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inside

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Canadian Avalanche Association
Box 2759
Revelstoke, BC V0E 2S0
(250) 837-2435
canav@avalanche.ca
www.avalanche.ca

Table of Contents


Kokanee
GLACIER
BEER
Kokanee
GLACIER BEER
BC'S
GLACIER
FRESH
TASTE
Kokanee is a proud supporter of the Canadian Avalanche Association
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canadianavalancheassociation **Avalanche News** Volume 74 ❄ Fall 2005

Avalanche News is the official publication of the Canadian Avalanche Association, a non-profit society based in Revelstoke, BC that serves as Canada's national organization promoting avalanche safety. The goal of *Avalanche News* is to keep readers current on avalanche-related events and issues in Canada. *Avalanche News* is published quarterly.

Avalanche News fosters knowledge transfer and informed debate by publishing submissions from our readers. Responsibility for content in articles submitted by our readers lies with the individual or organization producing that material. Submitted articles do not necessarily reflect the views or policies of the Canadian Avalanche Association.

Avalanche News always welcomes your opinions, teaching tips, photos, research papers, survival stories, new product announcements, product reviews, book reviews, historical tales, event listings, job openings, humourous anecdotes and really, anything interesting about avalanches or those people involved with them. Help us share what you've got. Please send submissions to:

Editor, Avalanche News
Canadian Avalanche Association
PO Box 2759, Revelstoke, BC V0E 2S0
Tel: (250) 837-2435 Fax: (250) 837-4624
E-mail: editor@avalanche.ca

Editor Mary Clayton
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Let's Talk

BY MARY CLAYTON

Back in August, I was lucky enough to be part of a brainstorming group working on the development phase of the ADFAR project. For those of you adverse to acronyms, ADFAR stands for the Avalanche Decision Framework for Amateur Recreationists, which is the project aiming to come up with a tool to help people make safe decisions in the backcountry. Similar tools have been devised in a number of European countries but we need one that's made in Canada.

There are some good reasons why we don't just translate one of those European devices, slap a maple leaf on them and call them Canadian. We ski in the trees, we have snowmobilers, we have more terrain and climatic zones than you can shake a stick at, and we do things differently over here.

Pascal Haëgli, ADFAR's project manager, is very aware of one mistake made in Europe which he's determined to avoid. That is, building a tool for amateurs without buy-in from professionals. Werner Munter's Reduction Method is a case in point. "Even though it wasn't developed for them, the guiding world felt this simplified method was forced on them," explains Pascal.

For the ADFAR project, that means consultation and communication with a diverse range of professionals, including researchers and forecasters as well as guides. Last month's meeting was another aspect of this continuing process and the final product will be all the better for it. Building a simple, effective tool for a complex problem like avalanche risk management is no easy task and it's important to acknowledge that a wide range of skills, knowledge and experience is required.

Consultation and open dialogue is hardly unique to the ADFAR project. It's a way of life here in Canada, and I think it's safe to say our reputation as a leader in the avalanche world owes much to this way of operating. I was talking to Colin Zacharias recently about how Canada's guiding community differs from other alpine countries. Colin has been an ACMG examiner since 1992 and has observed guide training in a number of different countries. He's also worked as an examiner and adviser for the American Mountain Guide Association. In his view, our culture of communicating gives Canadian guides a huge advantage.

"We're unique in the close relationship guides have with avalanche researchers, forecasters and practitioners," he says. "It's very different from other countries in that way. Here, a guide could find himself assisting Bruce Jamieson, or have Chris Stethem participate in his staff training. Aspirants have the opportunity to constantly interact with experienced people. In other countries, there's more of a barrier between guides and the other related professions, so guides don't get the same mentorship."

Keeping lines of communication open works for all of us, whether building a better a guiding program or resolving conflicting points of view. Here at the CAA, we've recently solved a significant problem by talking. That problem was the InfoEx. As those of you who are subscribers probably know, there has been a growing difference of opinion over who owns the InfoEx data and who determines how it is used.

The InforEx dataset – years of subscribers' input – has become an important and unique resource. Researchers from a variety of disciplines would love to get their hands on it. On one level, most everyone agrees that giving researchers more data to analyze is good for everyone. Science is one of the ways we get better at what we do.

But there's another level to be taken into consideration, one effected by lawyers and insurance brokers. Many subscribers don't want open access to their data because of the sensitive information it may contain. Reconciling those two points of view was no easy task, nor was it done in isolation. Clair's Executive Director's report on page 6 takes you through the history of that issue and the details of its resolution. I urge you all to read it. This is how your association works – through consultation, communication and creative solutions. Together, we get things done.

In this issue there's another good example of how individuals can effect change through communicating. You may remember last winter when a few e-mails were circulated reporting battery problems with Ortovox transceivers. It began with just one guy from the eastern states but over time, a couple of other professionals in the west, in Canada and the US, added similar experiences.

Those e-mails made their way to Ortovox (via *Avalanche News*, I might add) last spring. The company reacted very professionally and showed some real leadership. There was no denial from the European head office (at least publicly), no attempt at cover-up or buck-passing. They took the reports seriously, undertook their own investigation, and now have owned up to the problem and are working to fix it. Find out what Ortovox is doing about it on page 38 and chalk up another one for the power of communicating.

In 1997, a woman named Jody Williams won the Nobel Peace Prize for her work in organizing an international treaty to ban land mines. Some 120 countries signed on to that treaty, while the US, China and Russia abstained. She was asked, "How did you manage to organize all those non-governmental and grass-roots organizations on five continents, while three of the world's super powers were against it?" She answered with one word: "E-mail."

Communicating with each other gives us the power to shape our world. Let's keep talking.

InfoEx Evolution

BY CLAIR ISRAELSON

Status Report: InfoEx, Canadian Avalanche Information System Development, and Data Ownership, Security and Management Issues

Operational Background and Context

InfoEx is a program for the voluntary exchange of avalanche-related information between subscribers. This program is provided by the Canadian Avalanche Association (CAA) in accordance with an annual contract between the CAA and each of the InfoEx subscribers. The community of InfoEx subscribers currently includes more than 70 professional private and public sector operators delivering avalanche protection programs for ski areas, commercial backcountry skiing and snowmobiling, highways, railways, resource industries, national and provincial parks, and other winter activities.

The primary benefit to subscribers participating in the InfoEx program has been the timely and open exchange of snow, weather and avalanche-related information between peers, for operational decision making purposes. Subscribers are informed of what other operators are experiencing, so they can avoid being surprised by conditions that have been previously observed elsewhere. For the CAA, the primary benefit of InfoEx has been its use in the Industry Training Programs as a tool for training avalanche workers. The "in kind" value of InfoEx as a source of data for the Canadian Avalanche Centre (CAC) public avalanche forecasters to produce and verify public avalanche bulletins and warnings has been estimated to be in excess of $2 million annually. Over time the dataset, which now contains historical InfoEx information back to 1991, has become increasingly important for subscribers, CAA/CAC uses and research. One respected avalanche researcher has called it "the most powerful avalanche dataset in the world."

..."(InfoEx is) the most powerful dataset in the world."

In the spring of 2003, at the urging of Canadian Mountain Holidays, the BC Ministry of Transportation, Parks Canada and a consensus of InfoEx subscribers, researchers and others within the Canadian avalanche community, the CAA undertook the development of the Canadian Avalanche Information System (CAIS). The goal of the CAIS project was to integrate data collected and owned by the CAA with InfoEx data and data from all possible other sources to create a master CAIS dataset containing the avalanche-related information for Canada. The CAIS dataset could then be used in as many ways as possible to advance avalanche safety in Canada and internationally. There was broad agreement of the tremendous future benefit in ensuring the CAIS dataset is as comprehensive and complete as possible, and recognition that InfoEx was an important source for collecting information for the CAIS dataset.

As the guiding principles and architecture for the CAIS project began to be developed and discussed within the InfoEx community, some operators began to question the wisdom of integrating all InfoEx data into a single comprehensive CAIS dataset managed by the CAA. These operators were concerned their data could perhaps find its way into the hands of unknown third parties and used in ways that could be detrimental to the interests of the organizations that provided that data. Information about avalanche incidents and accidents, and the "point-in-time" comments or opinions of their workers that could prove to be inappropriate in the clear light of 20-20 hindsight, were seen by these organizations as being potentially sensitive. Although these concerns are not new, modern data transfer and processing technologies have exacerbated them.

These issues were explored at a meeting of the InfoEx subscribers at the CAA's annual general meeting in May, 2005. During those discussions, representatives of the CAA and other organizations advocated for transparency and full disclosure of InfoEx information, contending that in the modern age any data exchanged electronically between seventy or more operations cannot be effectively secured, and that the optics of limited disclosure could undermine public confidence in the professionalism and integrity of the Canadian avalanche community. Public sector operators noted that information originating from government agencies may be subject to federal or provincial access to information legislation, and therefore their InfoEx data submissions could effectively already be "public documents." Private sector operators noted their data is not subject to access to information legislation and that they were free to establish all terms and conditions for use of their data by others.

Throughout these discussions the question of who owned the InfoEx system and had ownership and rights to the historical information contained in the InfoEx dataset was admirably argued by both camps, without resolution.

Deliberations of the Boards of Directors

In the past two years, more than $80,000 has been invested into development of the CAIS, with an additional $40,000 proposed for fiscal year 2005-06. Given the uncertainty regarding InfoEx data in the CAIS, the Boards of Directors of the CAA and CAC deferred approval of the 2005-06 funding until these structural and legal issues were resolved.

At their face-to-face meeting of June 26 in Revelstoke, the boards of the CAA and CAC took considerable time to explore the InfoEx-CAIS issues. The board members observed that the strongly held positions of both camps of InfoEx subscribers were reasonable and legitimate and seemed related to the legal, insurance and operational risk-management environments of these organizations. They also noted potential for negotiation around common ground. Both camps strongly supported the CAIS concept and recognized the benefits of having the CAIS dataset contain all possible avalanche-related information from all possible Canadian sources.

The boards noted with interest that subscribers wanting enhanced security for their potentially sensitive data also stated that much of their InfoEx data was clearly non-sensitive. Further, these subscribers would be pleased to have their data from non-sensitive fields included in the CAIS dataset. Their only requirement was a need to retain ongoing ownership and control of data deemed to be potentially sensitive. Subscribers

advocating transparency and full disclosure for their InfoEx data were willing to have their entire InfoEx submissions contained in the CAIS dataset. A mechanism for resolution of the data security issues became clear.

Subscribers concerned with data security could review the list of InfoEx data input fields and classify those fields into two categories: non-sensitive and potentially sensitive. These lists could be submitted to the BC Helicopter and Snowcat Skiing Operators Association (BCHSSOA), the Canada West Ski Areas Association (CWSAA) and the Backcountry Lodge Operators of BC (BLBC) for review and ratification prior to the 2005-06 winter operating season. Then, InfoEx subscribers could be offered two options for participation in the InfoEx program. Under "Option 1," subscribers would agree to allow their entire InfoEx submissions to be included in the CAIS dataset. Under "Option 2" subscribers would agree to allow their non-sensitive data to be included in the CAIS dataset, while their potentially sensitive data would be held in a parallel, secured dataset.

"...the strongly held positions of both camps of InfoEx subscribers were reasonable and legitimate..."

Analysis, Legal Issues

To resolve InfoEx and CAIS related legal questions, the CAA retained the services of Sze Mei Yeung of Richards Buell Sutton ("RBS"), a highly-respected Vancouver legal firm with an extensive intellectual property law practice. After a thorough examination of past InfoEx contracts and other background materials, Ms. Yeung offered the following analysis that the CAA has accepted as definitive:

1. The CAA owns the InfoEx trademark, the InfoEx system, exchange system, the (CAIS) master data base and associated processes and underlying source code (other than certain server code that was licensed from Canadian Mountain Holidays), subject to ownership of Infoex data as outlined below.
2. InfoEx subscribers likely own their originally submitted inputs to InfoEx.
3. The CAA and the InfoEx subscribers likely have a joint proprietary interest in the industry output, and are thus potentially all co-owners of the existing InfoEx industry outputs.
4. Unless otherwise contractually agreed, co-owners of a protected work (i.e. the existing InfoEx industry outputs) cannot license the protected work or assign a partial interest in the protected work without the consent of all other co-owners.
5. Given the evolving nature of technology and the CAIS project, it is difficult for the CAA to predict all possible future uses and purposes for the CAIS dataset, therefore all possible future uses cannot be definitively defined in the new InfoEx contracts with subscribers.
6. If the CAA is to continue its significant investment and efforts in developing the CAIS it would be problematic and practically unworkable for the CAA to have to obtain consents from all InfoEx subscribers (including retroactive consents from past subscribers) on a going forward basis for future initiatives involving the CAIS dataset.
7. If the subscribers are able to recognize and sympathize with this difficulty faced by the CAA, (RBS) would suggest they assign ownership of their data that is stored in the (InfoEx) dataset to the CAA, provided that a restated subscription agreement … addresses subscriber concerns with respect to disclosure, data access and liability. It is the position of the CAA that all information contained in any dataset owned or administered by the CAA must be collected and managed in full compliance with all Canadian intellectual property and privacy legislation and in accordance with the terms and conditions in any contracts or agreements relating to those data. If any InfoEx subscriber decides the information they submit to the InfoEx is to be used only for those purposes specified in the relevant InfoEx contracts, the CAA is legally and ethically obliged to comply with that decision.

Board Direction for Moving Forward

The CAA remains committed to creating a comprehensive and useful CAIS dataset, while at the same time doing everything necessary to ensure the security of the information that InfoEx subscribers own or hold rights to, and deem potentially sensitive.

During their meeting of August 10, 2005, the boards approved the following motion: ***The Boards of Directors of the CAA/CAC have confidence that current efforts to resolve the issues of data ownership will lead to an agreement that respects the interests of all parties, and authorizes continued development of the Canadian Avalanche Information System. Initial emphasis should be on developments that are less dependent on the resolution of the data ownership issue, as determined by Clair and the contracted developers.***

The Boards have reviewed and ratified the guiding principles outlined below, and have tasked their Executive Director to do everything possible to ensure the InfoEx program and the CAIS are fully integrated and operational prior to the upcoming winter season.

Guiding Principles for InfoEx within the Canadian Avalanche Information System

1. Vision & Guiding Principles

The vision for the CAIS project remains unchanged from what was endorsed by the CAA and the InfoEx subscribers at their meeting of May 2003: ***To develop the capacity to collect and create a master dataset containing avalanche-related information from all possible Canadian sources, so that (CAIS) information may be used in as many ways as possible to advance avalanche safety in Canada.***

1.1 The CAIS dataset and InfoEx datasets (existing and future) will be developed and managed as separate and distinct data sets. Database structures and processes will

be designed to ensure comprehensive data collection, data integrity and security, and inter-operability between these systems.

1.2 In keeping with recent legal advice regarding effective management of intellectual property, the CAIS dataset will only contain data the CAA owns or holds rights to. The CAA Data Sharing Policy (under development) will apply to the CAIS dataset.

1.3 In keeping with recent legal advice regarding InfoEx, it is acknowledged that each subscriber's existing and future data in the InfoEx data set is owned by that subscriber, and that data will not be used for any purposes other than those specified in the annual InfoEx contracts without the express written permission of the subscriber, except as otherwise required by law. The CAA Data Sharing Policy (under development) will not apply to the InfoEx datasets.

1.4 Beginning winter season 2005-06, InfoEx contracts will assign ownership and rights to all InfoEx data inputs classified as non-sensitive to the CAA, for inclusion in the CAIS dataset.

1.5 Beginning winter season 2005-06, InfoEx contracts will offer subscribers the choice of assigning ownership and rights to data classified as potentially sensitive to the CAA for inclusion in the CAIS dataset, or retaining ownership and rights to their potentially sensitive data and having that data held in the secured InfoEx data set.

"...potentially sensitive data would be held in a parallel, secured dataset."

2. InfoEx & CAIS: A Conceptual Framework for Moving Forward

For winter season 2005-06, InfoEx contracts will be redrafted by the legal firm of Richards Buell Sutton to ensure compliance with all relevant intellectual property, licensing and contract law, and congruence with the concepts outlined in this document.

The revised contracts will offer subscribers a choice of two options for participation in the InfoEx program. These options will determine the subsequent ownership, management and/or uses of the data submitted. The CAA will advise each InfoEx subscriber to solicit legal and insurance advice prior to taking a decision on which option they should select.

Option 1: Full Release of Data Ownership and Rights

This option will offer InfoEx subscribers preferred subscription rates on the condition that the subscriber assigns full ownership and rights to both non-sensitive and potentially sensitive InfoEx data submitted to the CAA, (including the historical data submitted by such subscribers) and that this data may immediately be inserted into the CAIS dataset for future uses as determined by the CAA.

Option 2: Partial Release of Data Ownership and Rights

This option will offer InfoEx subscribers enhanced security and management for their potentially sensitive InfoEx data at subscription rates commensurate with this increased level of service. "Option 2" contracts will specify that:

The subscriber assigns full ownership and rights to their non-sensitive data to the CAA and that data may immediately be inserted into the CAIS dataset for future uses as determined by the CAA.

The subscriber retains full ownership and rights to their own potentially sensitive information and that data only will be inserted into the InfoEx dataset, with a limited license to CAA and other subscribers to use such data as contemplated by the InfoEx contract, during the current season. Each subscriber's data in the InfoEx dataset will only be released to third parties outside of the InfoEx community with the express written permission of the subscriber.

The InfoEx dataset will be managed by the CAA according to conditions as specified in the InfoEx contract for that particular winter season. Conditions will include royalty-free use by the CAC public avalanche forecasters, and royalty-free use by the CAA's Industry Training Programs.

Both contract options will specify the following:

The CAA and all InfoEx subscribers agree to indemnify each other against harm or damages resulting from that organization's failure to ensure the security of the InfoEx operating system and associated data submissions and outputs as specified in the InfoEx contract.

InfoEx subscribers will have full and unrestricted access to both non-sensitive and potentially sensitive data submitted by all other InfoEx subscribers during the winter season that they subscribe to the InfoEx.

InfoEx subscribers will also have unrestricted access to all current season data contained in the CAIS dataset.

In consideration of a service fee set by the CAA, all InfoEx subscribers will have unrestricted access to their own data from previous winter seasons that is contained in the InfoEx dataset.

InfoEx subscribers wishing to use other subscribers' data from previous winter seasons contained in the InfoEx dataset will be required to submit a written request to the CAA identifying the specific data requested and all intended uses. In consideration of a fee set by the CAA, the CAA will administer the process for acquiring and documenting the necessary consents from the other subscribers and provide that data for which consent has been obtained (if such consents are readily available).

InfoEx subscribers wishing to use CAIS data from previous winter seasons will be required to submit a written request to the CAA identifying the specific data requested and all intended uses. In consideration of a fee set by the CAA, and if the request is congruent with an approved Data Sharing Policy, the CAA will provide the data that has been requested.

Each subscriber's participation in the InfoEx will be under license to use CAA proprietary systems. Contracts may include non-competition or other clauses required to protect the CAA's proprietary rights, and capital and operating investments in development of the CAIS and InfoEx operating systems.

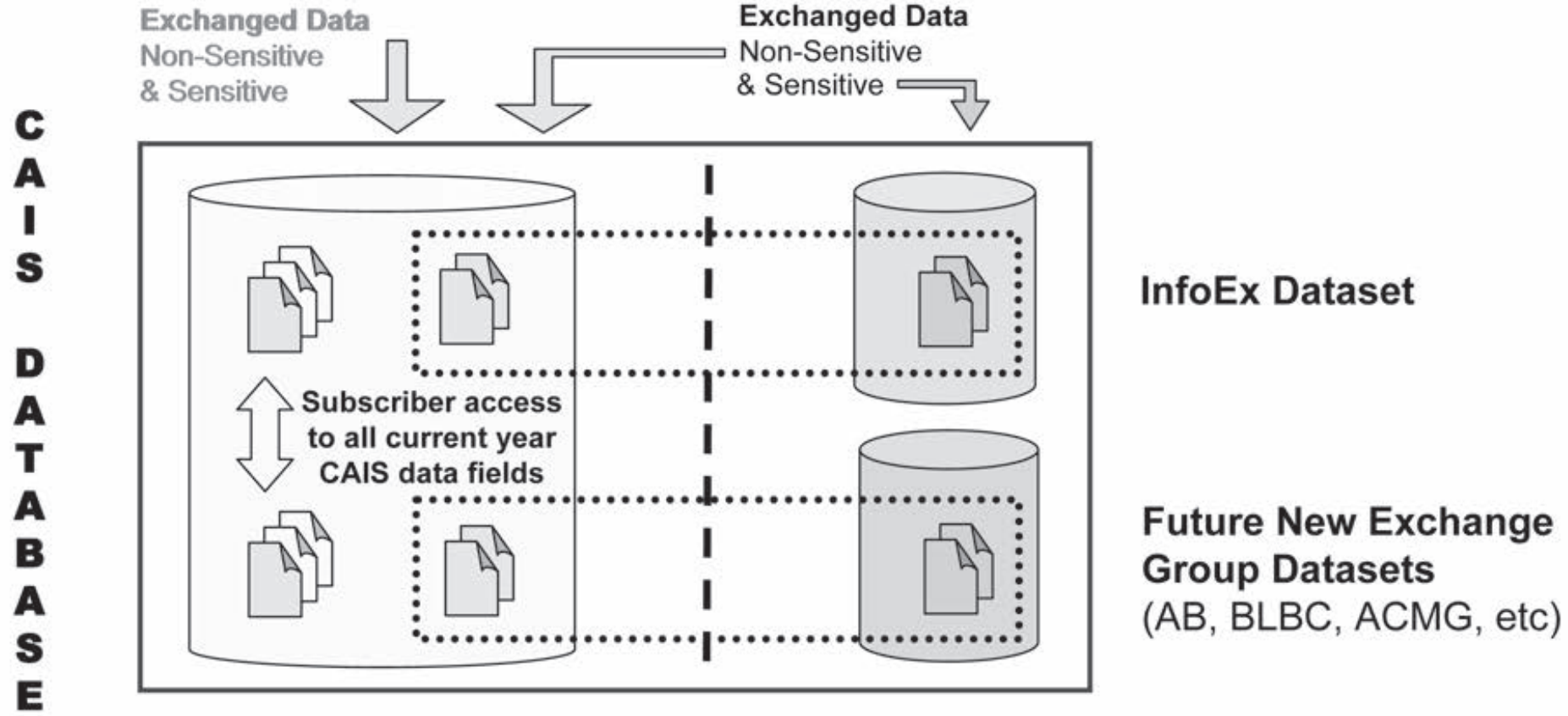
3. The Business Case For Continuing With InfoEx-CAIS Systems Development

As of 2005-06, more than $120,000 will have been invested into the CAIS project. While this may seem modest for the

Subscriber Chooses From Two Options Described in Contract

Option 1: CAIS Full Release

Option 2: CAIS Partial Release



Data fields	CAIS common + group specific		May be potentially sensitive
Data Access	Terms of CAA policies		Terms in annual legal contracts
Ownership	CAA owns system + data		CAA owns system, subscribers own their originally submitted data

scope and volume of work accomplished and the value of the resulting products, the CAA-CAC Boards of Directors have continually stated their position that this investment must be recoverable within a three- to four-year period. Mechanisms for achieving this requirement include:

3.1 The CAA will own or hold rights to all data in the CAIS dataset and may license or sell rights to use that data to researchers or other third parties according to terms contained in an approved CAA Data Sharing Policy.

3.2 InfoEx subscribers choosing "Option 2" may be assessed a one-time legal and programming services premium in 2005-06 to cover the CAA's increased legal and consulting costs incurred to meet their newly requested needs for enhanced data security.

3.3 Each season each InfoEx subscriber will receive up to one hour of technical support from the CAA free of charge. Additional technical support will be billed to the subscriber at the rate of $(to be determined) per hour.

3.4 Beginning in winter 2005-06, the CAA will charge higher InfoEx subscription fees for those who choose "Option 2" for participation in the InfoEx program. This fee increase will cover: the CAA's extra costs for developing and operating a distinct and secure InfoEx dataset (in parallel to the CAIS) for their potentially sensitive data; anticipated extra work to inform "Option 2" subscribers of all requests from researchers or others for uses of their InfoEx data; administering the required written "consent" or "non-consent" process for documenting subscribers' replies to those requests; and the extra work required to filter and verify the InfoEx data according to the consent documents returned by subscribers.

3.5 Beginning in winter 2006-07, the CAA will charge a higher Infoex subscription fee to those operators who do not have the minimum hardware or software required for fully electronic participation in Infoex. Other subscribers should not continue to pay for a dedicated evening shift CAA staff person to manually transpose the daily fax or "text only" formatted submissions of a few low tech subscribers.

3.6 The CAA will solicit statements of interest from other groups (BLBC, ACMG, etc.) to develop similar cooperative information exchanges that could utilize the InfoEx-CAIS technology with minimum added costs to the CAA, thereby generating new revenue streams.

3.7 The CAA will work to develop standardized, secure avalanche data management services for smaller operators lacking the means or technical capacity to develop comprehensive internal systems comparable to those systems in place at CMH, BC MOT, and Parks Canada. In time the CAA could develop data visualization and analysis tools, and create an affordable "industry standard / due diligence" avalanche data management product for those Canadian operations choosing to participate at an annual cost to be determined. Participants would fully own all of their non-CAIS data, and have sole and full access to their data at all times.

4. InfoEx-CAIS Project Development Priorities, Summer / Fall 2005

4.1 Programming required to achieve InfoEx – CAIS systems architecture and the data collection, management and security goals outlined above.

4.2 Programming to required to generate metadata documenting the data fields / contents of the CAIS and Infoex datasets, and the sources of those data.

4.3 Programming requested by CAC staff to support PAB production and new data collection services required for Alberta.

4.4 System enhancements to make the data transfer processes more "user friendly" for small operators and the less than technically advanced. This should include developing minimum hardware and software requirements for participants.

4.5 Programming required to facilitate the establishment of other information exchange groups.

Coming of Age at the BOD

BY STEVE BLAKE

Greetings.

As we roll into fall we are all starting to think about the snowy torrent again. A lot has been going on, as seems to be the norm these days. Rather than simply an update, I thought I would use up my space allotment with a general overview of where we are in terms of organizational evolution. Before I began participating on the boards, I didn't put a lot of thought into how the CAA/CAC has developed in its 25 years. I went to the meetings, had some fun, learned stuff . . . all good.

I did notice over time that things were getting bigger. The AGM has become the centre point of a week of meetings, professional development sessions and the occasional social event. The question then becomes, has this evolution been good or bad? Well, we'll never know for sure. (Do what I do – just hold on and enjoy the ride!) Change can be hard but it is not the 1980's anymore. Regardless of how nostalgic we want to be about the good old days, we have to accept that we have changed and the world has changed around us. Where do we go from here? This is a serious question to which we are working to find an answer.

Let's zoom out and back a couple of decades. The CAA came to be as a group of recognized avalanche specialists, with the nudging of some of their employers, wanting to pool their collective wisdom to make life safer in the mountains. Relationships were built with government agencies, educational institutions and industry partners. During this time the board members and the committee members did all the work. Their accomplishments were huge for a volunteer board and they represent the foundation of the envied professionalism that embodies the Canadian avalanche scene today.

It is absolutely normal for organizations to start this way; the board sets big picture goals and policy, manages finances and participates in the day-to-day operations of the organization. The heavy workload is alleviated by the use of committees. The board is made up of people who have specific technical knowledge in the field and strong management skills. The technical term for this is called a "Working Board."

The tempo picks up and the board recognizes they can't keep up the pace. The logical outcome is that committees are increasingly relied upon and a few paid positions are created. As the organization creates some momentum for itself, growth starts to snowball (big groan!). The board then makes the decision to hire one person to manage the paid staff. We have used various names for this position over the years and now we call it the Executive Director. At this stage the board is in transition to becoming a policy and governance board.

More time passes and the "Policy and Governance Board" (which I'll remind you is really just a fancy name for the committee of people you elected to look after things) becomes the body that sets the big picture goals, develops policy and clearly defines the limits of the ED's discretion. The relevant skill sets of board members become more oriented to board function rather than technical skills in the field. Remember John Hetherington's professional decision to step down as President to take on the role of Secretary/Treasurer because that skill set was lacking on the board? I suggest this will be the way from now on. That is, actively recruiting board members with specific specialized skills suited to specific board positions.

The here and now. We have grown from our roots as a group of concerned specialists to a $1.7-million company with two distinct subsidiaries. Have we lost focus on our membership?

We have always had strong ties to "industry" (a nebulous term I use generically for our employers). We have a membership category that captures this group and have had discussions about increasing the membership size of this group. What then becomes our responsibility to industry? Does the CAC become the new home for industry? Some of our corporate partners will fit well in the CAC; plenty won't. Many of the CAA's proudest achievements, the gold-standard setters like OGRS, InfoEx and Training Schools, form the fabric that weaves individuals and industry together into the Canadian avalanche community. Somehow our guiding documents, the Constitution and By-laws, need to capture this relationship in a way that is true to our history and relevant to our future.

And of personal growth. I'll use myself as an example, although there are dozens of better ones in our membership. Let's say I accept the next promotion that presents itself in my regular work. Before the end of my time in office I may no longer be able to claim Professional Member status. Does this render me irrelevant to the organization? Will I have to resign based on that? In many ways the skills I am developing now make me even more valuable in the policy/governance environment in which the boards now operate.

So what now? The boards will be wrestling with these and other questions and we will be looking for input from you, the members. Drafts of the respective CAA and CAC vision and mission statements will be developed starting in September. Our goal is to have these guiding documents word-smithed and ready for ratification at the AGM next May. This is quite a large and scary commitment for me to make, being new to the hot seat. I do know, however, that your Boards of Directors consist of some excellent, enthusiastic individuals who will enlist your participation in answering the big questions facing us all.

Have fun,

Sponsor's Corner: Marmot Mountain Works

BY MARY CLAYTON

For those of us who love the outdoors, Marmot is one of those companies that have been on our radar for a long time. Originally known for their down garments and sleeping bags, the Marmot line now includes tents, packs, gloves and a wide range of clothing. It has developed a name for products made for climbers, by climbers. The Marmot website describes how the company founders first began collaborating:

"In April 1971, University of California Santa Cruz students Eric Reynolds and Dave Huntley were in Alaska on the Juneau Icefields on a school project in Glaciology. It was here on the glacier, amongst these students, that the idea of a Marmot club began. To become a Marmot, you had to climb a glaciated peak with another Marmot. One of the rules of the club was that everyone was president. Most of the other rules dealt with the collegiate fascination with bodily functions."

From that fun-filled beginning grew a serious business that would cater to the special needs of those who spend extended time in the outdoors. Reynolds and Huntley began making prototypes of down products in their dorm room in Santa Cruz. In 1973, they moved to Colorado, where they teamed up with another climber named Tom Boyce. The three rented a 100-year-old building and in 1974, Marmot Mountain Works was born.

Marmot soon established itself as a company that developed its products through hands-on, real-life use. In 1976, founders Eric and Dave were among the first to see the outdoor possibilities for Gore-Tex. They sewed up some down bags with the new fabric and spent a week in a commercial frozen meat locker, comparing the prototypes with their standard nylon models. Impressed, they then tested the bags while sleeping under fire sprinklers. The rest, as they say, is history. Marmot immediately changed their entire product line, from down garments to sleeping bags, to Gore-Tex and became Gore's first customer in the world outdoor market.

According to Al Safrata, President of Marmot Mountain Works Canada, working with the CAA and its members is a natural progression of his company's founding principles. "When you look at how we've built our business over the years, we support people whose business is outdoors," he explains. "We really want to help the professionals. Safety in the outdoors is important to us."

Marmot has been a sponsor of the CAA since 1999. Over the years, Al says the benefits have been mutual. "The association is powerful for us. Our sponsorship gives us a forum to communicate with the actual users, be it at the annual meeting or on a more informal basis." Generally speaking, CAA members fit the sponsorship profile well. "If you look at our partners, we don't associate with the super heroes," says Al. "We work with the working outdoor professional."

For his own part, Al is a good example of his company's philosophy. "As long as I'm outdoors I'm a happy guy," he laughs. "Kayaking, skiing, ski touring, camping, sailing, I'm excited about it all. Even reading a book in the sunshine works for me."

Al has been with Marmot for 12 years and when asked what it is he likes about the company, he's quick with an answer. "I like what we focus on," he says. "We are always trying to make products that perform beyond our user's expectations. Recreational enthusiasts can forget about all the hassles of their day when they're outside and protected. If they're safe and happy, they can enjoy their outdoor experiences." Marmot's focus on maximizing individual experiences could even have a wider benefit, explains Al. "If people can get outside more, we'll all have a more relaxed and happy environment."

Another non-profit association close to Al Safrata's heart is the Marmot Recovery Foundation. Marmot Canada helps to sponsor their work, which is to raise awareness of and hopefully save the Vancouver Island Marmot. This animal is a uniquely Canadian species found only on Vancouver Island. It differs from other marmot species in behaviour, genetics and ecology and is easily identified by its chocolate-brown colour. Estimated in the mid-1980s to be more than 300 animals, the population is currently thought to be just over 100 animals. This makes the Vancouver Island marmot one of the rarest and most endangered mammals in the world.

If you are interested in donating to this cause, contact the Marmot Recovery Foundation at:

www.marmots.org.
Call Toll Free:
1-877-4-MARMOT (464-7668)
Or Write:
Marmot Recovery Foundation
Vancouver Island,
Box 2332, Stn A
Nanaimo, BC, Canada V9R 6X9

Marmot Facts:

- Marmots are the largest members of the squirrel family. Adults typically grow as large as a big housecat (about 5 to 7 kilograms).
- All of the world's 14 marmot species build elaborate underground burrows, hibernate during winter, and feed on grasses and flowers.
- Vancouver Island marmots love peanut butter.
- Four captive breeding centres currently house Vancouver Island marmots and their offspring.

Canadian Avalanche Centre Activities

BY JOHN KELLY, CAC OPERATIONS MANAGER

I was pleased and honoured to be chosen as the first operations manager for the Canadian Avalanche Centre. Helping to lead this new organization into the future will be an exciting challenge. The CAC in its first year was like a puppy, pleasing everyone by its very existence. Exuberant, playful and full of energy – we could do no wrong. But now that we are a year old it is time to wean off the puppy chow and begin training so we can become a productive working animal. When you stop being cute, you'd better be good.

We have six goals to work towards and three priority targets suggested by our stakeholders. I won't go into long-winded detail about these; you can review them at your leisure on our website and in our annual report.

The needs for public avalanche safety in Canada are large and growing. We have mountain areas with heavy snowfall and long winter seasons in geographic areas that are both disparate and distant one from each other. The mountainous areas in BC alone exceed all the mountainous areas of Europe combined.

Use of our mountains for winter recreation is increasing as more and more of us discover the joys of moving over and through snow in an increasing variety of ways. Being generous of spirit and welcoming (not to mention entrepreneurial) we are also increasingly inviting our friends from abroad to join us in the mountains. It is the fundamental goal of the CAC to help more people get out and enjoy the mountains of Canada in the snow, while also helping them come home safely from their adventure.

"...up to 90% of mountain sledders are unaware of the bulletin products that we offer..."

But you know all of this already and what you really want to find out is what the CAC is going to do in the next little while to promote avalanche safety and what we are not going to do and why. We know there are many needs. There are also many ideas on how to bring avalanche safety to the recreational public. The difficulty is targeting the activities and programs with the best chance of preventing the most avalanche accidents for the least amount of expenditure. Believe me when I say that what we can do is limited by the dollars available. More on that later.

In an expanding market, we suspect novice users are increasing faster than other types of users of avalanche terrain. This theory is supported by our contacts in areas such as Quebec and the North Shore of Vancouver who report a swell of new, uninformed users venturing into areas formerly the sole domain of hard-core backcountry denizens.

Coupled with this surge of novices in the backcountry is a disturbing observation of avalanche fatality statistics in Canada that leads us to conclude there is much work to do in spreading avalanche safety messages. Specifically, our observation shows our avalanche accident profile in relation to the danger scale differs considerably from both Switzerland and the United States. Canadians are more likely to get into accidents when the avalanche danger is "High" than either the Swiss or Americans. The fact we have more than our share of accidents under these conditions is a clear signal that people are not receiving the message. I think the people getting into these accidents are not reading the bulletins and forecasts that we produce.

One of the groups we will spend some effort targeting are snowmobilers. Again, our contacts tell us there is basic awareness work to be done, as up to 90% of mountain sledders are unaware of the bulletin products that we offer. Our methods will be grassroots – going to the shows, engaging clubs and participating in events. As a modest measure of our success I want to double the e-mail signup to our bulletin products from 3,200 to 7,000 by season end, with the majority of new subscriptions coming from sledders.

With the securing of provincial funding we will direct efforts to Alberta this year. Our activities will include a backcountry avalanche workshop in Calgary in November, participation in the Edmonton and Calgary snowmobile shows as well as the Banff Film Festival. We will also increase avalanche forecasting and bulletin services to regions of Alberta, although development will be slowed by the limitations of an assured data supply – something we will be looking to develop. Overall, our aim in Alberta is to supply targeted avalanche safety products to at-risk groups.

Nationally, our priority continues to be stabilising the funding of the Centre d'Avalanche de la Haute Gaspésie (CAHG) and the incorporation of the CAHG into the CAC. Encouraging words have been exchanged with various government agencies both provincially and federally but we have not yet seen a firm commitment. Specific changes you will see during the year, which reflect our national initiatives, is the development of a more bilingual facility. We are building our website and information systems with the idea that future French content will plug-in. We are crossing our fingers in hopes of being able to present the Haute Gaspésie forecast in French and English as an integrated part of our bulletin page.

The public avalanche bulletins are a relatively mature product compared to our other programs at the CAC. We receive more feedback, spend more time debating about bulletin effectiveness and have more ideas and vision about where we need to go than with any other product. We know we have work to do.

In the future there will be information and products for advanced users. You will be able to draw a shape on a map and see the 24- and 72-hour average snowfall, temperature and wind in that region by vegetation zone. A click will take you to a list of weak layers in the snowpack, crystal types, size and yellow flags. Another click will summarize all the comments from the user forums relevant to the area you have selected.

Avalanche photographs will be yet another click away. Bulletin areas will be rearranged to better reflect bio- and geo-climatic zones for avalanche formation. There will be more forecasts in more regions more often. We will be able to put out a special temporary product – say for the Olympics. Yes, this will all happen, but not this year.

The reality is that we have about $280,000 to spend on the public avalanche bulletin program, which represents 45% of our total CAC budget. With that we produce forecasts for

vast regions – the North Columbia forecast region alone is approximately the size of Switzerland's entire forecast regions combined.

While we do a good job – ongoing research at the University of Calgary is providing encouraging validation of our forecast accuracy (see Bruce Jamieson's article in this issue) – there is no denying we are stretched to accomplish what we do. This limits how fast we can advance and in what directions. Many of the short-term improvements to the bulletin program will thus be behind the scenes. I am interested in providing structure and substance to the existing forecasts by developing standards for bulletin production. I would also like to see the forecasters incorporate methods of weak layer modeling into our forecasts and I am keen to have them work with the Meteorological Service of Canada to improve the accuracy of weather forecasts in the mountain areas. These advances will lead to better warning products, but they won't look much different to the end users.

The CAC is coming up to its first birthday (feels like seven dog years!), and the changes since last October have been astonishing. My goal with the CAC is to continue the tradition of cooperation and inclusiveness inherited from the CAA. Our intention is to emulate our elder sibling, to remain nimble and lean and accessible, doing what is needed and recognizing what is possible. In time we hope to become the "seeing eye dog" for public avalanche safety from coast to coast to coast. For now we are learning and growing into that role.

An Update on Change at the CAA

BY IAN TOMM, CAA OPERATIONS MANAGER

I've been on the job now as CAA Operations Manager for about a month. It's been quite a month and certainly made for a summer unlike any I've had in the past. Big things were happening at the spring AGM this year and they're still going on right now. It's both an honour and a privilege to be working towards solutions for this association and its members in this new capacity.

"World class" is how many people refer to the CAA, its members, programs and services. In the past three years of work with the CAA as the Industry Training Program (ITP) coordinator, I've fielded so many requests for curriculum and assistance with avalanche training from around the world, I've lost count. My peripheral involvement in the ADFAR project has made me realize the CAA is truly going places few avalanche organizations have gone. It's a very exciting time right now for our community.

It's also a time of challenges. The spring CPD Seminar "Professionalism at a Crossroads" addressed many, but certainly not all, of the very important issues facing the avalanche industry today. These issues haven't gone away. In fact, this summer has seen some significant events that are both threats and opportunities for our association.

As an example, workplace safety was brought up at the CPD seminar as an issue more avalanche workers and employers need to be thinking about. Coincidentally, WorkSafeBC (The BC Workers Compensation Board) along with the Alliance of Worker Compensation Boards of Canada held a public forum on workplace safety in Vancouver this July 25-27. The issues discussed there are the exact ones we are faced with, namely, cultural attitudes towards risk and workplace safety. Of particular interest is an IPSOS-Reid survey measuring societal shifts in attitudes towards workplace safety as compared to those towards drinking and driving. You can find the survey's results on page 21 of this issue. Take a close look at BC. The attitudes here differ substantially from the national average and most other provinces in general.

The incredible amount of work the board and Clair have put into the InfoEx program is also another significant event. Clair's InfoEx status report in this edition is an eye-opening look at the future of the InfoEx and Canadian Avalanche Information System databases. Additionally, the completion of the English version of the NSS Online Project has created something that never existed before, and it's because of the CAA and its members. While not ratified at the spring AGM, the board's tireless work on a new constitution and bylaws is also indicative of the significant change the CAA is undergoing. These, and other events, are just the tip of the iceberg with what's happening in your association.

The changes at the CAA mean we're adapting. The CAA/CAC split had a significant trickle-down effect on how we staff the centre in Revelstoke. The resignation of Evan Manners after nine incredible years, combined with the need for additional staffing for CAC programming and the necessity to optimize current staffing, resulted in what has now become a massive restructuring of both organizations. It's not that we're exactly reinventing the CAA, but we've fundamentally changed how and why we do things to make the CAA and CAC better able to adapt to change and meet the challenges of operating a non-profit head on.

Some new CAA staff members were hired this summer. Randy Bente has filled the newly-created Information Technology Specialist position. He comes from a strong background in network administration, IT systems management and some database work. We're looking forward to working with him and developing the new IT-related programs and services of the CAA (of which InfoEx and the CAIS are only a part) into the future.

With the split of the CAC and all public programs and services, including RAC, it became obvious that having an operations manager and a schools coordinator was inefficient and redundant. I had always been puzzled why the Industry Training Program operated as more or less a separate business within the CAA. For one, it regularly caused confusion with regulatory bodies. They saw the training programs as being run by the CAA, which they were, but they were always referred to as separate from the CAA in our literature. I lost count of how many times I was asked for the certificate of incorporation for CAATS.

With the new restructuring, the training programs are now fully integrated into the day-to-day operations of the CAA. This will only benefit our association and the training programs, giving us better communication and integration with the rest of the CAA's programs and services. Unfortunately this meant that both the coordinator and registrar jobs were dissolved and their duties and tasks moved to other newly redefined jobs.

Part of my new job description as CAA Operations Manager includes ITP administration and logistics. Other aspects of the old school coordinator's responsibilities – such as course development, instructor training and hiring – will now fall to the ITP Chief Instructor, a newly-created position which has yet to be filled at the time of writing. Diversifying these duties will hopefully enable annual updates to the entire CAA curriculum, allowing the programs to grow and evolve with a little more ease than in the past.

Volunteering is another new development I hope to foster and grow during my time as CAA Operations Manager. Once I found out I had this job, I started to read about non-profit management and one thing became immediately very clear: non-profits are run by volunteer labor. It is true our association is built on the foundation of volunteer boards and committees, but that's a lot different than using volunteer help for day-to-day, front-line operations. It is something we have to look into and develop. If you are a member who wants to do more for the association, and who lives in Revelstoke, I'd like to hear from you. We require regularly scheduled, trained and trusted volunteers starting as soon as possible at the CAA.

Public perception, government scrutiny, operating standards and the general climate of the avalanche industry is changing, so we have to as well. Business cycles are an interesting thing to study and there is no shortage of research and opinion out there

on what non-profits should do, when and why. One thing is certain. Every business will be faced with mounting pressure from a variety of sources in their life cycle, which eventually presents them with a significant decision. That decision is whether to hunker down and entrench, or change and adapt to new operational realities.

I feel the CAA is doing well at adapting. The strength of our board, staff and most importantly, all our membership, is a testament to that. It's going to be a bumpy road ahead to streamline and optimize our new operating and staff structures. One thing is certain however, and that is we've got excellent people working with and for our association. You can be sure that when November comes and we all return to field work, the CAA's programs and services will be ready and waiting to support you. I look forward to working with you all in the coming months and making the 2005-06 operating year one of change and opportunity for us all.

Avalanche Workers in Canada: A Common Skill Set

BY IAN TOMM AND CAM CAMPBELL

Background and Context by Ian Tomm

One of the recommendations resulting from the CAA Educational Visioning Project completed in the spring of 2003, was the development of tools and/or resources to aid aspiring avalanche workers. While specific career guidelines are hard to define, due to the broad and very diverse skill sets specific to each of the potential career paths in the avalanche industry, the CAA Education Committee set out to try and address this recommendation. Dave Smith and Phil Hein were instrumental in getting this initiative off the ground with a draft set of the common skills, abilities and attributes of an avalanche worker in Canada. It was felt a comprehensive definition could benefit aspiring workers, by helping them understand exactly what we do at work.

In the summer of 2004, the CAA Board of Directors approved IPR funding to enable a broad survey of employers and senior avalanche personnel in Canada regarding this draft list. Cam Campbell was contracted to perform the survey and, over the course of the 04/05 winter, he solicited feedback from numerous employers. The feedback received was generally positive as to the key common attributes of avalanche workers in Canada and brought up good questions regarding the utility and specific value of the list to aspiring and current avalanche workers.

Initially the project was referred to as Career Development Guidelines. However, after the project was completed we realized the list was not sufficient to cover all potential career paths. For example, there was no mention of the guide training and certification process through Thompson Rivers University for the mountain and ski guiding disciplines of the avalanche community, nor was there any mention of the technical training and background necessary for many highways positions.

What has been developed to date is a thorough list of the common skills for avalanche workers in Canada, be they heli-ski guides, highways avalanche technicians, park wardens or ski patrollers. No doubt the list is open to some debate but most will agree it is a reasonable picture of what we all do every winter. It is important to recognize that most of the specific avalanche-related career paths out there carry their own specific education, training and certification requirements and this list does not address any of that. Nor does it address the time period required to develop these skills. Obviously the time between being a data collector to becoming solely responsible for stability decisions, terrain use and hazard management is considerable.

Most will recognize the utility of this for ITP[1] students and it is our intent to provide this document to Level 1 & 2 students in their pre-course packages starting this winter. Ideally this list will evolve over time and become more refined. Remarkably, it is the first list I've seen that attempts to summarize what it 'is' that we all do. If, when reading through this, you are struck with an idea or thought we'd love to hear it. Refining this definition has many uses, from training and education to awareness and advocacy. Making it better will benefit us all.

Industry Survey Report by Cam Campbell

Last March I solicited feedback from avalanche industry employers on a preliminary set of Career Development Guidelines for avalanche workers in Canada. I received almost 20 responses in total from employers in almost all aspects of our field (e.g. ski patrol, highways, heliskiing, backcountry guides and consultants). I would like to thank everyone who responded to my questionnaire. Your input was an integral part of the creation of this document. I believe this has the potential to be a valuable document for ITP and the CAA.

The following is a summary of the responses:

1. Are the eight categories (i.e. data collection, mountain travel, avalanche forecasting, avalanche control, terrain analysis, avalanche search & rescue, risk management and communication) appropriate? Why or why not?
   - Yes (16x)

[1] ITP: Industry Training Program, formally known as CAATS.

2. What guidelines would you add or delete?
   - None (8x)
   - Add:
     • OFA as a recommended option for 1st aid training
     • Be familiar with new safety measure technologies such as the Avalung and Airbag systems
     • "Let's call office skills something else. Table-Top skills?"
     • "I would add a category; Find Your Local Mentors. Especially if you are trained but outside of an operation Within this could be a sub-category, Volunteer; SAR avalanche tours, volley patrol, patrol exchanges."
     • Decision-making, analysis of good and bad decisions, human factors involved
   - Delete:
     • Densities for all 25 full profiles
     • Hand plotting storm or snow profiles; "computers do it all."

3. Do you provide opportunities for training and professional growth in these categories to new hires and recruits?
   - "The basic requirements for employment in my program are a CAA Level 2, blasting ticket, advanced 1st aid, minimum of three (preferably five) years experience as a guide of ski patrol, mountaineering, computer and map reading experience is nice to have. We train the remainder."
   - "We require new hires to have CAA Level 1, opportunity to improve skills is provided and recommended."
   - "Not much navigational training opportunities."
   - "We don't provide Transportation of Dangerous Goods Cert."
   - "Yes, in all areas except avalanche control."
   - "Yes after a probation period. Succession planning is big right now with eight of 10 Techs retiring in the next decade."
   - "In general I expect a Level 1 graduate / assistant guide to come with the hard skills and competencies that enable them to work effectively under the supervision of a senior guide."
   - "Instructional staff is expected to already have significant experience in most of the skills identified. Students receive training in most of the areas identified but not all."

4. How much of this list do you expect Level 1 graduates to have experience with?
   - Advanced 1st aid
   - Map and navigation experience
   - Mountaineering experience
   - Search and rescue skills
   - Accurate snow profiles and weather obs
   - "Plotting storm and snow profiles with computers is extra, people should be able to complete tasks manually before relying on technology."
   - "InfoEx is not always available to people in the industry."
   - Don't expect blasting experience
   - "Confident with all of it but not expected to be excellent."
   - "Nearly all."
   - "Experience will be high in field skills down to low for in-house skills for someone outside of an operation."

5. How much of this list do you expect Level 2 graduates to have experience with?
   - Advanced 1st aid
   - Expert skier
   - Advanced mountaineering skills
   - Advanced navigation skills
   - Terrain skills
   - Trip planning
   - Stability analysis
   - Weather forecast analysis
   - In-depth understanding of the PAB
   - Search and rescue skills (companion and organized)
   - "Plotting profiles with computer software is thought of as a plus." (Ski Patrol)
   - "Level 2 and CAA professional members should be a lot further advanced, as this list is only the basic requirements from which to build ones skill.s"
   - "All of it."
   - "All of it except blasting ticket."
   - "All except that we don't use digital beacons. So, we would not need graduates to be proficient with digital beacons to the point of being able to teach search methods with them."
   - "All of it to some degree. The talent pool is deep enough to be selective."
   - "The Level 2 graduate / ski guide has the advanced judgment and decision-making skills that allow them to work with

little to no supervision."
- "A Level 2 graduate should have had or taken the opportunity to gain experience in all of the categories described. It is likely however that there will be less familiarity in some areas such as Terrain Analysis if the candidate hasn't worked or played in a specific area."

6. Other comments
- "I am sitting here trying to figure out who and what this is for – I do not understand the objective of 'a set of career development guidelines for Operations Level 1 students." At what stage is this for? What do you mean 'not a tick list', it reads exactly like a tick list? Is it a guideline to become a "Professional Member"? If so, it should say that. If it is to gain experience to take the CAATS Level 2, it should say that. What am I missing here?"

Based on this feedback and the preliminary list, the following set of common skills of avalanche workers was produced:

Data Collection

Field Skills:

• Have a minimum of 100 on the job field days including the following observations:
• >50 recorded manual study plot weather observations,
• >50 recorded manual field weather observations,
• >25 full snow profiles including temperatures and several density measurements,
• >25 field test profiles,
• >50 avalanche occurrences observed on 25 separate days.

Observational Skills:

• Demonstrate quality observations through complete familiarization with the CAA Observation Guidelines and Recording Standards for Weather, Snowpack and Avalanches.
• Relate the accuracy of their observations with the outcomes of their stability analysis and forecasting.

Operational Skills:

• Ensure familiarity with their operation's database including data entry and analysis.
• Plot snow profiles both manually and with computer assisted profile programs.
• Plot storm profiles both manually and with computer software.
• Seek quality control and mentorship from supervisors to ensure accuracy and proficiency.

Mountain Travel

Travel Skills:

• Ensure their skiing or snowboarding ability exceeds job requirements (expert level).

Terrain Skills:

• Demonstrate the ability to recognize and avoid or minimize exposure to avalanche terrain through good use of route finding and track setting.

Navigation Skills:

• Understand and demonstrate accurate use of map, compass, altimeter and Global Positioning Systems.

Mountaineering Skills:

• Demonstrate basic rope handling techniques for protection against falls and for high-angle rescue.

Trip Planning:

• Understand basic elements of trip planning for field work ensuring objectives are met within operational timelines.

Avalanche Forecasting

Stability Analysis:

• Develop a good knowledge of stability factors and analysis through hands on experience.
• Seek mentorship and peer review in the workplace.

In-house Forecasting:

• Have a thorough understanding of the system and methodology used by their operation for stability forecasting, including the operational guidelines for avalanche hazard levels.

Knowledge of Weather:

• Have a basic understanding of mountain weather through coaching, self learning and formal education.

Knowledge of Snowpack Processes:

• Have a basic understanding of physical processes associated with a mountain snowpack through coaching, self learning and formal education.

Weather Forecast Products:

• Have familiarity with weather products commonly used by their operation, the CAA or the industry.

InfoEx:

• Understand the format and abbreviations for the Industry Information Exchange.
• Practice writing and submitting InfoEx data.

Public Avalanche Bulletin:

• Have familiarity with the Public Avalanche Bulletin.

Avalanche Control

Blasters Log Book:

• Maintain a personal log book from the first day of training in explosive use.

On the job Explosives Training:

• Meet operational objectives for safety.

CAA Avalanche Control Blasting course:

• Complete the CAA's Avalanche Control Blasting course.

WCB Blasters Ticket:

• Meet the requirements for obtaining the ticket for snow blasting.

Ski Cutting:

• Be able to ski cut avalanches safely and effectively according to job specific standard procedures

Terrain Analysis

Mapping Skills:

• Familiar with the use of maps, air photos and oblique photos to identify avalanche paths and record avalanche activity.

Avalanche Atlas:

• Become familiar with the local operation's avalanche atlas, including the location and physical characteristics of individual avalanche paths.

Target Atlas:

• Become familiar with their operation's target atlas.

Appropriate Test Locations:

• Be able to choose appropriate test profile sites based on safety and representation.

Local Knowledge:

• Become familiar with their operation's standard access routes.

Avalanche Search and Rescue

First Aid Training:

• Maintain a minimum of an 80-hour advanced level wilderness or occupational first aid course and annual CPR.

Companion Rescue:

• Have mastery of all aspects of companion rescue, including transceiver search and probing techniques.

• Have transceiver search skills that meet CAA and/or industry standards, including both analog and digital technologies (to the point of being able to teach a variety of search methods for each technology).

• Be familiar with new safety measure technologies such as the Avalung and Airbag systems

Organized Rescue:

• Be well versed in their operation's organized rescue plan and participate in mock rescues.

Risk Management

Safety or Risk Management Plan:

• Become familiar with the safety or risk management plan for their operation.

Decision Making:

• Demonstrate proficiency with the analysis of decision making and the identification of human factors.

Governmental Health and Safety Regulations:

• Ensure familiarity with all regulations that apply to the handling, use and storage of explosives and all regulations that apply to their operation.

Communication

Radio Communication:

• Demonstrate an ability to use VHF radio equipment and a familiarity with federal regulations.

Standard Operating Procedures:

• Be completely familiar with specific communication protocols designated by their operation's Standard Operating Procedures and safety plan.

Verbal and Written Skills:

• Seek out opportunities to practice verbal and written communication skills including computer skills.

Personal Development

Teamwork:

• Have ability to work effectively as an active team member towards a common goal.

• Demonstrate sound leadership abilities.

• Be familiar with conflict resolution strategies.

Professionalism and Ethics:

• Ensure an understanding of the professional responsibilities and ethics associated with avalanche professionals in Canada.

Fracture Character Guidelines Update

BY ROB WHELAN, TECHNICAL COMMITTEE CHAIR

During the winter of 2005, the CAA Technical Committee prepared a draft Observation Guidelines and Recording Standards for Fractures in Small Column Snowpack Tests. These guidelines were presented at the AGM in May. As a result of feedback from stakeholders at the AGM, CAA forecasters, ITP instructors and others, the committee has revised the draft.

The major revision was to group fracture characteristics into three major classes, while retaining the original fracture character descriptions and recording standards. A stumbling block in this process has been choosing labels (names) for the three major classes. At the time of writing this article, the proposed three classes are as follows:

SUDDEN – A major class which includes Sudden Planar (SP) and Sudden Collapse (SC)
RESISTANT – A major class which includes Progressive Compression (PC) and Resistant Planar (RP)
NON-PLANAR BREAK – A major class which includes ONLY non-planar breaks (NB), distinct from No Fracture

Experienced observers in good conditions will always attempt to observe and record the fracture character using the five-level scale (SP, SC, PC, RP, NB). If the column does not fracture in the test, this is recorded as No Fracture (NF).

We've heard strong arguments in favour of a simple ordinal system, such as the Birkeland/Johnson Shear Quality scale (Q1,Q2,Q3), and also strong support for a higher resolution scale such as CAA Technical Committee draft present at the AGM. We feel the new revision offers the advantages of both, in much the same way as the ICSSG Grain Classification system allows the observer to record a new snow grain in its major class Precipitation Particle (PP), or as a sub-class Spatial Dendrite

One potential problem with labeling PC and RP fractures as Resistant is that while they are less dramatic than Sudden fractures, experience shows that PC fractures will often occur in the first few loading steps of a test. This result could lead an inexperienced observer to interpret the result as a "sudden" fracture, when in fact it is actually " A fracture of noticeable thickness….which crosses the column in a single loading step, followed by additional compression of the layer with subsequent loading steps."

Work is still in progress on these guidelines. If you have any comments, questions or suggestion, please e-mail techcom@avalanche.ca

The following table summarizes the guidelines.

Fracture Character Major Class	Code	Fracture Character Sub class	Code	Fracture Characteristics
SUDDEN	Su	**Sudden Planar** (pop, clean & fast fracture)	SP	A thin planar* fracture suddenly crosses column in one loading step AND the block slides easily** on the weak layer.
		Sudden Collapse (drop)	SC	Fracture crosses the column with a single loading step and is associated with a noticeable collapse of the weak layer.
RESISTANT (other suggested labels include: Transitional, Gradual, Reluctant)	Re	**Progressive Compression** (indistinct)	PC	A fracture of noticeable thickness, usually greater than 1cm, which crosses the column with a single loading step, followed by additional compression of the layer with subsequent loading steps.
		Resistant Planar	RP	Planar or mostly planar fracture that requires more than one loading step to cross column and/or the block does NOT slide easily** on the weak layer.
NON-PLANAR BREAK	NB	**Non-planar break**	NB	Non-planar fracture.

* "Planar" based on straight fracture lines on front and side walls of column.
** Block slides off column on steep slopes. On low angle slopes, hold the sides of the block and note resistance to sliding.
*** No Fracture. If there is no fracture in the test, it is recorded as No Fracture (NF).

Workplace Safety Survey

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Each year in Canada, more than 350,000 workers are injured and another 1,000 die in workplace accidents. These work-related deaths, illnesses, and injuries are not and should not be an inevitable and acceptable cost of doing business. That view was the theme of a national forum held in Vancouver this summer, co-sponsored by WorkSafeBC (the Workers' Compensation Board) and the Association of Workers' Compensation Boards of Canada (AWCBC).

One of the most critical issues in changing the way employers and workers think about workplace safety is to have a baseline understanding of what the current attitude is. The results of an Ipsos Reid survey conducted for this forum show that more than 60% of Canadians – and almost 70% of BC residents - believe workplace accidents and injuries are an inevitable part of life.

"This is a significant finding and has important implications for workplace health and safety," says Rick Iverson, Professor of Human Resource Management at the Faculty of Business Administration, Simon Fraser University. "This is the first study to benchmark attitudes and beliefs about workplace injury against another important cause of injury and death: drinking and driving," says Iverson. "Nearly two-thirds of Canadians reject the idea that accidents and injuries caused by drinking and driving are an inevitable part of life. Shifting societal attitudes to similar levels for work-related injuries poses a major challenge."

Results varied by region more than two thirds of British Columbians agreeing that workplace injuries were inevitable. When benchmarked against the drinking and driving responses, the largest differentials in attitude were noted in Quebec.

Region	Agree: Workplace accidents and injuries are an inevitable part of life.	Agree: Accidents and injuries caused by drinking and driving are an inevitable part of life.
BC	67%	38%
Alberta	59%	41%
Saskatchewan and Manitoba	62%	37%
Ontario	56%	34%
Quebec	64%	34%
Atlantic Canada	61%	40%
Canada	61%	39%

Perhaps surprisingly, the results were similar among rural and urban respondents and relatively consistent across income levels. Educational level, however, had a marked impact on survey results. "Those with higher education were more likely to question the inevitability of workplace accidents and injury," said Iverson. "More than two-thirds of respondents with high school completion or less agreed that workplace accidents and injuries were inevitable yet fewer than half accept accidents and injuries from drinking and driving are inevitable."

The survey also asked how Canadians if either workplace-related accidents and injures or those caused by drinking and driving were serious problems in Canada today.

Region	Agree: Workplace accidents and injuries are a serious problem in Canada today.	Agree: Drinking and driving is a serious problem in Canada today.
BC	61%	90%
Alberta	74%	93%
Saskatchewan and Manitoba	72%	88%
Ontario	70%	88%
Quebec	71%	90%
Atlantic Canada	69%	94%
Canada	70%	90%

According to the Association of Workers' Compensation Boards of Canada website (www.awcbc.org) nearly 1,000 work-related fatality claims were accepted across Canada in 2003. That's almost as many alcohol-related traffic fatalities recorded the same year, according to Mothers Against Drunk Driving.

The study was conducted for the Association of Workers' Compensation Boards of Canada by Ipsos-Reid and is based on telephone interviews with a thousand Canadians conducted July 12-14, 2005.

Public and Technical Meeting Summaries

BY SUSAN HAIRSINE

May 4, 2005, Chair: John Birrell

Human Factors and Expert Decision Making
Laura Adams

Laura presented the results of her Masters Degree thesis that she recently completed. Her main objectives were to examine and identify the judgment and decision process of avalanche experts, to identify the human factors that influence avalanche experts ability to make sound judgments and decisions, and to explore how these findings could be used to develop strategies for decision skills learning, decision support and effective avalanche accident prevention.

Thirty-seven avalanche Canadian experts with extensive industry experience participated in her study. Laura explained her research methods, which included Naturalistic Decision Making, Cognitive Task Analysis and the Critical Decision Method (CDM). The CDM is a retrospective case-based method, where Laura asked each participant to describe his or her most significant avalanche-related decision-making experience. Her thesis contains these stories, and can be downloaded from Laura's website at Selkirk College.

Laura found that avalanche decision-making occurs at the centre of three systems of influence: human, physical and environmental. She discussed three themes that form the foundation of avalanche judgment and decisions expertise: knowledge and skills; information relevant to the three systems of influence; and experience. Laura found that avalanche experts use a hierarchy of judgment and decision complexity that integrates rule-based, analytic, intuitive, and systems thinking processes of decision-making. She explained the decision strategies used by avalanche experts, including pattern recognition, mental stimulation, and critical thinking. Laura emphasized that situation awareness and metacognition are key strategies in successful decision making.

Laura found that avalanche-related judgments and decisions occur within a dynamic context influenced by individual, team, client, organizational and socio-political human factors. She suggested that having a high level of personal mastery is important so decision-makers are not overly influenced by these human factors. In addition, Laura discussed the critical importance of communication and suggested that improved communication results in reduced human error and increased team performance.

Six key recommendations from her study are:

- Integrate a systems thinking perspective
- Capture avalanche domain knowledge and experience (e.g. databases, GIS)
- Enhance personal mastery and leadership capacities
- Build and support avalanche decision skills and expertise
- Improve communication
- Enhance team decision-making capacities

At the conclusion of her presentation, Laura presented a summary of how avalanche experts approach their practice. Laura thanked the professionals who participated in the research, as well as Bruce Jamieson and John Tweedy in their role as avalanche expert advisors to her research.

Building a Warning System: The Backcountry Avalanche Advisory
Grant Statham

Grant discussed the process used for building the Backcountry Avalanche Advisory (BAA). This is the fulfillment of a number of the recommendations in the Backcountry Avalanche Review carried out by Parks Canada. He added that there was great collaboration between the CAC and Parks Canada in this initiative. Grant then provided details of building the warning system.

Collaborative work began in mid-June 2004 with an expert panel meeting in Calgary. Grant showed some preliminary icon work and then discussed the final icons and colors that were chosen. Grant stated the "variable/spring" symbol was the most difficult to develop. Concurrent to the icon development, there was work done on the wording of the accompanying messages. There was significant debate over the words to be utilized, particularly at the middle warning level. There is no "perfect" word to describe any condition, as every person interprets language to mean something slightly different.

Two rounds of public focus testing of the words and icons were conducted, with sessions in Calgary, Golden, Revelstoke and the Bow Valley. The focus groups included students, backcountry skiers, snowmobilers and parents.

Grant showed the final product that was produced after a total of 15 versions. BAA warnings are derived through translation from the danger scale, so forecasters will continue to utilize the danger scale and the public avalanche bulletin as their primary warning tool. The most dangerous rating from the public avalanche bulletin will determine the icon. Forecasters maintain the ability to override the icon, if desired.

Grant thought he was almost finished building the advisory, but then realized that "aussi disponible en français" presents the same language challenges as in English. There were nine French versions before the translation was finalized. Grant concluded by thanking the number of individuals who helped with the project.

Using the Media for our Message
Mary Clayton

Mary explained how she and Giselle Danis, Communications Manager of Jasper National Park, did a media road show for five days to present the new avalanche advisory icons and media portal. The media feedback was overwhelmingly positive and they liked this new stuff. However, the media stated they only wanted to use it when conditions were poor. Mary worked to convince them of the benefit of publishing the information more frequently with the public, by using the analogy of the UV index, and some of the media agreed to try it over the winter. Mary then explained the password-protected media portal available through MSC, which the CAC uses to distribute the BAA.

A media kit was distributed at Avalanche Awareness Days in January 2005. Mary showed how some media outlets have implemented the avalanche icons. She gave an example by running a CFCN video clip that portrayed these icons shown on television last winter. Mary added that she is also working with the Weather Network to design maps and incorporate the icons. They are exploring the potential of providing more talking points for the announcers to accompany the avalanche forecast. Work will continue this fall on these initiatives.

Fracture Character Guidelines
Rob Whelan

Rob provided an update from the Technical Committee regarding the observation of fracture character guidelines. He showed the interim guidelines that were prepared over the winter. The different fracture character classes are used to describe the characteristics of shear fractures observed during stability tests. The proposed system is different from the existing US system (shear quality), which is more ordinal and ranks the quality of the shear.

One system ranks the quality and the other identifies the properties of the fracture as it occurs. The Technical Committee recommends that the fracture character system be adopted. However, Rob added that this is not unanimous in the Technical Committee. They are soliciting input from avalanche professionals and are working on a more complete definition of fracture character. This was available on the CAA website (what's new section) for comments throughout the summer. Following this feedback, the Technical Committee will make a recommendation to the BOD in the fall. (Editor's note: See page 20 for the committee's most recent recommendations)

Steve Conger asked the group what system they were using in their field applications. Ian was teaching the fracture character system as a learning tool in the ITP during compression tests. They want comments on the fracture character system, and members were asked to comment on whether a ranked or ordinal system would be desirable. Steve added that Dr. McClung finds the wording complicated and believes an ordinal system would be simpler. However, he stated there is room for both systems; we could design a hybrid system where the sheer quality is rated, as well as the fracture system. Rob stated this had been discussed but the Technical Committee found it added more complexity.

Rob closed by stating that while a system is in place for observing RB Release type, there is not as definitive a system for observing fracture character in Europe at present.

The Public Bulletin in the Winter of 2004/05
Alan Jones

Alan provided a summary of the Public Avalanche Bulletin program at the CAC. Five part-time forecasters were hired for the winter season of 2004/05. The CAC was incorporated in October 2004. In November, the forecasters had a training week and the first bulletin was issued on November 15, 2004. The Northwest region of BC was added as a regular bulletin region last winter.

Backcountry avalanche workshops in Calgary and Vancouver were held in November. The first accident report was on the website in December. There were six of these in total in the winter. Daily bulletins were issued between December 22nd and January 4th. The last bulletins of the season were issued April 25th.

Alan added that 620 icon-based advisories were prepared over the winter. There were 430 public avalanche bulletins (six regions), 21 public avalanche information reports (North Rockies), three special avalanche warnings (sponsored by BC PEP), and an estimated 250 personal contacts with media (print, radio and TV).

Other accomplishments included public events such as backcountry avalanche workshops and avalanche awareness days, 14 personal appearances in three provinces at trade shows, events, and group meetings, a MEC/CAC online avalanche awareness site 15 print media articles and media portal work, BAA/ATES system developed with Parks Canada, and providing storefront services for partner bulletins. Alan estimated that 615,000 people were reached with avalanche safety messages.

There have been six avalanche fatalities to date this year. Alan showed the graphical running average of avalanche fatalities for the past 10 years. He showed where the recent avalanche accident information is now available on the web page. This is basic factual

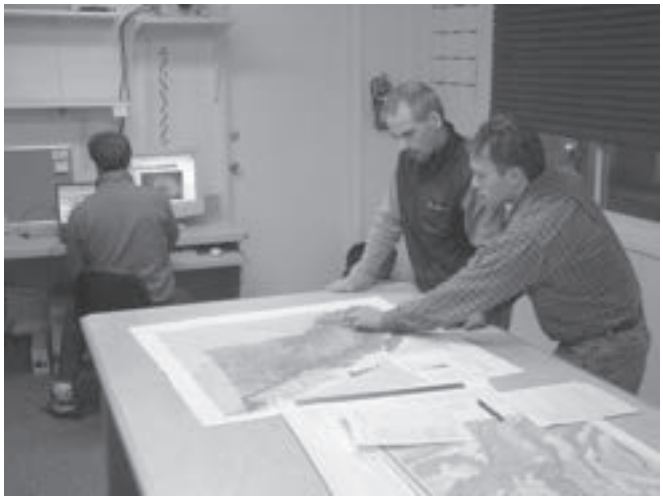
information to give to the public and the CAC worked in conjunction with the BC Coroner's office to release this data.

Alan showed the timing of the three avalanche warnings issued in relation to the avalanche fatalities. They were definitely pre-emptive and issued before the fatalities occurred.

Canadian Pacific Railway paid for a new and improved website for the CAA/CAC. Alan showed the new bulletin screen. The bulletin format has changed to a more journalistic style. He showed a summary of bulletin usage trend from 1991 to present. Numbers of people using the bulletin continues to increase. E-mail and website use has shown the biggest increase but the 1-800 number may be used more in future with added cell coverage in the mountains.

Alan described the top work priorities identified at the CAC roundtable meeting. These included developing snowmobile programs, continued support and improvements to youth and school programs, and develop and support the CAHG in Quebec to secure government funding. Lesser priorities include work on the Canadian avalanche danger scale, and RAC program promotion and support.

Alan thanked the contributors and sponsors of the PAB, especially the InfoEx subscribers who provide a major source of data from their various operations, as well as others who post their personal observations on the regional discussion board, or phone and e-mail the CAC.



CAC forecasters hard at work.

Photo CAC Staff

Applied Snow and Avalanche Research, University of Calgary
Bruce Jamieson

Bruce gave a progress report of work carried out in 2004-05. The avalanche program at the University went through a major organizational change and a five-year research chair was established. Highlights from the year include 250+ person days of fieldwork in Rogers Pass, Blue River and Kicking Horse Mountain Resort. Bruce added that after the unusual weather in January and February, March provided good snowpack data. Bruce had a strong team of graduate students and technicians and they appreciated the ongoing collaboration with Swiss researchers.

They made progress on the digital resistance probe, fracture propagation, nearest neighbour forecasting, daytime warming of upper snowpack, objective profile interpretation, faceting above crusts, spatial variability in start zones, and fracture characterization. There are a variety of papers on these subjects available on their web site: www.ucalgary.ca/asarc.

Bruce added that 12 of his graduates are now working with avalanche safety programs. There were more than 20,000 downloads from the University of Calgary web site last year. The ASARC group published three theses, five articles in *Avalanche News*, and five journal articles in the last year. Four articles are in press for the ISSW proceedings, and one is in press for a journal.

The ASARC program also made presentations to 250+ practitioners through a variety of seminars and to numerous recreationists at backcountry avalanche workshops, public forums, etc.

The five-year NSERC Research Chair in Snow Avalanche Risk Control at the University of Calgary was officially announced in November 2004. Increased funding has been received from the federal government as well as other contributors. The previous sequence of three-year projects is now a program and there is greater commitment from the University. This change has simplified planning.

Current research topics include propagation tests for deep weak layers, spatial variability with resistance probe, daytime snowpack warming, and other public safety initiatives including support to the ADFAR project.

Bruce's research staff for 2004/05 include Paul Langevin, Ken Matheson, Antonia Zeidler and Cam Campbell. The graduate students are James Floyer, Dave Gauthier and Laura Bakermans. Bruce closed by thanking his financial supporters, and organizations providing in-kind support.

A New Test for Fracture Propagation in Weak Snowpack Layers
Dave Gauthier

Dave briefly described a prototype test they have been working on for fracture propagation. They are trying to understand what happens between the trigger and the avalanche, by observing propagating fractures in the field test. Dave then discussed their test methodology where they isolate a column 30cm wide by 3m downslope, and then place a drop hammer apparatus (30cm x 30cm plate) with a 1 kg brass weight which is used to initiate a fracture. A video was shown to better illustrate this test.

Dave also discussed the data they record in the test. They tried to show that longer fractures equal higher propagation propensity. The researchers observed 914 fractures, in 11 different weak layers on 26 different days. They employed many technique variations during development of the test and a variety of small experiments were carried out.

There was plenty of data from stable weak layers during the winter. During the spring they had different experiences with their propagation testing on an active weak layer. Dave highlighted a test performed on March 23 and March 24, 2005 and showed graphs of his fracture tests. He detailed the promising results of these tests. He also discussed fracture arrest and the free surface, but

added that these results have yet to be analyzed.

The next steps include analysis of the 2005 data, which should help them to better understand fracture length and its relationship to the test technique, fracture initiation, propagation and arrest in the test, mechanics of the test technique and comparisons with other tests and human triggered avalanches.

For winter 2006 he plans to continue testing and refining existing techniques, and is hoping for more data from active weak layers. He will also carry out specific small experiments to answer questions from the 2005 data, and continue to work with high speed photography. Dave closed by thanking his supporters and assistants.

Using Yellow Flags to Assess Profiles
Bruce Jamieson
(This research appeared in full in* Avalanche News*, Vol. 73)

North Shore Avalanche Advisory
Scott Back

Scott works for BC Parks in the Vancouver area. He explained that Brent Matheson had a vision for a North Shore avalanche advisory prior to his untimely death. A number of partners have worked towards developing this avalanche advisory.

Scott then discussed how winter backcountry recreation on the North Shore encompasses three geographic areas with three groups of recreationists. There is a high proportion of people accessing these places who are completely unaware of the hazards in the area. People injure themselves in technical terrain, get caught in avalanches, or slide down icy slopes.

Scott reviewed BC Parks approach to public safety incidents in the past two decades. In 1997, avalanche danger signage was implemented at trailheads to address these public safety issues. In 2001/02, the North Shore Avalanche Advisory (NSAA) was formed. This was a public private partnership with four main objectives:

1. Produce a public avalanche bulletin;
2. Share weather and snowpack stability information amongst partners;
3. Issue special warnings to the public;
4. Build public awareness.

Scott explained the progress on the partnership and accomplishments in the past few years. This year the North Shore Avalanche Advisory will write a strategic plan and will initiate a Monday/Wednesday/Friday bulletin schedule. They have also been working with CAC staff in bulletin writing skills and they hope to change their bulletin format to match the one used by the CAC. The NSAA will participate in InfoEx and raise money through sponsorships and donations. They will also try to learn more about their user groups.

Scott summarized by stating this is an example of public/private partnership to promote public safety. The completion of a strategic plan will increase the professionalism and credibility of the partnership.

Structured Qualitative Assessment of Likely Avalanche Character
Roger Atkins

Roger explained that he perceived a need for improved communication of the complexities, the subtleties, and the subjective aspects of our perception of snow stability. Roger discussed how high-stakes decisions are based on uncertainty of information. He added that uncertainties are inherent and acknowledging this will allow us to move ahead and develop better mechanisms for coping. It is important not to reduce the complexity that would help with our decision making as professionals.

He reviewed the complexity of snow stability and stated there are multiple instabilities on different layers within the snowpack. Each instability can exhibit extreme spatial variability and all instabilities change over time. The temporal changes of the instabilities also exhibit spatial variability.

Each instability also produces avalanches of different character. Spatial variability has both random and systematic components. The systematic component of spatial distribution is related to the character of the instability and to the terrain.

Roger showed some graphs detailing the percentage of open runs by stability rating. He created a history-gram by stability rating by year. The general trend showed that less runs were open when there was poorer stability, but on any given stability rating there is a large variation of how much terrain is assessed as suitable for travel.

Comparison of the histograms from two years with very different avalanche characteristics also showed that the percentage of open runs was more dependent on the character of the instability than on the stability rating. The reason for this variation is because the stability rating (or avalanche danger rating) contains no information about the character of avalanches likely to occur, but in fact the character of likely avalanches is more relevant than the stability or danger rating when making travel decisions.

Guides and avalanche field workers are not consistently articulate at expressing snowpack concerns in written statements. Compared to public bulletin forecasters, teams of guides from diverse backgrounds cannot be expected to be especially adept at producing these written statements on a regular basis. Even in well-crafted avalanche forecasts, important messages are easily overlooked within the text of the bulletin.

As a mechanism to express the character of avalanches likely to occur, Roger proposed a structured qualitative assessment based on a checklist of different common avalanche regimes. Avalanche activity for each regime was assessed as likely, possible or

unlikely.

Roger showed examples of various types of avalanches as per the definitions and the avalanche character checklist he developed. He added that snow safety programs enjoy increased information sharing between operations in recent years, but essential thinking about the snow stability is often not communicated.

Roger summarized by stating a complete expression of snowpack instability includes an assessment of ease of triggering, an assessment of spatial variability, an assessment of trend, and an assessment of the character of avalanches likely to occur as a result of that instability.

Of these elements, only the character of likely avalanches has direct implications about backcountry terrain management. There is inherently less uncertainty about the type of avalanches likely to occur than about the probability of triggering avalanches on specific terrain features.

Roger concluded his presentation by stating that a one-word stability (or danger) rating does not contain sufficient information for informed decisions about travel on any specific terrain feature. However, very good decisions about specific terrain features are possible when the character of existing snowpack instabilities and the consequent relationship to the terrain are understood.

The purpose of the avalanche characterization checklist is to summarize the subjective assessment of the character of likely avalanche activity concisely and consistently. Roger thanked CMH for the use of company historical records and the CAA for access to historical public avalanche bulletins.

Avalanche Terrain Exposure Scale
Grant Statham

As part of the implementation strategy for the Backcountry Avalanche Risk Review, Parks Canada identified the need to develop a method for demonstrating the differences between avalanche terrain types and to include this as public information. This would give people additional tools to use when making terrain choices - before they were actually in the terrain.

Parks then developed the Avalanche Terrain Exposure Scale (ATES) with the assistance of many industry professionals, and this became public information in November 2004. Grant showed a variety of slides illustrating different types of terrain and then explained the scale. Terrain is defined as being simple, challenging or complex (Class 1, 2, and 3) and the ATES "Technical Model" presents detailed terrain criteria definitions for each level.

Grant then reviewed the steps taken in communicating this information to the public, including the parallel development of the ATES "Public Communication Model" - identical to the technical model but delivered in plain English for the general public.

Once the ATES was developed, Parks Canada compiled a list of 275 of the most popular backcountry trips in the Mountain Parks, referenced these trips to popular guidebook descriptions and provided an ATES rating for each one. This is now available in brochure form (English and French) and can also be found on the web pages of all the Mountain Parks (www.pc.gc.ca/banff). Parks' initial use of this system is to manage the terrain selection by custodial groups in the National Parks. Other potential uses of the ATES might include guidebooks, recreational leadership training, education, and GIS modeling.

Future issues to be addressed will be whether or not to incorporate the concepts of aspect (relative to wind and sun) into this scale. Professionals appear divided on whether aspect is actually a terrain factor (conventional thinking), or relates more to snow stability. A second version is expected once people have had time to gain experience using this scale.

Grant was asked if the exposure scale is aimed at recreational users, why it is being included in the curriculum of the Level 1 professional avalanche course. He responded that using a categorical breakdown of avalanche terrain appears to offer a successful method for teaching students the nuances of avalanche terrain and was well received by both students and instructors when it was tested on CAATS courses over the winter.

Workers Compensation Board
Gary Kreller

Gary described some of the organizational changes that have occurred in WCB throughout his career. He stated that a two-day investigation in the past now takes up to a year due to legal issues, with penalties taking up to two years. The claims officers do the initial accident investigations now and then it is turned over to an investigations branch for further action.

Gary congratulated the Fernie ski patrol on their timely communication when the Avalauncher accident occurred. In this incident, a snow launcher projectile flew about 100 ft and detonated in mid-air. He added that there are a number of metal parts in the assembly as well as the plastic parts. The Avalaunchers were shut down throughout the province following this accident.

Gary explained that rapid deceleration, caused by the nose cone coming off the head of the snow launcher projection, slowed it down as the base plate was coming off. The investigation branch has CIL/ Orien, the tail fin manufacturer and the explosives branch involved.

The Avalauncher can be used again if barriers are put in place, or it is fired remotely. They are looking at four things for improvement including the base plate assembly on the tail fin, a more solid nose cone, a stronger magnet, and a stronger explosive. He added that sometimes in shipping the explosives are breaking apart in the box.

Gary stated there are less than 20 avalaunchers in their jurisdiction. The CAA Explosives Committee will continue to be updated regarding further developments. Gary was asked if there would be a rewrite of the Blaster's Exam and he indicated that he hoped this would be the case.

Regional Nearest Neighbour Forecasting
Antonia Zeidler

Antonia gave an overview of her work from the past four years. Her aim was to improve the forecasting of skier-triggered avalanches by incorporating stability indices and snowpack properties into an avalanche forecasting model. She does this by incorporating a slab and weak layer evolution model to estimate slab and weak layer properties on days since the last manual snow profile in a proven study plot.

Antonia explained the model uses historical data to help those who forecast on a regional scale. She gave an example that used snow profiles from the Mount St. Anne study plot to forecast throughout the surrounding area. She used different predictor variables and response variables for persistent and non-persistent weak layers.

Since completing her thesis, she is now working on possible improvements. These include a more intuitive and easier model for weak layer evolution model, and snowpack properties for non-persistent weak layers. She will also try to determine if the yellow flag checklist for assessing manual snow profiles can be used in daily regional avalanche forecasting and whether compression test scores and fracture character are promising.

Antonia reviewed the six thresholds previously developed for yellow flags. She then summarized the results from her dataset at Mount Saint Anne. Preliminary results suggest that significant changes in the number of yellow flags over time are not observed for persistent weak layers, and hence that the count of yellow flags may not be a good predictor for forecasting skier-triggered avalanches on a regional scale. Yellow flags may indicate the propagation potential rather than the initiation of a fracture by a skier.

Antonia then reviewed the results of compression test scores and fracture character. Preliminary results on non-persistent weak layers showed that moderate compression tests were associated with both stable and unstable slopes. Antonia added that fracture character did not appear to add additional information for forecasting on a regional scale. Antonia closed by thanking Bruce Jamieson and her supporters.

Avalanche Terrain Mapping in the Chic Choc Mountains of Quebec
Stephanie Lemieux

Stephanie began avalanche mapping in the Chic Chocs with Dominic Boucher and Stephane Gagnon after completing her Level 1 last winter during the QCAP project. Stephanie's mapping project began in September 2004. She provided an overview of avalanche issues in Quebec and discussed Bernard Hetu's paper. Her project addresses the avalanche risk mapping and weather analysis that was a key recommendation from that report.

Stephanie has carried out research projects including dendrochronology studies, and geomorpholical impacts and avalanche path characteristics in the Chic Chocs, and analysis of climatic conditions and terrain characteristics favorable for avalanches in Quebec.

Her objective is to create a digital avalanche atlas for the Chic Chocs, classify the terrain by degree of exposure to avalanches, develop a tool for risk managers for entering and updating avalanche occurrence data, and provide better visual terrain information in the Gaspésie.

Stephanie reviewed topography and climate conditions in the Chic Chocs and showed slides of the popular ski touring areas. She described the avalanche program currently in place at the Centre d'avalanche de la Haute Gaspesie (CAHG) and the services provided to the public. These include avalanche bulletins, avalanche courses, avalanche safety equipment rental, data collection and providing other public avalanche awareness events throughout the region.

Stephanie discussed her long-term project goals and added that she is hoping to duplicate the avalanche information contained on the new trailhead kiosks Parks Canada has erected in the mountain parks. Stephanie closed by stating she is looking for suggestions on mapping as this is new for Quebec, and thanked her supporters.

Chic Choc Mountains.

Photo courtesy of Marc Deschênes

Slab Dimensions from Fracture Mechanics and Weak Layer Depth
Steve Conger on behalf of Dr. Dave McClung

Steve stated that Dr. McClung was out of the county and he was making this presentation on his behalf. Steve provided an outline describing the content of the talk, which is the calculation of basic slab dimensions from fracture mechanics and comparison with dimensions measured in the field.

Steve provided a definition of fracture mechanics as a quantitative analysis for evaluating structural behavior in terms of applied stress, crack length and specimen geography. Fracture toughness is a generic term for measures of resistance to extension of a crack. However, the term commonly includes results from simple tests of notched or pre-cracked specimens not based on fracture mechanics analysis.

Slab avalanches release by propagating shear fractures. The release cannot be described by the ratio of shear strength to shear stress. The release is involved with a ratio of fracture toughness in the weak layer/stress intensity factor.

The stress-intensity factor is a scaling factor used in linear-elastic fracture mechanics to describe the intensification of applied stress at the tip of a crack of known size and shape. Steve added that neither fracture toughness nor the stress intensity factor can be measured before avalanche happens. However, fracture mechanics govern and the physical principles tell us some useful information.

Steve discussed the results from the application of fracture mechanics to snow slab data calculated from fracture line data. On average, fracture toughness in tension (the body of the slab) is about five times that in shear in the weak layer. Fracture toughness in tension may be more than twice the toughness in the weak layer and perhaps as much as thirty times. Fracture mechanics suggests that, on average, the width of slabs should be about two times the length and on average the slab length should be 50 times the depth D, so the width should be about 100 times the depth D.

Steve showed some graphs and photos of slab width to depth ratio from measured and estimated data. The average value is about 100 and the fracture mechanics suggests the ratio is about 100.

Slab size based on depth (D) to the weak layer as calculated from fracture mechanics as confirmed by slab data can be shown as Length = 50D and Width = 100D. Steve added that it is important to note that these are average values and wide variations are expected and confirmed by field data on slab dimensions.

The previous results (confirmed by three data sets) suggest that , on average, the volume of a slab is approximately Volume (m^3) is approximately 5,000 D m^3 where D is in metres.

Steve added that we can use these to make decisions in the field to determine the volume of the potential slab slide. One example of this would be:

If D = 1 m, then V= 5,000 m^3

If the average slab density is 300 kg / m^3 the mass is 1,500 tonnes: a size 3 avalanche.

A second example was given:

If D = 0.2 m then V is approximately 40 m^3

If the density is about 200 kg/m^3 then the mass is about 8 tonnes, which is close to a size 2 avalanche.

Fracture mechanics suggests the width (on average) would be about 20m and the length (on average) would be about 10m.

Steve summarized by stating that in avalanche formation: strength has no meaning by itself; fracture toughness contains strength and much more. On average the slab width is about 2 X Length. On average the slab length (crown-stauchwall) is about 50 X D. Fracture toughness and slab dimensions both have wide variations in nature. Strong slabs (meaning greater toughness) are more difficult to trigger but if triggered they will be larger. He closed by thanking and acknowledging Dr McClung's supporters.

Dynamic Modeling of Extreme Avalanche Runout
Chris Borstad

Chris is at the UBC Department of Civil Engineering and said his talk should fill the quota of UBC math equations. Chris stated that one method of estimating avalanche runout is empirical runout calculation. One drawback however, is the difficulty in building an adequate data set due to the rarity of recorded extreme events.

His motivation for dynamic runout modeling was that speed estimates are not provided by probabilistic methods. Design and construction of defense mechanisms (highway sheds, stopping or deflecting mounds, walls, etc.) requires impact force calculations from flow speed and density.

Chris discussed Voellmy's dynamics model (1955) where an avalanche is modeled as an endless fluid and a steady state terminal velocity for a given slope angle is calculated. The two parameters are a Coulomb-type basal sliding friction and turbulent resistance within the snow/air suspension, proportional to the square of the speed. The point at which deceleration commences has to be chosen in order to predict runout distance of the centre of mass.

In 1980 Perla, Cheng and McClung built upon the Voellmy model, by eliminating the need to choose the point at which the avalanche begins to decelerate. They also used two parameters: Coulomb-type basal friction and turbulent resistance. Their model divided the avalanche channel into segments of varying slope angle and calculated the speed at the end of each segment.

Chris also discussed the leading-edge model, which is more conservative than centre of mass models and predicts longer runouts. This model employs the 1-D solution of conservation of mass and momentum, including a momentum correction at changes in slope and static internal pressure varying linearly with depth.

Chris discussed some other models currently in use. His model is more of a two-dimensional approach where the flow mass is divided into a number of distinct, connected blocks. The equations of motion are applied to each block in sequence. He showed a graph of how this would move down the slope.

Chris stated that all previous dynamic modeling approaches have simulated avalanche flow from slab release to runout. Basal entrainment will add to the mass and resistance terms while the flow is accelerating, but this is ignored in many models. Entrainment dynamics in snow avalanches are not well understood, so there is a large amount of uncertainty in neglecting entrainment while the flow is accelerating.

Therefore, Chris proposes a new approach: begin the numerical model in the middle of the track, at the position where the avalanche has reached maximum velocity. The flow is given this maximum velocity initially, and the mass is based on the geometry of the path and meteorological records if available. Entrainment is considered negligible while the flow is decelerating. The deceleration phase of the flow is then calculated by the model.

Chris explained possible locations of flow resistance: at the base of the flow, the free surface, or by internal rubbing/collision of particles. Basal sliding friction is the only parameter chosen for the model, thereby avoiding the redundancy of multiple-parameter models.

Future work includes model validation. This is particularly challenging because the extreme events of interest are rare. A comparison with empirical methods (method, for instance) could be done. Extreme events will destroy mature timber and overrun existing avalanche paths. Chris hopes to determine if the model will predict reasonable path enlargement and what speeds are necessary to fill the current path. Chris closed by thanking his project supporters.

Comparing Local Nowcasts vs. Regional Forecasts
Bruce Jamieson
(This research appears in full on page 56)

Using a Digital Probe to Do 10-Second Snowprofiles
James Floyer

James described his team's experience this season using a digital probe and what motivated them to conduct their study. He discussed one of the problems with traditional manual snow profiles, which is that you do not get accurate information on spatial variability by extrapolating information from a point measurement. One potential advantage with using a digital probe is that is far more measurements may be taken which should provide more information on spatial variability.

James showed the audience a Sabre penetrometer. The unit is four metres long and is lightweight at 1.5 kg. James stated that it does not take the place of a conventional snowpit observation, but it could supplement the knowledge gained from a snowpit and, in particular, help understand spatial variability within a given area.

He explained the equipment specifications and detailed how it works. The penetrometer records 500 readings per second and can collect twelve seconds of data per profile. About 100 profiles can be stored on the unit. It takes about five minutes to set up the equipment and ten seconds to perform the actual push. A little more time is required to store the data but once initial setup has been done it is possible to collect a profile in about one minute.

A profile done the old fashioned way, taking a bit longer than 10 seconds.

Photo courtesy of Ryan Gill

James showed some digital profiles collected by the group this winter. He pointed out that profile patterns for nearby pushes were very repeatable, which is encouraging. However, some limitations are the depth accuracy, the consistency of the force amplitude and the ability to distinguish low-resistance snow. The accurately of the depth of the layers can be measured with an error rate of 10-30%.

James discussed the four test objectives of the winter season and his results:

1. How does the force signal translate into hand hardness values? James showed a graph which explained that with the present equipment, it is not possible to distinguish between F and 4F snow.
2. How repeatable are the profile results? James stated this is hard to test as the test destroys the snow column it goes through. They selected areas of uniform snow to overcome this problem. Characteristic patterns existed in certain snowpack features and these were highly repeatable. However, the force amplitude and depth signals were inconsistent.
3. How accurately can the depth of layers be measured? James stated that present depth accuracy is not sufficient. In addition, there are variable speed issues, problems when hard crusts are encountered and the vertical resolution associated with the shape of the probe tip. The force response is also not instantaneous and there were problems with snow accumulating around the inset of the probe tip.
4. What is the minimum layer thickness that can be resolved? James stated that it was sub cm with good layer hardness contrasts and prior knowledge of weak layer location.

James concluded that penetrometer results were promising but not quite good enough yet to allow for detailed snowpack analysis. The patterns are highly repeatable. The depth accuracy of the penetrometer needs to be better. The consistency of the force signal amplitude also requires improvement. James thanked his sponsors and supporters.

Daytime Snowpack Warming over Terrain
Laura Bakermans

Laura discussed the results of her research on daytime snowpack warming over terrain. Her thesis objective is to better understand temperature changes within the top portion of the snowpack and the effects on snowpack stability, both over time and over terrain. Her research goals include developing a spatial warming index, displaying the warming index over terrain using GIS, and assisting in verification of the Swiss model SNOWPACK.

Laura showed graphics to give the group a quick review of radiation. Factors that influence daytime warming include time of

year/day, cloud cover, snow surface, aspect, slope angle, elevation and latitude. She then explained the field equipment they used to do their research.

Laura's fieldwork began in January 2005, with cold lab trials at Rogers Pass, using lights as the radiation source. They then conducted field tests at Gopher Butte on Mount Fidelity. Laura stated that significant melting out occurred around the equipment on some of the warmer days. She then showed a video clip to illustrate temperature changes over a 24-hour period.

For next winter, Laura plans to make some improvements to her field equipment, including making the temperature sensors lighter and investigating a more reflective paint to use. During her research next winter, she plans to measure near-surface snow temperatures on a variety of aspects and slope angles under different cloud cover and snow surface conditions,

She stated there is a lack of consistent terminology used to define solar aspect and describe solar effects. She closed by thanking her supporters and requesting feedback on the following chart that she and Bruce Jamieson have been working on to better define solar aspect and solar effects.

Effect of Solar Radiation on Dry Snow

Descriptive Rating	On Most Exposed Slopes (MES) Steep, sun exposed slopes in winter or steep and gentle slopes in spring	On Less Exposed Slopes (LES) Gentle slopes with low sun exposure in winter
Negligible	Minimal effect	No effect
Surface Warming	Warming but no melting expected	Minimal effect
Adjacent Melting	Melting of snow adjacent to rocks, tree branches, etc.	Warming but no melting expected
Surface Melting	Surface melting (< 2cm becomes moist or wet)	Melting of snow adjacent to rocks, tree branches, etc.
2+ Melting	Melting (> 2cm becomes moist or wet)	Surface melting (< 2cm becomes moist or wet)

Switch to Receive: The Aftermath of an Avalanche Involvement at Golden Alpine Holidays
Alison Dakin

Alison stated that in March of 2004, Golden Alpine Holidays had an avalanche involvement. She added that clients carry a lot of equipment that documents their adventures. This equipment includes cell phones, digital cameras, video cameras etc. and depending on geographic location, these clients have the ability to get these images out to a large audience, sometimes instantly.

Alison then showed a very moving docudrama one of their clients produced with footage of this avalanche incident and aftermath. She advised that in the new age of technology we have to be forward-looking in our decision making. This includes how we work with our guides and clients, and ensuring that we have a transparent process, which will benefit all of us in the long term.

May 5, 2005, Chair: Alison Dakin

Measuring Critical Slope and Slab Properties
Steve Conger

Steve began by stating that the failure point on slab avalanches is not visible. He added that forecasting is based on what we observe, measure, and learn from others and through mental visualization of patterns. He discussed the importance of density layering and slope features. Steve described how many of the relationships within the snowpack are related to density, e.g. failure stress (compression and tension) varies with it, mechanical forces (shear) rely on it and thermal conductivity varies with it. Steve also stated cohesive strength has been shown to be poorly related. He showed a graph to illustrate the range of density in the snowpack in two previous studies.

Steve added that the density signature of different snow crystals may be a better signature to look at layering. He showed the field set-up used this past winter at Rogers Pass and described how the Capacitec probe worked. Steve then showed some field trial data from Mt. Fidelity including manually measured and probe calculated density.

Steve also investigated how the probe might recognize very thin in an effort to see if the probe could be a useful operational tool. He added there appears to be no limit on the amount of data the probe can obtain other than sampling and recording rate. The amount of data is dependent on the speed in which the probe is manually inserted into the snowpack. He answered that it takes approximately one minute to probe a three-metre snowpack.

His preliminary conclusion was the probe did show differing layers, and there is promise that it is truly representing what the densities and layering are in the snowpack.

Further research questions are to determine if it is significantly adequate to recognize density and layering (key snowpack properties related to dry slab avalanches). As well as whether a spatial invariance of these select properties is evident and capable of supporting improved snow mechanics modeling. Steve closed by thanking his supporters and field assistants.

High Resolution DEM for Avalanche Terrain
Donna Delparte

Donna discussed using high resolution DEM models for avalanche terrain modeling. Most DEMs used in Canada for avalanche terrain modeling are at a resolution of 25 metres. The DEM to be created for Rogers Pass will be at five metres. Donna's research will examine what resolution is sufficient for modeling at a level helpful to practitioners and backcountry recreationists. She showed an example of 30-metre versus 10-metre DEM modeling.

Donna reviewed the benefits of high resolution DEM. These include better data (more accurate mapping of terrain features), better modeling and analysis (enhanced modeling capability for start zones and run out), better visualization (improved maps and 3D images), and better decision making ability (increased capacity for avalanche terrain evaluation).

Donna explained how you create a high resolution DEM and the equipment that is required. She showed an example for Revelstoke to Rogers Pass in Glacier National Park. Donna then explained start zone modeling with GIS information and described the parameters she used.

Donna stated that the 5m DEM will be useful for improved runout zone modeling. Donna will use the Alphabeta model. She showed a diagram to illustrate how a profile would look. She then showed a decision tree for a flowchart for determining avalanche terrain exposure scale. Sun and wind information (aspect) can be inserted into the model if desired.

Donna discussed the benefits of using GIS for risk model generation. These benefits include the capacity to reduce risk for backcountry travelers, facilities refinements based upon review by avalanche experts, aiding in the visualization of avalanche hazards, displaying how hazards are distributed, building a database that can be used for future reference and other modeling exercises. Donna added that GIS also has the ability to discern relationships between layers of spatial data and produce it visually for evaluation and refinement. The goal of producing the model will result in better decision making.

Donna described future applications as perhaps including a web-based pilot as a long-term goal. The data output for the model of the Avalanche Terrain Exposure Scale could exist as both static and dynamic products. Maps could be generated of the resulting terrain exposure that clearly reveals the three categories of simple, challenging and complex categories as draped over a terrain.

A more dynamic product may be the use of the Internet to provide a distributed GIS application that is interactive. Possible capabilities of the application could facilitate 2D and 3D visualization of the ATES draped over terrain, the ability to zoom in and out and print. The point and click capability in a user-friendly interface would act to stimulate users in considering terrain factors to mitigate risk in their backcountry decision making process. Donna closed by thanking her assistants, and Parks Canada and staff in Glacier National Park for their input on her project.

An Explosive Components Update
Everett Clausen

Everett expressed his delight in coming to this year's AGM. He then discussed the Fernie Avalauncher incident, which is being jointly investigated with WCB and the Explosives Branch in Ottawa. There are some shortcomings in the system that need to be addressed. Everett added that CIL/Orion has some of that responsibility, as does the supplier of the components.

Everett drew a diagram of the Avalauncher round and explained the components and their various suppliers. The integrity of one of the assemblies needs to be examined more clearly. CIL will ensure they take control of these products and assemble them in their plant to ensure they have had the quality tests that should be carried out. Moulds and plastics have changed and they would prefer to be able to control this aspect as well. They are looking at new methods of manufacturing the delivery package.

Some of the CIL product was sent to Ottawa for analysis as well as the tail fin from the other manufacturer. Everett explained some possible scenarios that could have occurred with the Avalauncher incident, and some things that the Explosives Branch was investigating. WCB has implemented remote firing or using barriers for the Avalauncher.

Everett added they have had good success thus far with the avalanche guard project being conducted at the Laurie slidepath in Rogers Pass. This was a very successful project and has met their expectations. On behalf of CIL Orien, Everett presented Bernie Protsch of the CAA Explosives Committee with a cheque to help the CAA with training initiatives as they see fit.

Avalanche Decision Framework for Amateur Recreationists Project
Pascal Haegeli
(This research appeared in full in* Avalanche News*, vol 73)

Profile: Marc Deschênes

BY MARY CLAYTON

With his ready smile and easy-going demeanour, Marc Deschênes seems like a very laid-back kind of guy. Don't let first impressions fool you. Since moving out west in 1983, Marc has shaped an impressive career for himself. In the summer, he's a very busy geotechnical contractor for the forestry industry. In the winter, he's an equally busy guide for both mechanized-skiing and ski-touring clients, a CAATS instructor and RAC provider. He's also chair of the CAA's education committee and a key player in the Québec outreach programs. And now, on top of it all, he's a proud father too.

Marc was born in Montreal in 1960 and had a typically sports-oriented childhood, with hockey preoccupying his winters. "I was a huge Canadiens fan," he recalls. "My dad used to take us to the Forum and catch several games each season." In addition to being the centre of the universe for NHL fans, Québec at that time was also a political hotbed. The Quiet Revolution was bringing massive changes to the political and social scene throughout the 60s, while the province's War Measures Act of 1970 remains one of the seminal moments of Canadian history.

"The War Measures Act had a strong influence on my parents," Marc remembers. "They were on the brink of moving out of the province." For his own part, Marc wasn't drawn to the fray. "I was too young to really understand what was going on but being bilingual from a very young age I wondered why the French and English couldn't just learn to get along."

His parents sent him and his siblings to YMCA summer camps in the Laurentians, where Marc first developed a taste for the outdoors. A family vacation out west in 1974 sealed his fate. "I remember, when I first saw the mountains I went 'wow,' he says with a laugh. "That definitely had an impact on me. My parents weren't into backpacking, we did the tourist thing and drove all over Alberta and BC in a rental car. But I had a feeling that I would probably go back."

Soon after, his older brother Bernard got a job in Lake Louise. His pictures and stories whetted Marc's appetite even further and in 1979, he took the plunge. "I got a job as bellman at the Prince of Wales Hotel in Waterton Park, and that summer I explored that park from east to west, north to south," he says. "I wasn't climbing yet, just backpacking and scrambling up peaks, but every inch of my spare time was spent exploring the wilderness."

At that time, Marc was enrolled at the L'Ecole Polytechnique in Montreal where he eventually earned a degree in geological engineering. In 1980, midway through his degree, he took a year off and spent that fall and winter traveling and working out west again. This time, he ended up working at Big White Ski Village in Kelowna and had his first introduction to backcountry ski touring. "I went on several of the classic trips of the Rockies," he recalls. "I didn't know much about avalanche safety and probably made several bad decisions but common sense usually prevailed and kept me out of trouble." He took a recreational avalanche course that year, and made some good friends who would later prove an influence on his career, Rob Whelan being one of them. "Rob talked me into getting into guiding," says Marc. "We were touring together and he was already guiding with Kootenay Heli-skiing back then."

Despite feeling the pull of the outdoors, Marc kept his focus on his educational goals. After graduating with his engineering degree, he moved to Calgary in 1983. There he enrolled in additional courses in computer technology and geophysics at the University of Calgary, hoping to get some work experience in the oil industry. No opportunities arose and he ended up working as a courier and a tree-planter until he found work as a geologist in the mineral exploration industry in BC.

He kept his winters free, however, to pursue guiding. In 1989 he earned his ACMG assistant ski guide ticket and became a full ski guide in 1994. Right from the beginning, Marc was interested in a wide variety of experiences, guiding heli-skiing, snowcat-skiing and ski touring. "I had the desire to get the mountain guiding ticket," he explains, "But I didn't want to let go of my geology career. I made the decision to keep up my summer job."

His summer career was developing at the same pace as his winter. By the mid-90s, terrain stability mapping had become mandatory for the forestry industry in BC. Marc was looking for a change, so he took an intensive course at the University of BC to augment his skills for that sector. He became a geotechnical

Marc and his family.

Photo courtesy of Marc Deschênes

consultant for the forestry industry and that work continues today. "I undertake terrain stability and soil erosion assessments, landslide investigations, some avalanche hazard assessments, road deactivation, drainage plans, it keeps me very busy," he says.

Marc bought a home in Nelson in 1990, and in 1993 started teaching his own recreational avalanche courses in the area. Teaching and guiding are a good fit, he finds, and he makes time for both. "The balance is nice. It's important to give back, especially to youth. The experience and knowledge I've acquired, it's nice to turn around and give some of it back."

In 1998, that experience and knowledge came to the attention of the CAA. "There was talk of a terrain course at the AGM that year," he remembers. "Peter Schaerer was going to lead this introductory avalanche mapping course, so I told him of my background and I was invited to get involved." His debut was a success and Marc has worked on the mapping courses ever since. In 1999, he began working as a CAA Level 1 instructor and is now a course leader.

In 2001, Marc became the leading candidate for an exciting new initiative. The Québec Collaborative Avalanche Project (QCAP) originated when the CAA was asked to help develop avalanche safety programming in Québec and assist in developing the forecasting skills for the staff at the avalanche centre in Québec's Haute Gaspésie region. That request resulted in a four-year NSS-NIF grant for $455,000 and Marc was chosen to become the project coordinator. (*Editor's note: see* Avalanche News *vol. 69 for Marc's summary of this project.*)

"I felt overwhelmed when I saw the list of things we needed to accomplish," Marc admits. "It was a real challenge because we were going to an almost foreign country. Language was not an issue, but not knowing much about their terrain, their weather and snowpack conditions, and especially the politics involved in how we were going to collaborate on this project, it was a lot to deal with."

Susan Hairsine, the project's administrative assistant, attributes much of QCAP's success to Marc's personality and ability to work with people. "Marc basically got everyone to work as a team," says Susan. "His casual style brought everyone forward, made people comfortable and made them want to be part of the solution." Marc agrees that teamwork is enjoyable to him. "A lot of time my work is very independent," he explains, "so I really enjoy the opportunities when I can participate in a team environment, sharing ideas and learning from each other."

These days, Marc has taken on yet another project – fatherhood. Felix was born in March of this year and Marc and his partner, Anne-Marie Prud'homme, are reveling in their new role as parents. "Being a dad has become a huge part of life," Marc says. "I'm absolutely thrilled with parenting, it's such a beautiful thing."

Are you clearing out your filing cabinets or cupboards?

If you've got old avalanche or snow-safety related material, the CAA Art Twomey Library will happily take it.

Contact Brent Strand at publish@avalanche.ca to make a donation.

Events Schedule

October 5-8, 2005

SARSCENE 2005

The 14th annual Search and Rescue Workshop is organized by the National Search and Rescue Secretariat and the PEI Emergency Measures Organization. Don't miss the games, workshops, tradeshow and search and rescue demonstrations.
Where: Charlottetown, Prince Edward Island
Info: www.nss.gc.ca
Contact: Call 1 (800) 727-9414 or e-mail: sarscene2005@nss.gc.ca

October 12-16, 2005

57th ICAR Congress

The International Commission for Alpine Rescue is once again hosting an open forum to discuss and share information on the latest developments in mountain rescue. ICAR represents 30 mountain rescue organizations from Europe and North America. The emphasis for this year's forum will be on search operations.
Where: Cortina, Italy
Info: www.ikar-cisa.org

October 28-30, 2005

12th Annual Wilderness Risk Management Conference

Held annually in the fall, the WRMC strives to educate wilderness practitioners on risk management and practical safety skills. We share field and administrative techniques in risk management, and work together to influence risk management standards in the wilderness adventure and education industry.
Where: Salt Lake City, Utah
Info: http://wrmc.nols.edu
Contact: Call Cheryl Jones (307) 335-2210 or e-mail: wild.risk@nols.edu

November 19-20, 2005

3rd Annual CAC Backcountry Avalanche Workshops

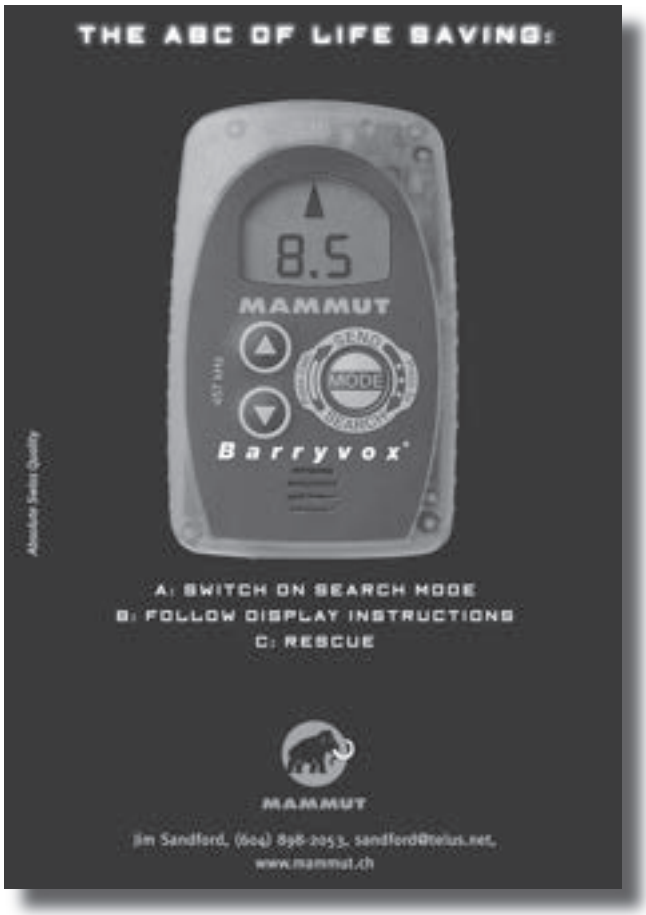
Held consecutively in Vancouver and Calgary, this full-day workshop is designed for backcountry enthusiasts of all levels. The day is highlighted by an international roster of speakers, sharing the latest research and newest ideas about avalanche safety and risk management.
Where: Nov. 19 - Vancouver; Nov. 20 - Calgary
Info: www.avalanche.ca
Contact: Call Ilya Storm (250) 837-2435 or e-mail: ilya@avalanche.ca

January 13-15, 2006

Avalanche Awareness Days

The CAC's annual event is already promising to be the best ever. This year, the national media event will be held on Jan. 13 at Big White in Kelowna, BC. Over the Jan. 14-15 weekend, some 30 communities and ski areas across Western Canada and the US will take part by hosting a variety of activities aimed at avalanche awareness and education. Remember, there's always room for more volunteers!
Where: Big White Village in Kelowna, and at a ski area near you.
Info: www.avalanche.ca
Contact: Call Jennifer George (250) 837-2435 or e-mail: jennifer@avalanche.ca


canadianavalanchecentre
Learn and Live:
Avalanche Risk in a Changing World.
COLUMBIA BREWERY
BACKCOUNTRY AVALANCHE WORKSHOP
November 19 - Vancouver: Ridge Theatre
November 20 - Calgary: University of Calgary
for more info visit www.avalanche.ca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Continuing Professional Development and You

Since the inception of the CPD program in 1997, the CAA has hosted 11 CPD seminars for its members and the avalanche community in Canada. Below is a list of the seminar themes to date. We are currently soliciting ideas for next year's meeting. What would you like to learn more about and who would you like to see and hear? Are there some big-picture issues you feel should be addressed? Or are there skills and techniques that we should be discussing? We've got some ideas, but we want to hear yours.

May 1997	Risk Management & Litigation Avoidance: Lawyer and Insurance Issues
May 1998	Avalanche Forecasting Best Practices: Heliskiing - Highways - Parks - Ski Resorts
May 1999	Risk Management Practices in Aviation: Crossover of Knowledge
May 2000	Explosives Seminar, Risk Management for Small Business
May 2001	Baffled by Beacons
Nov 2001	Beacons and Backcountry Travel for RAC Providers
May 2002	Adapting to ADAPT, New Tricks
May 2003	Under the Gun: Rules Based Decision Making
May 2004	Responding to a Rescue, Best Practices
May 2005	Professionalism at a Crossroads

Ideas for the Spring 2006 seminar include:

- Current Legal Issues in the Canadian Avalanche Community
- Science & Technology: How technology is changing the avalanche workplace. (Digital weather stations, automation, data collection/processing, modeling)

Please contact Ian Tomm at ian@avalanche.ca with your comments and suggestions for the Spring 2006 CPD seminar.

Ortovox Retrofit

BY MARY CLAYTON

Last winter, *Avalanche News* ran a short article about battery problems with the Ortovox M2. The problem came to light through a few e-mails circulating from avalanche professionals in Canada and the US, who were reporting their M2 transceivers shut off after receiving a blow. The problem seemed to centre on the battery connections, as some AA batteries with smaller dimensions could shift within the compartment and lose their electrical contact. While researching that issue, we heard from Ortovox's chief designer, Franz Kroll, who said his company would be undertaking a detailed investigation. The results of that investigation are now in and Ortovox has confirmed the reports.

According to their website, "while the Ortovox M1 and M2 passed the European standard for shock resistance, battery dislodgment has been observed under testing conditions different from the European standard." The website also notes that "the international standard for (AA) batteries allows for a significant variance in both the length and diameter. This means some batteries that meet the standards may lack a prominent negative terminal, which could allow the battery to dislodge."

In light of this news, Ortovox is offering a free exchange of the battery compartment lid for all M1 and M2 units. The new lid is designed to reduce the movement of the batteries within the battery compartment. For more information on how to receive a new battery lid, e-mail info@ortovox.ca.

North Shore Rescue Adds RECCO System

North Shore Rescue has now incorporated the RECCO avalanche rescue system into its search strategy. As search Manager Tim Jones explains, "More and more people are skiing with this type of device now. Anything that can make it easier to find somebody makes it easier on us–that's the bottom line."

RECCO technology uses harmonic radar to pinpoint a victim's precise location. The two-part system consists of a RECCO detector, used by organized rescue groups, and RECCO reflectors which are integrated into commercially available apparel, helmets, boots or protection gear. The reflector requires no batteries and never needs to be switched on.

"RECCO has an application for us with rescue and safety in a natural disaster and it has an application for bringing out a lot of subjects all at once without transceivers," says Jones. "The biggest benefit is there's a greater chance of people who would normally not wear transceivers, potentially being rescued alive. So I think the ski industry, by having this available for guys to buy as part of the equipment purchase without them even thinking about it, is probably going to wind up saving a life."

The RECCO avalanche rescue system is used by over 440 organizations worldwide to assist in the efficient location of avalanche burials. First introduced in 1983, the technology was developed by Magnus Granhed, with the cooperation of Stockholm's Royal Institute of Technology, in response to his personal experience with an avalanche tragedy. The RECCO system has been adopted globally by ski resorts, helicopter-skiing operations and search and rescue organizations as an additional tool for avalanche rescue.

Transceiver Ranges Communicated by Manufacturers and Dealers

BY FRANCOIS SIVARDIÈRE, ANENA

Definition

The range of a transceiver is the maximum distance within which the receiving transceiver receives a transmitting signal (or a simple 457 kHz transmitter). This range depends on numerous factors:

- Sensitiveness of the receiving beacon (therefore depending on the model)
- State of the receiving beacon batteries (that depends on the current temperature)
- Power of the emitting beacon (therefore depending on the model)
- State of the emitting beacon batteries (that also depends on the current temperature)
- Relative position in space of the two transceivers.

Giving the value of a transceiver range without allowing for these factors makes no sense.

Three facts

1. In their product "user guides" and/or on their packaging, most of the manufacturers only give the maximum range. This allows them to announce ranges longer than 50 metres. 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. In addition, and more importantly, maximum ranges only match a specific case, which is seldom obtained in reality (i.e.: coaxial antenna in case of 1-antenna transceivers).
2. To search for a buried victim, the strategy is based on the retained range value of the transceivers being used to receive. The search strip width that rescuers may apply is indeed twice this value. However, if one applies too large a value, one runs the risk of creating a search strip that is too large for the transceiver's range, which leads to some areas being missed, and perhaps some buried victims not found. That is exactly what may happen if one uses the maximum range as a reference value.
3. When rescuers organise the search of buried victims with transceivers, they should know what the range of their transceiver is in the most unfavourable case. That is to say depending on :
   - Batteries' state of emitting and receiving other signals, at the lower limit given by the manufacturers
   - Low temperatures (which has a negative effect on the batteries' condition)
   - Poor combination of emitting and receiving models
   - comment: respective position in space of the two transceivers may not be an essential factor (when doing the primary search, rescuers indeed point their receiving transceiver in every direction).

The search strip width that will be apply should be indeed twice this specific range. It's the knowledge of this value that will be useful. Hence its name : *useful range*.

Conclusion

Only the knowledge of the value of the useful range is important.

Not knowing and not reminding this value might be dangerous, even fatal!

On the contrary, knowing the value of the maximum range is useless.

Proposition of a recommendation

Ikar-Cisa officially recommends to every transceiver manufacturer and dealer to only communicate on the useful range of their transceivers, by no means on their maximal range.

Digital Weather Stations: No more shaking!

IAN TOMM, CAA OPERATIONS MANAGER

Bringing up digital weather stations in a conversation can evoke a multitude of responses from "way too expensive" to "shaking a thermometer is a rite of passage in this industry!" and everything in between. Many of us still work in places that employ more traditional weather equipment like the shake-down thermometers, hydro-thermographs, precipitation gauges and the old 'wet finger' wind gauge, but much of this equipment is getting to the stage of needing either significant maintenance or replacement.

The CAA's Industry Training Program (ITP) goes through two to three glass thermometers a year. This is due to a variety of reasons including shaking the mercury into the wrong end, cracking the thermometer on the head of the student taking their surface/form size, and dropping them. Replacements costs have come to the point of being borderline prohibitive and Garry Walton at SEAR has been quoted as saying the thermometers are darn near impossible to get any longer. This, combined with other issues of ailing Stevenson screens, precipitation gauges and hydro-thermographs, has been the motivator to find a better alternative.

This spring, I began the search for a digital alternative with some valuable direction from Simon Walker of the BC Ministry of Transportation. My goal was to find an affordable, durable and easily transportable digital weather station. Initially my efforts were less than heartening. I found highly portable and durable stations that were outrageously expensive and cheap stations that could almost be considered single-use disposable units.

Then I stumbled upon a great unit from Davis Instruments called the Vantage Pro2 station. This is a fully automated, wireless, solar-powered station with a remote console/data logger that can be used up to 300m away, 3km with transmitter upgrades. While it doesn't meet all our needs, it can be used in conjunction with some existing equipment to make a very robust, transportable and, most importantly, affordable weather station. Here is what the new ITP weather station will look like this winter:

- 3 snow boards (H2D, H24, HST)
- 1 HS stake and leveling stick
- 1 equipment box housing a density kit and/or sampling tube & scale
- Ruler, loupe, brush & pocket thermometer (for the 10cm snow temperature)
- 1 Vantage Pro2 Digital Weather Station that records:
  - Present temperature & 24-hr graphical trend
  - 24-hr max/min temperatures
  - Barometric pressure & 24-hr graphical trend
  - Wind direction & speed, including 24-hr trends for both data
  - Humidity & 24-hr graphical trend
  - Rain gauge (a winter heater for the tipping bucket is available but requires access to an electrical plug in)

All weather variables are reset at 11:59 pm and the console acts as a short-term data logger that keeps data for 21 days. The console is easily hooked up to a computer with weather software available for Mac or PC machines. In fact, if you have a computer that can be hooked up to the weather station permanently, you can save some money by not buying the wireless console. Instead, use the computer's software as the data logger (limitless capacity) and for current conditions reporting as well as a variety of analysis on historical data.

Out of the dozen or so stations I researched, this unit was the least expensive, easiest to operate and also had the greatest number of add-on options. I would say that if your organization is looking to either replace your old, tired Stevenson Screen and shake-down max/min thermometers, or you are looking to set yourself up with a station that can give you good data easily, this is the unit to consider.

What does it cost? Well, that depends on what you require, but basic units start around $550 US and go to $1,000 US and up with all the add-ons. When compared to the costs of more traditional equipment this looks like pocket change (thermometers are more than $100 each, plus guards, and hydro-thermographs and precipitation gauges are more than $3,000 each). I have made some good contacts within the company and they are very open to working with our industry should this unit prove popular. I've already had several inquiries from members and a bulk order could bring the costs down by 30% or more.

The CAA will be purchasing another two units for use this winter by no later than October 31, 2005. If you or the operation you work with is interested in purchasing a unit (or two) please contact me (ian@avalanche.ca) as soon as possible. The more orders we have the cheaper it will be. Bulk ordering new equipment like this can certainly be a benefit of membership in the CAA.

While these stations aren't exactly proven for winter avalanche operations, they do offer the most promising option when looking at replacing and/or upgrading your weather equipment. I've been testing one in my back yard all summer and I've grown quite accustomed to it and have found it very easy to use. Davis Instruments is a strong company with a fantastic support service. More information can be found at: www.davisnet.com.

Backcountry Access Adds Transceiver Instructional Video to Education Program

BY BRUCE EDGERLY, VICE PRESIDENT BACKCOUNTRY ACCESS, INC.

Equipment manufacturer Backcountry Access (BCA) has teamed up with filmmaker Teton Gravity Research (TGR) to create a new avalanche beacon training video. The new DVD, entitled "Tracker 101: Basic Searching with Digital Avalanche Beacons," will be available this fall, directly from BCA. It will also be included on all DVD copies of TGR's 2006 feature film, "Tangerine Dream." Hosted by TGR lead guide, Jim Conway, the video was filmed on location in Haines, Alaska. It is available from BCA for $15 (Cdn), including postage.

The 20-minute video opens with a sequence of skiers, snowboarders and snowmobilers riding in avalanche terrain. After a summary of avalanche statistics, Conway provides an introduction to safe backcountry travel techniques. He emphasizes the importance of pursuing further on-snow avalanche education and avoiding avalanches in the first place. Conway then walks the viewer through the primary, secondary and pinpoint phases of the transceiver search, accompanied by line diagrams illustrating each phase. He concludes with pointers on efficient probing and shoveling techniques. While Conway uses the Tracker DTS transceiver throughout the video, the lessons provided are fully applicable to all digital transceivers.

At the end of the DVD, the viewer can choose from a menu of animated tutorials on more advanced search techniques. These include lessons on electromagnetic flux lines, multiple burial searching using the "three-circle method," and multiple burial searching using the Tracker's Special mode.

The training DVD complements BCA's existing training and education program. As part of this effort, the company has donated and installed 30 of its "Beacon Basin" training systems across North America and Europe, with 20 more planned for 2005-06. These training parks feature 10 permanently buried transmitters connected to a central power source and control panel. The objective is to provide a fun and efficient way for beacon owners to practice with their beacons. BCA also offers a full lineup of educational materials, Powerpoints, and even company reps for assisting in educating the public.

For more information on BCA's 2005-06 education program, see www.bcaccess.com/education. To order "Tracker 101," contact BCA at (800)670-8735 or info@bcaccess.com.

While Teton Gravity Research uses the Tracker DTS exclusively, the lessons in their training video apply to all digital transceivers.

Photo BCA

Enhancing Route Selection Using a GIS

BY JAMES FLOYER, PHD STUDENT, ASARC, UNIVERSITY OF CALGARY

The Snow Avalanche Research Group at the University of Calgary (ASARC) is developing a Geographical Information System (GIS) for use during our winter field program. This short progress report describes some of the ideas we are working on and explains some of the possible benefits of organising routes, terrain photos and profile data in a way that is easy to visualise and quick to access.

Features

The ASARC GIS in its present form is intended to be used as an aid to route selection and as a way of organising and viewing route, terrain photo and snow profile information. The features include:

- Ascent and Descent Routes: marked with hazard areas where objective dangers or route finding difficulties may be encountered.
- Route Tips: clicking on a route on the screen brings up a more detailed route description along with information about what conditions are favourable and unfavourable for the selected route.
- Terrain Photos: polygons on screen outline areas where terrain photos exist – simply click on the outline to bring up the selected terrain photo.

- Observation Sites: these show snow observation sites visited by field staff during the current season, or previous seasons if desired. The icons for recent sites have a different colour.
- Profile Display: click on an observation site to bring up the corresponding snow profile along with other information for that field observation.

The basemap along with routes and observation sites can be scaled and printed out to any desired scale, although the resolution of the topographic information is consistent with a 1:50,000 NTS map. A custom printout of an area can be particularly useful when the destination area straddles two or more map sheets.

Enhancing route selection

When field staff are preparing for a day of winter fieldwork, the mornings are a busy and crucial period of time. It is intended to incorporate the ASARC GIS into the morning routine to allow staff to rapidly assess and compare route options and to determine whether or not a particular route is suitable for the present conditions. The user can also bring up recent snow profiles from nearby areas and view any terrain photos that cover the area. Some of this information is also available through other means (paper print outs or photo binders); however, the real benefit of this approach is that all the information is available from one interface, without having to hunt around for any required bits of information.

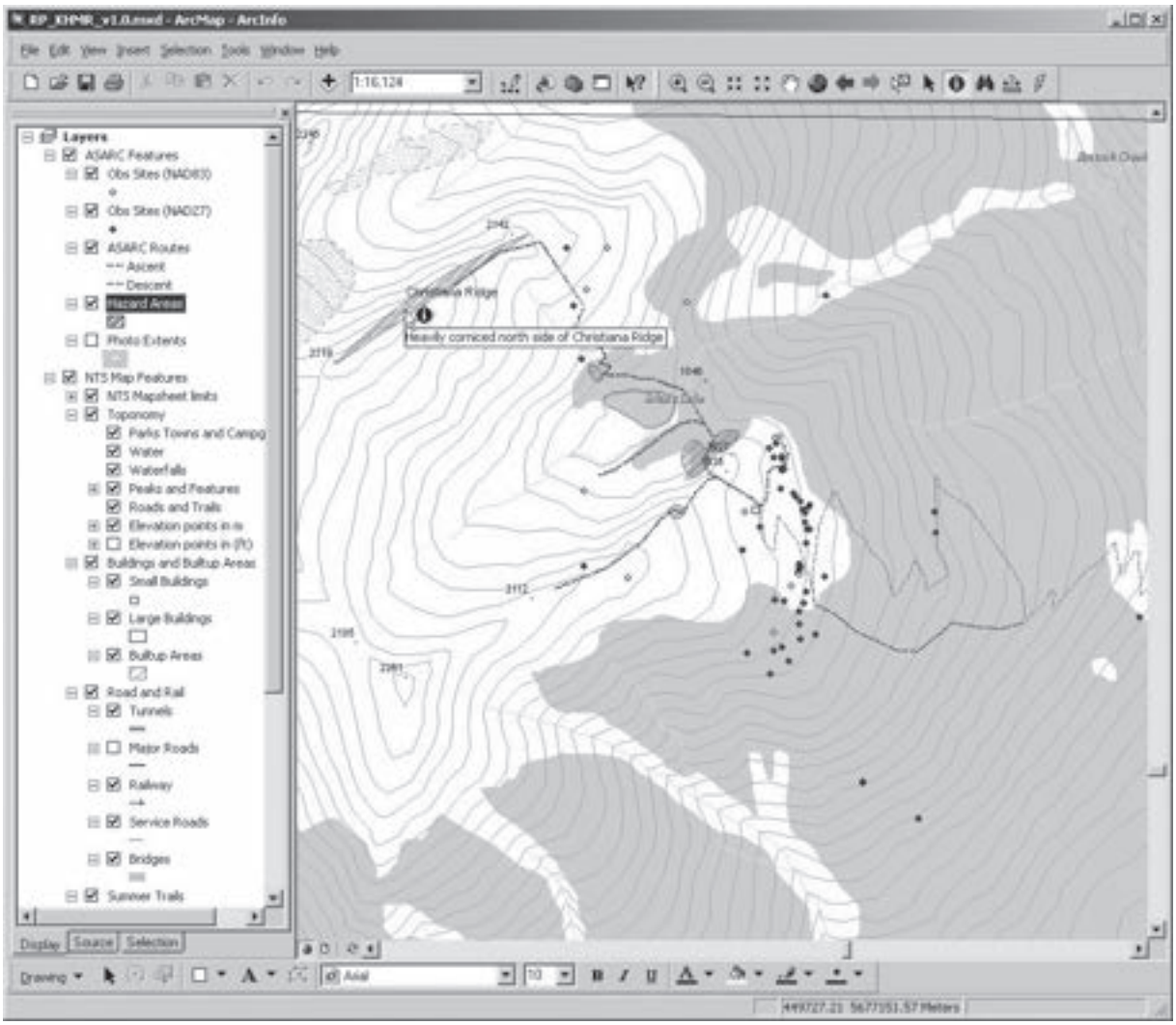
Start simple

The ASARC GIS was built using ESRI software (ArcInfo) and interfaces directly to our existing snow observation database. There are many enhancements that could be made to this system, including the ability to upload routes and destinations onto a GPS, display recent or historical avalanche occurrence data and view InfoEx data spatially according to where the operation is located.

We have deliberately chosen a strategy to start with a simple system that can be added to if an idea proves to be useful and popular within the group. The system will be field-tested at Rogers Pass during the upcoming winter; if it is successful there, we intend to expand the system to include our field station at Blue River for the following season.

Questions, comments, suggestions?

We welcome input and suggestions about this project from members of the avalanche community. Please direct your comments to: James Floyer, jafloyer@ucalgary.ca; or Bruce Jamieson, bruce.jamieson@ucalgary.ca.



CAA Avalanche First Responder Online Course

BY IAN TOMM

Official Launch Date: October 1, 2005

We are happy to announce that the final edits have been completed on the English version of the Avalanche First Responder website created through the CAA-NSS Online Learning NIF project. Official public roll out is slated for October 1, 2005 and we are positive the site will draw considerable attention from the general public, backcountry recreationists (snowmobile and skier) and various SAR organizations across Canada.

The CAA would like to thank the following subject matter experts who greatly contributed to this project through curriculum and content recommendations, editing and resource provisions:

- Rob Whelan, CMH, BCHSCCOA
- Phil Hein, Mountain Guide
- Niko Weis, JIBC, PEP
- Dave Smith, BC MoT
- Iain Stewart-Patterson, Thomson Rivers University
- Marc Deschêne, CAA Education Committee
- Janice Johnson, UBC
- Scott Aitken, BC MoT
- Terry Barter, Nelson RCMP
- Mark Klassen, Mountain Guide

You can check it out at: http://access.jibc.bc.ca/avalancheFirstResponse/index.htm

Let us know what you think. The NSS Project is ongoing, as the French translation of the project is just getting underway. This section is expected to be finished by mid- winter, so stay tuned.

Sponsorship:

If you or your organization is interested in sponsoring this site please contact Ian Tomm at ian@avalanche.ca. The CAA is currently looking for organizations to help with the hosting and support costs of running this site in addition to future content upgrades and expansion of the site.

El Niño: If Not, Why Not?

CAM CAMPBELL,

FREELANCE AVALANCHE RESEARCHER, VANCOUVER, BC

Many British Columbians believe that the El Niño-Southern Oscillation index (ENSO) provides a hint of the winter to come. If the index is in a strong El Niño (warm phase), BC'ers gear up for a fat snowpack season. We all remember the winter of 1999: strong El Niño and record snowfall in southwestern BC (Figure 1). This study looks at the validity of using the ENSO and other climatic indices to predict the winter to come. For this study, winter (February 1st) and spring (April 1st) water equivalent of the snowpack (SWE) for seven regions in BC were correlated with four different climatic indices: ENSO, Pacific North American (PNA), Pacific Decadal Oscillation (PDO) and North Pacific (NP).

Motivation for this article came from meteorologist David Jones' presentation at the 2004 Backcountry Avalanche Workshop on using ENSO as a predictor for West Coast snowfall. In his presentation, David showed that above-average snowfall on the West Coast is sometimes associated with a strong ENSO (warm or cold) but overall the correlation is relatively weak. Several other studies have focused on the relationships between snowpack and hydrologic variability and climatic fluctuations, especially in the Western United States (e.g. Yarnal and Diaz 1986; Cayan and Peterson, 1989; Koch et al., 1991; Redmond and Koch, 1991; Cayan and Webb, 1992; Chagnon et al., 1993; Dracup and Kahya, 1994; McCabe, 1994; Sittel, 1994; Ropelewski and Halpert 1996; Mason and Goddard 2001; Smith and O'Brien 2001; Patten et al., 2003; and the list goes on) but few in Canada (e.g. Moore and McKendry, 1996; Moore and Demuth, 2001).

Figure 1 – Full-depth profile at Fidelity Mtn. in the Columbia Mtns. during the winter of 1999 (Applied Snow and Avalanche Research, University of Calgary (ASARC) photo).

El Niño-Southern Oscillation (ENSO)

The ENSO index is calculated from the standardized pressure difference between Tahiti and Darwin, a small fishing village on the Chilean coast, and represents the effects of an El Niño event on the strength of the equatorial easterlies (Moore and Demuth, 2001). The occurrence of blocking in the Bering Strait is sensitive to the phase of the ENSO cycle and the frequency of blocking is most strongly influenced by the ENSO in January and February (Renwick and Wallace, 1996). "Blocking" refers to the breakdown of the prevailing mid-latitude westerly flow in the troposphere which produces persistent ridging over the northeast boundary of the Pacific, effectively blocking fronts associated with cyclonic activity over the Aleutian Islands from reaching BC Sixty-nine percent more days of blocking occurred during the cold phase of the ENSO cycle than during the warm phase, and the frequency of blocking days is 40% lower during the warm phase of the ENSO compared to other winters (Renwick and Wallace, 1996).

North Pacific (NP)

Trenberth and Hurrell's (1994) NP index represents the intensity of the Aleutian Low in winter and is the anomaly of the area-weighted mean sea level pressure to the mean between 1925 and 1988 for a given area over the North Pacific. Air temperature has been negatively correlated with the North Pacific (NP) index. That is, warm winters are associated with low NP values, whereas precipitation shows a weak positive correlation with NP (Moore and McKendry, 1996).

Pacific Decadal Oscillation (PDO)

As the name suggests, the PDO index is based on oscillations that occur somewhere in the Pacific Ocean every 10 years or so. In fact, it is the time series scores associated with the leading principle component of sea surface temperature in the Pacific Ocean, north of 20°N (Zhang et al., 1997). A positive PDO (warm phase) represents warmer than average water in the equatorial Pacific and colder than average water in the North Pacific, vice-versa for a negative (cold phase) PDO. Moore and Demuth (2001) found that snow accumulation tends to be greater during PDO cold phase winters, which explains lower observed winter accumulation after 1976 when PDO shifted from its cold phase to the present warm phase.

Pacific North American (PNA)

At 55 years old, the PNA index is the youngest used in this study. The PNA index is a mode of winter atmospheric circulation which is naturally and internally generated (Wallace and Gutzler, 1981). Positive values of the PNA (enhanced phase) represent an enhanced Rossby Wave over Western North America with southerly to southwesterly flow over the West Coast which results

in warm advection into the southern Coast Mountains (Moore and Demuth, 2001). Moore and McKendry (1996) found that BC winters dominated by enhanced PNA produced overall shallower than average spring snowpack. Intensification of the PNA index is associated with southwesterly flow over the eastern north Pacific which is likely to cause increased freezing levels and less precipitation, and result in less snow accumulation (Moore and McKendry, 1996).

Methods

The BC Ministry of Water, Land and Air Protection (MWLAP) divided the province into eight regions based largely on major drainages. Figure 2 shows the eight regions and the snow survey sites used in this study. The first thing you'll notice is a lack of sites in the northern half of BC In fact, no sites were used in the Northeast region due to insufficient data so you can disregard the Northeast. The southern regions, on the other hand, have sites with historical data dating back to the mid-1930s. For the sake of statistical significance an emphasis has been placed on the southern half of the province.

Yearly SWE data collected on, or within a few days of, February 1st and April 1st were obtained from the MWLAP's River Forecast Centre website http://wlapwww.gov.bc.ca/rfc/archive/historic.html. The regional average SWE was determined by averaging the SWEs from all snow survey sites used in that particular region. For the case of the Columbia region this means 11 sites (Figure 2), whereas due to insufficient data only one site was used to represent the Lower Fraser and Northwest regions. In order to maintain spatial bias, the average of all regional average SWEs was used to represent the provincial average.

Figure 2 – Map of British Columbia showing the eight regions: Northwest, Northeast, Coast, Upper Fraser, Lower Fraser, Thompson, Okanagan-Kettle and Columbia. The snow survey sites used in this study and landmark cities or towns are also marked (Source: British Columbia Ministry of Water, Land and Air Protection)

Table 1 lists the websites from which climatic index data were obtained. Most people would agree that the snow usually starts accumulating in the BC mountains sometime in November. For this reason SWE data on February 1st were correlated with the average index values for the previous three months (November, December and January) and SWE data on April 1st were correlated with the average index values for the previous November to March. In doing this, the total amount of snow on the ground is only compared to the index values of the months during which it accumulated.

Table 1 – Websites used to obtain climatic index data

Index	Website
ENSO	www.cru.uea.ac.uk/cru/data/ENSO.htm
NP	www.cgd.ucar.edu/~jhurrell/np.html
PNA	http://www.cpc.ncep.noaa.gov/products/precip/CWlink/pna/norm.pna.monthly.b5001.current.ascii.table
PDO	http://jisao.washington.edu/pdo/PDO.latest

Since all the data were normally distributed, Pearson linear correlation analysis was used to describe the associations between SWE and the climatic indices. Pearson's R statistic describes the strength of the correlation, with a perfect linear correlation represented by $R = 1$. The p-value is a function of R and the sample size (N) that quantifies the confidence in the correlation. In this case N corresponds to the number of years in which data were available. Multivariate least-squares linear regression was used to describe the influences that two or more variables may have on a single variable. Multivariate regression analysis produces a Coefficient of Multiple Determination (R^2), which is essentially an R statistic for linear associations in more than two dimensions. In order to directly compare the results from the two analysis techniques, Pearson's R statistic was squared. In accordance with most scientific studies, all correlation and regression coefficients were considered statistically significant at the $p < 0.05$ level. This means that there is a 5% chance of a Type II error where a coefficient is considered to be statistically significant when in fact it is not.

Results

Provincial

Figure 3 shows time series plots of yearly average PDO, PNA, NP and ENSO indices and provincially averaged SWE for both February 1st and April 1st from 1935 to 2004 (except PNA which doesn't start until 1950). Consider the three-year period

from 1940 to 1942. These winters were characterized by some of the lowest SWE on record and a period of strong La Niña, strong negative NP and strong positive PDO conditions. Now consider the winter of 1999. As mentioned before, this winter was characterized by high SWE across the province which coincides with strong El Niño, strong negative PDO and relatively weak positive PNA and NP conditions. Interpretation of the remainder of Figure 3 will be left up to the reader.

At first glance, it would appear that ENSO's performance is lacking compared to the other indices (Table 2). The correlation with February 1st SWE wasn't significant and although significant, the correlation with April 1st SWE was weak compared to the other indices. PNA was the best performer, in terms of predictive merit, for both April 1st and February 1st provincial SWE. It is also interesting to note that the correlations with ENSO and NP are positive (i.e. a strong El Niño or NP index corresponds to a high SWE) whereas the correlations with the other indices are negative. Of course, this cannot be seen in Table 2 as all the correlation coefficients have been squared.

Multivariate least-squares linear regression was used to assess the predictive merit of the top three performing indices combined. In this case, PDO, PNA and NP were used according to the following equation:

$$SWE = a\text{PDO} + b\text{PNA} + c\text{NP} + d \qquad (1)$$

When the three indices are combined, the R^2 for February 1st SWE was greater than for any individual index, suggesting that more variability can be explained by combining of PDO, PNA and NP. This, however, is not the case for April 1st SWE, where PNA outperforms the combined indices.

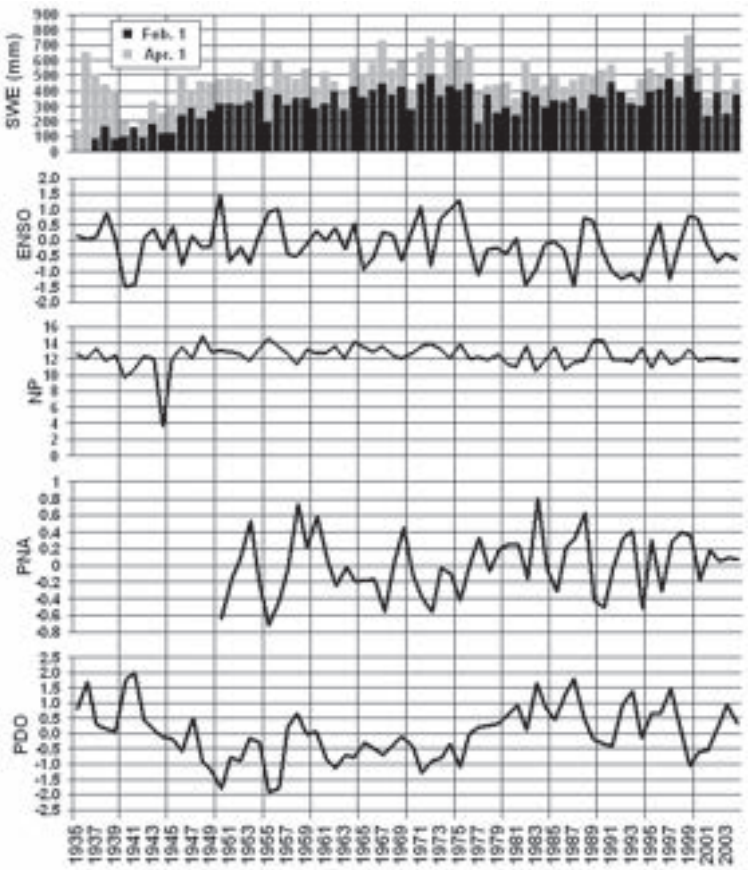


Figure 3 – Time series of the yearly averages of monthly Pacific Decadal Oscillation (PDO), Pacific North American (PNA), North Pacific (NP) and El Niño-Southern Oscillation (ENSO) index data from 1935 to 2004. Also shown is the provincially averaged Snow Water Equivalent (SWE) for both February 1st and April 1st from 1935 to 2004 (except PNA which doesn't start until 1950). There is no February 1st SWE data for 1935 and 1936.

Table 2 – Squared Pearson linear correlation coefficients (R^2) for the correlations between February 1st and April 1st provincially averaged SWE and each of the four climatic indices. The coefficient of multiple determination (R^2) for the equation: SWE = aPDO + bPNA + cNP + d is also given. All coefficients which have a $p < 0.05$ are marked in bold.

	ENSO			**PDO**			**PNA**			**NP**			***a*PDO + *b*PNA + *c*NP + *d***		
	R^2	p	N	R^2	p	N	R^2	p	N	R^2	p	N	R^2	p	N
Feb. 1	0.02	0.221	68	**0.24**	**$<10^{-3}$**	**68**	**0.26**	**$<10^{-3}$**	**54**	**0.13**	**$<10^{-3}$**	**68**	**0.29**	**$<10^{-3}$**	**54**
Apr. 1	**0.08**	**$<10^{-3}$**	**70**	**0.08**	**0.014**	**70**	**0.31**	**$<10^{-3}$**	**54**	**0.10**	**0.008**	**70**	**0.14**	**0.016**	**54**

Regional

Once again PDO, PNA and NP in Table 3 seemed to outperform ENSO with more statistically significant correlations and higher overall correlation coefficients. In fact, none of the regions had significant correlations between ENSO and February 1st SWE. All correlations with ENSO and NP are again positive, while all correlations with PDO and PNA are negative. All regions, except the Northwest, had significant correlations between at least one index and February 1st SWE. Once again, PNA seemed to be the best performing index for February 1st SWE, especially for the Thompson, Okanagan-Kettle and Columbia regions. Multivariate least-squares linear regression was again used to assess the combined predictive merit of the PDO, PNA and NP indices based on Equation 1. By combining the three indices, the ability to predict February 1st SWE for all regions, except the Columbia region, was improved. In fact, for the Upper Fraser region the three indices were able to account for 94% of the variability in February 1st SWE.

Table 3 – Squared Pearson linear correlation coefficients (R^2) for the correlations between February 1st regionally averaged SWE and each of the four climatic indices. The coefficient of multiple determination (R^2) for the equation: SWE = *a*PDO + *b*PNA + *c*NP + *d* is also given. All coefficients which have a $p < 0.05$ are marked in bold.

Region	ENSO			PDO			PNA			NP			*a*PDO + *b*PNA + *c*NP + *d*		
	R^2	*p*	*N*	R^2	*p*	*N*	R^2	*p*	*N*	R^2	*p*	*N*	R^2	*p*	*N*
Northwest	0.01	0.475	47	0.05	0.136	47	0.01	0.424	47	0.02	0.327	47	**0.27**	**0.004**	**47**
Coast	0.01	0.500	55	**0.12**	**0.009**	**55**	**0.14**	**<10^{-3}**	**54**	**0.16**	**0.003**	**55**	**0.36**	**<10^{-3}**	**54**
Upper Fraser	0.00	0.919	60	0.02	0.251	60	0.01	0.484	54	**0.09**	**0.021**	**60**	**0.94**	**<10^{-3}**	**54**
Lower Fraser	0.04	0.171	50	**0.23**	**<10^{-3}**	**50**	**0.23**	**<10^{-3}**	**48**	**0.22**	**<10^{-3}**	**50**	**0.53**	**<10^{-3}**	**48**
Thompson	0.00	0.998	62	**0.18**	**<10^{-3}**	**62**	**0.28**	**<10^{-3}**	**54**	0.06	0.057	62	**0.73**	**<10^{-3}**	**54**
Ok. Kettle	0.04	0.082	68	**0.18**	**<10^{-3}**	**68**	**0.30**	**<10^{-3}**	**54**	**0.13**	**<10^{-3}**	**68**	**0.40**	**0.005**	**54**
Columbia	0.04	0.091	66	**0.18**	**<10^{-3}**	**66**	**0.26**	**<10^{-3}**	**54**	**0.15**	**<10^{-3}**	**66**	**0.26**	**0.001**	**54**

The first thing you'll notice is an increased number of significant correlations and overall stronger correlations for April 1st SWE (Table 4) than for February 1st SWE (Table 3). Again, PDO, PNA and NP outperformed ENSO in terms of predictive merit. These three indices were, again, combined for regression analysis. By combining these three indices the amount of variability explained by the linear trends was improved for all regions except the Upper and Lower Fraser regions where NP did a better job alone.

Table 4 – Squared Pearson linear correlation coefficients (R^2) for the correlations between April 1st regionally averaged SWE and each of the four climatic indices. The coefficient of multiple determination (R^2) for the equation: SWE = *a*PDO + *b*PNA + cNP + *d* is also given. All coefficients which have a $p < 0.05$ are marked in bold.

Region	ENSO			PDO			PNA			NP			*a*PDO + *b*PNA + *c*NP + *d*		
	R^2	*p*	*N*	R^2	*p*	*N*	R^2	*p*	*N*	R^2	*p*	*N*	R^2	*p*	*N*
Northwest	0.07	0.066	51	**0.08**	**0.040**	**51**	**0.12**	**0.013**	**51**	**0.12**	**0.014**	**51**	**0.15**	**0.047**	**51**
Coast	**0.13**	**0.002**	**69**	**0.14**	**0.002**	**69**	**0.10**	**0.024**	**54**	**0.08**	**0.021**	**69**	**0.24**	**0.003**	**54**
Upper Fraser	0.01	0.455	60	0.03	0.159	60	**0.12**	**0.010**	**54**	**0.16**	**<10^{-3}**	**60**	**0.16**	**0.033**	**54**
Lower Fraser	**0.27**	**<10^{-3}**	**57**	**0.44**	**<10^{-3}**	**57**	**0.38**	**<10^{-3}**	**54**	**0.45**	**<10^{-3}**	**57**	**0.43**	**<10^{-3}**	**54**
Thompson	**0.16**	**<10^{-3}**	**67**	**0.41**	**<10^{-3}**	**67**	**0.40**	**<10^{-3}**	**54**	**0.18**	**<10^{-3}**	**67**	**0.46**	**<10^{-3}**	**54**
Ok. Kettle	**0.21**	**<10^{-3}**	**68**	**0.45**	**<10^{-3}**	**68**	**0.38**	**<10^{-3}**	**54**	**0.12**	**0.004**	**68**	**0.55**	**<10^{-3}**	**54**
Columbia	**0.13**	**0.003**	**68**	**0.30**	**<10^{-3}**	**68**	**0.34**	**<10^{-3}**	**54**	**0.15**	**<10^{-3}**	**68**	**0.40**	**<10^{-3}**	**54**

Top Five Sites

The top five performing snow survey sites, in no particular order, are: McBride in the Upper Fraser region; Blue River in the Thompson region; Fidelity Mountain in the Columbia region, Sullivan Mine in the Columbia region; and Fernie East in the Columbia region (Tables 5 and 6). ENSO has once again dropped the ball, PDO, PNA and NP, however, look promising (Tables 5 and 6). Again, the correlations with April 1st SWE were stronger than those with February 1st SWE for all sites and all correlations with ENSO and NP are positive, while PDO and PNA consistently show negative relationships with SWE. Once again, a combination of PDO, PNA and NP did a better job of predicting February 1st (Table 5) and April 1st (Table 6) SWE than any of the indices alone.

Table 5 – Squared Pearson linear correlation coefficients (R^2) for the correlations between February 1st SWE for the top five performing snow survey sites and each of the four climatic indices. The coefficient of multiple determination (R^2) for the equation: SWE = *a*PDO + *b*PNA + cNP + *d* is also given. All coefficients which have a $p < 0.05$ are marked in bold.

Site	ENSO			PDO			PNA			NP			*a*PDO + *b*PNA + *c*NP + *d*		
	R^2	*p*	*N*	R^2	*p*	*N*	R^2	*p*	*N*	R^2	*p*	*N*	R^2	*p*	*N*
McBride	**0.11**	**0.017**	**51**	**0.19**	**0.001**	**51**	**0.19**	**0.001**	**51**	**0.14**	**0.007**	**51**	**0.31**	**<10^{-3}**	**51**
Blue River	0.00	0.809	60	**0.12**	**<10^{-3}**	**60**	**0.23**	**<10^{-3}**	**52**	**0.07**	**0.048**	**60**	**0.53**	**<10^{-3}**	**52**
Fidelity Mtn.	0.08	0.077	42	**0.29**	**<10^{-3}**	**42**	**0.22**	**0.002**	**42**	**0.21**	**<10^{-3}**	**42**	**0.72**	**<10^{-3}**	**42**
Sullivan Mine	0.05	0.089	59	**0.30**	**<10^{-3}**	**59**	**0.45**	**<10^{-3}**	**54**	**0.26**	**<10^{-3}**	**59**	**0.47**	**<10^{-3}**	**54**
Fernie East	0.00	0.868	51	**0.27**	**<10^{-3}**	**51**	**0.40**	**<10^{-3}**	**51**	**0.29**	**<10^{-3}**	**51**	**0.43**	**<10^{-3}**	**51**

Table 6 – Squared Pearson linear correlation coefficients (R^2) for the correlations between April 1st SWE for the top five performing snow survey sites and each of the four climatic indices. The coefficient of multiple determination (R^2) for the equation: SWE = aPDO + bPNA + cNP + d is also given. All coefficients which have a $p < 0.05$ are marked in bold.

Site	ENSO			PDO			PNA			NP			*a*PDO + *b*PNA + *c*NP + *d*		
	R^2	p	N	R^2	p	N	R^2	p	N	R^2	p	N	R^2	p	N
McBride	**0.24**	**<10^{-3}**	**52**	**0.36**	**<10^{-3}**	**52**	**0.49**	**<10^{-3}**	**51**	**0.45**	**<10^{-3}**	**52**	**0.61**	**<10^{-3}**	**51**
Blue River	**0.18**	**<10^{-3}**	**67**	**0.42**	**<10^{-3}**	**67**	**0.45**	**<10^{-3}**	**54**	**0.20**	**<10^{-3}**	**67**	**0.51**	**<10^{-3}**	**54**
Fidelity Mtn.	**0.16**	**0.008**	**42**	**0.40**	**<10^{-3}**	**42**	**0.37**	**<10^{-3}**	**42**	**0.32**	**<10^{-3}**	**42**	**0.63**	**<10^{-3}**	**42**
Sullivan Mine	**0.12**	**0.009**	**59**	**0.44**	**<10^{-3}**	**59**	**0.44**	**<10^{-3}**	**54**	**0.32**	**<10^{-3}**	**59**	**0.58**	**<10^{-3}**	**54**
Fernie East	**0.09**	**0.030**	**53**	**0.31**	**<10^{-3}**	**53**	**0.40**	**<10^{-3}**	**53**	**0.36**	**<10^{-3}**	**53**	**0.52**	**<10^{-3}**	**53**

Discussion

The bottom line is: do not rely on ENSO to predict the snowpack depth in the winter to come. The other three indices (PDO, PNA and NP) either alone or combined do a much better job of predicting both February 1st and April 1st SWE at the provincial, regional and individual site scales. Overall, April 1st SWE showed better correlations than February 1st SWE with all four climatic indices. For the most part a combination of PDO, PNA and NP indices will give you the best indication of the winter and spring snowpack to come. For the Upper or Lower Fraser regions in April, your best bet is with NP. Finally, if you like to ski in the Columbia region in February, it's PNA all the way.

What about the effects of climate change? Well, certainly as our climate continues to change at an accelerated rate, the use of historical climatic data to predict the future becomes less valid. Most climate change models (and there are many) agree that as our climate continues to change, we are going to see more extreme weather patterns. The good news is this means more epic winters like 1999. The bad news is we'll also see more winters like last year and yes, I realize that it was only extremely bad on the coast. But now that we have these new prediction tools under our proverbial belts we can better decide in the fall whether to buy a new pair of fat boards or spend the money on airfare to South America.

Outlook for next winter? Well, I hesitate to make any predictions because things aren't looking good and I don't want to be the bearer of bad news. As of June 2005 the PDO and PNA indices were in a strong positive phase while the NP index was weak, and remember PDO and PNA are negatively correlated with SWE while NP is positively correlated. Anyone interested in a climbing trip to Chile?

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As a Vancouverite, Cam is very familiar with the Coast Range and the splendors it has to offer. When he's not skiing or mountain biking, Cam passes his time as an avalanche researcher for hire and part-time cabinet maker. So if you need help with a research project, or new custom cabinets, give him a call.

Avalanche Judgement and Decision Making
Part 1 - How Experts Do it

LAURA ADAMS

SELKIRK COLLEGE AND THE SELKIRK GEOSPATIAL RESEARCH CENTER, CASTLEGAR, BC

Introduction

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. Part II discusses the 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.

Part I Highlights

- Avalanche decision-making occurs at the centre 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.

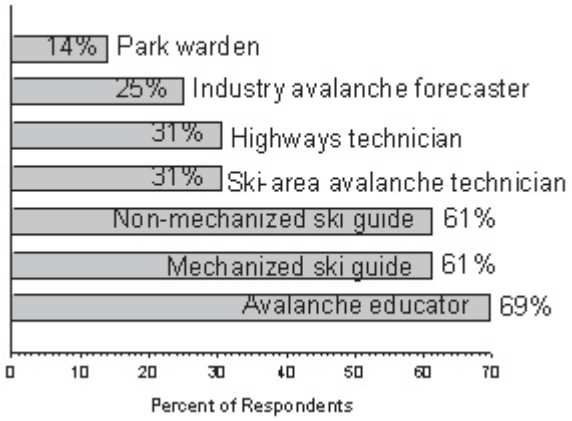

Figure 1. Area of expertise in the avalanche field. Note: Numbers total more than 100 as most participants had several areas of expertise.

Methods

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. 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.

Thirty-seven 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). Eighty-nine percent of the participants were male, and 11 % were female.

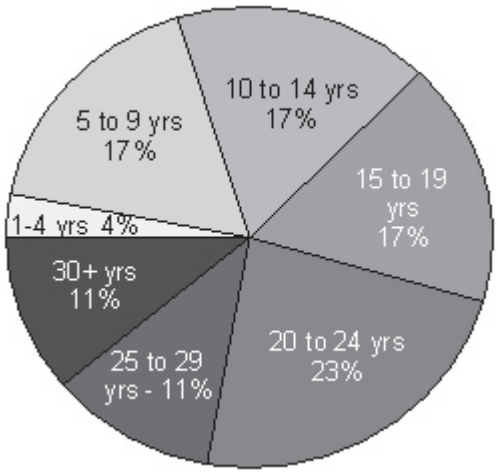

Figure 2. Years of professional experience working in the avalanche field.

A Systems Perspective of Avalanche Decision-Making

Avalanche-related decision making occurs at the centre of three systems of influence: human, physical, and environmental (Figure 3). Since human behaviour 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.

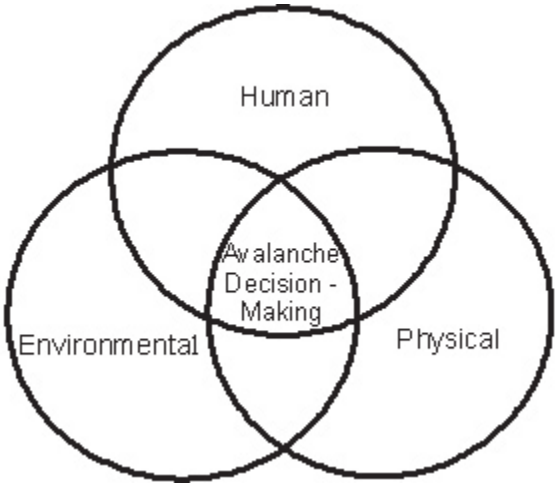

Figure 3. Systems of influence in avalanche decision-making. Note: The human system contains the individual, team, client, organizational, and socio-political realms. The physical system contains the terrain, including geographic location, slope aspect, angle, shape, and ground cover. The environmental system contains the snowpack and the weather conditions that create it and influence its instability.

The Foundation of Avalanche Judgment and Decision-Making 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 an expert's performance are acquired through experience. For example, Dave McClung from UBC, 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 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 Three Systems of Influence

Having information and data relevant to the human, physical, and environmental systems of influence was the third element in the foundation of 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 neighbour 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 of events specific to the avalanche field results 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 develop 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).

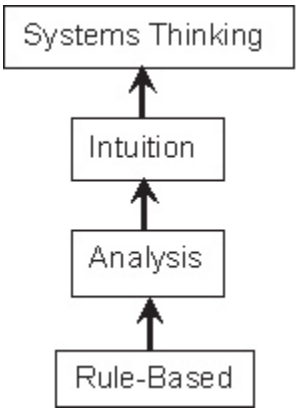

Figure 4: Hierarchy of avalanche judgment and decision-making complexity.

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, and 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 (see Klein, 2003). *Systems Thinking* integrates a holistic awareness of the human, physical, and environmental systems of influence.

Ninety-five percent 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 to me: "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 stated: "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 stated: "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 stated: "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 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. Eighty-five percent 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-makers 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 stating, "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 behaviours 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 Expert's 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).

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 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.

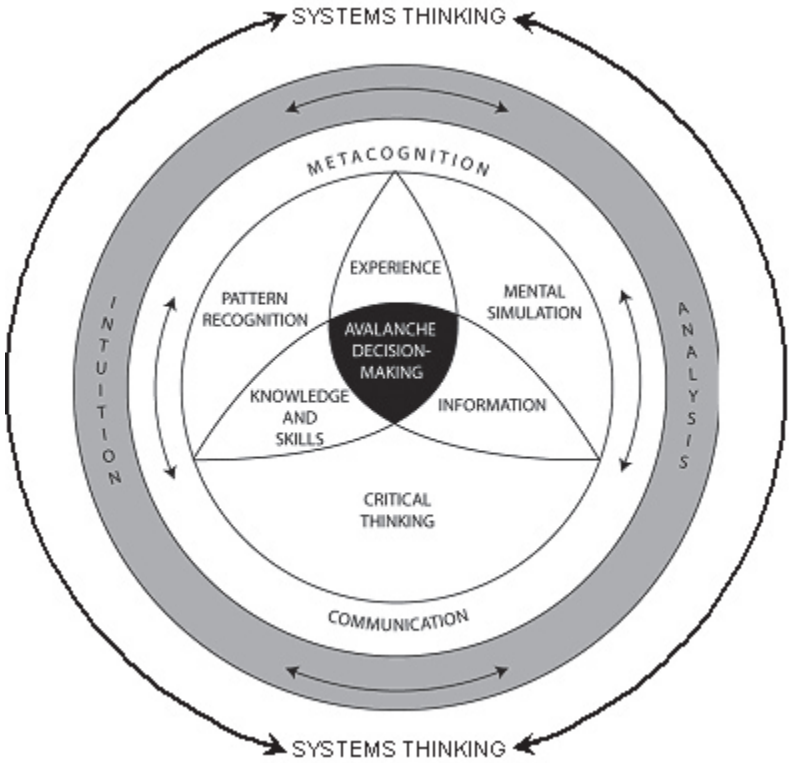

Figure 5. Conceptual model of avalanche experts' decision making modes and strategies. Note: Avalanche experts' decisions are made within a systemic process that unfolds from the centre of the system. Experience, knowledge and skills, and information relevant to the human, physical, and environmental 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 judgments and decisions. Intuitive and analytic decisions result within a dynamic systems thinking perspective.

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 affected 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 instructs mountain safety, risk management, and leadership at Selkirk College and coordinates the Avalanche program at the Selkirk Geospatial Research Centre. She has a Masters degree in Leadership and Training from Royal Roads University, a teaching certificate in adult education, and an honors diploma in Business Administration. She is a professional member of the Canadian Avalanche Association and the Association of Canadian Mountain Guides

Comparing regional forecasts of avalanche danger with local "nowcasts" – First results

BRUCE JAMIESON[1], ALAN JONES[2] AND JOHN KELLY[2]

[1]DEPT. OF CIVIL ENGINEERING, UNIVERSITY OF CALGARY
[2]CANADIAN AVALANCHE CENTRE, REVELSTOKE, BC

1. Introduction

One way of assessing a regional bulletin is to compare the forecast danger level with local observations, stability ratings or danger ratings (Schweizer et al., 2003). In this article we use this approach to explore the effect of spatial and time scales on the accuracy of regional forecasts. University of Calgary researchers provided the local danger ratings that are compared to regional danger ratings. This study is a spin-off from the Canadian Avalanche Association's Avalanche Decision-making Framework for Amateur Recreationists (ADFAR) project.

2. Regional bulletins

Two scales of regional bulletins were used as shown in Figure 1: The Canadian Avalanche Centre's (CAC) bulletin for the South and North Columbia Mountains (approx. 45,000 km^2 and 60,000 km^2, respectively) and Parks Canada's bulletin for the highway corridor through Glacier National Park (GNP, approx 450 km^2). The forecast regions for the South and North Columbia Mountains are approximately a hundred times larger than the GNP forecast area. (See Haegeli and McClung (2003) for a discussion of the scale of avalanche activity patterns in the Columbia Mountains.)

Figure 1. Map of forecast areas for Canadian Avalanche Centre and for Glacier National Park.

The GNP bulletin is produced each morning in the winter for the current day and for each of the following two days. The CAC bulletin is produced at least three times per week, occasionally more frequently. In the afternoon, the danger level is forecast for each of the following two or three days. Both the CAC and the GNP bulletins rate the avalanche danger separately for the alpine, tree-line (TL) and below treeline (BTL) areas. The danger is rated as either Low (1), Moderate (2), Considerable (3), High (4) or Extreme (5). The numbers for the danger ratings are currently not used in Canadian bulletins, but are used in some European countries and in this study. In addition to the danger ratings in each bulletin, avalanche forecasters consistently provide a paragraph or two of text, often to explain how the weather and snow conditions are contributing to the avalanche danger, and to discuss the avalanche danger in terms of the terrain.

3. Local "nowcast"

The observations for this study were made between 12 January 2005 and 14 April 2005. On each of 34 observation-days, University of Calgary researchers selected a sheltered site at or below tree-line. Usually on touring skis in teams of two or three, they traveled to the site and observed a detailed snow profile, at least two compression tests noting the fracture character, and usually a rutschblock test noting the Release Type (Schweizer and Wiesinger, 2001). They made other observations of snow stability and avalanches while traveling to and from the site. Also, they had access to weather, snowpack and avalanche observations from the hosting operation and from neighbouring avalanche safety programs. Using all available information, a danger rating for the drainage and the current day, called the local "nowcast", was selected by consensus for tree-line and or below tree-line—provided this could be done with confidence. Although on some days field staff were aware of the regional danger ratings, local field observations strongly influenced the local nowcast, as explained in the next section. On most days, ratings were recorded for both treeline and below tree-line, yielding two cases per day. The snowpack and avalanche experience of the researchers was typically less than that of CAC or GNP forecasters; however, this likely did not affect the ratings which required little extrapolation over time or space, and were reached by consensus between at least two people. During the discussions leading to the local nowcast, a systematic difference in ratings between those with more and less experience was not apparent.

In this study, the local nowcast is the reference danger rating to which the regional rating is compared. The local nowcast and the regional forecast danger rating are expected to differ in many cases because the CAC and GNP forecasters are extrapolating over

time and over areas much larger than the drainage scale of the local nowcast.

4. Results

Occasionally, the regional forecast or the local nowcast for treeline or below treeline involved more than one rating, e.g. "moderate increasing in the afternoon," or "moderate with areas of considerable." To simplify the analysis—and not because we question the relevance of such ratings—these two-level or transitional ratings were excluded, leaving 25 local nowcasts in Glacier National Park, six in the Dogtooth Range of the North Purcells, and 25 in the Cariboos near Blue River BC. These were paired with regional danger ratings as shown in Table 1. Because of differences in spatial scale, the 25 data from Glacier National Park were assessed separately from the 31 data from the North Purcells and Cariboos. The distributions of the regional ratings that were paired with nowcasts are shown in Figure 2. We used the GNP ratings prepared on the morning of each nowcast. Ratings for the day of the nowcast that were produced one or two days prior to the nowcast are analyzed in the next section.

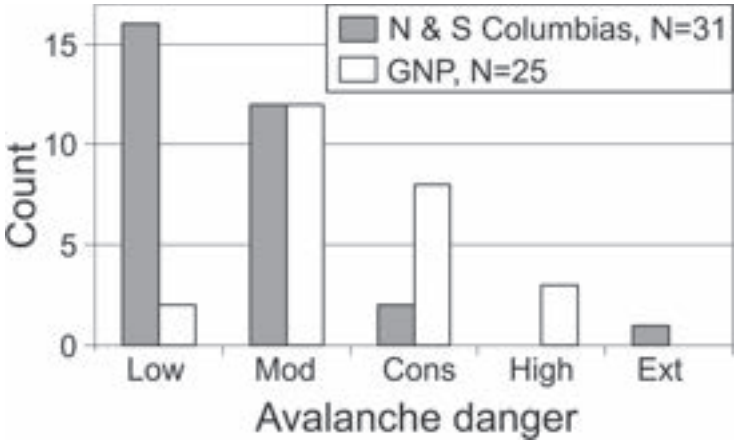

Figure 2. Distribution of danger ratings when corresponding local nowcasts for tree-line or below tree-line were available.

Table 1: Summary of data for comparing local nowcast with regional forecasts

Number of days	Number of cases	Sites for local nowcasts	Forecast region (Fig. 1)	Source of regional forecast
5	6	North Purcell Mountains	South Columbia Mountains	Canadian Avalanche Centre (CAC)
16	25	Cariboos near Blue River, BC	North Columbia Mountains	Canadian Avalanche Centre (CAC)
13	25	Highway corridor in Glacier National Park	Highway corridor in Glacier National Park	Parks Canada

For each nowcast paired with a regional danger rating, the difference was calculated by subtracting the number of the danger rating for the local nowcast from the number of the danger rating from the regional forecast. A positive difference indicates that the regional danger rating was higher than the local nowcast, and negative difference indicates that the regional danger rating was lower than the local nowcast. The distributions of the differences are plotted in Figure 3. The number of non-zero differences and the experience of making local nowcasts suggests the field teams were strongly influenced by local observations.

Notably, Figure 3 shows that in 72% of cases the GNP forecast agreed with the local nowcast (difference of 0) whereas the CAC forecast agreed with the local nowcast in 45% of cases. The CAC forecasts involve some differences of ±2 whereas there were no cases in which the GNP forecast differed by ±2 from the local nowcast. The greater agreement of the local nowcasts with the regional forecast in GNP could be due to various factors including the smaller scale of the GNP forecasts compared to the CAC forecasts and/or to the shorter time scale (i.e. higher frequency) of the GNP forecasts. All of the GNP forecasts used in Figure 3 were prepared the morning of the nowcast whereas 58% and 42% of the CAC forecasts were prepared one day and two days ahead of the local nowcasts, respectively. This is discussed further in the section on comparing the effect of spatial and time scales

Also, notable in Figure 3 is that 16% of GNP forecasts rated the danger higher than the local nowcasts whereas 12% rated the danger lower than the local

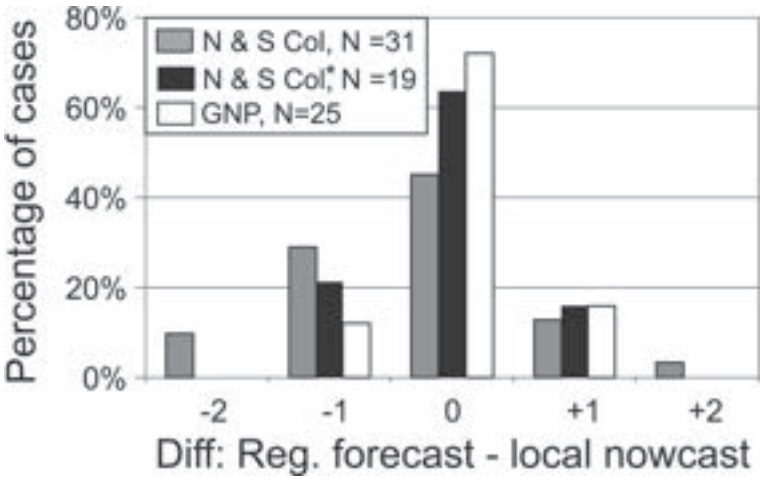

Figure 3. Relative frequency of differences between danger rating from the regional forecast and from the local nowcast for Glacier National Park (GNP) and for North and South Columbias. For the Columbias, the gray bars include twelve cases in which the regional forecasts identified factors contributing to higher danger in the sub-region of the local nowcast and the black bars exclude these cases.

nowcast. This difference of 4% is due to only one case. Surprisingly, CAC forecasts in which the regional danger rating was less than the local nowcast (gray bars in Figure 3) occurred in 39% of cases—more than twice as often as the cases in which regional rating exceeded the local nowcast (16%). This is inconsistent with forecasters "erring on the side of caution" as they extrapolate avalanche danger over space and time because of the high consequences of avalanche involvements.

There are at least two reasons for this apparent under-estimation of avalanche danger by the CAC regional ratings. First, the three differences of -2 occurred on 22 March (TL and BTL) and 23 March (TL) in the Cariboos. On all of these three cases, the text part of the bulletin for the North Columbias stated "Up to 80cm of snow fell in the last storm, with highest amounts in the Cariboos." In five of the nine cases in which the difference was -1, the sub-region of the local nowcast (Cariboos or North Purcells) was identified in text as having received more snow, more wind or had a poorer bond to a crust compared to most areas within the forecast region. This highlights the importance of the text part of the bulletin and the potential of smaller forecast areas to improve accuracy. There were a total of twelve cases in which the text part of the bulletin identified the sub-region of the local nowcast as having conditions favourable to higher danger: the eight cases identified above, plus two cases in which the local nowcast was the same as, and two cases in which the local nowcast was lower than, the regional danger rating. Excluding these twelve cases leaves three cases in which the regional danger rating was higher, and four cases in which the regional danger rating was lower than the local nowcast. Also, the frequency of cases in which there is no difference increases to 63% for the North and South Columbias (black bars in Figure 3), which is closer to the 72% calculated for GNP.

The second reason for the apparent under-estimation of avalanche danger by the CAC regional ratings involves the days chosen for the observations. For four of six cases in the North Purcells, the danger rating was low for the South Columbia Mountains, and for 12 of 25 cases in the Cariboos, the danger rating was low for the North Columbia Mountains (Figure 2). When the danger rating is low, the local nowcast cannot be lower and hence the distribution of the difference is truncated, i.e. each difference has to be 0 or negative. (There was only one case in which the observations were made when the regional danger rating was extreme and in this case the local nowcast was also extreme.) Considering these two factors, there is no evidence of systematic under-estimation of avalanche danger in the CAC forecasts.

5. Effect of forecast time

Fortuitously, the GNP regional forecast for each observation day was available in the morning of the observation day, the previous day and two days previously. This allows the local nowcast to be compared with regional forecasts that were prepared zero, one and two days ahead, as shown in Figure 4. The percentage of cases in which there is no difference between the regional forecast and local nowcast increases from 65% to 70% to 72% as the forecast time decreases from two days to one day to less than a full day. At each of the three different forecast times, there are four cases with a positive difference and three cases with a negative difference.

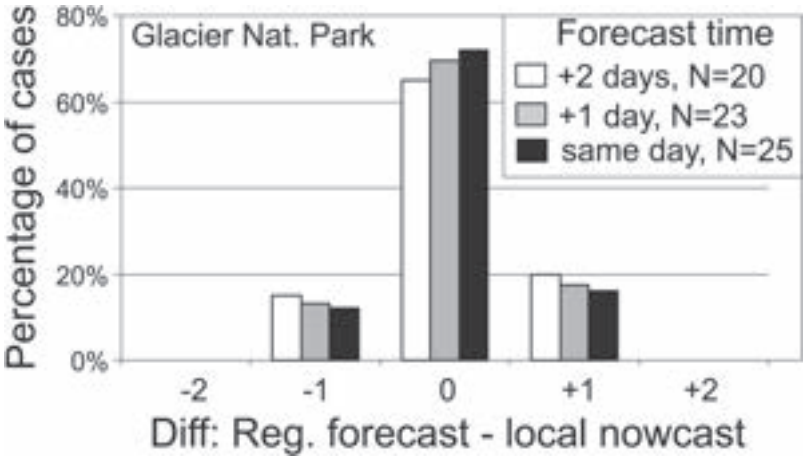

Figure 4. Relative frequency of differences between the Glacier National Park danger rating and the local nowcast. The number of days with no difference increases by 7% when the forecast time is reduced from two days to the same day.

6. Comparing the effect of spatial and time scales

Ignoring the comments about the spatial distribution of avalanche danger in the text part of regional bulletins, the differences in danger ratings between the regional forecast and local nowcast can be assessed to cautiously compare the effect of spatial and time scales. One and two days ahead, the GNP rating agrees with the local nowcast in 65% and 70% of 25 cases, respectively. Also one or two days ahead, the CAC forecast danger rating agrees with the local nowcast in 45% of 31 cases. Consequently, the GNP regional forecast agrees with the local nowcast 20% to 25% more often than the CAC forecasts with similar forecast time, and the improved accuracy by decreasing the GNP forecast time from two to one days or one to zero days is 2% to 5%. Hence the difference in spatial scale between the large forecast regions of the Columbia Mountains and the smaller forecast region within Glacier National Park appears to have greater effect on the accuracy of the bulletin than would be achieved by reducing the average forecast time by a day. This result must be interpreted cautiously since:

1. the datasets are small.
2. there are differences in the distributions of danger ratings for the forecast regions. Specifically, the CAC dataset involves an unusual number of low ratings (Figure 2) which skews the distribution of differences.
3. the density of weather stations in Glacier National Park is greater than most areas of the CAC forecast regions for the North or South Columbia Mountains.

As part of the spatial scale effect, it is difficult for CAC forecasters to be as familiar with many sub-regions of the North or South Columbias as the GNP forecasters are familiar with the highway corridor in Glacier National Park. However, CAC forecasters have shown they can often identify sub-regions such as the North Purcells or Cariboos when the weather or snowpack contributes

to greater avalanche danger. Consequently, there is more potential for improved accuracy of the danger rating of the bulletin by decreasing the size of some forecast regions—provided there are sufficient weather and snowpack observation sites—than by increasing the frequency of the bulletin from three to, say, five times per week.

7. Summary

Based on data from the winter of 2004-2005 in the Columbia Mountains, 56 drainage-scale ratings of current avalanche danger (local nowcasts) were compared with regional ratings of avalanche danger prepared zero, one or two days in advance. For the smaller forecast region (approx. 450 km^2), the agreement of the regional danger with the local nowcast increased from 65% to 72% as the time of the forecast decreased from two days ahead to the morning of the nowcast, showing improved forecast accuracy with decreasing forecast time. For two much larger forecast regions (approx. 45,000 and 60,000 km^2), the regional danger rating and the local nowcast only agreed on 45% of cases although the text portion of the bulletin often identified sub-regions where the weather or snowpack was contributing to locally higher avalanche danger. This indicates the importance of using the text portion of the bulletin in addition to the danger rating. It appears that danger rating part of the forecast for the larger regions has the potential to be improved more by reducing the size of the forecast regions (and hence increasing the number of forecast regions) than by increasing the frequency of forecasts from three times per week to, say, five times per week.

These effects of the time and spatial scale will be reassessed after the winter of 2005-06 when more local nowcasts are available from the Coast Range and the Rocky Mountains.

Acknowledgements

For meticulous snowpack observations, we thank Paul Langevin, Antonia Zeidler, Ken Matheson, Cam Campbell, Laura Bakermans, James Floyer and Dave Gauthier. The study relied on the logistical support and advice from the Avalanche Control Section of Glacier National Park and from Mike Wiegele Helicopter Skiing. Thanks to Pascal Haegeli, Susan Hairsine and Clair Israelson for encouragement and funding for the field work part of this study under the CAA's ADFAR project. For funding to analyze these data, Bruce Jamieson is grateful to the Natural Science and Engineering Research Council of Canada, the BC Helicopter and Snowcat Skiing Operators Association, the Canadian Avalanche Association (CAA), Mike Wiegele Helicopter Skiing, Canada West Ski Areas Association, the Canadian Avalanche Foundation and the Canadian Avalanche Centre.

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John Kelly: CAC Operations Manager

Age: 42

Lives in: Revelstoke

CAA member since: 1999

Previous positions: CAC Forecaster, Senior Avalanche Technician – Parks Canada, Secretary-Treasurer CAA

Previous life:

I left southern Quebec in 1989 in search of snow – I guess I found it! After putting myself through school by ski patrolling at Owl's Head, I came West to relax, get my head out of the books and to find a magic spot where the snow fell deep enough to cover the rocks. Naturally I ended up at Rogers Pass. Add several million vertical metres and a few thousand artillery rounds and here I am 16 years later - I haven't hit a rock since.

Plans for the CAC:

I see three priorities for the future of the CAC, the first being partner relations. We must develop and nurture partner relationships in the public and private sectors. The greatest need within this category is to develop feedback mechanisms so that we can maintain a two-way flow of information with partner agencies. This will be especially critical in Alberta and Quebec, but is equally important with corporate partners such as CPR, the Mountain Equipment Co-op, Columbia Brewery and RBC.

The second is to develop national public services. As the CAC grows to offer products and services across the country we will need to develop these into coherent programs that target public avalanche safety at various levels of need and investment. This will allow us to present the array of products that can be implemented for a given investment, as well as the ability to present the advantage that the next increment will bring. A modular framework will allow us to suggest additional products and services as and when we feel that they would be successful in reducing avalanche accident rates. Products and services could follow the following themes in order of increasing complexity:

- Discovery of needs
- Outreach and awareness
- Targeting at risk groups such as snowmobilers and youth
- Avalanche bulletins and warning products
- Tailoring appropriate packages of services according to local needs

Our third priority is to manage existing products, namely our recreational avalanche courses and our public avalanche forecasts and warnings. The RAC program is mature and at a stage where review and evaluation is required. Certain aspects of the RAC program, such as the Advanced RAC, are clearly in need of changes and review and renewal should be accelerated.

Compared to other programs at the CAC, the Public Avalanche Warning System (PAWS) is in a relatively mature state of development and execution. Improvements in scope, content and quality of products are ongoing and must be encouraged, but overall the program is effective as it stands. Goals and focus should remain on providing benefit to the backcountry users most in need. Each additional amount of effort to produce products should be weighed against the anticipated benefit of reduced accidents. We cannot afford to spend a great deal of effort to take the PAWS from 80% efficiency to 90% efficiency when other critical CAC programs are in need of major improvements and/or growth.

In addition to those priorities, I also see the following points as critical tasks for the coming season.

- To act as a catalyst in securing funding agreements for Quebec and Eastern programs
- To build links with the snowmobile community through contacts with clubs, federations and businesses
- Youth Programs development (Coordination of Snowsmart and Adventuresmart programs to provide better products to target youth)
- Structure and program design (Policy and procedure development for CAC programs such as risk management protocols for bulletin products)
- Act decisively on Recreational Avalanche Course renewal
- Maintain a close collegial relationship and an expanding network of contacts with CAC partner agencies and sponsors
- To manage the information technology systems crucial to the analysis of avalanche safety data and transmission of safety information to the public.

This new role promises to be both challenging and fulfilling. I'm looking forward to taking the CAC into the future, expanding our programs, services and outreach while maintaining our heritage of excellence courtesy of the CAA. We will strive to be the best source for avalanche safety and education in Canada.

Ian Tomm: CAA Operations Manager

Age: 31

Lives in: Calgary & Revelstoke

CAA member since: 1996

Previous position: CAA Industry Training Programs (formerly CAATS) Coordinator

Plans for the future of the CAA:

The Canadian avalanche community is currently in a period of change due to a variety of complex and interconnected circumstances. Some of this change is economic in nature, while other aspects have more to do with societal norms and their influence on business and operational practices. As the hub for all avalanche-related activity in Canada, the CAA is the natural epicenter for this change to occur. The CAA is where an increasing amount of people, not just the avalanche community, are coming for input, perspective, ideas and support during this time of uncertainty.

During times of change it is basic human nature to try to belong to a group like the CAA. In this role the CAA can't afford to underestimate its value, importance and stature within the avalanche community in Canada. In this regard I think the CAA is in an enviable position, one that has an incredible potential to effect real, positive change that will benefit all The CAA has its critics, but what I feel truly sets us apart is our ability to work together, even with our critics, to find and, more importantly, implement real-time, results-oriented solutions.

Collaboration and cooperation are core strengths of this association. The CAA was started in the interest of establishing and maintaining an association for avalanche workers in Canada to help support and facilitate information exchange, training, certification and a whole host of other values. During times of change, we need to rely upon these core values and strengths in order to facilitate the effective and efficient management of that change, ensuring the organization emerges stronger. Change management often involves the development of value through the diversification of products and/or services, increased industry presence and, most notably, effecting internal change resulting in a more rational, efficient and principled organization.

Ian and his wife Tammy Hertzberg on the summit of Nordic Peak.

Photo courtesy of Ian Tomm

This is the setting in which the CAA currently operates. It is a challenging setting and one in which the Operations Manager must excel, in order to manage the association and steer it through these uncertain times in conjunction with the Executive Director and the BOD. Done effectively, the Operations Manager will play a key role in developing the Association into a new, improved organization, ready to meet the current and future needs of the avalanche community in Canada.

Facilitating the CAA through this period of change management is an exciting opportunity. I feel ready to meet the challenge head-on and grow our association to take full advantage of the opportunities of the future. I'm looking forward to working with the Executive Director, BOD and various committees to develop and implement additional services. And, most importantly, I'm honoured to be in a position which upholds the standard of excellence and professionalism established by you, the individual members of the Canadian avalanche community.

Jennifer George: CAC Programs Services

Lives In: Revelstoke for the past three years, previous eight months in Nelson. Born in Connecticut.

Age: 37

Interests: Hiking/backpacking, biking, fresh-water fishing, running and travel.

Previous Jobs:

I started my career at IBM fresh out of university and I have held many management and business development positions in the Information Technology Consulting industry for the past 16 years. My most recent employment was as a senior-level headhunter for a Fortune 500 international company. In my career, my responsibilities have included marketing, sales, public relations, quality control, process redesign, and systems implementations.

Why the CAC?

For my last job, I worked remotely for my US employer from my home office here in Revelstoke. For many of my friends, this employment situation seemed ideal but it has its challenges. Such as, finding the appropriate footwear for the long commute from my bedroom to my office in the next room (where are those slippers!?) and making sure my laptop had a fresh cup of java in the morning before doing any heavy e-mail.

After relocating to Revelstoke several years ago, my goal was to secure local employment. The CAC opportunity provides an atmosphere in which I can leverage my skills to support the public and, thus, become more integrated into the local area. A side benefit is the ability to communicate daily with most of my co-workers without the use of a webcam. In other words, I can leave my high speed DSL "Electronic-Leash," laptop and slippers behind. I am looking forward to supporting CAC in its evolving role in developing products and services to better prepare recreational backcountry users in the winter season.

Expectations/Objectives:

I anticipate developing creative and cost-effective ways to support this non-profit organization. I recognize the CAC is a relatively new organization and everyone works together to make it happen. Therefore, I expect my role to be very organic and flexible to support the needs of this expanding organization. I will be organizing data to support the forecasters, planning logistics for events and outreach, coordinating materials for the RAC instructors, general office administrative support and making sure the forecast team has a fresh cup of java before any heavy data computing!

Randy Bente: CAA Information Technology Specialist

Age: 34

Lives in: Revelstoke (recently moved from Salmon Arm)

Interests:

Spending time with my family. I have a 10-year-old daughter, a three-year-old son, an eight-week-old daughter and a beautiful wife. I also love to ski, hike, fish, cook, mountain bike and swim. But above all my main hobby/interest is computers, especially security and networking.

Previous jobs:

Restaurant Manager, Managing Director for an Internet security appliance manufacturer, Network Technician, Systems Analyst and sales manager. I have contracted out to companies like RBC, Bell Canada, Xerox and Symantec.

Why the CAA?:

Your organization is very well run. I feel that I can learn a lot and make improvements and expand your service offerings. And ever since I first came to Revelstoke from Victoria 18 years ago, I fell in love with the town and community.

Expectations:

I truly want to help the team here utilize the technology you currently have and assist in improving existing and new services.

Dan Markham: CAC Director for Supporters

Age: 42

Lives in: Calgary, AB

Employer: Canadian Pacific Railway

CAA member since: 2003

Preferred method of snow travel: Tele-skis

Off-season pastimes: Mountain biking, road cycling and traveling around

Challenges facing the CAC:

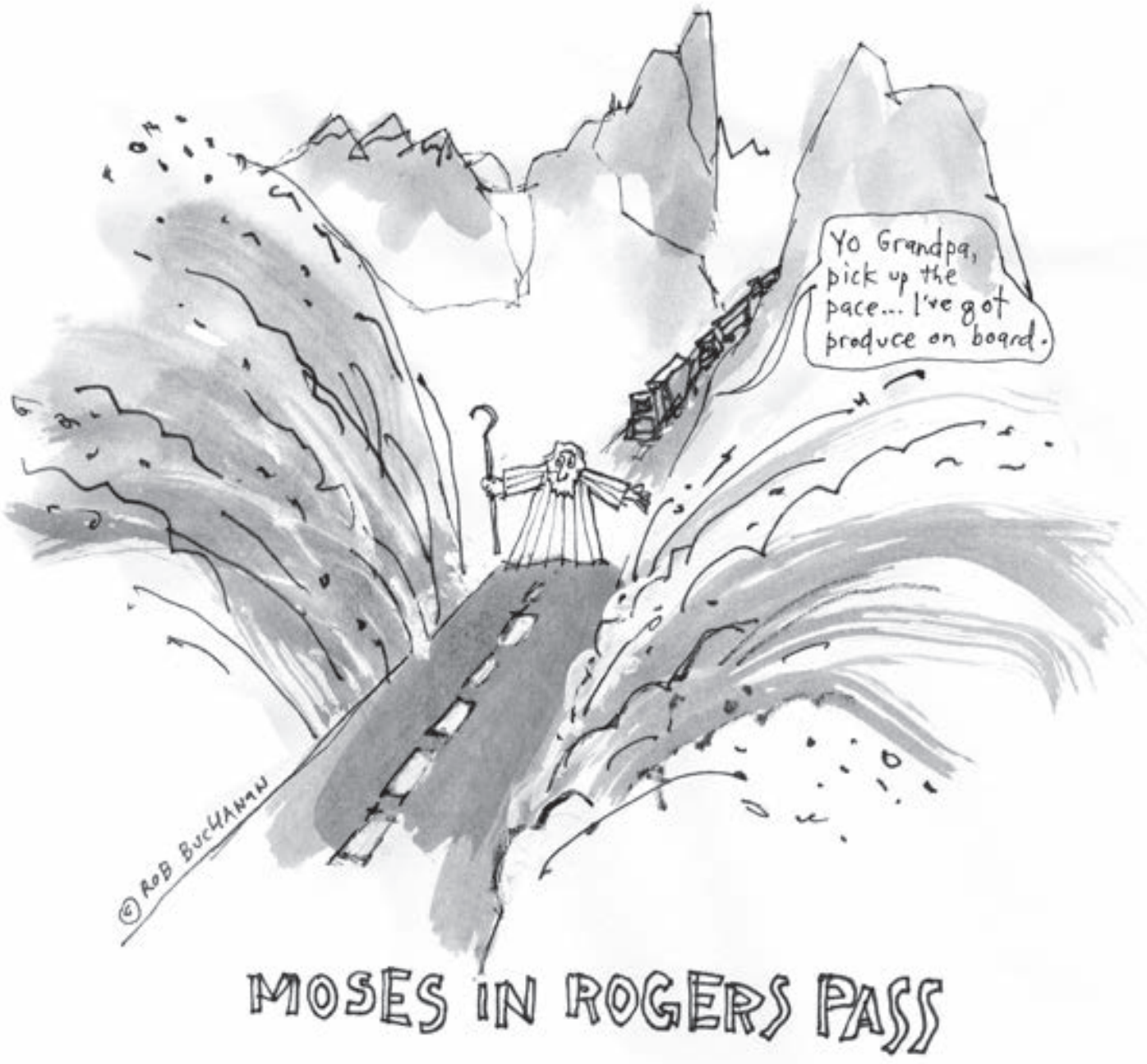
Clarifying the distinction between the CAA and the CAC. Building credibility for the CAC as "the" source for avalanche forecasting, awareness and public/non-professional education

Expectations/plans/visions for the future:

Build a large and strong non-professional membership base to:

1. More directly engage the public on awareness and education.
2. Be a real-time resource for new initiatives.
3. Solicit public support for key issues.
4. Expand the reach of fundraising initiatives.

Flakes
BY ROB BUCHANAN



Field Notes

Editor's note: *This document fell into our hands earlier this summer, just prior to a meeting of the CAA and CAC board members. The members were exchanging some information about themselves as a way of getting to know each other a bit better. This bit of personal history may have told them more about their president than they expecting.*

Steve Blake
Unauthorized Biography:

Steve was born in a mud hut deep in the heart of the bayou of Louisiana. A rambunctious child, he found himself in trouble with the law at an early age. It was in his third consecutive stretch at a juvenile detention facility when he discovered his true passion, tennis. A natural, Steve quickly climbed the ranks of the correctional circuit taking on felons many years his senior. Following back-to-back top five finishes at the "Nationals," he was offered a scholarship through Michigan State University.

After a disappointing freshman year Steve dropped out of tennis completely to concentrate on his studies in astrophysics. But the road to astrophysical enlightenment was not all quarks and pulsars. Disillusioned, Steve found himself wandering northern Africa with a ramshackle band of Bedouin punk rockers. Under Steve's firm but compassionate direction the group was able to focus their collective musical genius and their debut album went multi-platinum during its first week of release.

Tired from the rigours of the road, Steve turned his focus inward. For the next several months he spent his days meditating and guiding fly fishing in a small community in the Ural Mountains in the Union Formerly Known as Soviet. A Nobel Prize winner and standing Past-President of the Book of the Month Club, Steve is currently in hiding with a price on his head.

SNOWMOBILE GUIDES

BC Commercial Snowmobile Operators Association (BCCSOA)

The BC Commercial Snowmobile Operators Association represents commercial snowmobile operations and guides throughout BC and Alberta. Our objective is to promote, unite and enhance professional commercial snowmobiling through guide training and development. We invite all qualified applicants who wish to explore this booming field of adventure tourism to apply for SNOWMOBILE GUIDING positions with a variety of operators including:

Great Canadian Snowmobile Tours – Revelstoke
Toby Creek Adventures – Invermere (Panorama)
Rocky Mountain Tours / Snowfarmers – Valemount
Whistler Heli-Sledder – Pemberton Ice Cap
Silverstar Adventures – Vernon (Silver Star)
Kinbasket Adventures / White N' Wild – Golden
Jasper Snowmobile Tours – Jasper
Awesome All Season Adventures – Banff

Job Descriptions

Lead Guides will act as trip leaders who are expected to coordinate trip logistics, provide leadership, safety, communication and interpretive skills

Qualifications:

- 80hr Advanced Wilderness First Aid or WCB Level 3
- If guiding in possible avalanche terrain – CAA Avalanche Operations Level 1 certification offered by the Canadian Avalanche Association. Course scheduled for Nov 25 – Dec 2, 2005 (8 days). Otherwise – a minimum of a Recreational Avalanche Course (2 days).
- Class 4 Drivers License
- Basic Mechanical Knowledge
- BCCSOA guide training – to be hosted November 18-20, 2005

Previous Guiding & or Snowmobiling Experience – an asset but not necessarily a pre-requisite

Assistant Guides will support the lead guide in duties outlined above.

Qualifications:

- 40hr Wilderness First Aid or WCB Level 1 with Transportation Endorsement
- If guiding in possible avalanche terrain – ARAC – to be hosted by the BCCSOA. Otherwise – a minimum of a RAC.
- Class 4 Drivers License
- BCCSOA guide training – to be hosted November 18-20, 2005

Basic mechanical knowledge, previous guiding & or snowmobiling experience – an asset but not necessarily a pre-requisite

Photo Ray Mason

Qualified applicants are asked to submit resumes and cover letter to Amber Wood by e-mail only. info@bccsoa.com

BCCSOA
Box 9234
Revelstoke, BC
V0E 2E0 info@bccsoa.com

Final Focus

Photo Lori Zacaruk

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ZA Le Bresson 38660 LE TOUVET - FRANCE Tél : 33.(0)4.76.92.33.00 - Fax : 33.(0)4.76.92.33.09
http://www.gaz-ex.com