THE AVALUATOR – A CANADIAN RULE-BASED AVALANCHE DECISION SUPPORT TOOL FOR AMATEUR RECREATIONISTS

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ABSTRACT: An exceptionally high number of avalanche fatalities during the winter of 2003 forced the Canadian avalanche community to question the effectiveness of existing public avalanche safety programs in Canada. In response to the recommendations of several avalanche safety reviews, the Canadian Avalanche Association launched the ADFAR (Avalanche Decision Framework for Amateur Recreationists) Project for the development of a practical, science-based decision framework for amateur recreationists when planning for, or traveling in avalanche terrain. The goal of the project was to reduce recreational avalanche fatalities by improving risk communication and risk awareness among the fast growing number of winter backcountry enthusiasts in Canada.

The Avaluator is a new rule-based decision support tool for amateur recreationists, including backcountry skiers and snowboarders, snowmobile riders and out-of-bounds skiers and snowboarders. A key part of the Avaluator is a pocket card that assists with planning backcountry trips and facilitates field decisions. The paper provides an overview of the ADFAR project, describes the usage of the Avaluator and discusses the underlying design principles.

KEYWORDS: Avalanche Education, Risk Management, Decision-Making, Decision Support Tool

1. INTRODUCTION

The winter of 2003 is remembered as one of the deadliest winters for recreationists in Western Canada. The avalanche conditions of that winter were dominated by a persistent instability that developed in November and remained a serious concern for the entire winter. By the end of the season, 29 people had died in avalanches in Western Canada, which was almost twice the long-term average of 15 avalanche fatalities per winter. The tragic events of the winter suddenly made avalanche safety a topic of public interest in Canada and forced the Canadian avalanche community to question the effectiveness of the existing public avalanche safety programs. In response to the events, Parks Canada (O'Gorman et al., 2003) and the provincial government of British Columbia (Bhudak, 2003) commissioned major reviews to identify possible improvements to avalanche safety on federal and provincial

lands in Western Canada.

At that time, the avalanche awareness curriculum in Canada was primarily based on the premise that amateurs could use a simplified version of the knowledge-based approach that professionals use when assessing travel conditions in avalanche terrain. However, amateurs often lack the necessary practical experience to properly apply the theoretical avalanche knowledge. In order to address this issue, the Parks Canada review (O'Gorman et al., 2003) suggested the development of a practical, science-based decision framework for amateur winter recreationists as a major component for future avalanche safety improvements in Canada.

Over the previous decade, a number of rule-based decision methods had been developed for backcountry recreationists. They included the Reduction Method (Munter, 1992; 1997; 2003), the Stop-or-Go Method (Larcher, 1999; 2000), the SnowCard (Engler and Mersch, 2000; Engler, 2001), the NivoTest (Bolognesi, 2000), and the Obvious Clues Method (McCammon, 2000; 2002). With the exception of the Obvious Clues Method, all of these methods were developed in Europe, where

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Table 1: ADFAR related research project

i) Review of best practices
- Review of existing rule-based decision methods (McCammon and Haegeli, 2005; 2006a)

ii) Understanding of target audiences
- Study on the motivations, perceptions and current decision preference of the three ADFAR target audiences (Longland et al., 2005; Haegeli et al., in prep.)
- Estimation of non-commercial backcountry use trends in Western Canada (Haegeli, 2005)
- Estimation of average exposure of amateur backcountry skiers and snowboarders to various types of avalanche terrain in Western Canada (Haegeli, in prep.)

iii) Analysis of accident patterns
- Analysis of non-commercial recreational avalanche accident data from Canada and the United States for the development of the Avaluator (McCammon and Haegeli, 2006b)

iv) Snow science related projects
- Verification of danger ratings of some Canadian avalanche bulletins (Jamieson et al., 2006a)
- Assessment of predictive merit of snowpack observations on amateur decision-making (Jamieson et al. 2006b)

they have been widely promoted. While the impact of these methods on avalanche accident prevention remains unclear, the new approaches had clearly provided a new perspective and significant impetus for improved avalanche safety education.

However, there are considerable differences in backcountry activities and public avalanche warning systems between Canada and Europe. Canada has much larger forecast areas for public avalanche bulletins, a full range of snow and avalanche climates and greater popularity of snowmobile riding. All these differences precluded the direct application of an existing rules-based decision method. In order to address these issues, the Canadian Avalanche Association launched the ADFAR (Avalanche Decision Framework for Amateur Recreationists) project in the spring of 2004 with funding from the National Search and Rescue Secretariat. The goal of this three-year project was to comprehensively examine avalanche accident patterns in Canada and develop effective risk communication strategies for the recreational backcountry user groups most at risk based on best practices and vigorous science.

The goal of this paper is to give a brief overview of the ADFAR project and to introduce the Avaluator, the Canadian rule-based avalanche decision support tool. While the paper contains a detailed description of how to use the Avaluator, the primary focus is to explain the underlying design principles.

2. ADFAR PROJECT OVERVIEW

To produce the background material necessary for the design of a Canadian rule-based avalanche decision support tool, the ADFAR project included a number of research efforts.

While historic avalanche awareness initiatives primarily focused on snow science, the ADFAR project intended to address avalanche accident prevention more comprehensively. The related projects can be grouped into the four objectives (i) review of best practices, (ii) understanding of target audiences, (iii) analysis of accident patterns, and (iv) snow science related projects. It is beyond the scope of this paper to discuss each of the research projects in detail, but Table 1 provides an overview and reference for the interested reader.

3. FUNDAMENTAL DESIGN PRINCIPLES

In this section we will describe some of the fundamental principles that were used for the design of the Avaluator. These concepts provide the theoretical context for the decision support tool and explain how it interfaces with other avalanche awareness approaches.

3.1 Target audiences

The primary target audiences of the ADFAR project are (i) backcountry skiers and snowboarders, (ii) snowmobile riders, (iii) and out-of-bounds skiers and snowboarders. Even though research has shown that there are considerable differences among the decision processes of these three activities (Haegeli et al., in prep.), it is important for the credibility and acceptance of the Avaluator to design to a tool that can be used by all three target audiences. Multiple tools could create confusion since many users partake in several of the targeted activities.

A successful, all-inclusive decision tool should therefore be adaptable and fit into the decision procedures of the various activities. To do so, it cannot require any skills that are completely foreign or unreasonable for one of the activi-

ties. As an example, Haegeli at al. (in prep.) show that while the use of maps is very common in backcountry skiing (75% of all parties interviewed had maps), it is not possible to generalize this assumption as only 8%of snowmobile and 10% of out-of-bounds groups were carrying maps when interviewed.

3.2 Decision-making focus

While traditional avalanche awareness education primarily focused on teaching facts and skills about individual aspects of avalanche risk mitigation (e.g., snow science, terrain, rescue), the goal of the Avaluator is to provide a framework that brings these components together and produce well-defined decision situations. Decision-making in avalanche terrain has been described as a sequential process where the travel decision is constantly re-evaluated as new information becomes available at smaller scales (McClung, 2002a). It is important that a decision support system raises the awareness of scale issues in avalanche hazard assessment (Haegeli and McClung, 2004) and promotes the iterative decision process.

3.3 Levels of Mastery

Blake (2004) suggested that backcountry users can be grouped into four classes according to their awareness, knowledge and experience with respect to avalanche hazard. The groups have been labeled 'Unaware,' 'Untrained Recreationists,' 'Trained Recreationists' and 'Professionals.' This classification loosely follows the concept of stages of mastery from novice to expert proposed by Dreyfus and Dreyfus (1986). As individuals advance through the different stages, their decision methods become more refined. Research in decision support has shown that while knowledge-based methods work well for experienced decision-makers, rule-based methods are more appropriate for novice users (see, e.g., Gonzalez, 2004). This model suggests that effective avalanche awareness programs should follow a tiered approach with different decision tools for users of different experience levels. However, a continuum between these tools is required to encourage a natural progression through the stages of mastery.

In 2005, the backcountry avalanche advisory (BAA; Statham and Jones, 2006) was introduced as a simple communication tool to raise the awareness of the general public about

avalanche conditions. This initiative represents the first layer of a tiered approach to avalanche education. The BBA uses basic recommendations, such as 'Normal Caution', 'Extra Caution' and 'Not Recommended' to provide its generally unaware audience with very specific behavioral guidance about backcountry travel.

The ADFAR project and the Avaluator are primarily aimed at the next level of comprehension, which includes 'Untrained Recreationists' and 'Trained Recreationists' with only limited experience. Recreationists within these categories are generally aware of avalanche hazards and more advanced users might have a basic understanding of avalanches. Important concepts to introduce at this level are (i) What are right questions to ask? (ii) What are important pieces of information? and (iii) How do they fit together? This guidance will allow users to become familiar with basic risk management concepts and to gain practical experience in the field more easily. Klein (1998) points out that practical experience is a much more effective way to foster true expertise than traditional knowledge-focused approaches. As users improve their understanding through practical experience, the rule-based decision method can slowly be replaced by a richer knowledge-based system that allows for more subtle decision-making. It is therefore crucially important that a rule-based decision tool is integrated in an overall avalanche awareness curriculum that continuously encourages users to develop their skills further and strive for expertise. This is a significant departure from the approach promoted by Munter (1997), where the Reduction Method is suggested as a method for double-checking knowledge-based decisions.

3.4 Decision metric

Providing a well-defined decision situation includes a decision metric, which allows users to compare alternatives and make choices based on personal criteria. The most intuitive decision metric for decisions related to traveling in avalanche terrain is the risk of triggering an avalanche, getting seriously injured or killed in an accident. However, since it has proven to be difficult to collect reasonably accurate exposure data for backcountry travel (Haegeli, in prep.), it is very challenging to calculate meaningful risk related metrics for backcountry travel.

In place of risk, historic prevention value (McCammon and Haegeli, 2006b) has been adopted as the decision metric for the Avaluator. It represents the percentage of past accidents that could have been prevented if the accident parties had followed a specific decision guideline. To produce the most meaningful prevention value, the analysis of McCammon and Haegeli (2006b) focused only on incidents with potentially serious outcomes, i.e., accidentally or remotely triggered avalanches of size 2 or larger (CAA, 1995) or involvements that resulted in injuries or fatalities.

The move to prevention value as the decision metric has important consequences for the interpretation of the resulting recommendations. While risk-based decision tools can be used as predictive tools, decision tools based on prevention values do not have any predictive capabilities. In other words, users cannot reliably use these tools to predict if a specific slope will likely avalanche or if an accident will occur. Instead, the decision tools provide the user with a measure of often the current conditions have been observed in past accidents. This means that the Avaluator is primarily an awareness tool rather than a predictive tool. This is an important distinction from existing tools, which have often been falsely promoted as having predictive capabilities.

3.4 Decision responsibility

The Reduction Method provides the user with a definite decision by requiring the residual risk ratio (danger potential divided by reduction factors) to be equal to or less than 1 (Munter, 2003). However, such decision thresholds are highly personal and depend on various factors including current conditions, personal skills and personality traits such as risk propensity. Longland et al. (2005) have shown that there are significant differences in risk propensities among the target groups of the ADFAR project. Preset decision thresholds would most likely result in low acceptance of the Avaluator in backcountry user groups with high risk propensities. This would unnecessarily undermine the other benefits of the promoted decision approach in target audiences, where guidance is particularly needed.

Instead of presenting the user with a decision, the Avaluator aims at providing the user with a framework to make a well-informed decision based on relevant information. The prevention value is used as the objective decision metric and users have to decide for themselves what level of prevention value they feel comfortable with. The responsibility for making the decision is therefore fully in the hands of the user. However, this does not preclude the possibility for avalanche experts to include recommendations for reasonable decisions in the decision tool. This is particularly important for users with very limited experience.

McClung (2002b) proposes that the decision outcomes in applied avalanche forecasting generally to fall into one of three categories: (i) 'Go,' (ii) seek more relevant information to resolve uncertainty, and (iii) 'No go.' The equivalent decision recommendations for an awareness tool are: (i) Proceed with 'Normal Caution;' (ii) use 'Extra Caution' as additional knowledge and experience is required to manage the present avalanche hazard; and (iii) backcountry travel 'Not Recommended.' This reference to knowledge and experience should encourage users to continuously seek further training.

3.6 External limitations

There are also a number of external constraints for the design of a Canadian decision tool, which are particularly important when comparing to European decision frameworks.

In Western Canada, forecast regions of public bulletins vary widely in area ranging from approximately 100 km^2 to about 30,000 km^2 and bulletins are published between three and seven times a week. Bulletin regions in Europe are significantly smaller and bulletins are generally posted daily. For Canada, Jamieson et al. (2006a) showed that locally verified danger ratings agreed with the regional danger ratings posted in the bulletin in approximately 57 to 64 percent. This percentage was generally higher for smaller forecast areas and large-scale regional danger ratings tended to be more conservative. With the exception of the NivoTest (Bolognesi, 2000), all European decision frameworks use danger ratings as one of the primary input parameters for the decision process. The observations of Jamieson et al. (2006) show that in Canada, danger ratings should primarily be used for large-scale assessments. Any decision support system for slope assessments needs to have a mechanism to locally verify the bulletin danger rating.

An additional limitation that primarily affects the decision process at the trip planning stage is that the quality of Canadian maps does not compare to European map standards. While maps at the 1:25,000 scale are standard in Europe, the official topographic maps in Canada are published at a 1:50,000 scale. The larger map scale makes it more challenging to plan routes, identify key decision points and characterize them in detail.

4. AVALUATOR

The Avaluator (Haegeli and McCammon, 2006) is the new Canadian decision support tool for amateur recreationists who travel in avalanche terrain. It was developed based on the results of ADFAR research projects and the design principles described above. It consists of a decision card that is printed on waterproof synthetic paper and a 30 page companion booklet. The name 'Avaluator' is a combination of the words 'Avalanche' and 'Evaluator' to stress the importance of the continuous evaluation of avalanche conditions during backcountry travel.

While the Avaluator card (Fig. 1 and 2) is the central part of the Avaluator, the companion booklet provides the user with important context and background material on decision-making and risk management. The Avaluator is intended to supplement existing avalanche awareness literature as it does not contain any snow science information.

Risk management on a backcountry trip is broken up into a sequence of four distinct steps: (i) trip planning at home, (ii) recognizing avalanche terrain, (iii) slope evaluation, and (iv) good travel habits. This structure is used to demonstrate the importance of progressive and iterative risk management in avalanche terrain. The sequence loosely follows the well-established 3x3 formula (Munter, 1992; 1997; 2003), which has proven to be an excellent conceptual teaching and planning tool. However, direct application of such sequential strategies in decision-making requires considerable experience as it does not contain any additional decision guidance, such as rules about prioritizing observations or decision criteria (McCammon, 2005). While the Avaluator Card only provides specific decision guidelines for trip planning and slope evaluation, the booklet also contains basic recommendations on the other two decision steps. In addition, the booklet contains background material on avalanche rescue, avalanche danger rating scale, avalanche terrain exposure scale, gear checklists and refers to important information resources on mountain conditions.

The following paragraphs explain the various steps of the Avaluator avalanche risk management approach in detail.
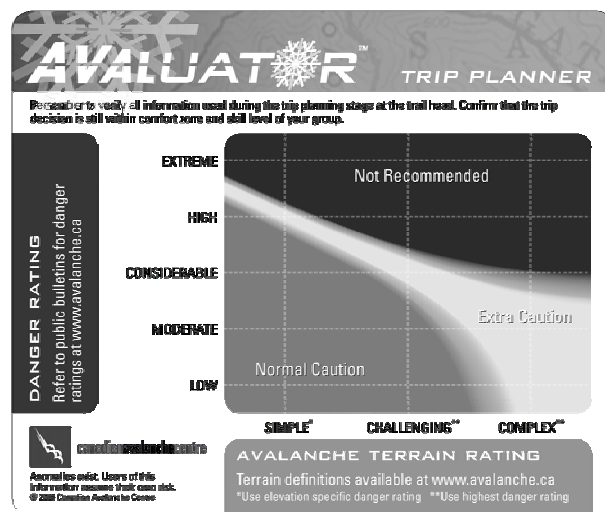

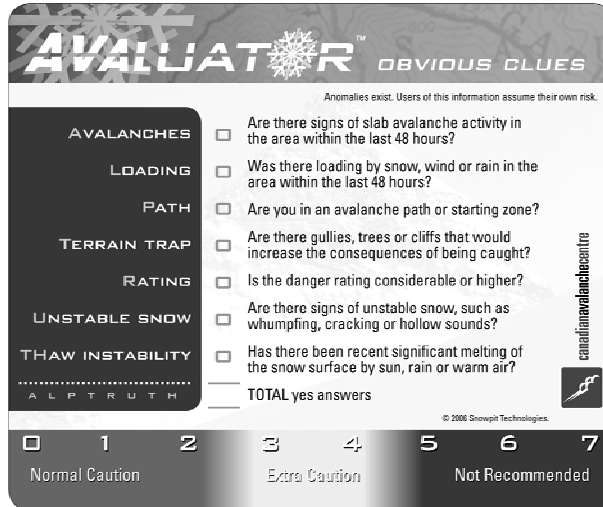Figure 1: Grey-scale rendering of Avaluator trip planning tool.

Figure 2: Grey-scale rendering of Avaluator slope evaluation tool: Obvious clues.

4.1 Trip planning

Trip planning is an important first step in avalanche risk management. The goal of this step is to select a backcountry trip that is appropriate for the current snow and avalanche conditions. The most common information sources used in this step are the avalanche bulletin, a weather forecast and terrain information from maps, guide books, brochures or personal knowledge.

A study on recreational decision-making (Longland et al., 2005; Haegeli et al., in prep.) showed that recreationists primarily use the bulletin danger rating to decide whether they go out or stay at home. However, once they have made their go decision, it is the type of trip that is the main factor for choosing among trip options. In other words, amateur recreationists do not seem to use terrain to gauge their exposure to avalanche hazard in a similar way that professionals do.

The chart on the front of the Avaluator card (Fig. 1) provides guidance for trip planning by combining snow and avalanche conditions (vertical axis) with the terrain of the intended backcountry trip (horizontal axis). The current snow and avalanche conditions are characterized with an avalanche danger rating and an Avalanche Terrain Exposure Scale (ATES; Statham et al., 2006) rating is used to comprehensively describe the terrain characteristics of the intended backcountry trip. Since it is standard in Canada to rate avalanche dan-

ger for all three elevation zones separately (alpine, treeline and below treeline), an auxiliary rule was designed to select the relevant danger rating. While it is sufficient to use the elevation specific danger rating in simple terrain, the highest danger rating has to be used for planning a trip in challenging or complex terrain. This rule is based on the idea that exposure to avalanche hazard is mostly confined to isolated slopes in simple terrain. Challenging and complex terrain are much more open and can be threatened by avalanches from multiple elevation zones.

While avalanche danger ratings have been used in avalanche risk communication for a long time, ATES trip ratings are a much more recent development and are less common. While most backcountry trips in the mountain national parks have been rated by Parks Canada (Parks Canada, 2005), the ADFAR project is currently rating the most popular trip destinations for all three target audiences outside the national parks in Western Canada. These ratings will be available on the website of the Canadian Avalanche Centre for the beginning of the winter season 2006/07. While this list will initially be limited, it is expected that ATES ratings will be adopted more widely in guidebooks and other reference materials in the near future (Statham et al., 2006).

The colors on the chart represent a consensus on travel recommendations for amateur recreationists from more than thirty avalanche experts in Canada. These professionals were

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asked to delineate the areas that correspond to the recommendations of 'Normal Caution,' 'Extra Caution' and 'Not Recommended'. The detailed definitions of these recommendations (Table 2) focus on the level of knowledge, skill and experience required to travel under these combinations of terrain and avalanche conditions. While backcountry travel under green conditions is regarded as generally safe for recreationists with limited experience, safe travel in the yellow area requires managing avalanche hazard at smaller scales and therefore considerably more training and experience. Backcountry travel in the red area is not recommended without professional guidance.

In essence, the chart represents a generalized 'run list', a tool commonly used in mechanized ski guiding for discussing the 'guide-ability' of specific terrain under given conditions. The graph shows the expert opinion that exposure to avalanche hazard can be lessened by choosing simpler terrain. A continuous representation was chosen to convey the continuous character of both rating scales. As the terrain becomes more complex, the need for managing the avalanche hazard at smaller scales increases. Color transitions are fuzzy to represent the probabilistic nature of avalanche hazard. However, intersection points between danger and terrain ratings (dashed lines) provide non-ambiguous guidance for users with limited experience.

It is rather surprising that historic frequencies of non-commercial avalanche accidents do not show any correlation between avalanche danger and terrain ratings (McCammon and Haegeli, 2006b). In other words, the peak of avalanche accidents occurs under considerable avalanche danger ratings regardless of the terrain rating of the trip. Most likely, this result is due to the coarseness of the danger and terrain ratings at the trip scale. Since accident frequencies are dominated by backcountry use, it can also be argued that this result confirms that recreationists do not use terrain to lessen their exposure to avalanche hazard as presented by Longland et al. (2005).

We argue that there is significant educational value in the trip planning chart despite the lack of correlation with historic accident data. Prevention values for the expert guidelines can still be calculated and provide useful background information for the user. The analysis of McCammon and Haegeli (2006b) shows that approximately 75% and 36% of all reported accidents could have been prevented if accident parties had limited their backcountry travels to the green or green and yellow areas combined respectively. The fact that the exact prevention value for the green and yellow area combined depends on snow climate and elevation zone further emphasizes the need for additional skill and experience to safely travel under these conditions.

4.2 Recognizing avalanche terrain

Recognizing avalanche terrain in the field is a crucial component of avalanche risk management. When backcountry travelers encounter avalanche terrain, they are faced with the critical decision whether to enter the terrain, go around it, or even go back. It is important that users of the Avaluator are made aware of these key decision points on their trips. If they decide to enter an avalanche path or its run-out, they must consciously accept the inherent risk and know that additional methods are needed for managing it. The Avaluator booklet provides a few simple guidelines for

Table 2: Travel recommendations for Avaluator trip planning chart

Recommendation	Description
Normal Caution (Green)	Accidents are generally infrequent. These conditions are appropriate for informed backcountry travel in avalanche terrain. Use NORMAL CAUTION. You should, however, always look out for isolated slabs and be especially careful if the avalanche bulletin mentions deep instabilities. Basic avalanche rescue skills are always appropriate when you travel in avalanche terrain.
Extra Caution (Yellow)	Accidents are more frequent and are likely to occur with human or natural triggers. Traveling under these conditions requires EXTRA CAUTION and advanced avalanche skills, including detailed trip planning, route-finding and navigation, stability evaluation, group management, rescue skills and wilderness first aid. You can learn these skills in avalanche and other courses, but practice and humility are essential.
Not Recommended (Red)	Conditions are primed for avalanche accidents. Even careful decisions can result in serious accidents. Since the margin of error is very small under red conditions, safe backcountry travel requires extremely careful planning and extensive experience. Backcountry travel under these conditions is NOT RECOMMENDED without professional-level safety systems and guidance.

recognizing avalanche terrain.

4.3 Slope evaluation tool

If people decide to enter avalanche terrain, they need a method to assess whether specific slopes are safe enough to cross. While slope evaluation requires years of training and experience, the Obvious Clue Method can help recreationists avoid situations that have lead to accidents in the past.

The back side of the Avaluator card (Fig. 2) presents a list of obvious clues to facilitate slope decisions. Detailed discussions on the origins of this method can be found in McCammon (2000, 2004) and McCammon and Haegeli (2005). The checklist can be used to keep track of danger signs during a backcountry trip. The number of clues that apply to a specific slope is a measure of how similar the conditions are to situations that have lead to accidents in the past.

The Obvious Clue Methods was chosen for the slope assessment method on the Avaluator for several reasons: (i) the method does not require any advanced skills; (ii) its performance has proven to be mostly independent of activity and snow climate; (iii) it is not highly dependent on an avalanche danger rating; and (iv) it performs well under low and moderate danger ratings (McCammon and Haegeli, 2006a; 2006b).

While the seven clues have been derived from historic accident data, they also provide a process-oriented view of avalanche hazard to the user. Following the pattern of the trip planning tool, the clues can be grouped into indicators for snow and avalanche conditions and terrain variables. The clues 'Avalanches,' 'Loading,' 'Unstable snow' and 'Thaw instability' provide indications about the local snow and avalanche conditions and can be used to locally verify the bulletin danger rating. The clues 'Path' and 'Terrain trap' describe the seriousness of the local terrain.

The decision-making study of Haegeli et al. (in prep.) shows that differences in snow quality seem to be much more important to amateur recreationists for the slope choice than differences in terrain variables and local observations. Raising the general awareness of these variables and their interactions will further facilitate the development of risk management expertise.

Similar to the chart on the front of the card, the back side of the Avaluator card shows a scale that presents travel recommendations in relation to the number of clues observed. In this case the thresholds for the recommendations are purely based on avalanche accident records from Canada and the United States (McCammon and Haegeli, 2006b). 'Normal Caution' is recommended for slopes with two or fewer clues, and would have prevented 90% of past accidents. Three and four clues ('Extra Caution' and prevention value of 47%) should alert users to consider their next steps carefully. Backcountry travel is 'Not Recommended' on slopes with five or more clues. These recommendations are more conservative than in case of the trip planner, since the margin of error is much smaller when making the final decision to enter a slope. To allow users to have full control and choose their own decision thresholds, prevention values are provided for all numbers of observed clues in the booklet. It is important to point out that while the prevention values for three or less clues have proven to be applicable most generally, the prevention value for higher numbers of clues becomes sensitive to snow climate, elevation and danger rating (McCammon and Haegeli, 2006b).

4.4 Good travel habits

The booklet provides the user with useful tips on route-finding (e.g., traveling on ridge crests, thinking of escape routes) and group management (e.g., only exposing one person if crossing a suspect slope, including everybody in the decision process). While the Avaluator does not address human factors explicitly, it is the intent that a well-structured decision process will make users less vulnerable to these influences. However, a more detailed discussion of human factors, such as heuristic traps (McCammon, 2004), should be part of any more advanced avalanche awareness training.

4.5 Overall performance of Avaluator

Used together, the methods of the Avaluator would have prevented the vast majority of reported accidents. Based on Canadian records, the most conservative configuration of the Avaluator (green-yellow boundaries for trip planning and slope evaluation) would have prevented up to 98% of historical avalanche accidents (McCammon and Haegeli, 2006b). The most permissive configuration (yellow-red boundaries) would have prevented approximately as many accidents as the German SnowCard (Engler and Mersch, 2000), which

is the highest-performing European decision aid in the comparison of McCammon and Haegeli (2006a). Above this level, actual prevention values vary with snow climate and elevation zone.

In order to use the Avaluator to its fullest potential, it is important to closely examine the characteristics of accidents that would not have been prevented by the decision recommendations. McCammon and Haegeli (2006b) show that these accidents primarily fall into the category of small isolated slabs. A much smaller, but often fatal, group of accidents that go undetected are related to deep persistent instabilities at moderate danger ratings. Alerting users to the characteristics of these accidents will not only improve the effectiveness of the Avaluator, but will also increase its educational value.

5. NEAR FUTURE

In today's world, marketing is a crucial component of a successful product. A marketing team is currently working on different strategies for the various target audiences.

Special attention is given to the out-of-bounds skier and snowboarder group. It is most likely the fastest growing backcountry user group in Canada (Haegeli, 2005) and has shown a notably higher risk propensity than the other user groups (Longland et al., 2005). A poster campaign focusing on the Obvious Clues might work best for their often spontaneous decision habits (Haegeli et al., in prep.).

The focus for the remainder of the project is on developing Avaluator teaching materials for introductory avalanche awareness courses. The Avaluator will also be included in the online avalanche course for first responders of the Canadian Avalanche Association (CAA, 2005).

6. CONCLUSIONS

This paper presented the Avaluator, a new Canadian decision support tool for amateur backcountry enthusiasts. The Avaluator is based on Canadian and U.S. avalanche accident data, social science including the risk propensity of target audiences in Canada, an element of expert opinion, and other research and background information specific to Canada that has been developed over the past two and a half years at a cost exceeding $600,000 by project end in March 2007.

The focus of the Avaluator is the decision-making process when planning for or traveling in the backcountry. After the backcountry avalanche advisory system (Statham, 2006), the Avaluator represents the second layer of a tiered approach to avalanche awareness education in Canada. The primary target groups are backcountry skiers, snowmobile riders and out-of-bounds skiers and snowboarders with limited experience in avalanche terrain. The simple decision tools aim at starting users towards the development of comprehensive avalanche risk management expertise.

The Avaluator is an awareness tool and does not have any predictive capabilities. In other words, it cannot be used to predict the likelihood of an avalanche accident happening. Instead it provides the user with a measure of how often the current conditions were observed in past accidents. While the Avaluator is aimed at users with limited experience, this new perspective might also provide more advanced backcountry travelers with new impulses for their risk management in avalanche terrain.

The Avaluator shows promise to considerably help reducing avalanche accidents in Canada. The big question mark is how wholeheartedly the outdoor community will adopt the Avaluator and apply its methods in the backcountry. It will take a few years to understand the full implications of the Avaluator on avalanche awareness education and see whether it has a direct effect on avalanche accident patterns in Canada.

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