Winter 2003 in Southern BC – Perspective, Recognition, Management

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ABSTRACT
The winter of 2002-03 began with the formation of a rain crust in November, followed by an extended period of fair weather and the development of a persistent facet crust combination in a below average snowpack depth. This condition was recognized during early season training, however the magnitude of the problem did not strike home until two serious ski touring accidents in late January and early February claimed 14 lives. Acceptance of the condition and adaptation of operations was critical to heli-skiing operations in the Interior Ranges of BC. By winters end there would be 29 fatalities in mountain recreation, the greatest loss of life by avalanches in Canada since 1964-65. In recent decades, the trend of well above average loss of life by recreationists in avalanches has coincided with below average snowpack depths and formation of persistent instabilities within the snowpack. Recognition of the uncertainty of these conditions and acceptance of the conservative approach to managing skiing operations is the legacy for future anomalous winters.

KEYWORDS: accidents, below average snowpacks, winter mountain travel, mechanized skiing

1. INTRODUCTION

Over the past century avalanche risk management in Canada has evolved largely in response to accidents which had a particular impact on one region or industry sector. In the early 1900s, most avalanche victims in Canada were transportation and mine workers. More recently, the majority of avalanche victims are backcountry recreationists.

The objective of this paper is to explore the nature of difficult years for winter mountain travel and the challenges in mechanized skiing during an anomalous winter like 2003. Winter mountain travelers are typically recreationists including skiers, snowboarders, snowmobilers and mountaineers. Persons working and using these means of travel have been included in this group, hence the term winter mountain traveller.

The number of winter mountain travelers has exploded in recent years in Canada. Snow avalanches are the primary winter natural hazard to which these groups are exposed.

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2. THE 2003 WINTER IN PERSPECTIVE

The 2002-2003 winter claimed 29 avalanche victims in Canada, all in recreational backcountry settings (Canadian Avalanche Association unpublished data). This is the largest number since the winter of 1964-1965, when 34 fatalities were recorded (Stethem & Schaerer, 1979, 1980). In that earlier winter only one of the victims was a recreationist and 33 died in mining and town site accidents.

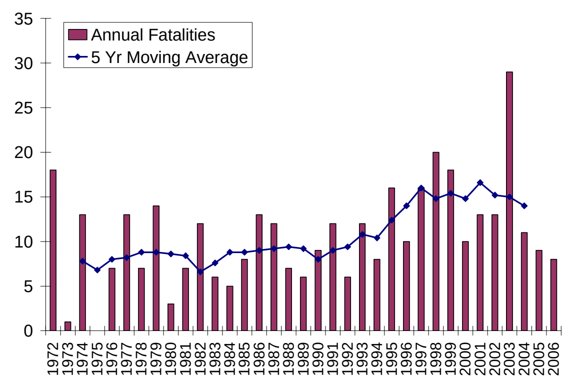

Figure 1: Numbers of avalanche fatalities per year in Canada, 1972 to 2006.

The number of avalanche fatalities in Canada in 2003 stands out above all others (Figure 1) in recent decades. The moving average of fatalities per year has risen sharply through the 1990's.

The activities of the avalanche victims of winter 2003 were in various forms of winter mountain travel (Figure 2). Backcountry skiers, snowboarders and snowmobilers make up the majority.

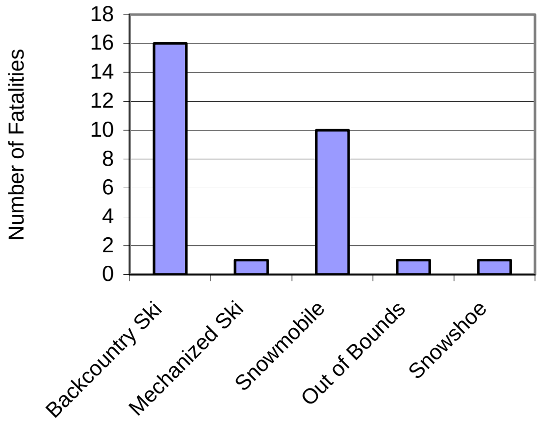

Figure 2: Activity of accident victims in 2003.

Two backcountry ski touring accidents in the Selkirk Mountains of B.C. during the 2003 winter gained international attention. The first was an avalanche accident involving two guided ski touring parties (a total of 21 people) at the Durand Glacier on January 20th. Seven persons died. The second accident involved a school outdoors group (total 17 people) in Connaught Creek. Seven students died.

At the Durand Glacier the avalanche was most likely triggered by the leading skiers in the group (personal observation). They had stopped well beyond the top of the slope to remove their skins. Below their track the snowpack depth quickly tapered over the final 10 m, into an area of a 50 cm snowpack overlying rocks. A loud bang was heard and the fracture propagated from the thin snow below the skiers down through unskiable terrain and then across the slopes and into the couloir where the group was climbing.

At Connaught Creek the trigger for the avalanche appeared to be natural, most likely wind loading. The avalanche started high in a gully on Mt. Cheops, 700 m above the group who were skiing up the valley bottom. The avalanche began on a mid-snowpack layer and within metres stepped down to the November crust. The ensuing propagation removed all the snow from the gully and engulfed the group below. The gully would usually sustain several avalanches during storms over the winter. The lower snowfalls of 2003 may have contributed by allowing the full winter accumulation to build up in the gully prior to the avalanche.

Winter 2003 was a winter with below average snowpacks, where a crust layer was observed to form during mid-November and then remained on the surface until it was buried in the first week of December. While that layer remained on the surface, faceting and surface hoar formation was widespread. This persistent weak layer was the bed surface for the disastrous avalanche events of mid-winter.

It is often the winters with below average snowpack depths and persistent weak layers where above average numbers of fatalities are observed in winter mountain travel and recreation. The winters of 1972, 1977, 1979, 1995, 1998 and 2003 (Schaerer, 1987; Canadian Avalanche Association, unpublished data) all stand out as above average (one standard deviation above the mean of the moving average) in numbers of fatalities for recreationists (Figure 3).

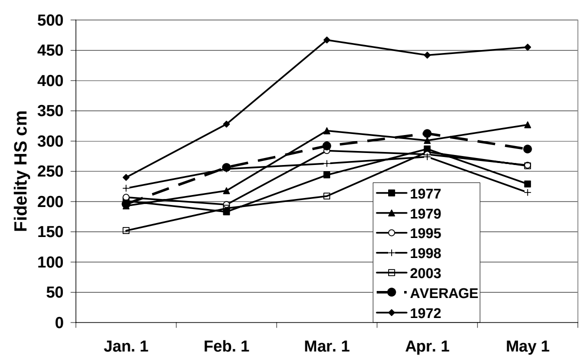

Figure 3: Month end snowpack depths at Mt. Fidelity in above average recreational accident winters.

The winter of 1971-72 is the only winter with above average snowpacks in this group. Early winter cold and depth hoar formation was followed by heavy mid-winter snowfall. Eighteen fatalities were observed, well above the average of 7 per year at that time. Of these 55% were winter mountain travellers associated with recreational activities.

All other winters described in Figure 3 fall below the average snowpack depth at some point. Snow machines, climbers or skiers (and snowboarders) provide a potential avalanche trigger by introducing shear stresses, which decrease over depth within the snowpack (Föhn, 1987, Camponovo and Schweizer 1996).
Thin snowpacks mean that when persistent weak layers form, they are more likely to remain near the snow surface, resulting in an increased potential for human triggering of slab avalanches.

Field experience has shown that below average snowpack depths combined with persistent weak layers are also associated with widespread propagation of fractures when slab avalanches do occur. Hence the worst-case scenario in recreation is often a below average snow winter where a persistent weak layer can be triggered from the surface and widespread propagation follows. On the other hand, during a heavy snow winter fewer persistent layers form and the pressure due to greater snow loads tends to promote sintering of the snowpack.

3. MECHANIZED BACKCOUNTRY SKIING

The history of fatal avalanche accidents in mechanized skiing (helicopter and snowcat) is well known. Of 372 avalanche fatalities in Canada during the period 1972 – 2006, 18% have been in mechanized skiing, the majority in helicopter skiing.

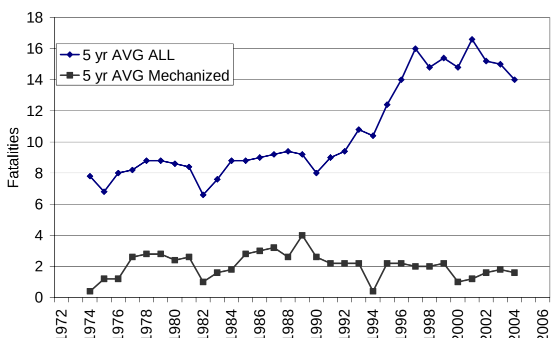

Figure 4: The 5-year moving average of numbers of fatalities in all avalanche accidents and those in mechanized skiing.

The recent trend in mechanized skiing is a slow decline in the moving average of the number fatalities per year since 1990 (Figure 4). During this same period the number of mechanized skier days has increased from approximately 50,000 in 1990 to over 90,000 in 2003. This means a significant decrease in the trend in the number of avalanche fatalities per skier day in recent years.

Recognition of the uncertainty of snowpacks with persistent instability and large propagation potential has been an important part of the development of the decision making process.

The risk reduction methods employed in mechanized backcountry skiing (helicopter and snowcat skiing) include avalanche forecasting, route selection and group management by professional guides, limited compaction and limited explosive avalanche control. The experience of the guides in the terrain is the most important factor in route selection.

The limited nature of explosive use is due to the vast areas of terrain, which are used by these operations relative to lift serviced ski areas. Similarly, with respect to compaction these operation have a very low skier density as compared to a ski area and therefore only a few runs receive repeated skier compaction.

Early season 2002-2003 training for the guides at Canadian Mountain Holidays (CMH) took place in late November at the Gothics Lodge (Selkirk Mountains) and in early December at the Bugaboo Lodge (Purcell Mountains). At both locations widespread crust, facet and surface hoar formation was observed at the snow surface.

The condition of the crust (Figure 5) was described as variable, often laminated with facets and it usually carried the weight of a skier in the alpine. Comments also included moist snow near the ground and a snowpack more dense than usual for that time of year. Descending below the tree line the crust became unskiable and the snowpack tapered to nil.

By the end of training all the guides were aware of the potential for a difficult winter. The question which remained, as it does with any early season instability, was whether or not the condition would improve and if so when. Given the thin snowpack the options for early season skiing were limited. The accidents at the Durand Glacier and Connaught Creek made it clear that the potential for widespread propagation on the November crust would persist through mid-winter.

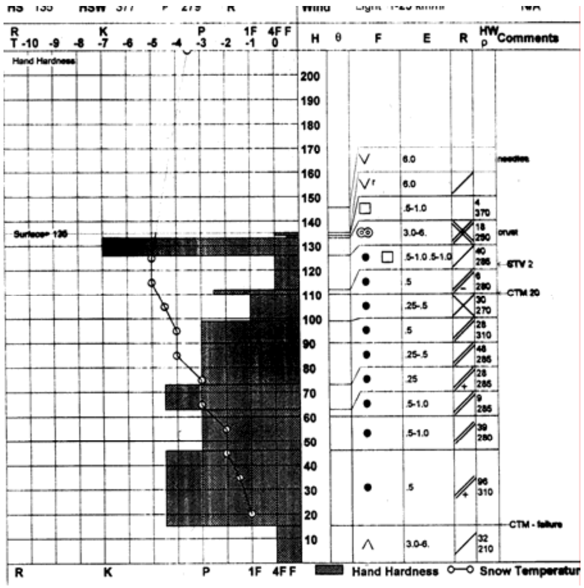

Figure 5: A snow profile from an east aspect alpine slope in the Gothics on December 2nd, 2003.

The areas of terrain which are to be skied are selected at the morning guides meeting at CMH. Local weather observation, outside information on weather and avalanche conditions and the season's observations to date are assessed to provide a stability evaluation. This information and the local knowledge of the guides are then applied to develop a run list for the day.

Atkins (2004) described how "the character of the likely avalanche activity leads directly to implications about how best to manage the terrain". In his analysis he used 2003 to illustrate that the character of a run list can vary significantly from season to season with similar stability evaluations and yet very different concerns in terms of the potential character of avalanche activity.

Figure 6 is a partial run list from January 2003 where the stability evaluation was 'good' for the alpine, treeline and below treeline. The runs outlined (60% of the full list) are those not even discussed for skiing that day. The light highlighting are closed runs (red), which include the North Frenchman area. The remainder (36% of the full list) are the open runs.

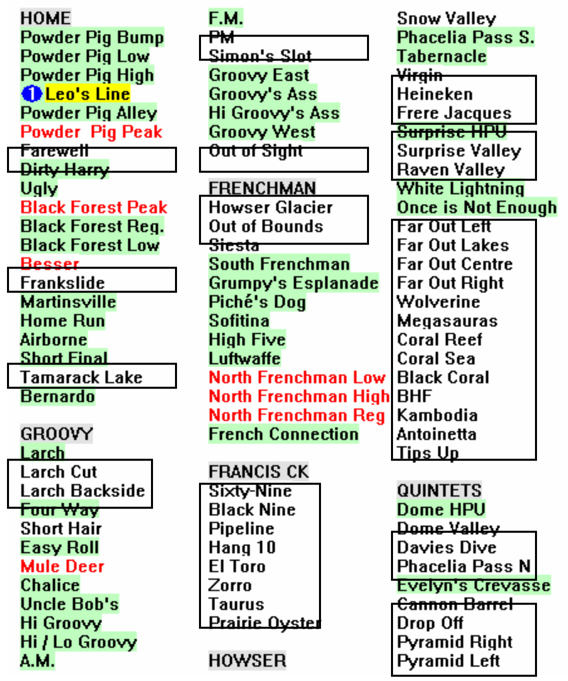

Figure 6: A portion of the Bugaboo run list for January 18, 2003.

Figure 7 is a run list from 2006 where the stability rating was good in the alpine and tree line and very good below treeline. All of the runs on the run list have been considered for skiing and of those on the full run list, 32% are red (light shading) and 68% are green. This is a very different run list make up given the similar stability ratings in the alpine and treeline zones in 2003 and 2006.

On those runs which are open for skiing (green) the skill of the guides in selection of lines and group management are the final measures used to protect the skiers in the field. A green run does not necessarily mean it will be skied in the final decision-making process.

Explosives and compaction can only be applied effectively over a small portion of the vast areas of terrain typical in heli-skiing. These are often the heavily used runs which are close to the base.

HOME	F.M.	Snow Valley
Powder Pig Bump	PM	Phacelia Pass S.
Powder Pig Low	Simon's Slot	Tabernacle
Powder Pig High	Groovy East	Virgin
Leo's Line	Groovy's Ass	Heineken
Powder Pig Alley	Hi Groovy's Ass	Frere Jacques
Powder Pig Peak	Groovy West	Surprise HPU
Farewell	Out of Sight	Surprise Valley
Dirty Harry		Raven Valley
Ugly	FRENCHMAN	White Lightning
Black Forest Peak	Howser Glacier	Once is Not Enough
Black Forest Reg.	Out of Bounds	Far Out Left
Black Forest Low	Siesta	Far Out Lakes
Besser	South Frenchman	Far Out Centre
Frankslide	Grumpy's Esplanade	Far Out Right
Martinsville	Piché's Dog	Wolverine
Home Run	Sofitina	Megasauras
Airborne	High Five	Coral Reef
Short Final	Luftwaffe	Coral Sea
Tamarack Lake	North Frenchman L	Black Coral
Bernardo	North Frenchman H	BHF
	North Frenchman R	Kambodia
GROOVY	French Connection	Antoinetta
Larch		Tips Up
Larch Cut	FRANCIS CK	
Larch Backside	Sixty-Nine	QUINTETS
Four Way	Black Nine	Dome HPU
Short Hair	Pipeline	Dome Valley
Easy Roll	Hang 10	Davies Dive
Mule Deer	El Toro	Phacelia Pass N
Chalice	Zorro	Evelyn's Crevasse
Uncle Bob's	Taurus	Cannon Barrel
Hi Groovy	Prairie Oyster	Drop Off
Hi / Lo Groovy		Pyramid Right
A.M.	HOWSER	Pyramid Left

Figure 7: A portion of the Bugaboo run list for March 21, 2006.

The North Frenchman area is an example of avalanche terrain near the lodge which is usually controlled by explosives. An important factor in decision-making for the guides during 2003 was concern for false positive information, which might be gained from explosive tests or stability tests. North Frenchman was bombed repeatedly using 12.5 and 25 kg ANFO charges with no results. Despite this type of result, it was not skied as the concern for the persistent instability and the propagation potential prevailed. French Connection, although green on some run lists, was not skied.

Finally on April 1st deep slabs Size 3 or larger were triggered by explosives on French Connection, North Frenchman regular and North Frenchman High. These ran to the valley and overwhelmed the skiing terrain.

Conclusions

Experience in Western Canada has shown that below average snow winters are often associated with persistent instabilities, human triggering of slab avalanches, widespread propagation and above average numbers of avalanche fatalities in winter mountain travel. Recognition of these conditions, such as those in winter 2003, is critical to risk reduction.

In mechanized skiing operations the 2003 winter was a condition beyond the experience of most guides. False positives which could have influenced the decision-making of the guides were tempered by a concern for the propagation potential of the buried crust facet layer. Recognition of the uncertainty of these conditions and acceptance of a conservative approach to route selection was the key to the skiing operation.

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