do your job. Some of the finest humans, the greatest athletes and the most backcountry savvy people I know happen to be avid snowmobilers. This doesn't mean there won't be some tough nuts out there, but just remember we're all human.

It is also essential to get out and ride. You don't have to be a star. If you give it your best shot it's surprising how many riders will teach you some tricks and help you when you're stuck. I was reminded of learning to kayak when everyone helps a swimmer and collects the pieces. Be honest, if you are not an experienced rider you won't fool anyone once you unload your sled in the parking lot.

I had an interesting experience last winter. The Sawtooth National Forest Avalanche Center faced its second snowmobile avalanche fatality in two years. The victim was a well-loved member of the local community. He grew up in town. He was a father, a husband, and a son. He made a tragically poor choice that day. How many of us have made similar choices and gotten away with it?

The day after Boe's memorial service, a local group of riders asked the avalanche center to go out to the accident site with them to get a better understanding of what happened and to say goodbye to Boe in a place he loved.

I felt tongue tied in the parking lot; I knew the words I spoke would start the day. Many things had been said around town since the accident, some of them very harsh and cruel. I took a big breath and looked around. "I am so very, very sorry about losing Boe. What I want to tell you today is what the avalanche center is about. First of all, we are not about criticism or judgment or blame. We are here to support you in the good times and the tough times. Right now is a very tough time, and we're here to help."

That is the bottom line. Ask yourself, "Do I want to help?" Then ask the snowmobilers what they would like to learn—don't tell them what you think they need. Have some patience and faith in the process. You'll be rewarded with a great response.

—Janet Kellam, Director,
Sawtooth National Forest Avalanche Center

in this issue

If you don't ride a sled, you ain't gonna have any cred.

—Craig Gordon
Riders in the Storm, pg 17

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american avalanche association

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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 executive director

Fall is a great season. The anticipation of winter can surpass the actual thing. Thinking of deep snowfalls, big avalanches, and powder. During winter it can all pass in such a blur. The rituals of autumn: ski magazines, weather station installations, pre-season meetings where we again connect with our soul sisters and brothers. Ah, another season of possibilities.

Looking back at the last year at AAA, we continue to advance our goals and objectives. Over the summer, Don Sharaf and the Education Committee have developed the AAA Professional Avalanche Worker School, explained in the last issue of TAR (vol. 24, no. 1). We look forward to this program becoming a staple of educational opportunities offered by AAA. In the one year that *Snow, Weather, and Avalanche Observation Guidelines* (affectionately known as SWAG) has been in print, 1200 copies have circulated into the snow and avalanche world necessitating another printing this summer. The widespread acceptance of this, our first publication, is very gratifying. The sales have also benefited the AAA bank account.

Speaking of the bank account, it's time for my annual appeal for membership development. The primary source of revenue for AAA is membership dues, which fund everything from production of *The Avalanche Review* (our primary product and reason for being) to fees for lawyers and accountants. Yes, we are big enough now to need lawyers and accountants. We've been able to hold the membership dues at their current level for 10 years now; at this point in time there is no push to raise dues. We would like to continue to increase our membership and thereby our working capital. Benefits of membership include receiving our ever-improving *The Avalanche Review*, the Membership Directory for Pro and Affiliate members, and discounts on SWAG and the new Professional Avalanche Worker School. But really, as a member you are giving as much as you are getting. Your dues further our goals as an organization to be the voice and instrument of the American snow and avalanche profession. A small profession perhaps, but a compelling one with many dedicated adherents. Many of us feel that way. If you do too, please spread the word and help us grow AAA.

At this time it is appropriate to acknowledge the Lifetime Membership of Gary Kuehn, a guide from Wanaka, New Zealand. Lifetime Membership represents a significant financial contribution to AAA. Thank you Gary.

Now for my next appeal: next summer we'll be electing officers for the AAA Governing Board. That's President, VP, Treasurer, Secretary, and Section Representatives. What is required? An interest and well...try to attend the semi-annual board meetings and answer your e-mail. The president runs the board and annual meetings and the secretary takes minutes—those are the labor-intensive jobs. We try to make the meetings as painless as possible and have some fun along the way too. If that is just too much to resist, let me know. But really, backing friends and acquaintances into a corner in order to fill out the board should come to an end. Willing, interested people sought.

A year from now will be the 20th Anniversary of the American Avalanche Association. Sue Ferguson presented the initial idea at the 4th ISSW in the Squaw Valley Theater and it was hashed out on the deck during a break. To think of how far we've come since then…and what we can still become. It's humbling and inspiring. Here's to inspiration and a good winter to you all.

—Mark Mueller, your Executive Director

metamorphism

The 2006 AAA Membership Directory will go to the printer around the New Year. If you have any changes you would like to make to your information, please email those changes to aaa@avalanche.org before January 1, 2006.

New Pro Members:

Rich Chandler, Big Sky, MT
Chad Colby, Whitefish, MT
Mark Dundas, West Glacier, MT
Kyle Fedderly, Whitefish, MT
Aleph Johnston-Bloom, Eden, UT
Craig Lutke, Sundance, UT
Matt McKee, Sandy, UT
Ron Rash, Basalt, CO
Marty Rood, McCall, ID
Ilya Storm, Banff, Alberta

New Member Affiliates:

Mike Bartholow, Auke Bay, AK
Ben Hatchett, Tahoe Vista, CA
Dan Kostrzewski, Bellingham, WA

from the editor

Here at *The Avalanche Review*, each volume's first issue has always been dedicated to the previous winter's backcountry summaries, taken primarily from the Forest Service avalanche centers. The last few years we have also included season roundups from Europe. In 2004 we began to organize more issues around a central theme. Many perspectives can expand insight, delve into practice, and complete our understanding of a topic. We found that during the ISSW in Jackson, we could stroll around the posters, listen to the presenters, and easily gather together new material or perspectives that represented similar patterns of thought. TAR's "decision-making issue" of last winter (23/3) was a product of that ISSW brainstorming process. Since then, we endeavor to stay abreast of research and innovations by general nosiness: we send out queries and chase down rumors. Some themes are carefully planned, others are seasonal or situationally obvious. We also rely on you, our readers, to send articles and items of interest our way. What do you talk about at the end of the day with your fellow snow geeks? What themes would you like to see us examine?

The theme of this issue of TAR came together at the last minute. It regards a vital, cutting-edge topic: snowmachiner avalanche education. This focus was in large part the brainchild of TAR's assistant editor, Toby Weed. He and Craig Gordon, Forest Service Utah Avalanche Center Forecasters in Logan and the Uintas, currently confront this challenging issue in a part of the West where "getting the word out" is further strained by divisive controversy between backcountry skiers and snowmachiners. We benefit from the experiences of Janet Kellam of the Sawtooth National Forest Avalanche Center in Sun Valley, Idaho, and Bob Comey of the Bridger-Teton Avalanche Center in Jackson, Wyoming. As always, we continually seek methods of teaching good decision-making that transform the concepts of snow science and human behavior into day-to-day self-awareness and practices that save lives.

—Lynne Wolfe, editor, The Avalanche Review

Jerry Roberts has the unenviable job of combing through resumés and applications as the AAA Certified Instructor reviewer. After a rocky summer, Jerry's doing well enough to provide TAR with an update of the membership program *(see next page)*.
photo courtesy Jerry Roberts

call for 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.

SUBMISSION DEADLINES
Vol. 24, Issue 3. 12/15/05
Vol. 24, Issue 4. 02/15/06

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Write it up; send it to us. *The Avalanche Review* is accepting articles, stories, queries, papers, photos.

american avalanche association

MEMBERSHIP APPLICATION

date_____

name_____

mailing address_____

city_____

state_____ zip_____ country_____

phone (hm)_____ (wk)_____

fax_____ e-mail_____

avalanche-related employment/employer:

_____

ALL CATEGORIES RECEIVE *The Avalanche Review*

MEMBERSHIP: ❒ **NEW** *(include resumé for review)* ❒ **RENEWAL**
(membership runs for one year: from October or March, depending on application date)

❒ **$40 PROFESSIONAL MEMBER:** Professional Member applicants will be screened by Section Reps and Membership Committee for a minimum of four years of education and experience and active professional involvement in avalanche activities. Must include resumé with application.

❒ **$35 MEMBER AFFILIATE:** Member Affiliate applicants will show lesser (but greater than minimum) education, experience, and involvement. Must include resumé with application.

❒ **$20 SUBSCRIBER:** no resumé requirement.

❒ **$800 LIFE MEMBERSHIP**

❒ **INTERNATIONAL MEMBERS** must include additional amount for postage: Canada $5US • Europe/South America $10US • Asia/Pacific $15US

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make checks in US$ payable to AAA

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So You Want to Be a AAA-certified Avalanche Instructor (or, *How to Fill Out the Form*)

Story by Jerry Roberts

I was asked to share ideas on how to fill out the required application for AAA instructor certification. I've pondered the request and will attempt to share ideas and relate common mistakes that many applications, particularly those that have been rejected, have included.

First, read the application. Second, read the application more carefully. The most important section of the application and the least thought about or under-documented is Requirement #1: PRACTICAL SNOW EXPERIENCE. Ten or more seasons of experience in focused snowpack-stability evaluation. This is usually the most overstated portion of an application. For a ski patroller with a control route, a snow-safety director, or an operational avalanche forecaster, this is an easy question to answer. But it is more complicated for a backcountry skier or guide. Most people in this latter group do not document their day in the backcountry. The snow-pit profile and daily observations just don't make it into a snow journal.

The second most misunderstood section is Requirement #2: SNOW SCIENCE AND THEORY. Some applicants include almost any snow experience since grade school. We are looking for reputable avalanche programs attended, college-related snow courses, and technical papers and articles written for publication. A solid educational background is necessary.

Requirement #3: TEACHING SKILLS. Letters of recommendation are important as they help validate an applicant's teaching experience and skills. But on several occasions, letters of recommendation have been unclear and ambiguous, not a full endorsement. Note: The reviewer is not a mind reader. If you have doubts or reservations about the applicant's qualifications, please do not write an endorsement. Review the applicant's resumé prior to submission. Be accountable for your recommendation.

As Richard Armstrong jokingly told me years ago, "If you aren't embarrassed by your resumé, do it over again." We want to see a professional presentation (resumé) that reflects the Jesuit/Zen axiom, "Less is more." Be brief, present only relevant information, and leave out fluff. Even if you are a great teacher and possess most of the qualifications, but fall short of the 10 seasons of experience, please wait until you have all 10 seasons before applying.

All AAA professionals are encouraged to apply for instructor certification. Most professional members with 10 or more seasons of focused snowpack/stability evaluation experience and good references can find their way into AAA certified instructor membership.

Jerry Roberts winters in Silverton, Colorado, where he keeps tigers off the road for the CAIC and CDOT.

AAA-certified instructors (2005): Tyson Bradley, William D. Beck, Dean Cardinale, Tom Carter, Sam Davis, Kelly Elder, Kellie Erwin, Bill Glude, Ethan Greene, Jerry Hance, Denny Hogan, Janet Kellam, Sandy Kobrock, Dan Moroz, Rod Newcomb, Dick Penniman, Evan Salke, Don Sharaf, Lynne Wolfe

what's new

Snowstruck Review

Story by Allen O'Bannon

Looking for some interesting reading this winter? Then I would recommend checking out *Snowstruck: In the Grip of Avalanches*, by Jill Fredston. It may not hold any new information about avalanches for those of us who work in the avalanche field but it does shed some great insight into the lives and work of Jill Fredston and Doug Fesler, or "jillanddoug" as the author says they are sometimes known. It is also a great book for highlighting some of the types of work avalanche professionals engage in. While hopefully most of us don't do as many body recoveries as Jill and Doug have, she does a wonderful job of painting the impact this side of search and rescue has upon one's psyche.

Jill shares with us her passion for avalanches and yet at the same time we begin to see effects of the loss of too many friends and acquaintances. She also shows us how hard it is to quantify human error in accidents. We can't make simple judgments about what leads to an accident when the forces behind human decision-making are complex and intertwined with many facets of our lives. Indeed there seem to be so many factors (according to the latest research) pushing at us that, as Jill states so well, "Instinct may help keep us safe if we use it to back away from an edge, but if we rely on it to assure us that everything is okay, we are likely to die."

The stories in the book are well chosen to illustrate a variety of avalanches: from those big enough to wipe out whole neighborhoods, to the small avalanche that is just powerful enough to knock someone off their feet at the wrong time. If I was left wondering about anything, it would have to do with the 1999 avalanche on Turnagain Pass that Jill refers to a few times but never goes into any detail about. But then again, having read about this event in the many newspaper accounts at the time I didn't feel as if I was left in the dark either.

If you have never heard of Jill and Doug then *Snowstruck: In the Grip of Avalanches* will be a great introduction to these two pioneers of Alaskan avalanche work and of worldwide avalanche education. For those who know Doug and Jill, this will be a great book to give to friends and family in order to give them some insight into the world of avalanche work. They may just look at you with greater understanding and appreciation of the work you do.

Allen O'Bannon is the author of Allen and Mike's Really Cool Backcountry Ski Book and Allen and Mike's Really Cool Telemark Tips. Allen has worked the last couple of years as science support in Antarctica.

IKAR Avalanche Search and Rescue Recommendations

Story by Dale Atkins

Two avalanche-related recommendations were approved at the 56th annual meeting of the International Commission for Alpine Rescue (IKAR-CISA) in Zakopane, Poland. The recommendations deal with the marking of clues on avalanche rescues and improving safety during search trainings with buried people. Both recommendations were developed and formulated within the Avalanche Rescue Commission and were also approved by the Terrestrial Rescue Commission at the Fall 2004 meeting.

Recommendation REC L 0003 Marking of Locations on an Avalanche was adopted by the American Avalanche Association during the Spring 2005 meeting. The recommendation provides a simple standard designating three colors — yellow, red, and blue — to be used as marking colors on avalanche search and rescues.

By consensus—about 20 countries—the avalanche perimeter shall be marked with yellow-colored (main color) markers. Probed areas shall be marked with red-colored markers, and clues and objects such as tracks in and out, skis, poles, hats, etc., shall be marked with blue-colored markers. For easier documentation the recommendation suggests the blue markers carry "clearly [large] visible numbers." The recommendation also adds that "two crossed markers" shall mark the last-seen area.

Recommendation REC L 0003 provides a core marking scheme that ski patrols and mountain-rescue teams can build upon. Teams may use any type or combination of markers (flags, flagging, ropes, banners, etc.) and may also adopt additional colors to designate other search techniques like transceiver, RECCO, and dogs. For example, in Colorado many dog handlers use green flagging while in France and in the Wallis region of Switzerland orange markers are used. Avalanche rescue may involve responses from multiple agencies and with the increasing standardization of search and rescue responses—mandated by the federal National Incident Management System—the color-marking scheme will help all avalanche rescuers.

The second recommendation, **REC L 0004 Search Training with Buried People**, offers six simple and practical tips for increasing the safety of people buried in avalanche search drills. (Typically most people are buried for dog drills.) While serious accidents in avalanche search trainings are very rare, the numbers of close calls and near misses are noteworthy. Burial spots have been "lost" for an hour or two necessitating "real" searches and rescues. Snow holes have collapsed on solo diggers, and probing has caused injuries to buried subjects. Avalanche-dog handlers and rescuers should review this recommendation.

Copies of both recommendations can be quickly downloaded from the IKAR Web site: www.ikar-cisa.org. Click on "Avalanche Rescue" and then go to "Recommendations."

About Transceiver Ranges Advertised by Manufacturers/Dealers

The International Commission on Alpine Rescue (IKAR) is proposing a new guideline on avalanche beacons, recommending that manufacturers only communicate the effective (useful) range of their transceivers, as opposed to their "maximum" range, which can be misleading to the consumer.

This proposal was made in September to the IKAR avalanche commission in Cortina, Italy. It was presented by the French delegate to IKAR, François Sivardiere. A shorter version was adopted, to be voted on at the next IKAR annual meeting. For information, contact the US delegate to IKAR and co-chairman of the avalanche commission, Dale Atkins: snodale@comcast.net, 303-544-1642.

Definition: Effective range and search strip width (twice the effective range) dictate the primary search pattern, not maximum range, which is based on lab tests not applicable to the field environment. This is a common misperception that all avalanche educators will be interested in clarifying with their students.

The range of a transceiver is the maximum distance beyond which a receiving transceiver does not receive a transmitting transceiver (or a simple 457 kHz transmitter). This range depends on numerous factors:

- sensitivity of the receiving beacon (depends on model)
- state of the receiving beacon batteries (also depends on temperature)
- power of the transmitting beacon (depends on model)
- state of the transmitting beacon batteries (also depends on temperature)
- relative position in space of the two transceivers (coupling)

Giving the value of a transceiver range without this kind of precision makes no sense.

Three facts:

1. In their products user's guide and/or on their packaging, most of the manufacturers only give the maximum range. This allows them to announce ranges longer than 50 meters. This is made at the expense of other manufacturers who present shorter ranges and at the expense of buyers who cannot compare different transceivers on this feature.

Also, and much more importantly, maximum ranges only match a specific case that is seldom obtained in reality (for example: coaxial antenna for one-antenna transceivers).

2. To search for a buried victim, the strategy will be based on the retained range value of used-receiving transceivers. The search-strip width that rescuers may apply is twice this value.

If one uses too large a value, one runs the risk of applying too large a search strip and then not allowing prospected areas. Some buried victims may not be found if one uses the maximum range as a reference value.

3. When rescuers organize a transceiver search for buried victims, they should know what the range of their transceiver is in the most unfavorable case, depending on :

- battery level of transmitting and receiving beacons, at the lower limit given by the manufacturers
- low temperature (which unfavorably affects battery condition)
- worst coupling of transmitting and receiving models
- comment: respective position in space of the two transceivers may not be an essential factor (when doing the primary search, rescuers point receiving transceivers in every direction).

The search strip width that will be apply should be twice this specific range. Knowledge of this value is useful, hence its name: "useful range."

Conclusion: The useful range value is important. Not knowing this value might be dangerous and even fatal. Maximum range value is useless knowledge.

Proposition Recommendation: IKAR-CISA officially recommends that all transceiver manufacturers and dealers communicate only the useful range of transceivers.

Professional Avalanche Worker School Update

Course Update: The inaugural course will be held in Salt Lake City from December 10-17. Last-minute spots may be available, so if interested go to www.americanavalancheassociation.org/PAWS.htm for more details. Look for a detailed summary of this course and thoughts for upcoming courses in either TAR 24/3 or 24/4.

3rd International Avalanche Conference Set

The Third International Avalanche Conference will be held September 4-8, 2006, in Kirovsk, Murmansk, Russia—just beyond the Polar Circle in the Khibini Mountains.The conference will cover results of ongoing avalanche work and provide idea and information exchange between members of the world avalanche community.

Topics for 2006 will include snow-cover stability; avalanche dynamics; temporal and spatial avalanche forecasting; avalanche control techniques; awareness, education and public warning systems; avalanche search and rescue; slushflows; properties of snow and snow-cover evolution; snow drift; instrumentation.

Registration and information is available at www.cas.kirovsk.ru

RECCO Partners with The North Face

The North Face has incorporated the RECCO avalanche-rescue system into seven of their Prodigy pieces for this winter season. By integrating RECCO reflectors into the Free Thinker jacket and pant, Sedition soft shell, women's Sirius jacket and pant, and women's Nyla down jackets, The North Face takes a proactive stand for supplemental safety technology.

Krak Arntson, snowsports director at The North Face, says, "I think it's good stewardship for us within the industry to promote avalanche safety. Offering RECCO as a feature on our products is a way to bring more awareness to the consumer and the snowsports participant."

Peter York, Squaw Valley ski patroller and Tahoe Nordic Search and Rescue member, sees The North Face's effort as benefiting all rescue operations. "It makes all patrol jobs–everyone's part of the job–a little easier," he says. "As more people have these reflectors in their garments their chances improve for live recovery in a slide within the resort or out of bounds nearby."

This season's introduction is merely the first stage in the relationship between RECCO and The North Face. They will have seven items carrying Recco chips this year in their product line, approximately 20 for Fall 2006, and more for Fall 2007.

Additional information about RECCO can be found at recco.com and in Dale Atkins article, *The RECCO Rescue System*, on page 15 of this issue of TAR.

Campbell Scientific's CR1000 Datalogger

The CR1000 is Campbell Scientific's newest datalogger that builds on the company's 30-year reputation for rugged and reliable measurement and control instrumentation. It retains the versatility of its predecessor, the CR10X, and provides increased memory, more measurement channels, and multiple telemetry options.

A complete CR1000-based system for most environmental-monitoring applications would include a 12V power supply, weatherproof enclosure, application-specific sensors, programming/communications software, and communication peripherals.

The CR1000 allows for multiple measurement and control peripherals and sensor connections. Most commercial sensors can be used with the versatile channels consisting of 16 single-ended or 8 differential analog inputs (individually configured), 2 pulse counters, 3 switched voltage excitations, and 8 control/digital ports. An RS-232 port and CS I/O port provide the multiple telemetry options for the datalogger, via radio, satellite, phone (land line, cellular, voice), Ethernet, and more.

The design of the CR1000 is for long-term, unattended monitoring for individual or network applications. The datalogger uses minimal power that can be supplied by rechargeable batteries or solar panels. It also provides increased on-board memory to store data or additional storage is available by using the CFM100 module with a CompactFlash® card. The CR1000 has an operating range of -25 º to +50 º C; an extended range of -55 º to +85º C is available.

Campbell Scientific, Inc., is a worldwide manufacturer of dataloggers, data-acquisition systems, and measurement and control products. To learn more about the CR1000 and to obtain detailed specifications, please visit www.campbellsci.com/cr1000.

Hacksaw Publishing Backcountry Field Card

Avalanche professionals and students alike can use this simple plastic card to measure slope angles in identifying potential avalanche terrain. It has a 2mm grid for examining snow crystals when studying the layers of the snowpack in snowpits. The Backcountry Field Card also includes handy rulers for measuring various layers. Another useful feature is the small group avalanche rescue flowchart, which provides a handy quick reference to check if an avalanche accident occurs.

The simple plumb bob weight system makes this card virtually indestructible. We constructed the card from a special plastic that has been freezer tested at –21°C (-6°F) degrees for 36 hours. When we removed the card from the freezer, the plastic did not crack, deform or break when we repeatedly bent it back and forth. The smoke gray color makes a great background for studying snow crystals.

We polled a number of avalanche professionals during the development of this card, asking them what size and what kind of material they wanted the ideal snowpit field card to be made from. The majority said they wanted a larger card that they could hold while wearing gloves—but at the same time, small enough to fit in a jacket pocket. The 4.5" X 7" size meets both of these requirements in most cases. Most of the professionals also wanted the card to be made of plastic, for its lower thermal conductivity. Other cards made of metal tend to ice up in the field.

The flowchart design for the small group avalanche rescue flowchart plan on the opposite side of the card was designed by Dale Atkins of the CAIC. It is a quick reference flowchart for conducting small group avalanche rescue. Use it as a training aid in classes or as a group leader's reference to ensure that in a moment of crisis, the group is able to remain focused on the critical tasks at hand.

The Backcountry Field Card is suitable for both the professional and novice. The field card is an economical item for any avalanche school to issue to its students. It is available for $5.50 each (shipping & handling included) from Hacksaw Publishing, Inc., 867 unit A, Hill and Dale Road, Golden, CO 80401; 720-746-1543; http://members.aol.com/bsfbsnow.

G3's Wedge: Adding Turbo To The TARGA

Presented at the Winter Outdoor Retailer show this past January, the TARGA Wedge is now shipping. Developed as an accessory to the G3 TARGA and T/9 bindings, the TARGA Wedge is sold with longer screws and easily integrated into the TARGA bindings between the binding's toe plate and shim. Designed with downhill performance in mind, the five-degree wedge reduces rocker launch, promotes flexion of the boot and immediately engages the G3 spring cartridges upon initiation of the turn. Constructed with high-impact, cold-resistant plastic, the Wedge creates a more active binding, improves turning efficiency, and provides greater stability at speed.

The TARGA Wedge retails for $21 USD or $23 CAN and is available from your favorite G3 dealer or online at www.genuineguidegear.com.

Naxo nx21 raises the bar on alpine touring

Designed primarily for resort-based backcountry skiers, the nx21 is the beefiest A.T. setup on the market. The binding features a maximum DIN value of 13, widened rotation arms, and a "downhill lock" mode. It weighs in at five pounds per pair, including brakes: five ounces more than its predecessor, the nx01, and seven ounces more than the Fritschi Freeride. While the difference in weight is minimal, the difference in performance is not. Those lucky enough to test pre-production models last spring were impressed by the binding's edgeholding ability on hardpack. This is mainly due to the two improvements that were made to increase its torsional rigidity: wider arms on the binding's Virtual Rotation System (at the toe piece) and closed tubing in the rails underfoot.

The maximum DIN 13 release value and downhill mode lock also inspire confidence. The "dh lock" is a spring-loaded latch on the heel piece that eliminates any potential for inadvertently switching to touring mode. With the higher DIN settings, Naxo also added aluminum to the toe and heel pieces for less wear and tear when changing settings.

Naxo's Virtual Rotation System has not changed. The triple-pivot toe-piece design is what really sets these apart.

Naxo had some breakages its first year, 2003/04. But those problems were addressed and the return rate on last year's nx01 was negligible, according to distributor Backcountry Access. With two years of abuse and refinements under its belt, look for Naxo to take a strong stand among North American pro patrol and "outta bounds" crowd this year.

Pro pricing available to avalanche professionals: Naxo nx01: $264; Naxo nx21: $310. For more info, contact Backcountry Access at (800) 670-8735 or info@bcaccess.com

media

Don't Let THIS Happen to You!

Story by Karen Russell

I started out with so much potential, brimming with colorful attitude and shapely lines. People commented on my brilliant contrast and sharp attitude.

Yes, I could have been anything: a focal image in an editorial spread, a close-dropped detail illustration... perhaps even a cover image or a full two-page tabloid spread!

Sadly, my potential was squandered when I was not archived properly. Instead, my original image became part of a slideshow, then I was sized down and resaved in a Word document. Later still, I became part of a PowerPoint presentation and I submitted yet again to further jpeg compression as my only copy became embedded in a low-res PDF.

By this point I was barely useful, hardly fit for a thumbnail icon on a low-rent Web page. Graphic designers cringed when they saw me, for I had become a drab, muddy, low-resolution image. My crisp detail and glowing color were lost, never to return. On close examination, I was irreconcilably pixilated, seemingly made up of many small boxes rather than the delicate array of tiny brilliant dots that had once captured my essence. I bled color—highlights and shadows lost with indistinct midtone values.

Yet I could so easily have been saved! If my original file had only been preserved and archived on a hard drive and/or recordable media, I would still maintain all my rock-star glory, ready to be called up and provided at a moment's notice. Just think of it—the ability to be utilized by virtually any application, from high-end publishing to a lowly Web site.

Don't make the same mistake; don't let this happen to your valuable images!

A great image can make or break a story. Even the best story doesn't amount to much if it isn't read. And we humans are visual creatures. A brilliant photo entices us to begin reading and then keep reading; it maintains our attention when our eyes might otherwise tend to stray away.

It is a privilege to make the stories come alive on the pages of *The Avalanche Review*. The knowledge, expertise, and practical information each writer provides and the care taken to impart ideas is inspiring. But all too often the accompanying photos are just too low resolution to allow much design leeway—sometimes they really shouldn't be printed at any size.

When I say a larger file is needed, that doesn't mean you can simply open the image in Photoshop and increase the resolution there. Yes, the numbers are larger, but sizing up a tiny image does not improve the file. Once the detail is gone, nothing will bring it back. I do the best I can, and I have some tricks up my sleeve, but it's impossible to restore what has been lost. And now that The Avalanche Review is being produced in color, it's more important than ever to take and preserve impactful visual images.

I could get into a discussion of file-compression modes and production-value requirements, but let's keep it simple: take the biggest pictures you possibly can, take lots of them, keep the originals and send them to me.

Remember, every time you save and resave with jpeg compression, you are losing data that will never be returned. Simply preserve one original copy and you need never worry.

COMMON PITFALLS:

1. Your pictures start life too small.
It's fairly simple to set your camera to the highest possible resolution. But if you can't find your manual, surely you have at least one techno-geek pal who will be happy to help. Keep in mind you'll need to reset your default resolution each time you change the camera battery.

2. There's not enough storage space on your camera.
Buy a bigger photo card. They really are not that expensive (cheap as dirt at Sam's Club) and well worth the price to store several days or weeks of photographs before necessitating hard-drive dump.

3. This is the only shot.
Ensure you get a useable image by taking many frames of the same subject. It can be difficult to tell from the camera's tiny micro screen whether you nailed the focus. Go wide; go tight; go horizontal; go vertical. Try snapping the same subject from slightly different angles to take advantage of different light exposures. One picture may "blow out" the sky while another may "blow out" the snow. But the two can be joined for a match made in heaven. Provide both images and let the magic of Photoshop begin!

4. You need to crop, lighten, size, etc.
Send the entire, original, untouched, unsized, untweaked image. Go ahead and also send a lower-res version of your finished idea, if you like. But unless you spent $1K on your monitor, have it calibrated on a regular basis, and keep in close contact with TAR's printer regarding their current production values, what you see may not even be close to how it will actually reproduce on press. That's my job. Plus, starting from scratch with the whole banana gives the layout myriads of options.

5. Your e-mail won't attach big files.
No problem. Send low-res images with your story to Lynne, then snail-mail a CD. Or if you're somewhat techno-savvy, I have an ftp site where you can upload monster files. Send me a note to find out more.

Karen Russell, your friendly TAR production specialist, lives and works in scenic Driggs, Idaho. She operates her own graphic design firm, Fall Line Design, whose company motto encourages clients to NEVER MISS A POWDER DAY.

snow science

Backcountry Recreationists' Risk of Exposure to Avalanche Hazards

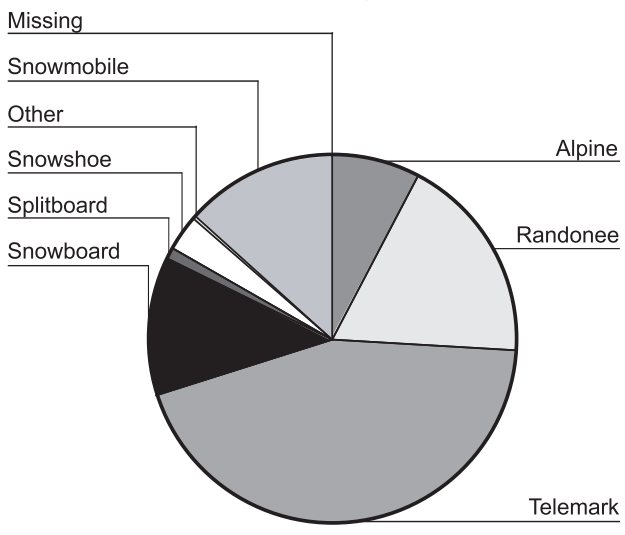
Story by Jessey Tase

Every year an average of 152 backcountry recreationists are caught in avalanches, and statistics show the majority of avalanches that catch people are actually human triggered. The increasing popularity of winter recreation and improved technology, allowing people easier access to more remote locations, has led to a continual rise in avalanche fatalities over the past decade in most Rocky Mountain states.

There is extensive knowledge on where, when, and how avalanches occur. There are many avalanche-education centers that host avalanche-education seminars and classes, numerous books devoted to the awareness of these hazards, and hundreds of internet sites with statistics and information regarding safe travel in the backcountry. Avalanches are very avoidable hazards. To better understand why avalanche deaths are increasing, we must discover who is most at risk for these hazards and why.

The risks a backcountry recreationist encounters are the result of a number of decisions and actions. Of these factors, what governs the amount of risk each recreationist experiences? This study investigated this question by studying a number of potential risk factors.

Backcountry Travel Methods



A Web-based survey method was chosen for its potential to reach the broadest range of backcountry recreationists. Respondents were asked questions relating to eight different potential risk factors: gender, age, travel method (telemark, snowmobile, etc.), avalanche training, frequency in the backcountry, preparedness, group decision-making processes, and adventure goals. Eight hypotheses were developed to identify which recreationists are most at risk:

1. Male recreationists
2. Recreationists between the ages of 25-29
3. Recreationists on snowmobiles
4. Recreationists with basic levels of avalanche training
5. Recreationists who travel most frequently in the backcountry
6. Unprepared recreationists
7. Recreationists who travel in groups with unclear decision-making processes
8. Recreationists with more extreme adventure goals

Participants were also asked a series of questions to determine their level of avalanche exposure. They were asked if they had ever witnessed an accident, been involved in an accident, or been involved in more than one accident.

The survey was posted on the internet on October 2003, and data was collected until March 2004. In order to obtain the largest possible sample, I added an incentive by awarding an avalanche transceiver (supplied by AvalancheTools.com) to one randomly chosen participant. I also advertised extensively, posting ads where recreationists from all backgrounds would observe them.

Certain survey answers were combined and categorized prior to statistical analysis. Then descriptive statistics, chi-square contingency analysis, and logistic regression analysis were used to analyze the data. In the interest of brevity, not all the survey questions are discussed here, but the entire master's thesis, including the survey questions and details about the combination and categorization of survey responses can be found online at www.fsavalanche.org/NAC/techPages/theses/tase.pdf.

Avalanche exposure was categorized. They were either involved in an avalanche accident or not. Of those who had been involved, those who had witnessed an accident were considered "somewhat involved" and those who had been hit or caught by an avalanche were considered "very involved."

Frequency in the backcountry was categorized into "not very often," "often," and "very often." Questions relating to preparedness were combined and categorized into "not prepared," "somewhat prepared," and "very prepared." Group decision-making questions were combined and categorized into "poor group dynamics," "fair group dynamics," and "good group dynamics." Questions relating to adventure goals were combined and categorized into "not extreme," "somewhat extreme," and "very extreme."

All eight potential risk factors were analyzed using a two-sample chi-square test based on whether or not the participant had been involved in an avalanche accident. A second contingency analysis was performed for some of the eight potential risk factors to compare the selected variables to the recreationists' level of avalanche involvement. Highly significant chi-square tests with three or more categories were also subjected to logistic regression analysis to determine which categories made statistically significant contributions to the overall pattern of results.

Results

1463 people participated in the survey. This total includes approximately 50 who did not complete the entire survey. Approximately 70% discovered the survey via the internet. The survey sample included 138 females and 1325 males. Age ranged from 15–65, with a mean of 34.5 and a median of 33. The largest proportion fell into the 25–29 age range. The participants in the survey used a number of different methods of travel as Figure 6 shows.

The largest proportion (44%) used telemark equipment as their primary travel method. Other methods include snowmobiles, snowshoes, splitboards, snowboards, alpine skis, and randonee skis. Out of the total respondents, 31% were involved in avalanche accidents, and 22% had actually been hit by an avalanche.

The eight potential risk factors were tested for statistical significance. A statistically significant association was found between gender and the involvement of recreationists in avalanche accidents. Significantly more men had been involved in avalanche accidents (33% of the men versus 16% of the females).

The investigation of hypothesis two found a statistically significant association between age and a recreationist's involvement in avalanche accidents, but it was not the 25–29 year olds that were more often involved; the older age groups actually showed a higher proportion of involvement in avalanche accidents.

The investigation of hypothesis three found that telemark and randonee skiers were involved in significantly more-than-expected avalanche accidents—not the snowmobilers as hypothesized.

Hypothesis four found that those with advanced levels of avalanche training were involved in significantly more avalanche accidents than those with basic levels of training.

The testing of hypothesis five found that indeed, those who spent more time in the backcountry were involved in significantly more avalanche accidents.

Hypothesis six was not supported by the testing and it was actually found that those recreationists who were more prepared were involved in significantly more avalanche accidents.

The investigation of hypothesis seven found that those with "fair group dynamics" were involved in significantly more avalanche accidents, which was contrary to the initial hypothesis.

The investigation of hypothesis eight found that those participants with a "very extreme" rating were involved in significantly more avalanche accidents than expected.

Conclusions

This project set out to address the question: What influences backcountry recreationists' risk of exposure to avalanche accidents? The data and analysis show that there are a number of independent variables that influence the risk. Some of these variables have a statistically stronger association and play a greater role in determining risk than others. Moreover, some of these variables can be changed, while others cannot.

For the variables that can be changed, such as avalanche-training level, preparedness, and group dynamics, I would recommend the continued use of avalanche education to try to influence likelihood of avalanche-accident involvement.

Unfortunately, the analysis presented here indicates that avalanche education and training are not currently reducing the number of avalanche accidents, as one would hope. Avalanche-training courses should be frequently revised using information such as this study. For example, courses could use these data to stress the role of good group dynamics and provide specific examples of ways to improve communication and group behavior. Further research into avalanche training, including recreationists' perceptions of their own ability to assess avalanche risk as well as their preparedness could give a better understanding of why these variables are associated with higher avalanche-accident involvement.

A complicated finding of this research is that although avalanche education is considered the best method for preventing avalanche accidents, those with the most training were involved in the most accidents. Analysis of participants' preparedness yielded similar results: those who were more prepared were involved in more accidents. I do not believe this indicates avalanche training has negative effects, rather I think it shows that those that take the most risks also prepare and train themselves appropriately for the hazard.

There are several important questions my survey methodology did not accurately address. My survey did not elicit the age of the participants when they were caught in the avalanches. This information could potentially change the results of hypothesis two and would be useful in more accurately determining which age groups are at greatest risk.

Another important factor would be when recreationists began to acquire formal avalanche-education training: whether they started getting this training before or after being involved in an avalanche accident, and whether they have been involved in any avalanche accidents since getting this training. These questions would help to more accurately determine how well avalanche education is preventing avalanche accidents.

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Jessey Tase recently completed her master's degree in geography and GIS from the University of Montana in Missoula. She now lives in Durango where she works for the San Juan National Forest making maps.

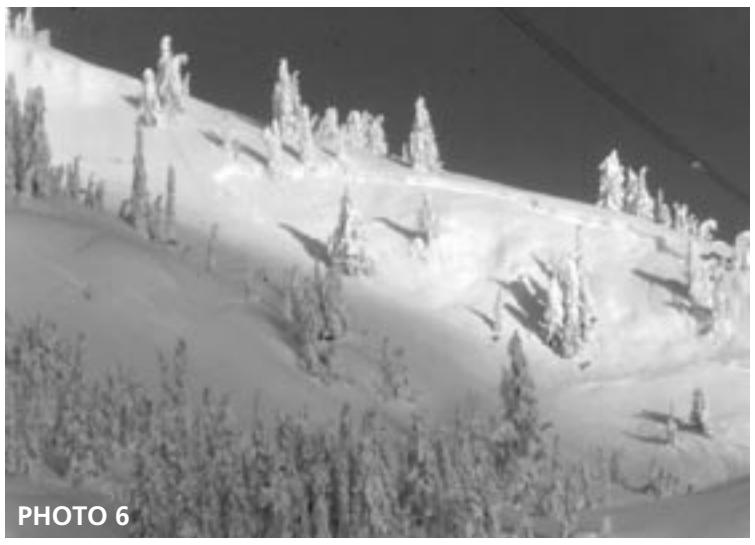
PHOTO 6

Slope Anchors and Islands of Safety: TRICK or *treat*?
ANALYZING RISK IN AVALANCHE TERRAIN

Story and photos by Jon Andrews

This article may seem basic to some, but it is important to review from time to time how we read avalanche terrain and how we teach terrain analysis. When teaching a course, we can sit in a room and review photos of avalanche terrain, conduct armchair analysis of slope stability, and stay 100% safe. Being out in and observing avalanche terrain in all kinds of snowpack conditions is a little more risky, but our aim in an avalanche course is to teach the art of calculating risk.

Teaching Terrain Analysis

Reading and understanding avalanche terrain is difficult due to the complexities an avalanche slope can provide. A local skiing on home turf tends to learn over time, if they survive, details of terrain intricacies they travel through day after day. Obvious visual clues such as trees and rocks stand above the snow surface. Other visible variations in the terrain can be breakovers and wind deposits of snow. And there are hidden, underlying weak spots in a slope unknown to a non-local. The local skier knows a lot about the visual aspects of the terrain in winter but may not have seen the lay of the ground in the summer or in a low snowpack.


PHOTO 1

The snow traveler in unfamiliar terrain may have a difficult time sorting through avalanche terrain. On the other hand, we have seen in recent human-factor research that the traveler in unfamiliar terrain may have some advantage; a local can become complacent over time with the terrain or average and usual snowpack conditions. When an unusual snowpack situation comes along, it is easy to overlook the unusualness of the situation. You will hear from people who have skied an area for many years, "I have never seen that slope slide." Over time, people who travel and ski the same route do tend to relax and not recognize unusual conditions. In photo 1, this very popular route is traveled by hundreds who are unaware they are going over a two-ton cornice.

99% of the skier- or hiker-triggered slab avalanches I have seen are triggered from a shallower weakness in the slope, such as a hidden rock outcrop or slight change in terrain where there is an uneven distribution of slab.

In a Maritime snowpack, it is common to ski from one island of safety to another and not expose oneself to the middle of a slope. If the slope were to avalanche then one may be able to ride it out. In Maritime snowpack conditions this can often work. However, some snowpack conditions turn these islands of safety into tricky situations when they can turn into triggers or hot spots in a slope.

The slope in photo 2 always avalanches from a rock outcrop hidden under 3-6 feet of snow. The rock outcrop is a breeding ground for faceted snow that sticks up into the snowpack, making a shallow trigger point unseen from above.

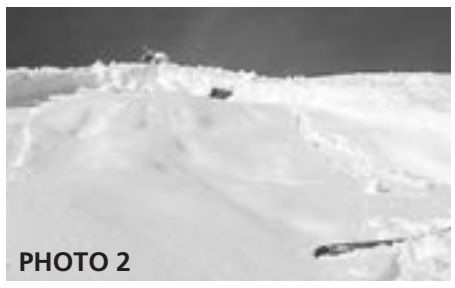
PHOTO 2

Watch how people ski and travel in the snow and you'll notice we are drawn to objects such as trees, rock bands, lift towers, and groups of people. I don't know why. Maybe it makes us feel more comfortable in our decisions; maybe these points give us better depth perception? When we climb up a slope, we try to keep near rock bands and trees where slabs are shallower and consequences minimal. However, these are areas of weakness where slab formation is often shallower; places for weak layers that the weight of a skier or climber can affect.

It seems like everything we say and do is a double-edged sword when dealing with snow pack and avalanche terrain.


PHOTO 3

In photo 3 the boot-pack trail goes right up the center of the bowl instead of along the tree-lined edge. There is a meter-thick slab sitting on 10cms of facets. Sometimes you hear, "It's okay in certain snowpack conditions to climb straight up a slope," but other times we say it is less risky to go around and assess the slope from the top.


PHOTO 4

The slope in photo 4 has consistent slope angle and uniform shape. The underlying ground surface is smooth and there is a good compression zone at the bottom. The only time I ever saw this slope avalanche was a natural when the entire snowpack crept, buckled, and slid to the ground. This is a slope I feel comfortable skiing, given the right snowpack, as it has no hot or weak spots.


PHOTO 5

Slope anchors can be deceiving: are there enough anchors to hold the slope in place? I find rocks don't do much to help hold a slope but rather enhance hidden weak areas. There seems to be enough tree anchors in photo 5 to hold the slope in place. In photo 6 the trees only add to "communicating weak spots" as you can see the slab crowns from trees to terrain features. Slight changes in terrain can be trigger points and often hard to see. Breakovers that change angle only by a few degrees can be lurking dragons waiting for the unsuspecting. Sometimes you hear, "I was skiing and went over this little roll in the slope that you could hardly tell was there and bang, it popped!" In photo 7 you can see a slight change in terrain angle. The crown runs right along this change in terrain from the tree.


PHOTO 7

Anchors or stress concentrators, roll-overs, facet gardens, real zones of safety: these are important nuances of terrain whose recognition or lack thereof can have serious consequences. As educators and decision-makers, we must be able to point to these features in the field or in a photo to help our students make the most informed decisions in simple or complex terrain.

Teaching Group Decision-making

I once taught an avalanche course to five students in the field. The students evaluated the slope, but no one could agree if we should ski the slope or not. Some wanted to and others thought there was too much risk involved. The group was really taken aback when they found out I would not let them ski the slope. They realized I was really making them make decisions that would potentially affect the outcome and them. It was a quiet hike out. In a lot of courses I have attended or taught, it seems that many students are not very serious about decision-making because they have been lucky and not had many close calls. They often sport a cavalier attitude if they have skied for quite some time and have not seen tricky avalanche cycles. Teaching risk assessment is serious business. I wanted my students to have a discussion and make a group decision. But since the group was not working together dynamically, a decision had to be made for them.

A group agreeing on how a situation should be handled (group dynamic) is interesting to watch. People are like snow flakes, no two are alike, but we can sketch some general categories:

- Risk takers.
- Those who don't want to take risks.
- Those who don't care what the risk is.
- Those who don't know what the risk is.
- Those who want to travel in the snow and not spend the time to figure out what the risk is.
- Those who spend too much time in the classroom and do not practice their methods.

So there are many opinions about whether a slope can be safely skied.How do we teach diverse groups of risk takers, evaluating terrain, snow pack, weather, rescue, group dynamics, and so on? The tough part to me is how to group people up with varying levels of risk. The smaller the group, the easier for the instructor to interact and the easier the decision process for the students. There is no safety in numbers, only added RISK.

That's what we are teaching in avalanche courses, is it not? Ways to minimize the risk by learning about the environment we are in and letting the students decide what kind of risk they want to take.

Risk and Professionals

Why are more and more avalanche professionals being caught, buried and killed in avalanches? Is it because the more you know, the less risk you feel you are taking? Is having more knowledge creating a complacency factor? Then why are a lot of avalanche professionals who've been in the business a long time still alive?

I have a lot of un-answered questions, but I think we tend to overanalyze situations. When we think too much about a problem, we tend to skip or forget about basic principles that should factor primarily into our decisions. We should stick with the basics and have good habits to fall back on. Our basic courses should teach the basics of terrain, weather, and snowpack, then have advanced courses to teach advanced topics. Let the students make the risk calculations, if possible. Make them feel like they are living on the edge and the decisions they make will really affect them, personally and as a group, based on what they know and how they feel about risk.

Jon Andrews is an Avalanche Forecaster at the Stevens Pass ski area in Washington and enjoys teaching serious avalanche courses to people who are after something more than just a certificate of completion.

Avalanche Judgment & Decision-making Part I

Story & Photos by Laura Adams

Heli-ski tracks punctuate the landscape in the southern Selkirks, British Columbia.

A growing body of research indicates significant enhancements can be achieved in decision quality and decision-skills learning programs for decision-makers of all levels through the study of how experts make decisions in real-world settings. This article is the first installment of a three-part series from my masters degree research in human factors and expert decision-making. Part I identifies and describes the judgment and decision processes that avalanche experts use to solve the decision problems they face in their profession. In Part II, I will discuss human factors that influence avalanche experts' ability to make sound judgments and decision actions. In Part III, I will examine these findings in light of recent advancements in strategies for decision-skills learning, decision support, and effective avalanche accident prevention.

- Avalanche decision-making occurs at the center of three systems of influence: human, physical, and environmental.
- Current information relevant to the three systems of influence is critical for sound judgment and decision actions.
- As avalanche decision-makers gain knowledge and experience, they develop more expansive mental models and use increasingly higher levels of decision complexity.
- The level of expertise of the decision-maker, the systemic context of the situation, the degree of time pressure, and the level of uncertainty within the human, physical, and environmental systems of influence determine the application of decision modes.
- Avalanche experts use the decision strategies of pattern recognition to make effective judgments, and processes of critical thinking and mental simulation to analyze whether their judgments are accurate and if their planned actions will work.
- Metacognition and situation awareness are integral to objective and sound decision-making and offer powerful strategies to counter the influence of potentially dangerous biases and heuristic traps in the decision process.
- Effective communication within teams results in higher-quality decisions by adding collective knowledge, information, resources, and diverse perspectives to the decision process.

To derive an understanding of avalanche experts' decision processes and the human factors that influence their decisions, I used Naturalistic Decision Making (NDM) and Cognitive Task Analysis (CTA). NDM examines the kinds of cognitive skills, knowledge, and experience that are involved in avalanche experts' real-world problem solving and decision-making. CTA seeks to capture this expertise, and make it accessible for decision-skills training and support.

I collected data in two phases during my research. In the first phase, I used an electronic survey, and in the second, I facilitated two avalanche experts' focus groups. Using a retrospective case-based method known as the Critical Decision Method, I asked Canadian avalanche experts' to "describe your most significant avalanche decision-making experience, including how experience, knowledge, skills, and human factors influenced your decision." Their stories are woven throughout this article.

37 Canadian avalanche professionals participated in my research, representing 12% of the 314 professional members of the Canadian Avalanche Association (at the time the research was conducted). Participants represented a cross section of Canadian avalanche industry expertise *(Figure 1)* and possessed an extensive experience base *(Figure 2)*. 89% of the participants were male, and 11% were female.

A SYSTEMS PESPECTIVE OF AVALANCHE DECISION-MAKING

Avalanche-related decision-making occurs at the center of three systems of influence; human, physical, and environmental *(Figure 3)*. Since human behavior is best understood in the social and natural frameworks in which it occurs, sound judgments and decisions cannot consider one of these systems in isolation. Understanding the inter-relationships between these phenomena requires a systems-thinking perspective.

The avalanche decision-making process involves making complex judgments about current conditions and the level of uncertainty within the three systems of influence. It then requires making critical decisions regarding what actions will be taken. These judgments and decisions occur within a dynamic process, and are embedded within a broad situational (terrain, snowpack, weather) and human context. Therefore, avalanche-related decisions are not made as discrete events or isolated moments of choice. Understanding the context that surrounds the decision process is essential.

FOUNDATION OF AVALANCHE JUDGEMENT AND DECISION EXPERTISE

Three themes emerged as the critical foundation of these avalanche experts' capacities for making sound avalanche-related decisions:

1. Experience

Experience lies at the heart of sound avalanche-related decision-making and results in superior knowledge, skills, and information processing capacities. A helicopter ski guide described this phenomenon stating, "Experience is a huge factor in avalanche decision-making, as the accumulated mileage gives me a conscious and unconscious base of knowledge which to draw from." Participants described how they accumulated avalanche experience over the years, and in different geographic regions and snow climates. For example, one expert explained, "Exposure to a variety of regions and snowpack conditions helps round out my thinking. When I encounter coastal conditions in the Rockies, or buried facet layers in the Coast range, I can adapt my thinking and decision-making based on what I'm observing at the time." This finding is consistent with literature on experiential learning and expertise that suggests key characteristics of experts' performance are acquired through experience. For example, Dave McClung from the University of British Columbia suggests experience is fundamental to objective avalanche decision-making, not only to accurately evaluate the snowpack, but also to aid complex decisions and avoid dangerous human biases.

2. Knowledge and Skills

Past experiences blend together to build a knowledge base that enables experts to make sense of current situations and conditions. As one participant stated, "Knowledge is the accumulation of experience, for example, the association of a particular slope angle to its likelihood of sliding in certain conditions, or the influence of wind and snow deposition on slab formation when the air temperature is at a certain value." Experts in my study described how their experiences enabled them to understand and practically apply the knowledge and skills they had gathered throughout their industry

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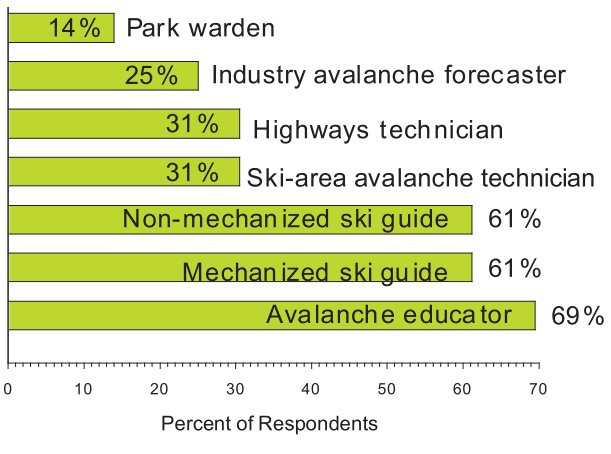


Figure 1. Area of expertise in the avalanche industry
Total is greater than 100 as most participants had several areas of expertise.

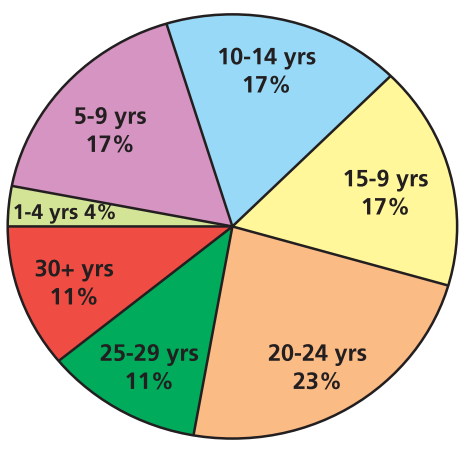
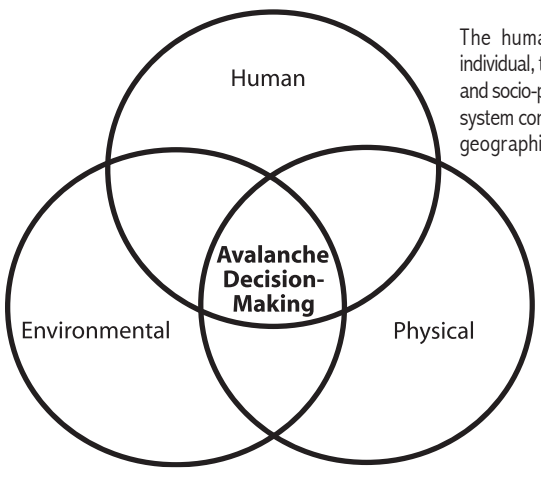


Figure 2. Years of professional experience working in the avalanche field.



The human system contains the individual, team, client, organizational, and socio-political realms. The physical system contains the terrain, including geographic location, slope aspect, angle, shape, and ground cover. The environmental system contains the snowpack and the weather conditions that create it and influence its instability.

Figure 3. Systems of influence in avalanche decision-making

DECISION-MAKING

continued from previous page

training and professional-development programs. For example, a ski-area avalanche forecaster related to me how he used his knowledge during a difficult avalanche control mission in unusual conditions: "Thankfully our skills learned through training and experience aided us to place ourselves in a location that reduced our likelihood of becoming involved in the avalanche. I believe this action saved our lives."

3. Information Relevant to the 3 Systems of Influence

Having information and data relevant to the human, physical, and environmental systems of influence was the third element in the foundation to avalanche experts' decision-making success. Participants discussed the critical importance of having a "data-rich environment" in which to support their decisions. Their stories included extensive references to the need for relevant current and historical information in the decision process, for example, site-specific snowpack data, influencing weather conditions, nearest-neighbor observations, client information, and history, organizational logistics, and culture.

MENTAL MODELS

Mental models are internal representations that portray the avalanche domain and drive our processes of understanding. Experiences and knowledge events specific to the avalanche field result in the creation of these highly integrated knowledge structures. A senior avalanche forecaster for highways emphasized the extent to which mental models aided his decisions: "The success of that week [of avalanche forecasting and control] of very large, continuous avalanches was based in my knowledge of the terrain and how it performs in a storm such as this."

Rich mental models provide the decision-maker with knowledge of the relevant elements of the decision problem, a way of integrating these elements to form meaning, and a system for using this understanding to project future states. These mental models guide avalanche experts to the most important aspects of the decision problem and filter out irrelevant information. The use of mental models results in reduced information management, since the avalanche expert does not need to process all of the available information in order to make an effective decision. When faced with a situation requiring decision action, the avalanche expert employs his or her mental model and it is immediately obvious what decision options make sense.

AVALANCHE EXPERT JUDGMENT AND DECISION-MAKING MODES

As avalanche decision-makers develop more expansive mental models, their thought processes evolve in qualitatively new ways of thinking and knowing, and they use increasingly higher levels of decision complexity. Initially, judgment and decision actions are rule-based and include an increasing use of analytical processes. As they gain knowledge and experience, intuitive decision-making becomes more prevalent and important. I suggest that when avalanche decision-makers are able to recognize subtle perceptual cues and maintain a constant awareness of the current conditions within the human, physical, and environmental systems of influence, they have evolved into systems-thinking processes.

Therefore, avalanche decision-makers evolve through a hierarchy of judgment and decision-making complexity *(Figure 4)*. This hierarchy can be seen as a continuum where higher levels of judgment and decision capacities incorporate the lower one(s).

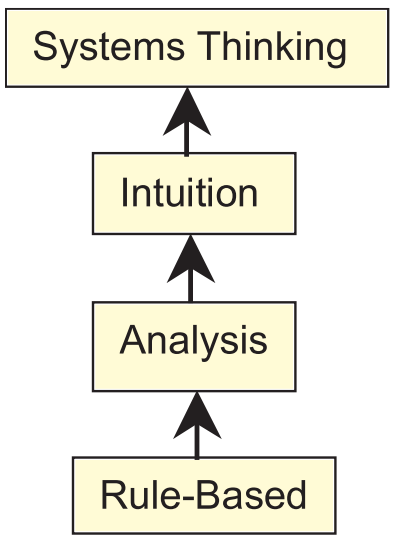


Figure 4. Hierarchy of avalanche judgment and decision-making complexity

Rule-based processes are consciously controlled by a stored rule or procedure, for example, standard operating procedures carried out in pre-identified conditions or situations. Analysis utilizes a conscious process of reasoning that requires time and deliberate effort. For example, analyzing synoptic-scale weather and snowpack information, then considering local conditions and observations in order to make snow-stability and terrain-use determinations. Intuitive decision-making pre-consciously utilizes the mental models and extensive repertoire of patterns that we accumulate and refine over years of experience. Sets of perceptual cues are unconsciously organized and grouped together to form patterns or "knowledge chunks." In a future situation, when a few of these cues are noticed, we know that we can expect to find the others. We recognize the situation as familiar by matching it to a pattern encountered in the past, including the associated routine for responding with action. As we acquire more patterns and strategies, our expertise increases. It becomes easier to make complex decisions, since we see new situations with a sense of familiarity and recognize how to act. Systems Thinking integrates a holistic awareness of the human, physical, and environmental systems of influence.

95% of participants reported using intuitive processes in their critical decision summaries. In 83% of these cases, intuitive decision-making was the primary mode of cognitive (thought and understanding) function used. This finding is consistent with the literature on high-stakes decision-making that identifies intuition as the primary decision mode used by experts in natural settings. Intuition alerted these avalanche experts to recognize potentially dangerous situations, such as the ski-area forecaster who explained, "I had this compelling hunch the whole snowpack was about to let go." Intuition also signalled the need for analytic processes when faced with situations of uncertainty. For example, one expert said, "I tend to know if my choice is acceptable. If the consequences are serious, I feel a niggling doubt or 'gut feeling.' Then I'll try to get more information and usually the right choice becomes evident."

APPLICATION OF DECISION MODES

The level of expertise of the decision-maker, the systemic context of the situation, the degree of time pressure, and the level of uncertainty within the human, physical, and environmental systems of influence determine the application of these modes. These modes complement one another to produce effective decision actions. For example, when avalanche forecasting (e.g., office-based morning meetings), these experts had more time and information resources available and used analysis as their primary mode of decision-making. While in high-stakes, time-pressured field decisions, intuitive processes prevailed. In any situation, when these experts encountered decision problems that rule-based or intuitive processes were unable to handle, they shifted to analytic processes. This included, where time permitted, consultation with other team members.

While I suggest the primary mode of decision-making is determined by these variables, it is important to note that one process did not completely exclude the others. My study findings concur with the work of other research that suggests single decision problems are often solved using different modes, even though one mode may appear to be more dominant. For example, an avalanche expert may use systems thinking and intuitive processes for the parts of a problem for which adequate knowledge and mental models exist, while rule-based or analytic processes may be used to solve other parts of the problem. I noticed these experts often used the non-primary mode as a quality control check, such as in the case of a ski-area forecaster who described the morning analysis process and then said, "The final point is – how do I feel about it?" Similarly, analysis was often used to check intuitive decisions as a gauge to whether the intuition was based in knowledge and informed experiences or potentially misleading biases.

DECISION STRATEGIES

The avalanche experts in my study used the following decision strategies:

1. Pattern Recognition

A majority (88%) of the participants reported pattern-recognitional processes in their critical decision summaries. For example, one expert said, "As time goes by I am able to spot the trends of events that are leading down the dark road of a difficult decision." Pattern recognition enabled these experts to make sense of a situation by comparing it with their past experiences or by seeing subtle relationships between the complex factors that were influencing the current situation. These experts also recognized when things were abnormal. For example, recognizing patterns and critical anomalies was the key factor that enabled one forecaster to provide critical advice to the leaders of another group to change their trip location from the area they had planned to ski tour the next day. "My knowledge of current and building conditions in the area led me to think about the lack of releases on these north faces, and that the possibility of them coming down was high." Later that morning, a massive avalanche released on that north-facing slope, in the exact area the group had originally planned to be.

2. Mental Simulation

Mental simulation is an envisioning strategy where decision-makers use their imagination to construct a

Avalanche debris in the southern Selkirks, British Columbia.

sequence of events to observe the outcome. This strategy was utilized extensively by participants in my study (76%). For example, one expert related: "The question of 'what if' occurs every time I come across avalanche terrain. For me, assessing the consequences is very important in my decision-making and determines my perception of risk on the terrain." Another participant emphasized how effective the application of mental simulation is in complex decision-making, as, "The same terrain cannot be treated in the same way since snow conditions are constantly changing." Mental simulations enabled these avalanche experts to analyse the potential results of a decision action and revise their plan as necessary.

Two recent tools that facilitate mental simulations offer great promise to support sound decisions. Alex Van Herwijnen & Bruce Jamieson's research describing the characteristics of avalanche fracture suggests using descriptive information to characterize the triggering potential and characteristics of avalanches. For example, a sudden fracture that crosses the entire column and easily releases the overlying block (sudden planar) provides a visual indication of the fracture character that can be extrapolated to simulate the potential and type of avalanche release in surrounding terrain. Roger Atkins recently proposed an avalanche characterization checklist that defines avalanche regimes and their associated risk management strategies. An increase in the awareness of the character and distribution of likely avalanches, for example, large, dry, deep slabs on basal persistent weak layers, can be translated directly into improved terrain management.

3. Critical Thinking

We think critically when we apply standards to our thought processes, such as raising vital questions, analyzing self and peer assumptions to determine whether they are justified, evaluating other points of view, or examining the reasoning process for consistency in interpretation when drawing conclusions. 85% of the critical decision summaries in this study included descriptions of critical thinking. For example, an avalanche forecaster was preparing terrain for an international extreme ski event. His snowpack assessment resulted in significant concern due to the presence of a deep snowpack instability. However, after conducting extensive explosive control and observing helicopter skiing in the adjacent area, there were no avalanche releases observed. Still questioning, he sought additional information from a local helicopter ski group. He related, "The local guides seemed totally unaware of the deep snowpack instability and gave no meaningful feedback." The next morning, one of the slopes had released in a 250cm-deep slab avalanche. He called event management and told them the event was off. In his critical decision summary he explained, "It is easy to say YES and have your clients love you. I am ultimately paid to say NO and that is the hardest of decisions, but so far has never been the wrong one." Several weeks later, the entire helicopter-skiing industry in that region cancelled the remainder of their season due to snow-stability concerns.

SITUATION AWARENESS AND METACOGNITION

It is widely recognized by high-stakes decision researchers that situation awareness and metacognition are fundamental to sound decision-making. My research supports this idea. Situation awareness (SA) is our capacity to maintain an accurate perception of our external environment by detecting the source and nature of problems and situations that require attention. Decision researcher Mica Endsley argued that situation awareness involves much more that simply perceiving information in the environment. It requires understanding the information in relation to the decision-maker's goals, and then projecting the future states of the environment. Metacognition extends SA to our internal environment and is a higher-order of judgment and decision-making complexity related to systems thinking. Metacognition is our knowledge of, and ability to control, the state and process of our mind. It has also been described as our ability to take our own strengths and limitations into account.

A ski-touring guide described using metacognition as a regular process in his decision-making, "I take the time to absorb the surroundings and the mood in the air while my clients get ready. It's a process that I regularly go through, as I like the subconscious approach before I go through my rationale thinking approach." Another participant discussed his use of metacognition as an analytic process to check potential biases arising from affective or social influences, saying, "It is valuable for me to understand how I operate under stress and what is motivating the choices I am making. This is important because I find it keeps me honest and allows me to focus on objective conditions rather than subjective opinions or emotions." Metacognition enables decision–makers to be aware of their thought processes and control them appropriately. Thus, metacognitive skills and situation awareness are crucial for proficient problem solving and decision-making.

COMMUNICATION AND TEAM DECISION-MAKING

While an individual decision-maker may bear the final responsibility for the decision action, team members often contributed to the final product. Team environments add information, resources, and diverse perspectives to the avalanche decision problem. Teams operate as knowledge systems, and the building of shared mental models and the collective consciousness of the team mind creates a highly efficient context within which avalanche judgement and decisions can occur. Shared mental models provide a context within which information and tasks can be interpreted, as well as a basis for predicting the needs or behaviors of team members. The results of extensive research indicate that team decision-making is preferred when tasks are extremely complex, as it is unlikely a single individual possesses all of the relevant knowledge with which to discover adequate solutions.

I found the capacity of teams to make effective decisions was a direct function of the quality of interactions amongst team members. Environments that encouraged effective and open communication resulted in improved judgment and decision actions, and reduced subjective biases that may have been present in an individual decision-maker. In addition, effective communication fostered shared mental models regarding goals and conditions between decision-makers and management, resulting in collective understanding and higher levels of support for the decision-maker's judgments and decision actions.

Research indicates high-quality communication is associated with high-quality solutions and team performance. Higher rates of verbalization results in better decision-making, such as task-specific information exchange, suggestions of intent, acknowledgements, and disagreements. The importance of communication has been widely recognized in the literature and, along with enhancing predictability, has been identified as the primary method of reducing human error in high-stakes decision-making.

A CONCEPTUAL MODEL OF AVALANCHE EXPERTS' DECISION-MAKING MODES AND STRATEGIES

I constructed a conceptual model that describes the judgment and decision-making modes and strategies used by the avalanche experts in my study. This model integrates the elements of judgment and decision-making within a holistic system *(Figure 5)*. In this model, avalanche experts' decisions are made within a systemic process that unfolds from the center of the system. Experience, knowledge and skills, and information relevant to the human, physical, and environmental systems of influence provide the foundation. The decision strategies of pattern recognition, mental simulation, and critical thinking are driven and fed by this foundation. Through the use of metacognition and situational awareness, avalanche experts are internally and externally aware of the factors that influence their judgments. Effective communication fosters and enhances the quality of their judgments and decisions. Intuitive and analytic decisions result within a dynamic systems thinking perspective.

CONCLUDING REMARKS

A major goal of my research was to decouple the judgment and decision processes of avalanche experts and to illuminate the decision modes and strategies they use in real-world settings. I suggest that a more complete understanding of these processes and the systemic factors that influence successful judgments and decisions (Part II), will enable avalanche decision-makers of all levels to significantly enhance their judgment and decision capacities. It is important to note that decision-makers should utilize decision modes and strategies that are appropriate and effective for their level of knowledge and experience, in order to ensure they are making accurate judgments and sound decision actions. In addition, NDM research suggests the best way to improve decision skills is to learn from how the experts do it. This approach has lead to significant advances in decision-skills learning programs. In Part III of this series, *Developing Expertise in Avalanche Decision-Making*, I describe the key factors in the development of avalanche judgment and decision expertise and offer an integrated set of strategies to support and enhance decision skills at novice and expert levels.

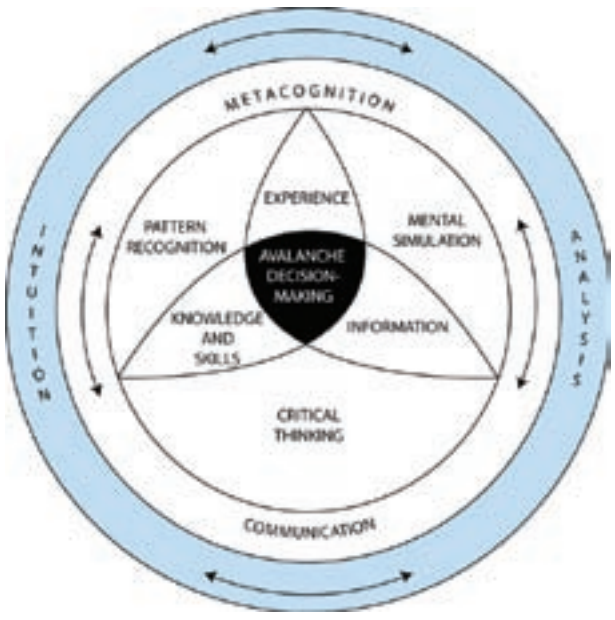


Figure 5. Conceptual model of avalanche experts' decision-making modes and strategies

ACKNOWLEDGEMENTS

My research is dedicated to the group of Canadian avalanche professionals who took the time to reflect upon their experiences and relate their insight to me. When I read their stories and facilitated the focus groups, I was deeply impacted by their words, and I realized how much we can all learn from their experiences of decision success and human error. My thanks are extended to the Canadian Avalanche Foundation, Selkirk College, and the Social Sciences and Humanities Research Council of Canada for providing financial support, and to Arc'Teryx for outdoor clothing and equipment. I wish to acknowledge Bruce Jamieson and John Tweedy who offered valuable insight and good thinking in their role as avalanche expert advisors to my research. Conversations with Chris Stethem, Dave McClung, and Ian McCammon provided encouragement and wise perspectives.

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Laura Adams lives in Nelson, BC and works as a consultant, guide, educator, and safety specialist in the mountain industry. Laura is an ACMG ski guide and CAA avalanche forecaster with a teaching degree in adult education and a masters degree in leadership and training. Laura's recent research examined human factors and expert decision making in Canadian avalanche experts. She is a former member of the Education Committee for the CAA and continues to instruct in the CAA professional training school. Laura also works as an instructor and researcher at Selkirk College and the Selkirk Geospatial Research Centre. For more information on her research and publications, contact her at ladams@selkirk.ca

SnowPilot: A Researcher's Dream

Story by Doug Chabot

Instead of just having your own nuggets of snow data, SnowPilot mines all the gold together into an information mother lode

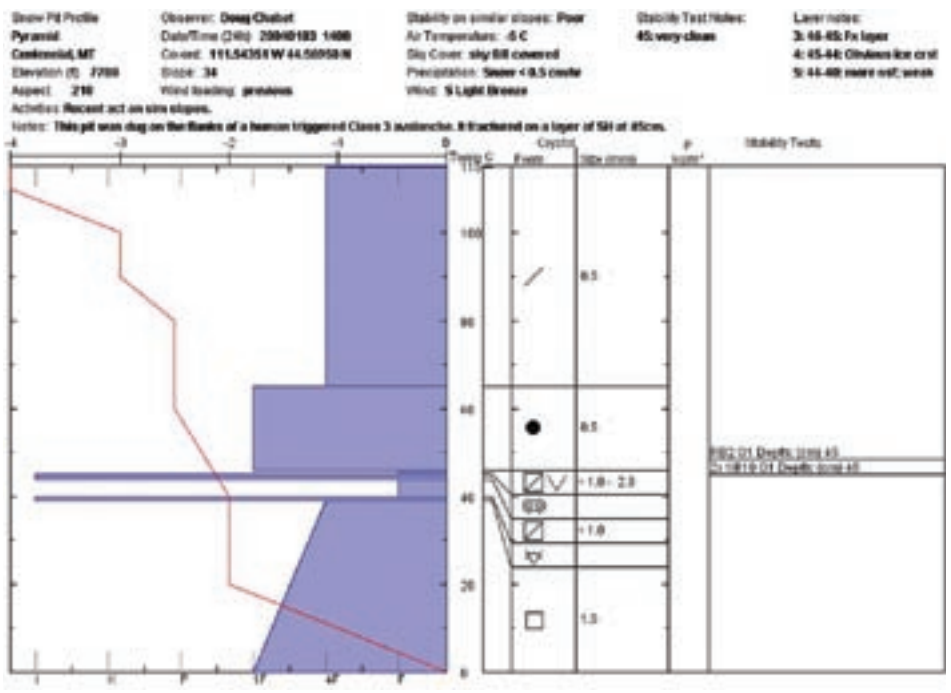
After years of development SnowPilot became operational last winter. There's been some growth spurts along the way; now it's new, improved, and robust.

SnowPilot is a multi-tiered software program that allows you to enter pit data or avalanche-occurrence observations into a personal digital assistant (PDA or Palm Pilot), synch with your PC, then print a snow profile. For those of you still attached to your pencil and notebook, the updated SnowPilot allows you to bypass the PDA and enter data straight onto your PC. Anyone with simple computer skills and a working knowledge of recording snowpit data can benefit from the program. Besides spitting out a nice color snow profile, it also allows you to save your raw data in a text file and the pit image as a jpg.

The real beauty of this system is an additional Web component. After recording your pits you can upload them to a centralized database at www.snowpilot.org. Here you can look at your own and everyone else's snow profiles. Last year over 300 pits were recorded in the database, which can be searched by state, range, or date. And if you're a researcher who wants to get crazy with the raw data, that's possible too—although you'll need approval from the Avalanche Data Czar, Karl Birkeland.

SnowPilot is free to download. Our Friends of the Avalanche Center received grants to create this program with the understanding that it would be freeware. If you don't have a PDA you can still download and use the program on your desktop. But I must say, the real power of the program is utilizing a PDA in the field; you only need enter the data once, as opposed to copying it from your notebook. Within minutes of getting back to the office, I hot synch my PDA and get lots of products from one pit: a picture of my snow profile that I can save, print, email, and post; a text file of my raw data that I can save and manipulate; and access to the main database where I store my profiles and look at others.

In all honesty, SnowPilot could be frustrating in the field if you've never used a PDA before. The savvier you are at entering text, numbers, and navigating,



the easier life will be. I'm able to enter data as fast as I can with a notebook. But remember, the PDA part of this application is optional—you can always enter data later onto your PC.

As it stands now, almost all snowpit data is recorded in notebooks. Sometimes observers will rewrite it to share with coworkers, but in most cases the data is not accessible to others. Now, instead of everyone having their own nuggets of snow data, these small pieces of gold will be bunched together into a mother lode of information—a researcher's dream. Even more impressive is that you'll benefit from having your own digital record of pits in the form of jpgs and text files. All for the low, low price of nada.

Give it a try and let us know what you think. It's a work in progress, but it's looking good. You can get all the gory details, instruction sheets, and software from the official SnowPilot Web site: www.snowpilot.org.

Doug Chabot, director of the Gallatin National Forest Avalanche Center, needs a solar panel on his pack to keep his cell phone, sat phone, radio, PDA, pager, and i-pod charged.

RIDING THE MIDDLE LINE

continued from page 19

the most-likely future avalanche victims in the region. The local backcountry skiers also know who I am; a traditional skier riding a loud smoky machine en route to upper elevations.

As a snowmobile-assisted powder skier and neutral player in a conflict dividing the regional backcountry, I am riding a fine line right down the middle. I join a new and growing breed of wintertime backcountry user, one that may best represent the middle ground in this growing conflict. Snowmobile-assisted powder skiers and snowboarders represent an emerging user group that has seen astonishing growth in the region. The freedom found in unrestricted backcountry and the unimagined access to untracked powder lines found in the region are combining to make the region a sought-out destination for motorized-vehicle-utilizing powder hounds. It is within this group that I gain the most hope, both in terms of avalanche education and any sort of resolution in the conflict over backcountry powder. We embody the connections between the conflicting groups. Any hope for future repairs in the community lies in the realization of our likenesses.

Snowmobilers and skiers view many aspects of their experience in backcountry powder snow similarly. The need to escape the rigors of life in modern society by winter outings is present in each group. Both see the same aesthetic beauty in the refreshed snowy mountain environment. Both are physically and mentally challenged by their sport and the medium of powder snow. Snowmobilers and skiers alike are drawn to their pursuits by the all-encompassing feelings of freedom, speed, and flight. Both are attracted by the same smooth, untracked snow. In fact, when members of each user group are brought together in collaborative mediation efforts, they are often surprised by the similarity in their ways of thought and the parallel ways they each look at the powdery world. It is little wonder that the two groups coexist and cooperate well together within Cache Valley and western American society, at least when they are away from the contested snow.

During the summer of 2005, managers of the Wasatch-Cache National Forest returned a decision based on a final mediation effort between the two conflicting parties. Both groups were asked to submit a management plan for the disputed area, and the Forest would choose the most workable option. The decision came back in favor of the snowmobilers, returning over 50% of the previously closed public lands to "open to over-the-snow motorized use." Now, for the first time since I've been in Logan, the local snowmobilers are quite happy with the Forest Service, a fact that I certainly plan to take advantage of.

The spindrift wet my notebook and crept into my open pack. We had seen enough of the crown. It was a classic example of a wind slab resting on a thin, faceted, weak layer. It was time to descend back down into the pile of deposition and the ugly burial site below a couple stout firs. After a crazy avalanche year of near misses and tragic fatalities, the need to increase avalanche awareness among snowmobilers and get them to listen to what I have to say about backcountry avalanche danger is starkly clear. For me, getting the word out any way I can has become the highest priority.

Toby Weed is the Logan-area backcountry avalanche forecaster for the Forest Service Utah Avalanche Center.

Proving riders and skiers can co-exist in the backcountry, Chris Palcic tows Karen Russell outside the wilderness boundary on the west side of the Tetons, 2005. *photo by Jazz Russell*

SNOWMACHINER LESSONS LEARNED

Story by Bob Comey

We all know snowmobilers ride in avalanche terrain. Here are some of the things the Bridger-Teton National Forest Avalanche Center's staff learned in the past few years.

- **Face shots rock.**
- **The snowmobile community is very well organized, well funded, united, and motivated by threats to access.**
- **Slope testing with a large powerful sled is different than ski cutting.**
- **Off-trail mountain riding is difficult, especially in deep powder.**
- **Class participants are very eager to learn and some of the best audiences you'll find.**
- **Recovery of deeply buried victims near the toe of a slide by party members can be incredibly swift and successful.**
- **We like to ride for many of the reasons that we like to backcountry ski.**

Bob Comey is the head of the Bridger-Teton Avalanche Forecast center. He has been skiing since he learned to walk.

Snowpro Plus+ Implements Lemons

Story by Gary Sims

At ISSW 2002 in Penticton, BC Canada, Ian McCammon and Jürg Schweizer presented a paper, *A Field Method for Identifying Structural Weaknesses in the Snowpack,* and a poster that developed a simple method for analyzing snow profiles and flagging certain characteristics associated with instability of the interfaces between adjacent snow layers. Coined "lemons," these flags were proposed as good indicators of instability—especially useful for novices learning how to interpret snow profiles.

At the 2004 ISSW, Schweizer and others developed a set of critical layer and interface properties similar to the lemons. Using profiles from the Columbia mountains, the methods was simplified by Bruce Jamieson and Schweizer in their March 2005 paper, *Using a Checklist to Assess Manual Snow Profiles*. They identified three layer properties and three interface properties to be tested against critical ranges and used to flag instabilities in the snow profile. The paper also provided a method for determining the flags.

The three layer properties are average grain size, hardness, and grain type.The interface properties are difference in grain size, difference in hardness, and depth.

First look at each layer and flag it when the properties meet the critical range. For example in their example on page two, the layer is flagged one to three times if average grain size is greater that 1 mm, or hardness is less than One-Finger (1F) or if the primary grain type is a persistent type.

Next take each interface between adjacent layers and flag the interface where the properties meet the critical range. For example, the interface is flagged up to three times if the difference in average grain size between two layers is greater than 0.5 mm or difference in hardness is greater than 1.0 (each hand hardness has a specific value set) or interface depth is between 20-85 cm.

Once the flags are drawn on the profile, the number flags at the interface layer are added to the maximum flag count in the layer above or below to arrive at a total count (0-6). The predicted failure interfaces are those with the maximum number of flags. More than one interface can have the same number of flags. The maximum number of flags for any interface is the structural-instability index of the profile.

This method makes it very easy for novices to recognize the unstable layers. However, as noted by Jamieson and Schweizer, "its value in making decisions about avalanche risk is unclear, especially for experienced avalanche practitioners."

Gasman Industries developed Snowpro Plus+, which produces high-quality plots of snow-cover profile information according to the International Classification for Seasonal Snow on the Ground. It was developed about 10 years ago in conjunction with the Snow Avalanche Programs of the BC Ministry of Transportation and has been frequently updated for worldwide use.

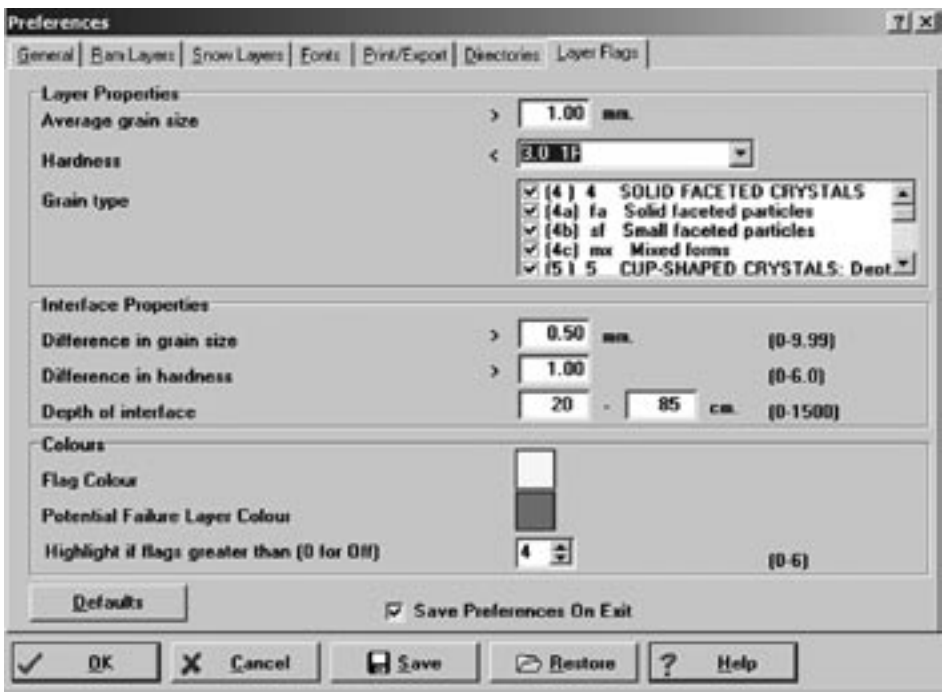


figure 1

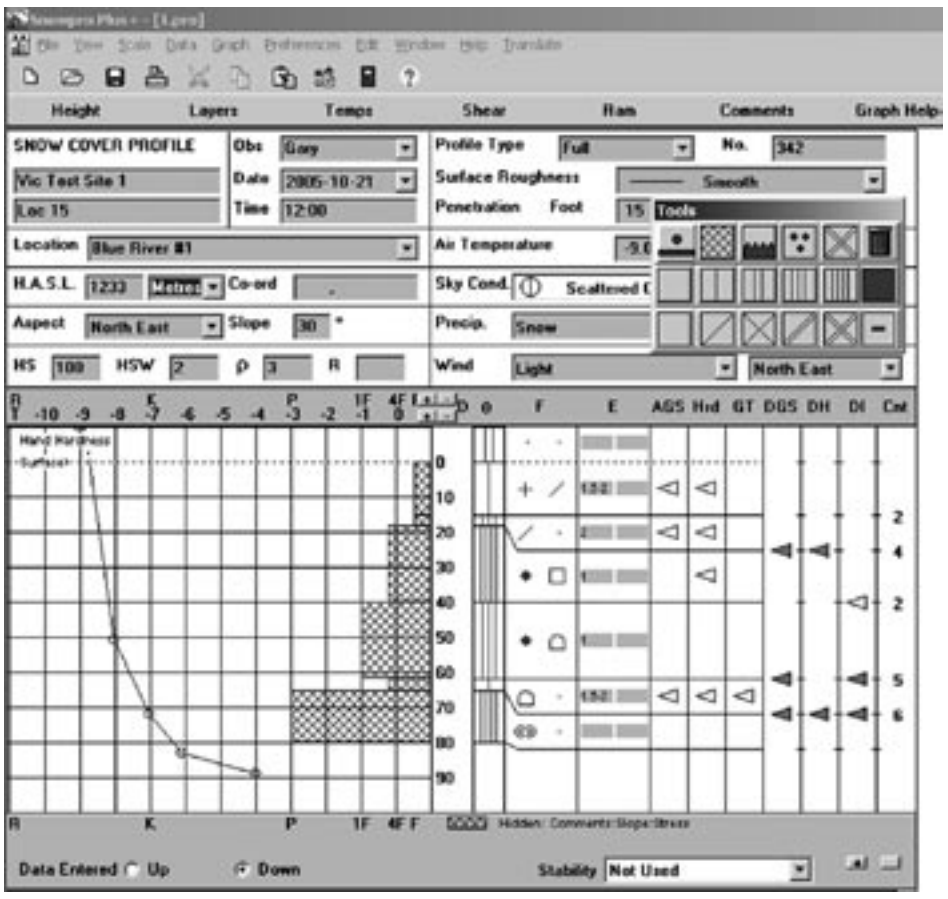


figure 2

The critical range values for the layer and interface properties are user-configurable so that these values can be tailored for a particular area's snow types and conditions. Figure 1 shows the Layer Flags preferences screen. SnowPro allows the ability to set the color of the flags and to set a test so that if more than a certain number of flags are set at the interface, then the flags there are marked a different color. In Figure 1 the layer flags are yellow; if there are more than four flags at the interface, then those flags color red.

The initial default list of persistent layers as used by McCammon, Schweizer, and Jamieson are based on current grain types available in Snowpro Plus+. Any of the grain types can be disabled by unchecking them. Others can easily be added to a text file in the software directory in order to show up in the list.

Figure 2 shows a sample Snowpro Plus+ profile with yellow flags on the layers, red flags on the interfaces, and the total count to the right. This screen can be toggled between the regular profile data with the simple click of a button on the bottom of the profile.

Gasman Industries appreciates feedback and suggestions from the snow community to improve the software. Contacting Gary Sims for further information. *(See the SnowPro Plus+ advertisement on the bottom right of this page for contact information.)*

I would like to acknowledge Bruce Jamieson for answering a number of questions on his method in order to implement the yellow-flag feature.

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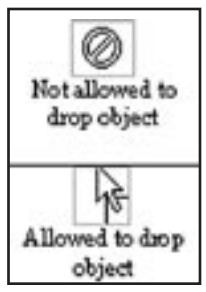
Gary Sims is the president of Gasman Industries Ltd., in Victoria, BC Canada. He has developed computer software for the skiing and snow industries for over 20 years and has worked with the BC Ministry of Transportation to develop weather station and avalanche data collection software. He has been a ISSW commercial exhibitor and currently sells Snowpro Plus+ software for graphing snow-profile data.

Snowpro Plus+ Tips and Tricks

Story by Gary Sims

Snowpro Plus+ has a rich set of tools for constructing snow profiles and usually provides at least two ways to do anything. Over the next few issues of TAR, we provide software tips and tricks to help you become very proficient. Send specific questions to info@gasman.com. A demo version can be downloaded at www.gasman.com/demorequest.htm

figure 1



Drag and Drop: quickly construct a new profile

A profile can be constructed by entering data into the tables for snow temperatures, layers, etc. Use View menu option to open the different tables. You can also use the drag-and-drop feature to quickly build a profile.

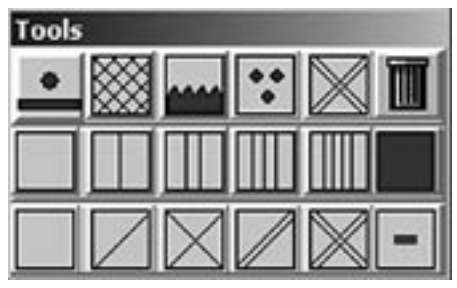
To "click" is to put the mouse cursor over an object and press the left mouse key down. To "drag" is to click on the object, hold the left mouse key down, then move the object to the desired location. To "drop" is to release the left mouse key with the object at the desired location. If your right mouse button is set in Windows Control Panel to be the primary button, then use the right mouse button.

When dragging an object, the mouse cursor will change to one of the forms in Figure 1. You can drop an object when it matches the bottom symbol.

Try this to create a quick profile:

1. Start the Snowpro software and create a new profile (Menu File, New).
2. Enter Snowpack Height (HS) in cm.
3. Make sure you can see the Tools palette *(Figure 2)*. Press F2 key to toggle on/off.
4. To create a layer, click on a water-content icon *(Figure 2: 2nd row)*, drag it to the profile graph, and drop it in the column to the right of the snow depth/height numbers. If row 2 is not visible, click on the 1st row icon, 3rd from left. The first layer becomes the surface layer.
5. Repeat again for each layer. These will default at 10 cm intervals.
6. To size a layer, hold the Ctrl key, click on the water-content icon on the graph, and move the mouse up or down to size the layer. Size is displayed at the bottom of the graph.
7. To add a grain type, click on the grain-type icon *(Figure 1: 1st row, 4th from left)* and drag the desired grain type to the column under F on the right side of the profile *(Figure 3)*.
8. Grain diameter and comments can be entered by clicking on the placeholder on the layer and entering the value. Hand hardness can be dragged to column R.
9. To add a snow temperature, click on the snow-temperature icon *(Figure 2: 1st row, left-most icon)*, drag it to the left side of the snow, and drop it at the intersection of the depth (or height) and temperature.

figure 2



10. To delete an object, drag and drop it on the garbage can on the Tools pallet *(Figure 2: 1st row, right icon)*.

Objects added to the profile can be moved by a simple drag and drop. Most objects can be moved on the graph and will swap automatically with similar types if dropped on the other icon.

A tool tip which contains information about the object and available options will appear when you place the cursor over the object. Make sure "Snow Field Hints" is checked in the Preferences General tab.

High-Quality Profile Export Graph

Snowpro can export graphs as either bmp or jpg files. A jpg has a smaller file size. You can control the quality of jpg files by changing the jpg-quality value on the Print/Export Preferences tab: 65-100 (below 65 gives a grainy graph) and up. If you set to 100, you get a very good image but the file size will be large *(Figure 4)*. 65 is usually the best trade off between quality and file size.

Larger export-image width and height sizes give a better representation as more pixels are used when rendering the graph. For example a graph set to 2000 by 3000 pixels will have smoother lines than a graph set to 200 by 300. Experiment with different values. A bmp has very good quality but produces a much larger file size.

Pop Up Menu – hiding objects

When constructing a profile, there is often so much information it can be difficult to drag and drop new objects on the graph. Hide specific classes of items while constructing the graph by right clicking over the graph and selecting the hide or show options. Reshow the column before printing the profile.

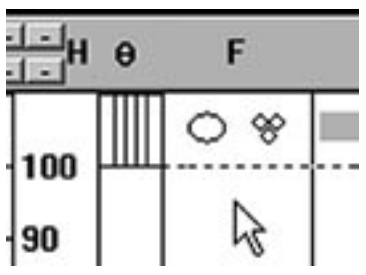


figure 3

Layer and Shear Comments

On very thin layers you may find that comments overlap. You can easily move these or even hide them by holding the Ctrl key down and clicking on the comment. Each click will move the comment to a new position. Hold the Alt key down and click on the comment to hide. You can also position or hide these individually on the table-entry screens (F4 key: layers, F6: shears dialogs). Hold the Alt key and click on the water-content icon in the layer row to redisplay the comment for that layer.

figure 4

crown profiles

The RECCO Rescue System

Story by Dale Atkins • Photos by Dan Kostrzewski

Terskol, Caucasus, Russia. February 10, 2004. A large avalanche buried seven teenage snowboarders. For more than a week, 160 ski patrollers and soldiers and nine avalanche dogs searched but found no one. On February 20, two mountain rescuers from Germany started to search with RECCO and found the first victim in five minutes. Buried three meters deep, the boy had reflectors on his ski pants. Fifteen minutes later, another victim is found. His cell phone had responded to the detector. The next day, detectors located two other victims. One carried a walkie-talkie, the other a cell phone.

You may know of RECCO, some of you even know how use it, but what do you know about RECCO? To answer this question requires a closer look at the RECCO Rescue System and how it might make the search and rescue and education jobs of avalanche workers easier. Like any technology, it is not only important to learn how to use the equipment, but it is also important to learn why and when to use it.

A new technology?

The roots of RECCO go back to the early 1970s in response to a personal experience with an avalanche tragedy. In December 1973, Magnus Granhed was halfway up a lift in Åre, Sweden, when an avalanche swept away two skiers. For the next three hours, he and others searched with probes and dogs before finding the two dead. One victim was a friend who left behind a wife and child. Magnus's experience in the rescue and with the tragedy motivated him to find a better way to search for buried victims.

In 1974, Magnus collaborated with researchers from the Royal Institute of Technology in Stockholm. A research team first studied all the existing and proposed technologies for locating buried avalanche victims, including magnetism, radiometry, radar, and transceivers. Transceivers were found to be the most effective but suffered three disadvantages: high cost, they require user interaction to turn on and off, and batteries can go bad. The Swedish team was not alone in seeking better search technologies. Researchers in Austria, Germany, Italy, and the United States were also looking for better ways to find avalanche victims.

By the mid-'70s, it seemed the most interesting solution would be to provide every skier with some sort of passive responder or reflector. Ground-penetrating radar was not practical. The echo or return signal was not specific enough to determine whether the target was a body, rock, ice, or wood. The better solution was thought to be secondary (also termed responder or harmonic) radar.

Skiers could carry a small reflector that would double the radar's frequency and reflect it back. Thus, the echo produced by the responder could be identified with a high degree of accuracy. In 1975, American John Lawton—inventor of the Skadi avalanche transceiver—suggested a system where the responder would be part of a ski lift card. What was a simple and elegant idea on paper was only that. It would be years before the idea could be applied, as there was literally nothing known about the effects of snow on microwave signals.

To learn more, Magnus, in cooperation with Stockholm's Royal Institute of Technology, set up and conducted a painstaking experiment during the winter of 1978/79. All winter long, every two hours, signals of different frequencies were transmitted into the snow. This was long before today's age of digital convenience, and all observations and data collection had to be done manually. In 1980, Magnus formed RECCO AB and created the first prototype. Later that winter, Magnus could search for and detect the reflected signal when the search antenna was aimed toward a buried reflector. The monumental problem of how to filter out the strong search signal so the much weaker return signal could be detected had been solved.

"We like to compare that with standing next to a jet plane as it takes off and being able to hear the rustling of leaves being raked together just close by," Magnus says. The detector weighed 16 kilos and had a range of five meters. In 1984, the first commercial detectors were placed in Zermatt, Switzerland, and after considerable testing by Air Zermatt and Bruno Jelk, head of Mountain Rescue Zermatt, the system was incorporated into their avalanche-rescue plan and response. By 1987, the RECCO system was in use by about three dozen ski areas in six countries.

Fast-forward nearly 20 years. Today's detector weighs one-tenth the weight of the original and has a maximum range of 200 meters in the air and 30 meters in snow. Detectors are in place at more than 440 ski areas, heli-ski operations, national parks, and with mountain rescue teams in 17 different countries. In addition, it has also been adopted by a number of departments of transportation and the militaries of several NATO countries.

What is the RECCO System?

Readers of *The Avalanche Review* may remember two detailed articles about RECCO that appeared in the January 1994 issue, so only a quick summary is presented here. The RECCO system consists of two parts: a detector and a reflector. Rescue groups use the detector; reflectors are integrated into shell clothing, boots, helmets, or protection gear. The system uses harmonic radar to provide a precise location of a buried victim.

The system works on the principle of frequency doubling. The detector transmits a microwave signal that is doubled in frequency and bounced back when it hits a specially tuned reflector. The signal is directional so the operator can follow it straight to a buried victim. The range of the detector is a complex calculation of many variables including moisture content of snow and orientation of the detector to the buried RECCO reflector. Because range is so affected by orientation—like a transceiver—and snow wetness, RECCO recommends a 20-meter search corridor—10 meters on each side of the operator's path.

The detector can be used from the ground on foot or skis but is even more effective when used from the air. The signal's greater range through air and more perpendicular line of penetration through the snow enhance detection performance. This additional strength has made it a regularly utilized primary search tool on almost every European rescue helicopter and a new choice of heli-skiing operations like Bella Coola Heli Sports.

The reflector is a small electronic transponder with a copper aerial and a diode covered in protective plastic. In the factory it is mounted by the clothing/equipment manufacturer to the outside of gear. During its early years, RECCO sold individual self-adhesive reflectors but is moving away from that strategy and now works directly with manufacturers. The reflector works best when worn on a helmet or in pairs: pant and jacket or right and left boot. Many major snow-sports brands, about 70, including The North Face, Vans, Atomic, Arc'teryx, Sessions, Millet, and Quiksilver, now incorporate RECCO reflectors into their products.

Has it found anyone alive?

The first live victim located was a woman in 1987 found in Lenzerheide, Switzerland. She had been given a pair of reflectors earlier in the day and absentmindedly stuck them in a pocket. It was good enough. Later that afternoon while skiing, she was caught and buried; probing and dogs failed to find her. Once the detector arrived, she was quickly located and recovered alive. Though success came early, it was not until January 2001 when a snowboarder was buried and found alive at Les 2 Alpes (France) that resorts and rescue teams took serious notice of the technology. In 2002, the detector technology was improved, netting

Continued next page ➡

The RECCO system began testing prototypes during the '70s, and by 1987 the system was adopted by ski areas in six countries.
photo courtesy RECCO historic archives

Simulated search scenario with RECCO detector and avalanche transceiver at Mountain Rescue Training Seminar.

Dominique Hunziker, Air Rescue Switzerland technical director, explains helicopter search technique with the RECOO system.

RECCO CEO Magnus Granhed searches with the system he invented. Mountain Rescue Training Seminar. Blue River, BC.

RECCO

continued from previous page

greater range and increased accuracy and, as a result, there have been more successes in recent years.

- On December 29, 2002, a group of eight snowboarders triggered an avalanche while riding off-piste in Savognin (Switzerland). They carried no transceivers, shovels, or probe. Two were completely buried. The alarm was sounded by cell phone and the first ski patrollers arrived within eight minutes. A helicopter with more rescuers arrived 20 minutes after the alarm. At 40 minutes after the alarm, the first victim was found by probing as a second helicopter arrived with a RECCO detector. (This victim died two days later in the hospital.) The second victim carrying RECCO reflectors was found within five minutes using the detector. Unfortunately, the rider could not be revived. At the time of the accident Savognin did not have a detector.

- In November 2002, a snowboarder ventured off-piste and fell into a crevasse on the Kaunertal Glacier (Austria). None of his five companions saw him disappear. It was only at the end of the day that they realized their friend was missing. The usual ski-area search—checking the slopes and bars—failed to locate the rider. Well after sundown, rescuers returned to the glacier and two teams set out to search the crevasses. The victim had RECCO reflectors and was soon found alive and uninjured 15 meters down in a crevasse.

- On March 4, 2004, one backcountry skier in Prägraten, Austria was buried. Neither the victim nor his friend carried transceivers or RECCO reflectors. The companion called the ÖAMTC (Austrian Helicopter Service), and thanks to the cell-phone network's GPS system, the caller's position was immediately located. Two rescue helicopters with a dog team and RECCO responded. The victim carried electronic gear that responded to the detector. As rescuers were following the signal to the victim, they spotted a ski tip just above the surface. The buried skier was found alive. It was probably the cell phone or camera detected by the RECCO detector.

RECCO reflectors are tuned to the detector and give the best range, but there are other reflectors that can respond to a signal. The most common are the diodes in electronic gear. The equipment does not need to be turned on. The devices can include but are not limited to radios, transceivers, some cell phones, electronic cameras, and video recorders. In these cases, the range is reduced dramatically to perhaps as little as 2 to 20 meters, but this does present another reason to reach for the detector at the earliest possible stage of the search.

What are the limitations?

All rescue technologies (whether probes, dogs, transceivers, radar, etc.) have limitations and this applies to RECCO as well. Wet snow—liquid water—will attenuate or decrease the search signal. Wet snow is certainly an avalanche problem, but wet-snow avalanches claim relatively few deaths, accounting for only 9% of all US avalanche victims.

For a victim not equipped with RECCO reflectors but suspected of carrying electronic gear, the search range must be reduced. Instead of a 20-meter width, a 10-meter search width should be tried first. If that fails, the distance should be cut in half again. In water, the range will be less than 30 cm. False-positive signals are relatively rare, but sometimes do occur. In very shallow snow I have found large-diameter rebar and large aluminum signs. The range in these cases was very short.

Is RECCO a body recovery tool?

The simple and short answer is no. RECCO is a rescue system designed for organized rescue by ski patrols and mountain rescue teams and has found people alive. The sad fact is that outside of a ski-area boundary, rescue teams seldom find buried victims alive: only 6% of the time.

activity	dead/dead+alive	mortality %
In-area skiers	18/31	58
Out-of-area skiers	43/55	80
Climbers	64/76	84
Backcountry skiers	82/92	89
Snowmobilers	71/76	93

Table 1. Mortality rate for buried victims found by organized rescue teams, 1950–2004. (Data from the CAIC.)

Typically, by the time an organized rescue team is notified, responds, and finds the victim, too much time has transpired and the victim has expired. But, in the US during recent years, three factors have come together to provide optimism for rescue teams: cell phones (faster notification), helicopters (faster travel), and more accidents happening near ski areas (shorter distance). Responses are getting faster.

Time is certainly the enemy of buried victims, but some victims do survive long burials. Every buried victim should be given the benefit of the doubt that he might survive. In the US there have been a couple of recent burials where victims survived about 24 hours, including a 2003 burial at Mt Baker, Washington. The longest time for a survivor buried in direct contact with snow (known to this author) is 43 hours for an American woman buried while walking along a road near Macugnaga, Italy, in March 1972.

Incorporating RECCO into the rescue

Integrating RECCO into a rescue requires thought, preparation, and practice. The process starts by evaluating potential problems to formulate needs. When considering resources such as dogs, RECCO, snowmobiles, or any other resource, rescue leaders must determine how many are required to effectively and efficiently cover their resort or area of responsibility. Then rescue leaders must plan how to best to utilize the resource. This means planning:

- where will it be cached
- who will maintain it
- who will organize trainings
- who will respond with it
- who will operate it
- when will it be used
- how will it be used at the accident site
- reviewing its performance after use

The first seven steps should be written into an organization's rescue plan and practiced. RECCO provides training and can offer suggestions as to how to best incorporate it into rescue plans. The last step, which is important when utilizing any type of search technology, is key for any organization to best learn how to take advantage of RECCO.

To become proficient requires practice—practice finding reflectors, practice using the detector around other rescuers, and practice in the worst possible weather. To become successful during rescues requires practice in realistic avalanche-rescue exercises, so the operator can be confident using the detector in all situations. Like a well-practiced avalanche dog and handler who can work in and among rescuers, a well-practiced RECCO operator can do the same, even when other rescuers are equipped with reflectors.

Integrating RECCO into rescues

- Keep the detector with other hasty-search gear.
- The detector and operator should respond with the hasty team.
- The operator must be electronically "clean." (Transceivers should be still worn, but can be carried on the back. Same with a handheld radio.)
- The detector search can be done simultaneously with the transceiver, dog, spot probe, and clue searches.
- The operator should carry (or better yet, have a helper) and place flags along the search route. This keeps track of searched areas and allows for areas to be re-searched accurately.
- As with the transceiver search, once the slide has been searched with RECCO and no victims are found, the task can be marked as completed and the operator can assist in other ways.
- Searchers can use RECCO belts on days with significant hazard and a sufficient number of transceivers are not available. A belt can also be used to mark a victim who could not be immediately recovered due to worsening danger and subsequent reburial.

RECCO and education

Working and playing in avalanche terrain is a risk best mitigated with education and good judgment. RECCO is active in avalanche awareness education and has distributed 250,000 copies of their *White Book*, which has been translated into four different languages. This pocket-sized book is available to avalanche educators—for free—around the world. In addition, by incorporating avalanche-rescue technology directly into consumer products, RECCO has served to introduce the topic of snow safety to skiers and snowboarders on a mass scale and in environments where education was not often discussed.

Final thoughts

RECCO is not a companion rescue system or an alternative to a transceiver. It is a system for organized rescue teams and complements other rescue methods such as avalanche dogs, transceivers, and probe lines. RECCO can make rescues easier and faster, and if rescues can be done faster, rescues will save lives. It gives the buried victim one more chance to be found alive.

Dale Atkins is a long-time forecaster with the Colorado Avalanche Information Center and first used RECCO in 1987. Dale has received compensation from RECCO AB for work done.

education

Riders in the Storm

catching a new wave of snowmobile avy education

Story by Craig Gordon

Avalanche education is at a crossroads. As a matter of fact, we've passed the intersection and now have to maneuver back to the head of a fast-moving pack. I'm not a marketing expert, but avalanche-education programs need to follow an aggressive business model to keep ahead of and anticipate future trends in order to get the message out to a diverse crowd of multiple-user groups. Those of us who teach avalanche-awareness classes to snowmobilers often lament the fact we never seem to spark the interest and get the same numbers as a skier or a non-motorized group talk. I don't claim to have all the answers, but I do have some suggestions.

Snowmobilers ponder snow stability in the Rodeo Grounds on Utah's Logan Peak. *photo by Toby Weed*

My experience teaching snowmobilers began the winter of 1999/00. Utah State Parks and Recreation granted the Forest Service Utah Avalanche Center (FSUAC) monies to stem the tide of increasing avalanche accidents involving snowmobilers and create a snowmobile-specific program. When I first started lining up snowmobile-specific avalanche-awareness talks seven years ago, I was elated to get a group of 20 or 30 riders to show up. Other times, the pendulum would swing into awkward territory with just a handful of riders attending. Much to my chagrin, I even got skunked a few times. In the early days my presentations were pretty primitive: slide shows, the usual avy gear for props, and a final Q & A. There weren't many snowmobile-specific slide shows and mine was a crossover from a non-motorized one, but it got my foot in the door. By the second year, groups started calling me with requests, and now I regularly speak to nearly 2000 snowmobilers each year. My talks have matured into nerve-wracking techno multimedia events, and some of my venues can attract about 100 riders. While these numbers are encouraging, I think we can increase interest in avalanche education even more.

First we need to view ourselves as educators. Certainly, plenty of skilled avalanche professionals with no lack of experience regularly give avalanche presentations. However, like me, they usually come from a ski patrol background where the only snowmobile experience revolves around riding to the explosives cache or helping get a toboggan from one side of the mountain to the other.

We used 'biles, as we called them, more for transportation. (If you use the term 'bile with a group of riders, they'll look at you like you're from another planet.) Most of us avoided them and certainly tried to never get too far off a groomer or we might spend time digging out the machine and answering questions from bewildered skiers about what we were doing.

So the problem may lay in how we see things compared to how they see things. Let's face it, we come from different perspectives. As a young patroller there's lots of peer pressure to learn about snow. Not only will it keep us alive, but the more we know, the better chance we'll get a more challenging route, we'll get to throw more shots, or maybe someday we'll be running the show. In addition, there's a rich culture of master-apprentice relationships and a deep respect for snow and avalanches. In many respects it's a never-ending romance. It takes years and sometimes decades of honing skills just to gain the confidence of peers.

While many snowmobilers have been around for a long time and can rattle off the last time "Billy's Bowl slipped," high-performance snowmobiling and all-mountain riding is still in its infancy. Avalanche fatalities among sledders began to rise dramatically around 1992. This coincides with the advent of more powerful, lighter high-tech machines and, more importantly, advances in track design, length, and lug or paddle size. When advances in gear outpace people's avalanche awareness, more people get into avalanche terrain with less skills; the result is usually more fatalities. All of these factors helped propel snowmobilers into the avalanche-fatality limelight, but that shouldn't be news to any of us.

As avalanche professionals spread the gospel to motorized ears, what works and what doesn't? I've got some advice, but I don't profess to know the secret. Much of my work comes on the heels of my peers who did most of the pioneering: Jill Fredston and Doug Fesler in Alaska, Doug Chabot and Ron Johnson on Montana's Gallatin,Blase Reardon in Glacier country, Janet Kellam in Idaho, Bob Comey and his crew in Wyoming. All of them did the groundbreaking in the field of snowmobile avy education. What I have found is through trial and error and at times embarrassment.

If you're gonna walk the walk, yup, you gotta get on a machine and ride! Now you don't have to get after it and set the standard in hill climbing for the group on your first day out, but just being on a machine will help you understand the skill it takes to ride steep slopes, especially in deep snow. I've got to admit at first it's pretty humbling. You'll get stuck, you'll curse, and you'll tweak your back. But in time you'll learn how to throw the machine around when you need to be aggressive and grab a fist fulla throttle! Riding a machine also takes away the us-and-them element. It can be the great equalizer. You'll find riders are very willing to help you out and coach you to get better. All this helps our cause as avy professionals when we make an effort to get into their world. Bottom line: if you don't ride a sled, you ain't gonna have any cred.

A good way to talk to sledders at a trailhead is to ask about their machines. We're psyched to talk about our gear, and snowmobilers are 10 times as enthusiastic. Ron and Doug have got it dialed because they read all the snowmobile mags and really know what they're talking about. I admit I'm more of a poser and as soon as possible, I start luring the unsuspecting rider into conversation about snow, avalanches, and the current advisory. More times than not, it works. Just being seen at the trailheads and interfacing with the riding public is huge. I've gotten to know a lot of hot riders who now call in snow and avalanche observations.

If you can hold beacon clinics on a busy weekend, it's one more foot in the door. Last winter Backcountry Access donated a beacon-training facility to my program. I installed it at a popular trailhead and it rocked! On a busy weekend, 40-60 riders would swing by Beacon Basin, usually before riding, to test their avalanche-transceiver skills. I couldn't have pulled off the labor-intensive installation without the help of several members of the Utah Snowmobile Association, and that brings me to my next point.

Get involved. If we want people coming to our gigs we need to get involved in theirs as well. Your local snowmobile association (every state has them) is a great conduit. Not every club member is a Jackson Hill Climbing Champion. Often they're successful professionals—doctors, lawyers, accountants, etc.—who like to socialize and volunteer as much as they like to ride. These aren't the hard-cores, and you can't reach them through the local shops. These are folks with whom you can build a trusting relationship, and over time they help us by promoting avalanche forecasting and education programs that target riders. I have had tremendous success partnering with the Utah Snowmobile Association for six seasons. This relationship has yielded donations for avy placemats, our 1-800 phone-line stickers, a weather station, and a Polaris-sponsored snowmobile for my avalanche-forecasting program for the western Uinta Mountains. They're a great governing body in the industry to partner with for grants; they provided $4000 towards *Know Before You Go*.

A few years ago Doug Chabot saved avalanche educators a tremendous amount of work by compiling and distributing a PowerPoint talk geared specifically for snowmobilers. Since then Janet Kellam, Bob Comey, and a host of others have created great courses and presentations, including guide-specific courses. The common thought among avalanche educators is that avalanche awareness talks should be straightforward and to the point, "simplified" not "dummied down."

Tailor your talk toward riders.

Include as many pictures of snowmobiles in your PowerPoint presentation as possible. Think about it—we'd be less interested in an avy talk that made little mention of our sport.

Place more emphasis on proper travel techniques and terrain analysis.

Avalanche professionals work with a very complex medium and are able to understand its properties. Snowmobilers may not be as interested in the science of the snow as you are.

Make your presentation exciting, fast moving, dynamic, and filled with lots of snowmobile references.

A lot of snowmobilers have "safety meeting" burnout from their regular jobs. The last thing they want to do is attend yet another safety talk, particularly when it comes to recreating. Be familiar with rider culture and the terms they use.

Be sincere with your message.

It's not us against them, it's avalanche education.

With an group, we're not going to get through to each individual. Some folks will blow us off and do their own thing anyway. We can't save everybody from themselves. We can, however, strive to get to know the user group and market our message in the most professional way we know how. You'll be pleased and possibly surprised with the positive outcome.

Craig Gordon has tremendous energy for all things avalanche. He has become more than an intermediate rider, but his true love remains backcountry skiing, averaging 200 days a year on skis. Craig works as an avalanche forecaster in the western Uinta Mountains for the Forest Service Utah Avalanche Center.

At a popular Uinta trailhead during a busy weekend, the Beacon Basin may host up to 40-60 riders testing their avalanche-transceivers. *photo by Steve Seckinger*

Riding the Middle Line

Avalanche Forecasting in a New Backcountry

Story & Photos by Toby Weed

Craig Gordon approaches an avalanche site on Whiskey Hill in the Monte Cristo area of northern Utah, where a wind-slab avalanche killed a snowmobiler on the final day of March last year.

A single skidding snowmobile track disappeared abruptly over the edge. The track was centered at the apex of a fingernail–shaped crown. Hurried postholing footprints of a single rescuer also entered the slide–path here. Tracks left by an unarrested butt slide gouged into the crusty surface of the shallow basal layer of snow that still remained on the steep slope after the avalanche. The out–of–control elevator ride undoubtedly had added to the adrenaline rush and confusion as the panicked companion switched his transceiver to receive and began his frantic search in the carnage of refrigerator–sized blocks and twisted trees at the bottom of the slope. Westerly winds continued to drift snow onto the fresh bed surface. Icy broken particles stung our exposed faces as we stood leaning into the steep slope examining the crown of the impressive hard–slab avalanche. Craig Gordon of the Utah Avalanche Center sheltered his face from the blowing snow, raised his voice so he could be heard above the wind, and asked a question, **"How the ---- do we get the word out to these people?"**

As the most skilled backcountry snowmobile riders employed by the Forest Service Utah Avalanche Center, it was our mission to investigate the site of a fatal avalanche on Whiskey Hill in the remote Monte Cristo region of northern Utah. Sadly, the scene told a clear story of the tragedy. The day before, an unlucky snowmobiler had dropped into a steep wind-loaded slope, triggering a large hard slab. The avalanche did not run far on the short slope, but heavy blocks of deposition had violently pummeled into thick trees at the bottom and traumatically killed a young man in the prime of his life. The victim was wearing a transceiver and his party quickly recovered his body. But this fact aside, the accident shared several commonalities with many of the other avalanche tragedies during a record season in the state, and it highlighted the major problem we have with "getting the word out." Time and time again, avalanches are killing (or almost killing) folks who have neither taken an avalanche class nor accessed a recent avalanche advisory.

Last winter, avalanches killed eight people in the Utah backcountry. The deaths illustrated a fairly even spread across different groups of backcountry users: one skier, two snowboarders, two snowshoers, and three snowmobilers. With three out of eight snowmobiler fatalities in Utah during the 2004/05 avalanche season, the numbers reflect a disturbing national trend—between 1998 and 2004, snowmobile fatalities far outpaced all other user groups in the US, representing 43% of all avalanche fatalities. Interestingly, four out of eight (50%) of last year's fatalities in Utah wore transceivers, but only two (25%) had been exposed to any form of formal avalanche education and may have accessed a current avalanche advisory. In all cases, had the victims visited the local avalanche center's Web site or called one of the many avalanche hotlines around the state, they would have found out that deadly human-triggered avalanches were considered probable or even likely on the very slopes where they met their demise.

According to the International Snowmobile Manufacturer's Association, snowmobile registrations in the US were up 51,000 in 2005 from the year before. Nationally, there are now nearly 1.8 million registered snowmobiles. Close to 35,000 of these are registered in Utah, where well over 90% of the 2.3 million people reside bunched up in an urban corridor beneath the western flanks of the Wasatch range. The popularity of snowmobiling near my home in the complex limestone mountains near Logan has grown significantly in the past few years. Riders from the more populated Salt Lake valley with less options for varied open terrain, find lots of untracked powder up here. Utah's fantastic, famous powder falls in great quantities on the area and on such exciting terrain that the region has become a destination spot for high-end riders from across the country. They join a growing number of Cache Valley locals who call these mountains their backyard.

Here, beginning only a few years ago, a few bold pioneers riding amazingly powerful custom-built sleds began opening access to an extreme alpine playground as rugged and exciting as any in the West. They were followed by an escalating crowd of motor sports enthusiasts pushing the extreme cutting-edge of their sport. Hill-climbing, the sport of riding powerful snowmobiles up steep mountain bowls or chutes, is now possible even on stock, factory-built machines sold by the thousands in the cities and towns of the Intermountain West. In the snowmobiling world, machine technology is advancing much faster than avalanche awareness. At an alarming rate, avalanches are killing more and more mainstream Americans who, in many cases, are completely unaware of the peril.

I began my backcountry avalanche-forecasting job in Logan mid-winter in 2003. In each of the past three seasons, I've visited scenes of numerous miraculous near misses where snowmobilers triggered and somehow survived huge avalanches. Incredible luck appears to be the only consistent factor that prevented fatalities in these slides. Most large snowmobile-triggered avalanches go unreported at the time of the event, but secondhand mind-boggling stories of survival gradually filter down to me. Once, a completely buried sledder without a transceiver was located by his panicked son randomly kicking a foot through the deposition. Another time, I heard of an experienced elderly rider whose foot was found sticking out of a football-field-size pile of deposition. Many of the hardcore local riders are pretty snow savvy, and a number have experienced more than one serious avalanche. Our avalanche awareness talks and introductory classes for snowmobilers are well attended. But despite our efforts, it seems that many who ride in these mountains still aren't getting the word.

Last winter, snowmobilers triggered several large avalanches in the region, amazingly turning their sleds and escaping with little more than fine snow-dust on their helmets. On a bluebird Saturday following a stormy week in early December, two riders in the middle of a broad and popular hill-climbing slope called Cornice Ridge triggered a monster slab. Amazingly, the two were able to escape off the northern flank of the slide and into the expansive half of the bowl that did not run. A third rider who was watching from the open flats below fired up his sled and scooted out of the way as tons of chunky deposition slammed into the popular lunching spot from which he was watching his friends.

In late February, against the wishes of his slightly more cautious companions, one member of a large party attempted a hill-climbing run on the steep funnel-shaped east face of Mount Magog. He triggered a very broad avalanche from below but somehow managed to escape, turning his sled and racing past his awed party. Only incredible luck stopped the large avalanche just feet short of his entire group who had congregated in a narrow neck at the bottom of the path. Just a week before, two shaken snowmobilers informed a Forest Service employee at the nearby Franklin Basin trailhead that they were on their way back down to Logan to purchase transceivers after one triggered a large slab avalanche from below. The rider had apparently been speeding up the slope when it broke apart. He was able "to get 'er turned around" in time to outrun "a 20'-high wave of snow."

Craig Gordon of the Forest Service Utah Avalanche Center explains the physics of a fatal slab avalanche on Whiskey Hill. Sadly, it often takes a tragedy to make some riders aware that their avalanche knowledge is scanty at best.

A defacto ambassador to the backcountry snowmachine crowd, Toby Weed utilizes a late-model snowmachine as well as his skis to access avalanche terrain and assess conditions.

I am growing weary of contemplating the local luck factor in avalanche survival, and I am overwhelmed by a dark feeling that comes with the itchy knowledge of inevitable avalanche tragedies in the region. Bad luck was a factor in the tragic death at the site we were now investigating. Here, in a sudden violent moment, as heavy chunks of hard-slab avalanche smashed into immobile firs, a life had been prematurely extinguished, despite heroic efforts by his party and an amazingly rapid recovery effort. There was a hint of frustration in Craig's voice, and I felt it too. The avalanche season had been long and busy for both of us. We'd invested hundreds of hours, many well before dawn, producing accurate avalanche advisories for nearby mountains. We'd spent hundreds of days in the field, testing and feeling the snow and countless hours preparing and presenting awareness talks and introductory classes. Thousands of people from across the state regularly checkd our advisories and attended our lectures. In many ways we were successful in getting the word out, yet avalanches were regularly killing people who do not go to the avalanche classes or access our advisories. How do we get to them?

As increasing numbers of snowmobilers find their way up into the steep upper elevation Bear River Range backcountry, more and more are exposed to avalanche danger. The same situation is developing in mountainous country all across the West. The problem for an avalanche forecaster in this situation certainly doesn't solely lie in accurately assessing avalanche danger. I can labor away forever at 6am, internally debating the precise wording of my advisory on a day with considerable danger. But the chances are pretty good that the next person to die in an avalanche will not have heard my warning. The problem isn't in the content of the advisories, and we do get the word out to thousands of backcountry travelers who regularly use the information we provide. Clearly however, the advisories are just not regularly being accessed by the probable next avalanche victim. We can yell "dangerous" at the top of our lungs, but the people who need it the most just don't seem to hear. The problem is how to get the word out so that it will be heard and believed by the folks most at risk.

A few factors limit our ability to get the word out. One may be the effect of a rather masculine feeling of invincibleness inherent from having a very powerful and speedy machine between one's thighs. Many snowmobilers I've met feel that they will be able to ride out of any avalanche they might trigger. Several have already done so, and they feel that riding skill and raw power, rather than luck, are the most relevant factors in their survival. When small- or medium-sized avalanches are active in the Logan area, snowmobilers routinely and intentionally trigger slides just to test their escape skills. For a rider on a big sled, avalanches that could be a major risk to a skier are hardly an issue. Snowmobilers in this area tend to not report avalanches they feel are insignificant, if they report them at all.

On a positive note, even in the last three years I've noticed a substantial increase in transceiver use by snowmobilers in the region. Unfortunately, wearing a beacon may only to add to a rider's sense of invulnerability. The snowmobilers on the way back down to Logan to buy transceivers in February might have figured that just having the devices would keep them safe the next time around.

The avalanche site we were presently examining fit into a pattern of sorts. It seems that these deadly avalanches tend to be much bigger and significantly more powerful than anything the victims may have expected to see. In fact, many of the hard-slab avalanches we've looked at recently were much bigger than the one we now stood upon. Scores of the monsters we'd witnessed in the past few months simply were not survivable. How can you explain to someone on top of the food-chain, someone riding a new REV 900, that he needs to be humbled by the deadly power of a snow slide?

Another limiting factor could be the effect of increased snow stability in popular riding areas caused by compaction from repeated tracking. Of course, just as ski compaction increases snow stability on heavily skied slopes, numerous snowmobile tracks in a steep bowl will probably help hold things together. The danger ratings I allocate in my advisories are for untracked slopes. There are nearly 68,000 acres of extremely active avalanche terrain designated as Wilderness within the bounds of my forecast area, and hundreds of avalanche paths in the region remain untouched all winter. On many days the actual danger on slopes compacted by snowmobiles is probably at least a step lower on the international danger scale. (The Swiss Federal Institute for Snow and Avalanche Research in Davos suggests that sticking to "frequently skied slopes" is a factor decreasing avalanche risk.)

The discrepancy between forecast and real conditions in well-traveled snowmobiling areas might cause my advisories to fall on deaf ears. Snowmobilers regularly find days when they can't trigger a dangerous avalanche even when I say there is a good probability of human-triggered avalanches on steep slopes in the backcountry. After a few days of finding conditions more stable than forecasted, local snowmobilers may think I'm crying wolf, only to be hoodwinked the next time they go out by a deeply buried weak layer lurking beneath the tracked-up slab. In the situation we were investigating, the real Whiskey Hill, which had not avalanched, had been heavily tracked throughout the season. The nearby slope responsible for producing the deadly avalanche had been only rarely ridden, and a substantially greater danger probably existed here.

Perhaps the most influential factor limiting my ability to get the word out may stem from the existence of an incredibly divisive conflict between motorized and non-motorized winter users of public lands. It is a conflict that has seriously affected the Logan backcountry community and the regional avalanche center for at least the last 10 years. The conflict centers on steep upper-elevation slopes, the kind of terrain sought after most by both powder skiers and snowmobilers—avalanche country.

When I came to Logan three years ago I had no idea what kind of turmoil I'd find here. Nowhere in the West is the conflict between snowmobilers and non-motorized backcountry travelers more acute than in the mountains where I work. Here, a growing ethos of clean, quiet, aerobic, adventure recreation comes into direct conflict with a political majority of fun-loving speed enthusiasts riding on noisy, powerful, polluting snowmobiles. As a public employee, an avalanche educator, and a powder skier/snowmobiler, I find myself riding right down the middle in the heart of neutral ground.

The mountains around here are managed by the United States Forest Service as the Wasatch-Cache National Forest. Forest Service directives mandate that each Forest Region must update their Forest Use Plans every 15 years. As forest managers across the West update their plans, which designate appropriate public access, they must take into account the growing conflicts between motorized and non-motorized forest users. In direct response to numerous vocal and written complaints from backcountry skiers whose quiet powder experience is being compromised by increasing numbers of snowmobiles in the backcountry, forest managers instituted a new travel plan in 2003 that closed around 7500 acres of powder terrain to snowmobile use. The closed terrain included prime backcountry skiing and snowmobiling terrain accessed by the Tony Grove and Franklin Basin winter trailheads on the north side of Utah State Highway 89, which runs through the Logan Ranger District and provides year-round access to the forest. Without the commonly cited issues of definable natural-resource damage, wildlife-habitat displacement, or wilderness designation, the forest managers broke new ground with the winter motor-free designation of this land. The closure was instituted purely to separate user groups, and it brought to the forefront the idea that untracked snow is a natural resource.

As one might expect, the closure angered the well-organized local riders who, during the heat of the debate, actually "declared war" on the Forest Service. A roadblock in communication instantly developed. Snowmobilers would not listen to a word of a Forest Service avalanche advisory, and some may have felt our service leaned toward backcountry skiers, so why report avalanche activity? Snowmobilers view powder skiers as elitists, who would like to keep the powder and the mountains all to themselves. Access advocate Val Simmons told me once on a ride in the Tony Grove high country, "A handful of skiers who are in great shape think that they can close the mountains to us." The longtime local rider and inventor/owner of Simmons Flexi-ski laid out the argument, "If this area was closed to us, we could not get up here and enjoy it. Snowmobiles capable of accessing this terrain are attainable these days by common folks. What would we do in the winter without this?" I was struck by the reasonableness of this argument.

I live in a fairly small community and the local riders know me for what I am: both a federal employee and a powder skier riding an out-of-date sled around looking at snow and avalanches. I carry skis strapped to the back of my snowmobile. When the snow gets too deep as I head toward upper elevations, I park the sled and skin up. Time spent on skis is crucial to our assessment of backcountry snow stability. All the avalanche professionals I know are also powder skiers, so you know what I'm talking about here. We feel the snow through our skis and jab it with our poles. We test steep slopes with ski cuts or well-placed deep turns. We are trained by experience to hear subtle indicators as we move silently across buried weak layers. I try to explain these things to snowmobilers when they see me with skis, but the mere sight of the boards may actually hinder my ability to get the word out to some people.

Although a definite minority in the community, backcountry powder skiers by far make up the bulk of those who regularly access our advisories. Skiers or snowboarders sent in over 95% of the observations received by the center in the 2004/05 avalanche season, and only five snowmobilers mingled with the crowd of over 100 attendees at the Friends of the Logan Avalanche Center's fundraiser dinner. Most of my good friends in the community and those who generally share common political beliefs are powder skiers—many are hardcore non-motorized advocates. But the problem remains that snowmobilers are now

Continued page 12 ➡

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