

THE BACKCOUNTRY AVALANCHE ADVISORY:  
DESIGN AND IMPLEMENTATION OF A NEW PUBLIC AVALANCHE WARNING SYSTEM IN CANADA

Grant Statham<sup>1\*</sup> and Alan Jones<sup>2</sup>

<sup>1</sup>Parks Canada Agency (PCA), Banff, Alberta

<sup>2</sup>Canadian Avalanche Centre (CAC), Revelstoke, British Columbia

**ABSTRACT:** Public avalanche forecasters continually search for ways of communicating sophisticated information in a comprehensible format. To accommodate this need among audiences with varying knowledge, Parks Canada (PC) and the Canadian Avalanche Centre (CAC) redesigned the Canadian public avalanche warning system. This system uses a layered approach to risk communication by providing different products aimed at specific audiences. This paper focuses on the development and implementation of Layer 1: the Backcountry Avalanche Advisory (BAA). The goal of this system is to embed avalanche awareness into the public mainstream, offering avalanche information to everyone regardless of their experience. The BAA is a four-level scale for communicating avalanche conditions using graphic icons and simple sentences. This system was designed to incorporate internationally recognized symbols and colors, together with concise and unchanging text messages that are easily understood. Product development included consultation with a broad range of industry experts, followed by extensive public focus group testing. This system was launched in January 2005 and made available to the public and media for all PC and CAC bulletin regions. Distribution is through a dedicated media portal where approved media outlets are given free, password access to an array of weather and warning products. Currently, BAA warnings are broadcast daily during the winter through radio, television and newspaper outlets in British Columbia and Alberta. All reporting regions in Western Canada produced a daily BAA during winter 2006. Widespread broadcast of avalanche information will have an important long-term effect on public understanding of avalanches. Frequent exposure through newspaper, radio and television will take avalanche awareness to a cultural level. Canadians will be well served through having avalanche information discussed in the public mainstream.

**KEYWORDS:** avalanche forecasting, risk communication, media, avalanche education

## 1. INTRODUCTION

The need to increase public awareness of snow avalanches in Canada is well recognized. Part of the role of public avalanche forecasters is to provide means to increase avalanche awareness, and forecasters are continually searching for ways to communicate sophisticated information in a comprehensible format. In 2004, Parks Canada undertook a project to restructure the methods used for communicating avalanche risk to National Park visitors. The project was founded upon recommendations contained within Parks Canada's Backcountry Avalanche Risk Review (O'Gorman et al, 2003), which offered some common themes:

- Develop risk communication strategies directed towards the "least aware"
- Produce layered information accommodating varying levels of experience

- Review the avalanche danger scale
- Develop icon based communication
- Promote partnerships with the media

Using these recommendations as guiding principles, PC approached the Canadian Avalanche Centre (CAC) to propose collaboration in the development of a four-level Backcountry Avalanche Advisory (BAA) system, to be delivered to the mainstream media through a dedicated portal. This paper describes the development, implementation and results of this project.

## 2. BACKGROUND

As a result of rising trends in recreational backcountry use (O'Gorman et al, 2003), Canadian public avalanche forecasters need to communicate with a new, broader spectrum of backcountry users. Growth in all sectors of the backcountry market has changed the demographics of backcountry use, with the mainstream realization of Canada as a premier winter alpine destination. Wintertime use of the Canadian backcountry is no longer the realm of a

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*Corresponding author address:* Grant Statham, Parks Canada Agency, Box 900, Banff, Alberta, Canada, T1L 1K2; Phone: 403 762 1568; E-mail: grant.statham@pc.gc.ca

specialized niche of experienced and skilled users; it is open to anyone with a pair of skis or snowmobile and a desire to travel on snow.

On February 1, 2003, 17 students from a Calgary area private school were engulfed in an avalanche in Glacier National Park – seven students died. In the following months, Parks Canada's Backcountry Avalanche Risk Review (O'Gorman et al, 2003) identified 36 recommendations Parks Canada should undertake to improve backcountry avalanche safety within National Parks.

Responding to these recommendations, PC and the CAC have developed a new method of communicating avalanche risks to a less sophisticated audience – in other words, the creation of a simplified layer of avalanche information (Layer 1). The premise is that by using more straightforward communication methods, the delivery of avalanche information can be greatly expanded through partnerships with the mass media.

### 2.1 The Canadian context

Canada has vast, sparsely populated mountain ranges. Multiplying the area of the Swiss Alps by ten gives an approximate geographic comparison for the mountains of southern British Columbia and Alberta. Relatively small public forecasting budgets are spread over this vast Canadian geography. Although regionally specific forecasting is improving, present forecasts represent broad geographic regions with substantial climate and snowpack variation within those regions.

Another simple but important observation of backcountry use is the willingness of Canadians to drive long distances. It is common for backcountry users to travel 4-6 hours for a weekend of recreation, and many people have the flexibility and willingness to access multiple locations (and snow climates) within a short period of time. If weather or snowpack conditions are not good in one region, Canadians will drive to another region for better conditions. This fact demonstrates the need to represent the "big picture" when communicating backcountry conditions to the general population.

Another important consideration in Canada, outside of national parks, is the extensive use of snowmobiles for travel and recreation.

Snowmobilers have the ability to access vast and remote avalanche terrain, and do so at faster speeds than human-powered backcountry recreationists. Different methods of communication must be used to reach snowmobilers, who are a very different demographic than the typical backcountry skier, snowboarder, snowshoer or climber.

Perhaps the most important reality of the Canadian situation is the existence of a well-developed commercial sector of avalanche professionals. This network is what populates much of the backcountry in winter, and provides the vital data for sustaining public avalanche bulletins outside national and provincial parks. It is critical that public avalanche information systems in Canada integrate seamlessly with the professional systems. Public and professional systems must support each other and work in harmony.

### 2.2 Media as an audience

Avalanche forecasters have learned (often the hard way), that mainstream media is very interested in avalanche related stories. Avalanches make interesting subject matter, and the human drama that unfolds in the aftermath of an accident resonates with the majority of Canadians safe in a warm home. Typically, avalanche professionals have viewed the mainstream media with skepticism, as the majority of coverage has been focused on sensational events. It is only in recent years that forecasters have begun forging partnerships with media outlets with the shared goal of broadcasting avalanche warnings.

It is clear that the media wants avalanche information, and so it is incumbent upon avalanche forecasters to use the power of the media to their advantage. Herein lies a classic dilemma: science vs. communication. Overly complicated, or extended text-based warnings will not capture the media in the long term. For sustainable relationships, the media needs timely, simple information that is easy to access, broadcast and understand. The time has come for the science of avalanche prediction to embrace the art of communication, and to place a greater emphasis on the need to translate technical information into terms that are appropriate for non-expert audiences (Leiss, 1999).

### 2.3 Societal comprehension

There are numerous examples of science-based material which is communicated to the public with success. An obvious example is forest fire hazard, which uses the Canadian Forest Fire Danger Rating System (CFFDRS). Just about everyone understands what fire hazard means, and when most people see the sign beside the road they understand it.

It is important to recognize the high degree of science behind forest fire danger ratings, and the broad scale at which these ratings are communicated to the public. Fire danger rating is the process of systematically evaluating and integrating the factors determining the ease of a fire starting and spreading, the difficulty of control, and the resulting impacts based on an assessment of ignition risk, the fire environment (fuels, weather, and topography) and elements at risk. (Canadian Forestry Service, 1987). The CFFDRS distils these complex variables into a standardized danger rating system which the public understands. This is where avalanche awareness needs to go, and this analogy suggests the level of comprehension required to take it there.

### 2.4 Building public trust

The notion of warning is entrenched in public avalanche forecasting and is the principal objective of the public avalanche forecaster. Provision of hazard information to assist the public in managing their risk is analogous to the concepts of warning.

This can however be to the detriment of the avalanche forecaster. Public communication continually focused on precaution will eventually dull its audience. Recognition of good conditions, and positive encouragement to take advantage of those conditions is essential for building public trust. Walking the fine line between warning and encouragement is not easy, and is the mark of a seasoned avalanche forecaster. It should be the objective of all avalanche forecasters to move beyond a style of continuous warning, to acquire the experience to recognize good conditions, and the confidence to communicate this message to the public.

## 3. DEVELOPMENT

### 3.1 Layered structure for the public avalanche warning system

The principal objective of this project was the development of simplified public avalanche information; however the need for a continued offering of detailed public avalanche information was also recognized. Safe and informed backcountry use must be supported with technical details on the interaction between snow and terrain, as well as the requisite training and experience required for specific activities. Integrating advanced information with basic level warnings requires a layered approach.

Communication initiatives must identify target audiences. Blake (2004) suggested the existence of four unique backcountry user groups:

1. The Unaware
2. The Untrained Recreationist
3. The Trained Recreationist
4. Professionals

Each of these audiences has a different level of understanding of avalanche information, and hence requires different methods of risk communication. The corresponding layers of avalanche communication adopted by PC and the CAC can be summarized in the following categories:

- Layer 1 – icons, signal words, basic phrases, etc
- Layer 2 – public bulletins, terrain ratings, etc
- Layer 3 – specific weather and snowpack observations, etc
- Layer 4 – professional data information exchange

Information organized in this format attempts to match target audiences with information appropriate for their comprehension level. Layer 1 is the only “new” addition to the information currently offered in Canada, while the remaining three levels have been in existence for decades. Only the categorization of these levels can be considered new.

### 3.2 The hook – Layer 1 as enticement to learn more

One of the principal objectives of Layer 1 information is to entice the public to learn more about backcountry safety. Wherever possible,

Layer 1 information should be accompanied by directive statements such as: *For more detailed information go to [www.avalanche.ca](http://www.avalanche.ca).*

In other words, it would be irresponsible of avalanche forecasters to offer simplified information in Layer 1 and not provide an access route to more detailed information contained in Layer 2. This is a common technique used in the communication of weather forecasts, whereby icon summaries include footers directing the public to more detailed information.

### 3.3 The backcountry avalanche advisory

Figure 1 shows the four-level BAA scale developed as the system for Layer 1 avalanche warnings. This system is intended to nest with the current 5-level Avalanche Danger Scale (CAA 2002), which will continue to be used in Layer 2. The BAA is not intended to replace the Avalanche Danger Scale, and in fact communicates a different message. The primary objective of Layer 1 information is to alert the public to the general avalanche conditions, which the BAA accomplishes by communicating on a broad (mountain range) scale.

*Green, yellow and red* are colors associated with the corresponding actions *go, caution and stop* (Conger, 2004). This colour scheme is universally understood by society and, in the context of recreational use of avalanche terrain, is the ultimate product of processing many variables, regardless of the system used or skill of the user. All users of avalanche terrain, from professionals to amateurs, realize an ultimate decision point at some time in their day – yes, no or maybe. When the decision stands at “maybe”, people need to gather more information to facilitate the decision.

### 3.4 Design considerations

Avalanche forecasters, communication specialists and a commercial artist designed the BAA icons. Symbols were chosen for their international recognition, to cross language barriers and to facilitate black and white publication.

Text was pared down to the minimum possible for communicating the message, signal words were selected after lengthy debate and the consideration of over 30 possible choices, and the headers were designed to categorize the information and describe the target audience.





Avalanche Conditions	Travel Advice	Guidance for Amateur Recreation
 <b>Good</b>	<b>Normal Caution</b>	Avalanches are infrequent but possible. Appropriate conditions for informed backcountry travel.
 <b>Serious</b>	<b>Extra Caution</b>	Avalanches will occur with human and other triggers. Avalanche training and experience are essential for safe backcountry travel.
 <b>Poor</b>	<b>Not Recommended</b>	Avalanches are occurring frequently. Inappropriate conditions for backcountry travel without extensive avalanche training and experience.
 <b>Variable</b>	<b>Extra Caution</b>	Conditions change from good with frozen snow to poor with melted snow. Avalanche training and experience are essential to monitor conditions for safe travel.
For more details: <a href="http://www.avalanche.ca">www.avalanche.ca</a> or 1 800 667 1105 Users of this information assume their own risk		

Figure 1 – The Backcountry Avalanche Advisory

Focus testing was conducted among various user groups, including snowmobilers, skiers and the general public. The aim was to understand comprehension and perceptions of the various messages and to provide the final (and most important) filter prior to publication. In total, fifteen drafts were produced in English and nine in French before the final version was reached.

An important lesson learned from this exercise was the wide variation in perception. Language perception is inherently individualistic, and ultimately there is no “perfect” word for describing a specific avalanche condition. This was apparent in both English and French, where identical perception issues presented themselves, despite different languages and different words.

### 3.5 Determining a BAA rating

Although the BAA communicates a different message than the Avalanche Danger Scale, the danger scale is an essential background tool that avalanche forecasters will use when producing the BAA. The public will not see references to the danger scale in Layer 1 information, even though it is the invisible background. BAA ratings default from the highest danger rating of the three-elevation band warnings presently given in Canadian Layer 2 bulletins.

When considering this method of defaulting from the highest of the three danger ratings, it is important to analyse the historical distribution of the highest danger rating applied for each bulletin (Figure 2).

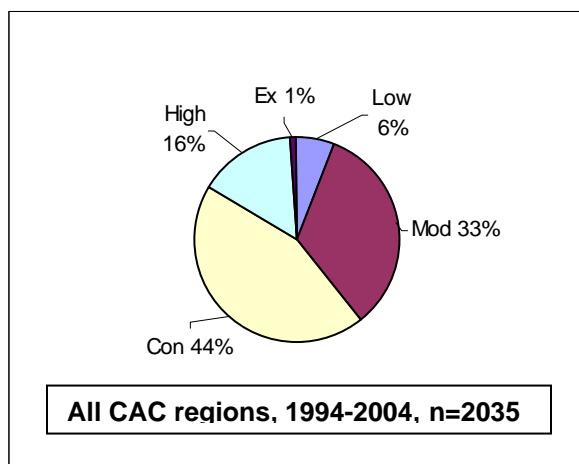


Figure 2 – Distribution of highest danger ratings (Jones, 2004)

Figure 2 shows that if a five-level (danger scale) system were used in Canada for Layer 1, the default to *Low* would occur less than 6% of the days, while the default to *Extreme* would happen only 1% of the days. The remainder of the days, or 93%, would default to one of three main danger ratings: *Moderate*, *Considerable* and *High*. On closer inspection of the data for danger rated as *Low*, the number could be reduced to 4% when specific warnings documented in the text are taken into account. Based on these results, it was decided that the five-level danger scale rating could be combined into a three-level BAA scale as shown in Figure 3. Using this combined, 3-level scale, the resulting distribution of BAA levels is: *Good* (39%), *Serious* (44%), and *Poor* (17%). This illustrates that there will be a reasonably good distribution of BAA ratings, and that the BAA rating will not sit unchanged at *Serious* (yellow) for weeks.

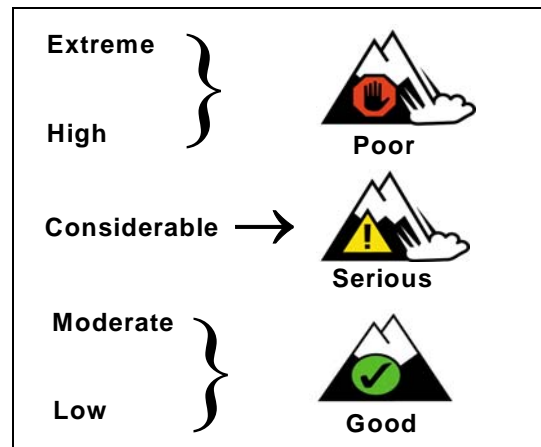


Figure 3 – Danger Scale (Layer 2) translation to the BAA (Layer 1)

These default levels are not automated and inflexible, but are determined by the avalanche forecaster, who may choose to override the default rule in particular situations. The most likely condition for this to occur is under *Moderate* danger with a persistent instability in the snowpack, whereby the forecaster may choose to maintain a *Serious* (yellow) BAA rating.

### 3.6 Moderate danger and good conditions

The difficult question of whether to publish *Good* conditions when the public avalanche bulletin danger rating is *Moderate* must be addressed. Anecdotally and statistically, Canadian avalanche forecasters rarely rate below *Moderate*. Figure 2 shows that the danger scale rating of *Low* is

applied to all elevation bands less than 6% of days. It is authors' opinion that the majority of the informed public in Canada, and indeed the forecasters themselves, interpret the rating of *Moderate* to mean that conditions are generally stable, with isolated pockets of instability.

One consequence of applying *Moderate* when the conditions are generally stable can be observed by reviewing the danger scale ratings applied in bulletins to avalanche fatalities. Green et al. (2006) showed the distribution of fatalities under *Moderate* to be 29% in Switzerland, 26% in the United States, and 7% in Canada.

Clearly the Canadian situation is different than in either Switzerland or the United States. One possible explanation is the persistence of buried instabilities in the Canadian snowpack, a frequent and dangerous condition when the danger rating may not drop below *Considerable* for an extended period. Another possible explanation could be cultural, and it would not be unexpected if a Canadian forecaster applied a more conservative rating than a Swiss forecaster.

The reality is that in Canada the danger scale rating of *Moderate* means that conditions are generally stable, and relatively few fatal accidents are likely to occur. In the interests of simplifying public communication on a broad scale, facilitating distribution through the media, and building public trust, joining *Low* and *Moderate* into a combined Layer 1 rating of *Good* (green) is merited.

### 3.7 Variable avalanche conditions

One problem when defaulting the BAA with the highest danger rating from the three elevation zones is the inability of any one danger rating to clearly express important short-term changes in conditions. An important example of this situation is during melt-freeze cycles, whereby the upper snowpack may be frozen solid early in the day with the corresponding *Low* danger rating. As the day advances and the temperature rises, the upper snowpack melts and becomes unstable, potentially resulting in a *High* danger rating by the afternoon. Analysis of historic avalanche ratings indicates a common use of footnotes and text to describe this situation.

For this condition, the BAA offers a fourth level called *Variable*, a specific warning level designed to accommodate melt-freeze cycles. Forecasters do not default from the danger scale rating under

this situation, but apply the rating of *Variable* independent of any danger scale defaults.

## 4. IMPLEMENTATION

From November to April, all regional forecast centres in Western Canada deliver BAA warnings to the CAC hub via a web entry form and an eXtensible Markup Language (XML) file transfer process. At 1600 (PST) each day, an automated process compiles these files and transfers one bundled XML file of BAA warnings from the CAC to a media portal.

### 4.1 Media portal

A media portal is a password-accessed web site where approved media outlets can easily obtain information tailored for their needs. The Meteorological Service of Canada (MSC) maintains a portal for distributing weather information to the media and has partnered with the CAC to deliver avalanche warnings using this outlet. This is critical support for the BAA, as typically it takes years to establish relationships with media and promote the use of new products. Coupling avalanche information with weather products in one easily accessible location is a logical step towards marketing new avalanche warning products to the media.

Data transferred from the CAC is converted at the MSC site into Adobe Acrobat files that can be viewed and downloaded by media. Figure 4 shows the media portal presentation, offering warnings for the next 24-hour period (0 to 24 hours), and the following day (24 to 48 hours). Media generally receive this information in the evening for immediate publication. Warnings are available in both English and French.



South Coast <small>[get PDF]</small>			
Forecast Valid Date	Guidance for Amateur Recreation	Travel Advice	Avalanche Conditions
2006-4-20	 Serious	Extra Caution	Avalanches will occur with human and other triggers. Avalanche training and experience are essential for safe backcountry travel.
2006-4-21	 Serious	Extra Caution	Avalanches will occur with human and other triggers. Avalanche training and experience are essential for safe backcountry travel.
For more details: <a href="http://www.avalanche.ca">www.avalanche.ca</a> or 1 800 667 1105 Users of this information assume their own risk			

Figure 4 – MSC media portal presentation

### 4.2 Website

The CAC offers one-stop shopping for all Canadian avalanche warnings through its website,

[www.avalanche.ca](http://www.avalanche.ca). The BAA is used to demonstrate the big picture of avalanche conditions throughout Western Canada. Scrolling over a particular region will highlight the BAA warning for that area; clicking on this region will take viewers to the Layer 2 public avalanche bulletin.

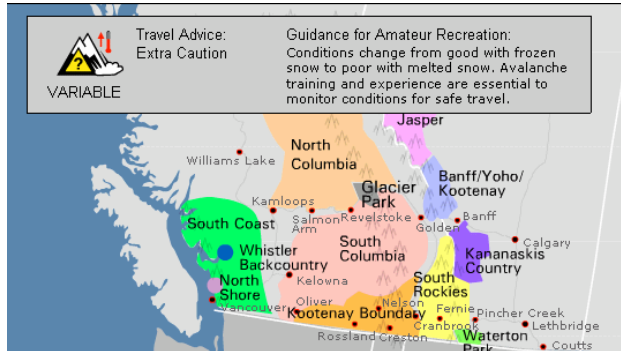


Figure 5 – BAA viewed through a mouse rollover on [www.avalanche.ca](http://www.avalanche.ca)

#### 4.3 Print, television and radio media

Various newspaper media have begun publishing BAA warnings, including the Edmonton Sun and Vancouver Province. The Vancouver Province weekly readership is 862,700 (NADbank, 2005) throughout British Columbia. Figure 6 shows their daily presentation style.

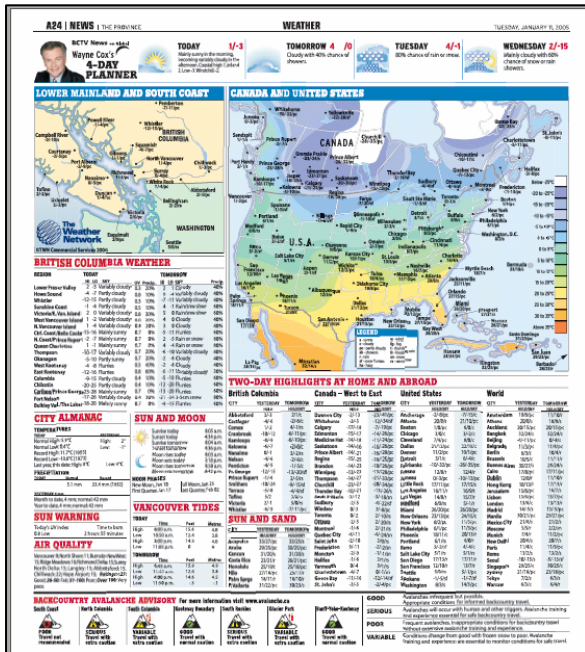


Figure 6 – BAA published daily in the Vancouver Province (across the bottom of the page)

To date, only one television outlet is broadcasting BAA warnings. CFCN television reaches the Calgary market and typically broadcasts avalanche warnings prior to weekends.



Figure 7 – CFCN Calgary television

106.5 Mountain FM accesses the Banff market and couples BAA warnings with their ski report, which is broadcast fifteen times per day through the ski season. A typical sound bite is “Avalanche conditions are rated as Good in Banff Park and Serious in Kananaskis Country. Visit [www.avalanche.ca](http://www.avalanche.ca) for more information”.

#### 5. CONCLUSION

The BAA warning system offers a simplified method of communicating broad scale avalanche conditions to the media and general public. It prioritizes messaging by distilling avalanche bulletins into short, effective symbols and sound bites, and aims to increase public awareness of snow avalanches to all Canadians and our visitors.

The BAA warning system was a grass roots initiative, beginning with a survey of field workers, becoming part of an independent review, and ultimately reaching implementation through this project. Feedback from the public, media, and professionals has been generally positive. Challenges remain in the continued marketing of this system to the media, which will be an ongoing process requiring continued monitoring and innovation.

The communication potential offered through an evolving and dynamic media portal is powerful; however educating and sustaining the long-term attention of the media remains a challenge. In the fast paced world of news media, ensuring long-

term publication of avalanche warnings will remain a substantial challenge against competing interests, deadlines and space/time restrictions.

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## 7. REFERENCES

- Blake, S. 2004. Considering Considerable and Other Considerations. Proceedings of the 2004 International Snow Science Workshop in Jackson Hole, Wyoming. USDA Forest Service, Fort Collins, CO. p.470-475
- Bruns, W. 2004. Avalanche Safety in the Public Domain. Canadian Avalanche Association Avalanche News. Volume 69. Page 18.
- Canadian Avalanche Association. 2002. Observation Guidelines and Recording Standards for Weather, Snowpack and Avalanches. Canadian Avalanche Association, Revelstoke, B.C.
- Canadian Forestry Service, 1987. Canadian Forest Fire Danger Rating System – A Users’ Guide. Three ring binder (unnumbered publication).
- Cloutier, R. 2003. British Columbia Public Avalanche Safety Program Review. Report prepared for the British Columbia Solicitor General by Bhudak Consultants Ltd.
- Cloutier, R. 2003. Review of the Strathcona-Tweedsmuir Outdoor Education Program. Report prepared for Strathcona Tweedsmuir School by Bhudak Consultants Ltd.
- Conger, S. 2004. A review of colour cartography in avalanche danger visualization.
- Proceedings of the 2004 International Snow Science Workshop in Jackson Hole, Wyoming. USDA Forest Service, Fort Collins, CO. p.477-482.
- Greene, E., T. Wiesinger, K. Birkeland, A. Jones, G. Statham. 2006. Fatal Avalanche Accidents and Forecasted Danger Levels: Patterns in North America and Switzerland. Proceedings of the 2006 International Snow Science Workshop. Telluride, CO (In Press).
- Jones, A. 2004. Public bulletin and fatality statistics. Presented at the May 2004 meetings of the Canadian Avalanche Association (unpublished).
- Leiss, W. 1999. The Importance of Risk Communication. Newsletter of the International Council on Metals and the Environment. Volume 7, No. 2.
- Newspaper Audience Databank. 2005. Weekly readership by resident market. [www.nadbank.com](http://www.nadbank.com)
- O’Gorman, D., P. Hein, W. Leiss. 2003. Parks Canada’s Backcountry Avalanche Risk Review. Parks Canada Agency. Banff, A.B., Canada.
- Wogalter, M.S., D. M. DeJoy. K. R. Haughery. 1999. Warnings and Risk Communication. Taylor and Francis. 365 p.