OUT-OF-BOUNDS AVALANCHE AWARENESS: ASSESSMENT, CURRENT PRACTICES, AND FUTURE MANAGEMENT

Ian McCammon*
SnowPit Technologies, Salt Lake City, UT

Pascal Haegeli and Matt Gunn
Simon Fraser University, School for Resource and Environmental Management, Burnaby, BC

ABSTRACT: Increasing numbers of recreationists are accessing the backcountry beyond the boundaries of winter resorts. For recreationists, the sudden transition to backcountry avalanche conditions poses a risk management challenge. For resorts, the content and presentation of out-of-bounds (OB) hazard information presents a risk communication challenge.

The goals of this project were to gain a better understanding of avalanche awareness among OB users and to identify effective strategies for informing their decisions in OB avalanche terrain. Because the OB phenomenon is multi-faceted and complex, we used a mixed-methods, multilevel ecological approach involving focus groups, intercept surveys, expert interviews, site visits, and a retrospective accident analysis. Qualitative analysis supported a precautionary stage model consisting of five general categories of OB user. Since each of these categories is characterized by a unique orientation towards risk, it appears likely that each category is best targeted by specific interventions. We conclude by presenting a preliminary framework for resort operators that facilitates diagnosis and treatment of common OB risk communication problems.

KEYWORDS: decision making, resort operations, education, risk management

1. INTRODUCTION

Many mountain resorts in North America provide access to public lands that lie beyond their boundaries. Such access is popular with a growing number of out-of-bounds (OB) recreationists who seek a lift-assisted backcountry experience. Often, these recreationists find themselves in the midst of backcountry avalanche conditions for which they may be poorly prepared. And when accidents happen, it is often the resort staff that performs the rescue.

Resorts that provide backcountry access typically grapple with two questions. First, they must decide how much information to provide to OB recreationists regarding backcountry hazards such as avalanches. Second, they must decide how to provide that information in a manner that is effective. Resorts face the added challenge of having a very narrow window for providing any risk messages – perhaps a few seconds as the recreationist passes through a backcountry access gate. Many resorts have evolved effective strategies for dealing with OB access but currently there is little research to guide resorts that struggle with these questions, or to address the needs of the OB recreationists themselves.

* *Corresponding author address:*
Ian McCammon, SnowPit Technologies, P.O. Box 9038, Salt Lake City, UT 84109 tel: 801-520-3067; email: ian@snowpit.com

The purpose of this project was to identify ways that might effectively facilitate avalanche awareness among OB recreationists. In contrast to efforts that emphasize a formal educational process, this project focused on understanding avalanche risk from the perspective of the OB recreationist, and the ways in which resort operators might be effective in facilitating well-informed decisions regarding OB avalanche hazard.

2. BACKGROUND

Three previous studies have investigated the response of skiers and riders to OB avalanche hazard. Longland et al. (2005) found that OB recreationists were primarily motivated by good snow and challenging terrain. These individuals reported a relatively high acceptance of negative avalanche outcomes and were more likely to engage in risky activities than other winter backcountry recreationists. In an intercept survey in Utah, Silverton (2007) found that compared to backcountry skiers, OB recreationists had less formal training and were less likely to follow minimum safe practices. Björk (2007) utilized online and intercept surveys at a Swiss resort, and found that OB skiers with high self-reported risk management skills reported greater exposure to avalanche risk. OB skiers also reported taking more risks when carrying avalanche equipment. Skiers who occasionally visited OB terrain were less likely to consider themselves at risk of avalanche involvement. Björk's findings suggest heterogeneity within the OB population

and the need for targeted approaches when communicating avalanche risk.

3. RATIONALE

A recreationist's decision to go into OB avalanche terrain does not happen in a vacuum. Many factors influence the decision, ranging from personal knowledge and skills to social context and boundary signage. To be effective, avalanche awareness messages must take into account the range of influences that exist between the decision maker and the decision environment.

3.1 Exploring the decision ecology

The ecological approach is a research perspective that embraces influences from multiple sources in an interdependent, dynamic analysis. This approach incorporates two assumptions that are especially well-suited to OB decision making: 1) that multiple levels of influence dynamically affect individuals, and 2) a causal interdependence exists between behavior and the environment (Stokols, 1996).

Figure 1 shows an ecological model of the influences on OB avalanche decision making. The cultural environment is divided into a local "ski hill" culture and a broader meta-culture (media and societal influences). This model was used as a framework to structure the mixed-methods triangulation approach used in this study (Creswell and Plano, 2007). Methods included focus groups with OB riders, expert interviews, site visits to OB areas, field intercept surveys and a retrospective OB accident analysis.

3.2 Identifying a behavioral construct

As a research tool, an ecological model is a broad net that can capture the key variables, or moderators, that influence behavior in a decision environment. While it is possible to implement risk messages based on *ad hoc* combinations of moderators, interventions will be far more effective when they take advantage of the structural relationships within the environment as a whole. Behavioral models established by research in other risk management domains provide useful constructs that can capture these structural relationships.

While many models of health and safety behavior are described in the literature, relatively few enjoy broad empirical support. In this project, we matched ecological findings against a total of 13 behavior models, 11 of which are well-established (Glanz, Rimer and Lewis, 2003; Conner and Norman, 1995), and 2 of which appear in the avalanche decision making literature. These 13 behavioral models incorporated a total of 58 distinct moderators

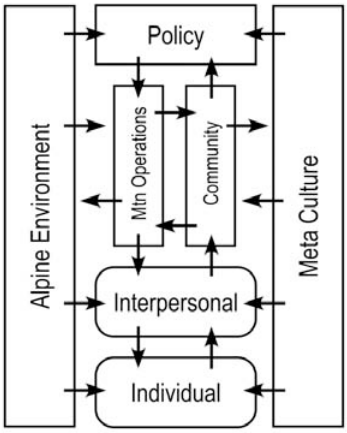


Figure 1. The multi-level ecological model used in this study, showing interdependent factors that might influence decisions in OB avalanche terrain.

4. METHODS

4.1 Focus groups

Focus groups were conducted with OB recreationists to understand ecological behavioral moderators from the receationist's perspective. Sessions were structured as script-based discussions with participants recruited from six ski locales in Western Canada. Participants were screened for OB experience, level of avalanche training, and personal experience with avalanches. The script was constructed to elicit information about moderators at various levels of the ecological model. Participants were compensated for their time and provided with an optional avalanche safety briefing following the focus group session.

Sessions were recorded and transcribed, and then analyzed using long table analysis (Krueger and Casey, 2000) to match responses to ecological levels, and thematic coding to match responses to the 58 behavioral moderators. Results were tabulated by incidence (number of mentions), extensiveness (how many participants mentioned the theme), and frequency (how many focus groups in which the moderator was mentioned). Table 1 shows the qualitative classifiers that were used to assess frequency and extensiveness.

4.2 Site visits

The purpose of site visits was to observe OB usage and mitigation practices at a sample of mountain resorts. Locales were selected based on the occurrence of recent OB avalanche incidents, routine usage of OB avalanche terrain, and logistical convenience. Site visits to Canadian mountain

resorts also coincided with intercept surveys and focus group sessions.

Classifier	*Proportion of analytical unit*
All	All units
Most	More than two-thirds
Many	Less than two-thirds
Few	Less than a third
None	No occurrence

Table 1. Classifiers for focus group and interview results. Analytical units for focus groups were sessions and participants and locales for expert interviews.

4.3 Expert interviews

The purpose of interviewing subject experts at ski areas was to understand common issues and challenges in managing OB recreation. We conducted these interviews either in-person or by telephone. Interviewees were selected by snowball and convenience sampling, and interviews followed a script-guided format (Patton, 2002).

Handwritten and audio records of the interviews were thematically analyzed by locale. Content analysis consisted of thematic pattern, frequency, and extensiveness analysis (Patton, 2002) using the qualitative classifiers shown in Table 1.

4.4 Qualitative synthesis

Analysis of focus group, interview and site visit results revealed dominant behavioral moderators in the ecological model. These moderators were matched against the 13 behavioral models to identify which model(s) most accurately represented the factors influencing the decisions and behavior of OB recreationists. A single model was identified that represented a practical fit to the qualitative data. This model (the Precaution Adoption Process Model – see Section 5) provided a framework for the two subsequent quantitative components of this study.

4.5 Intercept survey

Intercept surveys were conducted between January and March 2008 at five Canadian mountain resorts. Participants were intercepted at boundary exits and re-entry points. In areas having a mix of OB recreationists and backcountry travelers, the latter were screened out on the basis of destination. Survey questions were designed to characterize OB skiers and their avalanche related behaviors including experience, training, equipment use and terrain choices (Dillman, 2007). Respondents were also classified according to the model identified in the synthesis analysis.

4.6 Accident analysis

We obtained source data for retrospective OB accident analysis from a pre-existing database maintained by SnowPit Technologies (U.S. accidents), and a supplemented database maintained by the Canadian Avalanche Centre (Canadian Accidents). To minimize reporting biases, we analyzed only OB avalanche accidents that involved fatalities or injuries requiring a hospital stay. Accident victims were evaluated by accident locale, age and gender, and classified according to the model identified in the synthesis analysis. Data for the U.S. and Canada was pooled when $P < 0.05$ in comparisons.

5. RESULTS

5.1 Focus groups

We conducted seven focus groups with 34 participants, 79% of which were male. Reported ages ranged from 19 to 51 years (mean 28.7 years). Eighty-one percent of participants reported 3 or more seasons of OB experience, and 91% said that they went out of bounds 6 or more days each season. Eighty-two percent reported non-OB backcountry experience in avalanche terrain; 93% of these participants had 30 or fewer days in the backcountry. Twenty-four percent of participants reported having had formal avalanche training.

In addition to the 58 behavioral moderators derived from the health behavior models under investigation, 13 additional moderators emerged from the focus group analysis. Theoretical saturation was reached relatively quickly in the analysis, with 97% of all moderators having appeared by session number four. This suggests that given the same questions, additional focus groups with similar audiences would have produced little new information.

Behavioral moderators that appeared in all focus groups are listed in Table 2. It is notable that moderators from five of the seven ecological levels are present, suggesting that OB avalanche decision making has multiple complex influences.

5.2 Site visits

We visited five mountain resorts in Canada and seven in the United States between January and April of 2008. One other Canadian resort and seven US resorts were also contacted by telephone and email.

There were seven distinct policies for boundary management at the 19 resorts in this study (Figure 2). Four were variations of an open boundary policy, where guests were permitted to leave the resort anywhere along the boundary. Controlled access gates were not always accessible due to temporary in-bounds closures, and

controlled gates were closed when OB start zones threatened in-bounds ski runs.

Behavioral moderator	*Ecological level*	*Incid.*	*Ext.*
Behavioral capability	Personal	95	Most
Behavioral categ.	Personal	56	Most
Inter-partner trust	Interp.	56	Most
Precaution-outcome	Personal	50	Most
Media role modeling	Metacult.	48	Most
Protect. self-control	Personal	43	Most
Boundary signage*	Mtn ops.	41	Most
Familiarity	Personal	40	Most
Effect of safety gear	Personal	31	Most
Expert halo	Interp.	43	Many
Vulnerability	Personal	31	Many
Social proof	Environ	29	Many
Self-efficacy	Personal	27	Many
Reciprocity	Interp.	27	Many
Weather/affect*	Environ	22	Many

Table 2. Behavioral moderators mentioned in all focus groups. Incidence is the number of mentions in all sessions, and extensiveness is relative to the number of respondents. An asterisk (*) denotes new moderators that emerged from discussions.

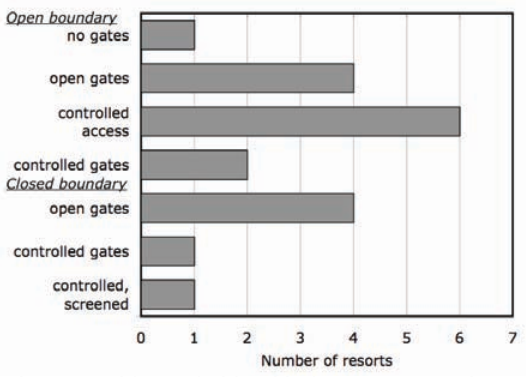


Figure 2. This study identified seven general approaches to managing ski area boundaries. Policies involving open boundaries were more common.

Three policies were variations of a closed boundary policy, where guests were not permitted to leave or re-enter the resort except through specified access points. Screened gates were used at one resort where guests were required to obtain a separate pass to access a backcountry-like area adjacent to the boundary. Focus group participants cited policy differences as a source of confusion when traveling between areas.

We examined 35 OB gates in this study. While gates were often similar within each resort, there was substantial variation between resorts (Figure 3). The number of signs at each gate ranged from 1 to 9 (median 3) and the number of words per gate ranged from 12 to 398 (median = 117). During site visits, only a handful of people were observed reading the signage. In focus groups, participants reported that boundary signage was routinely ignored by themselves and their partners.

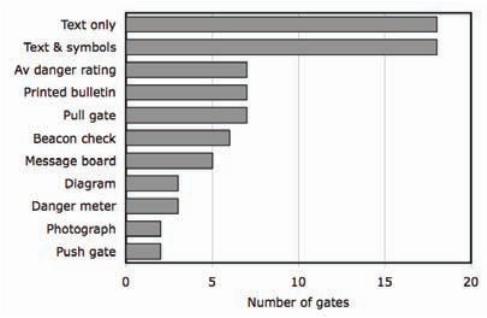


Figure 3. Gate configuration elements and information formats of the 35 gates viewed in this study

5.3 Expert interviews

A total of 43 resort professionals were interviewed in this study. Figure 4 shows the breakdown of their organizational positions.

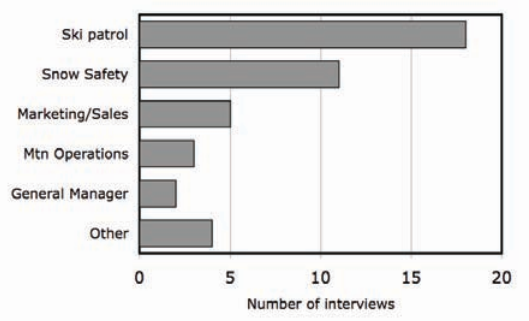


Figure 4. Individuals interviewed in this study, by employment position.

Eighty-six themes emerged from content analysis of the interviews. Themes at the environment level proved unique to each area, and so this ecological level was excluded from the analysis. Theoretical saturation appears to have occurred after interview number 14, suggesting that conducting further interviews at similar areas would not substantially improve the overall picture of the OB phenomenon.

Thematic content extended to all levels of the ecological model, mirroring the issue complexity found in the focus group analysis. Themes that exhibited a locale extensiveness of two-thirds or more are shown in Table 3, along with ecological level and incidence among respondents

Theme	Ecological level	Incid.
Signage & boundary maint.	Mtn Ops.	52
Comprehension of hazards	Personal	31
Carrying rescue gear	Personal	28
Informing guests re av cond.	Interp.	27
Growing OB usage	Comm.	27
Infl. of tracks on behavior	Personal	27
Community av ed	Comm.	25
Comprehension of boundary	Personal	24
Inform. guests re boundary	Policy	21
Guests unint. exiting bdy	Mtn Ops.	21
Gear as fashion accessory	Personal	21
Resort community relations	Comm.	17
Aware-unskilled OB usage	Personal	17
Collaborative policy form.	Policy	16

Table 3. Interview themes that appeared in two thirds or more of the locales studied. The personal level is defined relative to the OB decision maker, not the interviewee.

5.4 Qualitative synthesis

Analysis of focus group, interview and site visit results revealed dominant behavioral moderators in the OB decision ecology. These moderators were matched against the 58 moderators derived from the 13 behavioral models. Several models received partial support in the analysis, and others received full support but failed to address all of the dominant moderators. One model, the Precaution Adoption Process Model, provided a framework that fully accommodated the key moderators that emerged from the qualitative analysis.

The Precaution Adoption Process Model (PAPM) assumes that people progress through a series of distinct stages when adopting precautionary behavior (Weinstein and Sandman, 2002: Weinstein, 1988). At each of these stages, people think and behave in qualitatively different ways, and so the kinds of information that they need, and the interventions that will be effective, vary from stage to stage. The PAPM has proven successful in domains where risk perception, social cues, and environmental factors play key roles in behavior (Rimer, 2002). The stages of the Precaution Adoption Process Model, framed in the ecology of OB avalanche decisions, are as follows:

Stage 1: Unaware – Individuals have no functional knowledge of the hazard, and make no connection to local conditions or personal danger. Because they perceive no risk, they will generally pay little attention to warnings and will be easily influenced by decisional cues such as tracks and other people.

Stage 2: Unengaged – Once people are aware that the hazard exists locally they may not believe that they are personally at risk. These individuals may comprehend warnings, but false alarms can easily lead to warning blindness (Bliss and Fallon, 2006; Rogers, at al., 2000).

Stage 3: Engaged – Once people are aware that a hazard might affect them, they are receptive to information regarding that hazard.

Stage 4: Emergent mitigator – People at this stage have actively sought out structured precautionary knowledge (avalanche training or equivalent), although they may be inconsistent in applying that knowledge.

Stage 5: Routine mitigator – People at this stage consistently recognize and effectively mitigate the hazard.

Weinstein and Sandman (2002) describe a disengagement stage between stages 3 and 4 that we did not observe in focus group discussions or in expert interviews, and so this stage was omitted from the model. Also, because OB avalanche precautions are an amalgam of actions rather than single act, stage 3 represents both the awareness that precautions may be necessary and a receptiveness to precautionary information.

Focus group participants were classified by PAPM stage based on information provided in their screening forms and their responses during focus group sessions. These results appear in Figure 5. Thematic comparison of the responses from individuals in stages 3 and 4 showed significant extensiveness differences in themes related to vulnerability, severity, precaution effectiveness, interpersonal trust, and negative media role modeling.

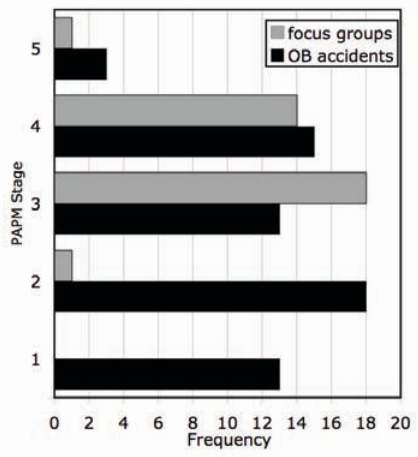


Figure 5. Precautionary stages in focus group participants and in OB avalanche victims.

5.5 Intercept survey

At total of 390 OB recreationists were intercepted at five Canadian resorts. The median age of respondents was 27 years (mean 28.9) and 88% were male. While 47% of respondents reported carrying a beacon, only 29% carried a bea-

con, shovel and probe. Twenty-nine percent of respondents reported having formal avalanche training.

Respondents were classified into the five precautionary stages based on their responses. Individuals with formal avalanche training were assigned to Stages 4 and 5 as one category, since their level of proficiency was unknown. The low representation of individuals in stage 1 is likely due to priming effects of the survey instrument.

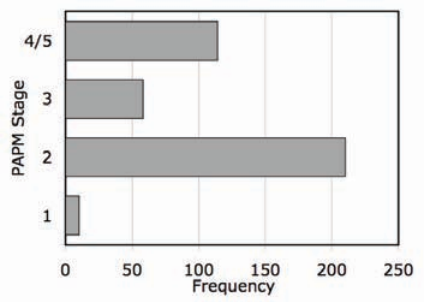


Figure 6. Distribution of PAPM stages among intercept survey respondents.

5.6 Accident analysis

Since 1990, a total of 57 people were seriously injured or killed in U.S. OB accidents, and 26 people seriously injured or killed in Canadian OB accidents. Age distributions for OB victims did not differ significantly between the two countries (Mann-Whitney tied-rank $P = 0.13$). Ages of OB victims ranged from 16 to 61, with a mean of 29 years (median 26 years). No significant differences were found in the gender proportions of OB avalanche victims between the two countries (Haber-corrected chi-square, $P = 0.69$); 89% of OB avalanche victims were male.

OB avalanche victims were also classified by PAPM stage. Comparison of victim stage distributions using a chi-squared contingency table yielded $P = 0.45$, an indication that OB avalanche victims did not significantly differ in their stage classification between the two countries. Figure 5 shows the pooled results for OB avalanche victims.

6. DISCUSSION AND APPLICATIONS

Qualitative analysis of focus group sessions, expert interviews and site visits supported a five-stage precautionary model as a practical construct for understanding how OB recreationists interact with avalanche hazard. Further evidence for a five-stage precautionary model was found in the intercept survey results (although results for stage 1 are unlikely to be accurate due to priming effects) and in retrospective accident analysis.

Weinstein and Sandman (2002) provide evidence that the most effective forms of risk communication move individuals to progressively higher stages in the model. Because people perceive and manage risk differently at each stage, the mediators that instigate transition to higher stages will be unique to each stage.

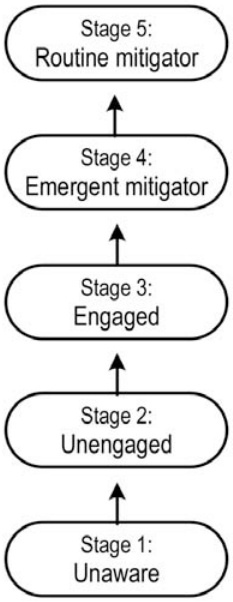
Focus group results provide some insights into which mediators will be most effective in encouraging precautionary behavior. Although participants resided primarily in stages 3 and 4, their responses frequently referred to mediators of change that had been effective for them at earlier stages. And a direct comparison of responses of participants in stage 3 and 4 revealed likely mediators of vulnerability, severity, action-efficacy, interpersonal trust, and negative media role modeling.

Studies of the PAPM in a range of domains have enumerated various stage-based mediators of change (de Vet et al. 2008; Sniehotta et al. 2005; Weinstein and Sandman, 2002; Weinsten et al. 1998). Other investigations provide insights into effective stage-change mediators, particularly at the lower levels of the model (for reviews, see Cialdini 2001; Thaler and Sunstein, 2008; Underhill, 1999). Many of these mediators are summarized in Figure 7.

One of the last questions in both the focus group sessions and expert interviews asked people to speculate on what interventions might be most effective in raising avalanche awareness among OB recreationists. Respondents provided many innovative ideas but notably, many suggested interventions that had already been implemented at various resorts with highly variable success.

Weinstein et al. (1998) describe “intervention mismatch” where treatments do not correlate with the precautionary stages of the audience. In these cases, interventions have been found to be relatively ineffective. In this study, we believe we observed this effect at a number of resorts that had implemented OB avalanche awareness interventions that had been successful at other resorts, only to see them disused or ignored. Further research into this promising area is certainly warranted.

Figure 7 lists many of the interventions that were either suggested by focus group participants or subject experts, or were observed during site visits. These interventions are matched to the mediators of stage change described above.



	Personal	Interpersonal	Community-Culture	Operations
Stage 5: Routine mitigator	*Habit formation* *Self-efficacy* *Precaution identity*	*Peer norms* *Decisonal aids*	Info support Teaching Mentorship	Beacon parks Danger updates
Stage 4: Emergent mitigator	*Vulnerability* *Self-efficacy* *Expediency*	*Peer expectations* *Expert halo*	Avalanche training Awareness programs Cues to action	How-to clinics Beacon checkpoints Guest contact
Stage 3: Engaged	*Experiential learning* *Social learning*	*Peer expectations* *Expert halo*	*Media modelling* *Social proof* *Cultural norms*	Severity signage Enforcement Choice architecture
Stage 2: Unengaged	*Observational learning*	*Peer modeling*	Awareness media *Social proof*	Choice architecture Track management Awareness signage
Stage 1: Unaware	← Change mediators →			

Figure 7. Mediators of stage change and interventions matched to the precaution model, by ecological level. Stage-change mediators appear in italic; interventions that were observed or suggested appear in plain text.

7. LIMITATIONS

As with any preliminary research, caution is advised in broadly applying these results. Limitations of this formative study include: 1) focus group bias due to social norms, authority, social acceptance, framing, priming and anchoring effects, 2) limited scope in site visits, interviews, and intercept surveys, and 3) reporting biases in OB accident data.

8. CONCLUSIONS

Although these results are preliminary, this study has developed a framework that may be useful for resort operators in examining the effectiveness of their OB avalanche awareness interventions. While it provides a formal structure for this type of examination, we suspect that Figure 7 is simply a conceptual approximation of the institutional knowledge that is present at the many mountain resorts that already manage OB recreation effectively.

ACKNOWLEDGEMENTS

Support for this project was provided by a New Initiatives Fund grant of the National Search and Rescue Secretariat (SAR-NIF) of the Government of Canada to the Canadian Avalanche Centre. The second author was supported by a postdoctoral fellowship of the Social Science and Humanities Research Council of Canada. Support for site visits and analysis of U.S. mountain resorts was provided by SnowPit Technologies.

The authors extend their sincere thanks to the following individuals who generously provided their time and expertise: Rowan Harper, Kyle Hale, Mike Rubenstein, Rusty Nobel, Michael Dalzell, Trevor Gavura, Dave Illes, Brad Eliason, Jacqueline Burke, Rocket Miller, Brian Leighton, Stuart Rempel, Robin Siggers, Latimer Forest, Mark Vesley, Kristine Grimble, Brian Johnston, Patrick O'Sullivan, Brandon Woolley, Jake Hutchinson, Jeff Fericks, Jason Fife, Julie Rust, Bob Comey, Mike Rheam, Jake Elkins, Eric Henderson, Gwyn Howat, Jes Hanle, Pat Ahern, Peter Carvelli, Frank Waikart, Randy Doyle, Patrick Eibs, Rob Nicholich, Rich Bingham, Randy Elliot, Peter Karst, Fay Johnson, Ron Johnson, Doug Richmond, Paul Baugher, Rob Gibson, and all survey and focus group participants.

The authors would also like the thank the following resorts for hosting this research or providing information about their operations: Alpental/Summit at Snoqualmie, Arapaho Basin, Aspen Highlands Ski Area, Aspen Mountain Ski Area, Bridger Bowl, Brighton Ski Resort, Crystal Mountain, Fernie Alpine Resort, Jackson Hole Mountian Resort, Kicking Horse Mountain Resort, Lake Louise Mountain Resort, Mount Baker Ski Area, Snow Basin Ski Resort, Sun Valley Resort,

Sunshine Village, Telluride Ski Resort, The Canyons Resort, Vail Resort, and Whistler-Blackcomb.

REFERENCES

Björk, C., 2007. Off-piste skiers' risk perception and its effects on behaviour and risk management. Prepared for the Swiss Federal Institute of Technology Zurich, Zurich.

Bliss, J. and Fallon, C. 2006. Active warnings: False alarms, in *Handbook of Warnings*, M. Wolgater, ed., Lawrence Erlebaum.

Cialdini, R. 2001. *Influence: The Psychology of Persuasion*, Allyn & Bacon, New York.

Conner, M. and Norman, P. 1995. *Predicting Health Behavior*, Open Univ. Press, Buckingham UK.

Creswell, J. and Plano, V. 2007. *Designing and Conducting Mixed Methods Research*, Sage, Thousand Oaks, CA.

Dillman, D. A., 2007. Mail and internet surveys: The tailored design method. Hoboken, NJ: Wiley.

Glanz, K. Rimer, B. and Lewis F. 2003. *Health Behavior and Health Education*, 3rd ed, Josey-Bass, pp. 22–39.

Krueger R. and Casey, M. 2000. *Focus Groups: A Practical Guide for Applied Research*, 3rd ed. Sage, Thousand Oaks, CA.

Longland, M., Haider, W., Hägeli, P., & Breadmore, B., 2005. Study brief: Decision making by amateur winter recreationists in avalanche terrain Retrieved from http://www.avisualanche.ca/publications.html

Patton, M. 2002. *Qualitative Research and Evaluation Methods*, 3rd ed. Sage, Thousand Oaks, CA.

Rimer, B. 2002. Perspectives on intrapersonal theories of health behavior, in *Health Behavior and Health Education*, 3rd ed (K. Glanz, B. Rimer, and F. Lewis, eds), Josey-Bass, pp. 144–163).

Rogers, W. Lamson, N. and Rousseau, G. 2000. Warning research: An integrative perspective, *Human Factors*, 42 (1):102–139.

Silverton, N. A., McIntosh, S. E., & Kim, H. S., 2007. Avalanche safety practices in Utah. *Wilderness and Environ. Medicine,* 18(4), 264-270.

Sniehotta, F., Luszcynska, A., Scholz, U. and Lippke, S. 2005. Discontinuity patterns in stages of the precaution adoption process model, *British Journal of Health Psychology*, 10:221–235.

Stokols, D. 1996. Translating social ecological theory into guidelines for health promotion, *Am Jnl of Health Promotion*, 10:282–298.

Thaler, R. and Sunstein, C. 2008. *Nudge: Improving Decisions about Health, Wealth, and Happiness*, Yale Univ. Press, New Haven, CT.

de Vet, E., de Nooijer, J., Oenema, A., de Vries, N., and Brug, J. 2008. Predictors of stage transitions in the precaution adoption process model, *Amer. Journal of Health Promotion*, 22(4): 282–290.

Weinstein, N. et a.1998. Stage theories of health behavior: Conceptual and methodological issues, *Health Psychology*, 17 (3): 290–299.

Weinstein, N. and Sandman, P. 2002. The precaution adoption process model, in *Health Behavior and Health Education*, 3rd ed (K. Glanz, et al. eds), Josey-Bass, pp. 121–143.