Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

Visitor Perceptions of Natural Hazards at Whakapapa and Turoa Ski Areas, Mt Ruapehu

A thesis presented in partial fulfilment of the requirements for the degree of

Master of Philosophy
in
Geography

at Massey University, Palmerston North,
New Zealand.

Celeste N. Milnes

2010

Abstract of a thesis submitted in partial fulfilment of the
Requirements for the Degree of M.Phil. (Geography)

Visitor Perceptions of Natural Hazards at Whakapapa and Turoa Ski Areas, Mt Ruapehu

By C. N. Milnes

Whakapapa and Turoa are ski areas located on the active volcano Mt Ruapehu, in the Central North Island of New Zealand. Mt Ruapehu is located within Tongariro National Park, one of the 14 National Parks administered by the Department of Conservation (DoC). Visitors to Whakapapa and Turoa ski areas encounter an array of hazards, including icy slopes, ragged cliffs and drop-offs, and thousands of other mountain users. Hazards unique to Whakapapa and Turoa include the threat to human safety from lahars, ash falls, pyroclastic flows, erosion, rock falls, crevassing and ballistic bombs due to the active volcanic nature of this mountain. Managing these hazards at Mt Ruapehu is complex due to the number of factors involved. This dynamic site hosts visitors who are moderately experienced and prepared, but may be complacent about the danger to personal safety within these areas.

The intention of this research was to investigate how the public perceives hazards at Whakapapa and Turoa ski areas at Mt Ruapehu, and look at the particular hazards to which visitors feel they have been exposed. In order to identify gaps in public awareness of hazards, the current study at Whakapapa and Turoa ski areas involved surveying 400 members of the public, analysing the output from these surveys, and conducting semi-structured interviews with staff from Ruapehu Alpine Lifts, Institute of Geological and Nuclear Science and DoC. RAL safety management staff, DoC staff, and GNS scientists were spoken to in regard to their role as hazard communicators through identification of ways that they present safety messages to ski area visitors.

A basic demographic profile of visitors to Whakapapa and Turoa ski areas was identified and problems of communicating risk to ski area users in terms of their tendency to overestimate ability and take significant risk were outlined. Visitors to Whakapapa and Turoa ski areas were shown to have only moderate awareness of hazards and a number of suggestions for ski area management are provided. The author has identified a number of areas where the public's knowledge and practice around hazards is lacking and has made recommendations for the stakeholders.

Key words: hazards, hazard perceptions, hazard management, visitor management, risk perceptions, Turoa, Whakapapa, Mt Ruapehu, skiing, snowboarding, volcanic hazards.

ACKNOWLEDGEMENTS

I would like to acknowledge several people who have supported me throughout this dissertation. I would like to thank my supervisors, Dr Martin Brook and Dr Juliana Mansvelt for their guidance, patience and valuable contributions during this project. Graham Leonard and David Johnston from GNS Science, as well as Andy Hoyle and Chris Emmett from Ruapehu Alpine Lifts have been incredible. Finally, I would like to thank my family for their support and encouragement throughout this process.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF PLATES

CHAPTER ONE

INTRODUCTION

Plate 1.1 Skiers at Whakapapa ski area.

1.1 INTRODUCTION

Management of visitors within Whakapapa and Turoa ski areas is complex as visitors potentially face a number of natural hazards. Although inherent risks may be apparent to managers and experienced visitors, the extent to which casual ski area visitors comprehend natural hazards has both influence over and implications for both the way individual visitors behave, and how hazards are managed within these sites. In order to improve the effectiveness of visitor compliance and increase visitor safety it is important for emergency and safety management officials to understand how the public interprets their situation in relation to hazards and their potential response during a crisis. This information could be applied to the ongoing development of risk mitigation strategies.

Whakapapa and Turoa are ski areas located in the Central North Island of New Zealand (Figure 1.1). They are located within Tongariro National Park, one of the 14 National Parks administered by the Department of Conservation. Both ski

areas are sited on Mt Ruapehu, an active composite andesitic stratovolcano (Montgomery & Keys, 1993).

Figure 1.1 Map of New Zealand (Source: From Christianson, 2006).

Whakapapa ski area is located on the northern slopes of Mt Ruapehu which are the traditional lands of the Ngati Tuwharetoa people (Department of Conservation, 2006). The upper slopes are within the original gifted area. Turoa ski area is located on the southern slopes of Mt Ruapehu which are the traditional lands of the Ngati Rangi and Ngati Uenuku people (Department of Conservation, 2006). Ruapehu Alpine Lifts operates both ski areas under licences issued by the Department of Conservation (DoC). The decision making framework around hazard management is set within the statutory plans of management and the policy guidelines developed by the protected area agency (Pickering, Harrington & Worboys, 2003). DoC, the Institute of Geological and Nuclear Sciences (GNS) and Ruapehu Alpine Lifts Limited (RAL) are responsible for informing the public about potential hazards and keeping them from harm.

Visitor management within the ski areas is made difficult due to the nature of the potentially hazardous environment, an expectation from visitors of safety and the number of agencies working together. Winter mountain users at Whakapapa and Turoa are visitors with differing levels of knowledge about natural hazards and how to respond to them. The transient nature of those at risk makes it particularly difficult to educate visitors on the hazards and guide their response in the event of a crisis (Christianson, 2006). Visitors to these ski areas encounter an array of hazards. These include Whakapapa and Turoa's notoriously icy trails (Ruapehu Alpine Lifts, 2009a), which produce slopes causing skiers and snowboarders to slide uncontrollably, endangering themselves and others. Mt Ruapehu's weather is also of concern to mountain users and ski area management, as wind and

white out conditions are common throughout the winter season (Thomson, 2006). Avalanches stemming from weather systems are common at Mt Ruapehu (Dignan, 2009; Dignan, 2008; Hendrikx, 2007; Irwin, MacQueen & Owens, 2002; Prowse, Owens & McGregor, 1981), although management attempts to mitigate the risk of avalanche hazard through control work and other safety measures (Ruapehu Alpine Lifts, 2009a; McNulty, 1984). Public awareness of avalanches will be examined in the present study and will assist in identifying those populations with less knowledge of their danger. Other mountain users are a considerable hazard at ski areas, although academic literature relating to the perceptions held by mountain users of others could not be found. The present study contributes to this line of investigation.

Hazards unique to Whakapapa and Turoa include the threat to human safety from lahars, ash falls, pyroclastic flows, erosion, rock falls, crevassing and ballistic bombs due to the active volcanic nature of this mountain. Considerable work has been done on the volcanic processes at Mt Ruapehu (Lube, Cronin & Proctor, 2009; Massey *et al.*, 2009; Cronin, Neall, Lecointre & Palmer, 1999; Proctor, Cronin, Fuller, Lube & Manville; Hancox *et al*., 1997; Hackett & Houghton, 1989) and the staff response to the mountain's eruption detection system (Christianson, 2006; McLay, 1995), but only limited work has looked at the public response to the detection systems and possible threat of volcanic hazards (Coomer & Leonard, 2005; Leonard, Johnston & Paton, 2004; Ward, Paton, Johnston & Becker, 2003). This present study focuses on a specific population and their perceptions of hazards in a way that academic literature has not covered before.

The issue of managing these hazards at Mt Ruapehu is very complex due to the number of factors involved and that hazards may be manmade or naturally formed (Ruapehu Alpine Lifts, 2009a). The setting provides a unique opportunity to add value to academic knowledge about the way people view hazards. The results also have a commercial appeal and relevance to RAL and other New Zealand ski areas. The more they know about their customers, the better they will be able to cater to their needs and respond in emergency situations.

Some of the methods employed in the present study were replicated from Espiner (1999). Espiner (2001; 1999) and Hayes (2008) analysed the effectiveness of hazard warning signs and the safety of visitors while preserving the significance of the outdoor experience at Franz Josef and Fox Glaciers in the Southern Alps, two other largely unmodified visitor attractions. The similar

methods used between these studies allow direct comparison between different National Park populations. This may open the way for other research in this area, particularly ski areas located on volcanoes in Japan (Walker, 1997) or residential populations residing near volcanic hazards in Iceland (Bird, Gísladóttir & Dominey-Howes, 2009, 2010; Gudmundsson, Larsen, Höskuldsson & Gylfason, 2008; Jóhannesdóttir & Gísladóttir, 2010) and a possible comparison between the perceptions and hazard responses of people from either country.

In order to identify gaps in public awareness of hazards, the current study at Whakapapa and Turoa ski areas involved surveying 400 members of the public, analysing the output from these surveys, and conducting semi-structured interviews with staff from RAL, GNS and DoC. RAL safety management staff, DoC staff, and GNS scientists were spoken to in regard to their role as hazard communicators through identification of ways that they present safety messages to ski area visitors. This survey information will help park management understand whether they can be doing more to advance visitor awareness and perception of hazards at Whakapapa and Turoa and how well their existing hazard management is working. The data from this study will be of use to GNS, DoC, Massey University and RAL. The author of this study will provide information which will help providers appreciate public awareness of hazards and assist them to better educate people of the potential dangers. The focus of this study will be on the winter skiers, snowboarders, staff and non-skiing visitors. The results may help to inform RAL's policy and practice as well as add valuable knowledge to existing literature.

Plate 1.2 Safety signage at Turoa ski area, top of High Noon Express.

1.2 RESEARCH OBJECTIVES

The aim of this study is to investigate to what extent do visitors to Whakapapa and Turoa ski area demonstrate an awareness of hazards and how effective are hazard warning signs and public information media in creating appropriate visitor awareness and behaviour?

This study focuses on the alpine skiers and snowboarders using the Whakapapa and Turoa ski areas during the winter months in large numbers. The concentrations of public visitors during the winter months make it an incredibly hazardous location due to the hazards outlined above. These hazards will be studied as the overall hazard perception of Mt Ruapehu has not been examined in the past. The natural hazards found at Mt Ruapehu, combined with facilities and human nature make managing risk to an acceptable level an integral part of the daily operation of both areas (Ruapehu Alpine Lifts, 2009a).

The following objectives were developed at the beginning of this research project:

Objective 1: *To determine whether there are any differences between hazard perceptions at Whakapapa and Turoa and between other specific demographic groups and look at basic visitor characteristics and use patterns for the two ski resorts.*

This will give a better understanding of how visitors perceive hazards adding to existing research. It will also assist managers in more effectively implementing visitor management strategies through analysis of the different perceptions of various demographic groups.

Objective 2: To analyse the specific hazards to which visitors feel they have been exposed.

The study survey will review hazards respondents have listed and ask about the specific hazards of lahars and other volcanic events, avalanches and leaving ski area boundaries. This will add to what is known about visitor perception of volcanic hazards at Mt Ruapehu and add new knowledge about the awareness of other hazards.

Objective 3: To assess the effectiveness of the current hazard sign system in communicating the actual hazards to visitors.

A better understanding of the way hazard signs are perceived will allow for the researcher to assess the value of signage within ski areas, and may help to inform visitor management strategies.

Objective 4: To examine public awareness of natural hazards on Mt Ruapehu.

This will be explored through a survey of ski and snowboard visitors to Whakapapa and Turoa on their perceptions of natural hazards within and outside of ski area boundaries. Literature on natural hazards at ski resorts, effective responses to hazards at ski resorts, responses to warning systems and signs, hazard mitigation, risk (real and perceived) will all be reviewed.

1.3 STRUCTURE OF THE DISSERTATION

The dissertation comprises a further six chapters:

Chapter two introduces and describes the study setting, including history of skiing at Mt Ruapehu, the range of hazards to which visitors are exposed at the two ski areas and the management of these hazards.

Chapter three reviews relevant background literature related to past studies at Mt Ruapehu, research on risk and hazard perceptions, and an overview of methods used to communicate risk.

Chapter four discusses the methodology used to carry out and achieve research objectives.

Chapters five to seven present and discuss survey findings relating to study objectives. Chapter five addresses objective 1, looking at visitor demographics of the survey. Chapter six addresses objectives 2 and 3 looking at visitor perceptions of hazards and sign recall. Chapter seven reviews the previous chapters' information, comparing results with outcomes of interviews and addresses objective 4.

Chapter eight revisits the study position and summarises research objectives.

CHAPTER TWO
STUDY AREA

Plate 2.1 Turoa ski area from the High Noon Chairlift.

2.1 INTRODUCTION

This chapter introduces and describes the study setting, including the range of hazards to which visitors are exposed. Current visitor management approaches and hazard mitigation strategies are outlined and a range of visitor management issues specific to the study setting are discussed with a view to better understanding existing visitor attitudes towards hazards.

2.2 BACKGROUND INFORMATION ON SKIING AT WHAKAPAPA AND TUROA

Whakapapa and Turoa are ski areas located in the Central North Island of New Zealand. They are located within the Tongariro National Park, one of the 14 National Parks administered by the Department of Conservation. Both ski areas are sited on the active composite andesitic stratovolcano, Mt Ruapehu

(Montgomery & Keys, 1993). Mt Ruapehu is a volcanic cone (Figure 2.1) surrounded by an apron of volcaniclastic deposits (lahar and fluvial sediments), otherwise known as a ring plain (Hackett & Houghton, 1988; Cronin, Neall, & Palmer, 1996).

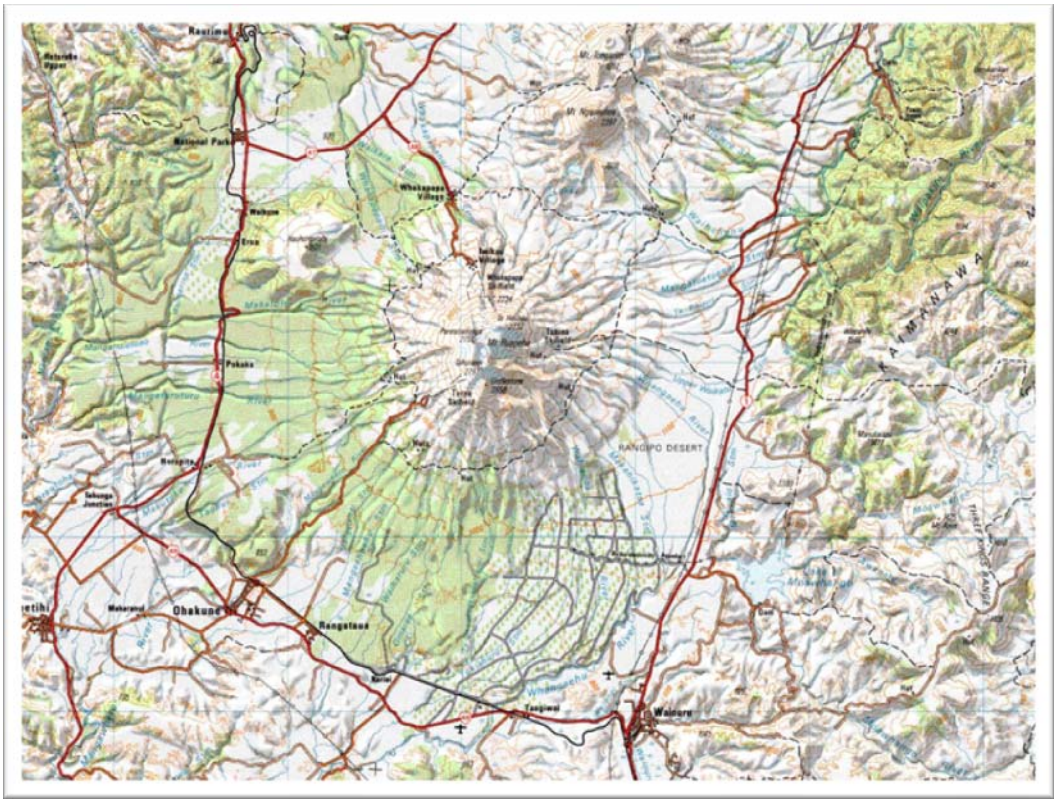

Figure 2.1 Map of Ruapehu region (Source: Land Information New Zealand, 2009).

On any given day during the winter months Whakapapa and Turoa may have thousands of skiers and snowboarders on their slopes. Whakapapa and Turoa are the most popular snow-sport areas in the North Island (G. Leonard, personal communication, October 8, 2009). Whakapapa has 45 ski club lodges which can accommodate approximately 2000 members overnight (G. Leonard, personal communication, October 8, 2009). The total number of skier days in 2008 across both areas was 440,000 (Ruapehu Alpine Lifts, 2009b). Due to the huge numbers of people using the mountain the safety of visitors is of paramount concern. There are many potential hazards for skiers and snowboarders at Whakapapa and Turoa including the volcanic dangers from lahars and eruptions, weather hazards and the mountainous climate hazards including ice, avalanche, cliff and rock dangers. Storms, unpredictable snow and hard ice are all part of skiing at Mt Ruapehu.

Mt Ruapehu is the most recently active of the three volcanoes within the Tongariro National Park due to:

- The high activity of Mt Ruapehu, having erupted over 60 times since 1945.
- Having a hot acid 10 7 m³ lake in the active crater.
- Summit glaciers and seasonal snowfields help and create a major lahar risk.

(Montgomery & Keys, 1993).

2.3 HISTORY OF SKIING AT MT RUAPEHU

Skiing at Mt Ruapehu began in 1913 with the formation of the Ruapehu Ski Club. Mt Ruapehu is host to three ski fields; Whakapapa (Figure 2.2), Turoa (Figure 2.3) and Tukino. Whakapapa is located on the northern side, Turoa to the south-western side and Tukino is located on the eastern side of Mt Ruapehu.

Figure 2.2 Whakapapa ski area trail map (Source: Brown Bear Ski, 2009).

Whakapapa and Turoa are both owned by RAL and are large commercial ski areas. Whakapapa is the largest ski area in New Zealand (McLay, 1995; G. Leonard, personal communication, October 8, 2009) and a possible lahar through the ski area is the greatest hazard to human life from a volcanic perspective (Hancox *et al*., 1997).

RAL was formed in 1953 as a public company to develop ski facilities at Whakapapa. The first chairlift in New Zealand was installed at Whakapapa in 1954. Rope tows and chairlifts were installed in the 1950s and 1960s. This increased the development of the mountain area primarily as a winter snow sport destination, but to a lesser extent for summer sight-seers too. A rope tow was installed on the southern side of Mt Ruapehu in 1978 and Turoa was launched. The High Noon T-Bar followed in 1979, with the Jumbo T-Bar (1983) and the Movenpick quad chairlift (1987) being installed in the years after. After the 1995-1996 series of volcanic activities New Zealand Ski Fields Limited, who operated Turoa, sold their operation license to RAL. RAL continue to operate both ski areas.

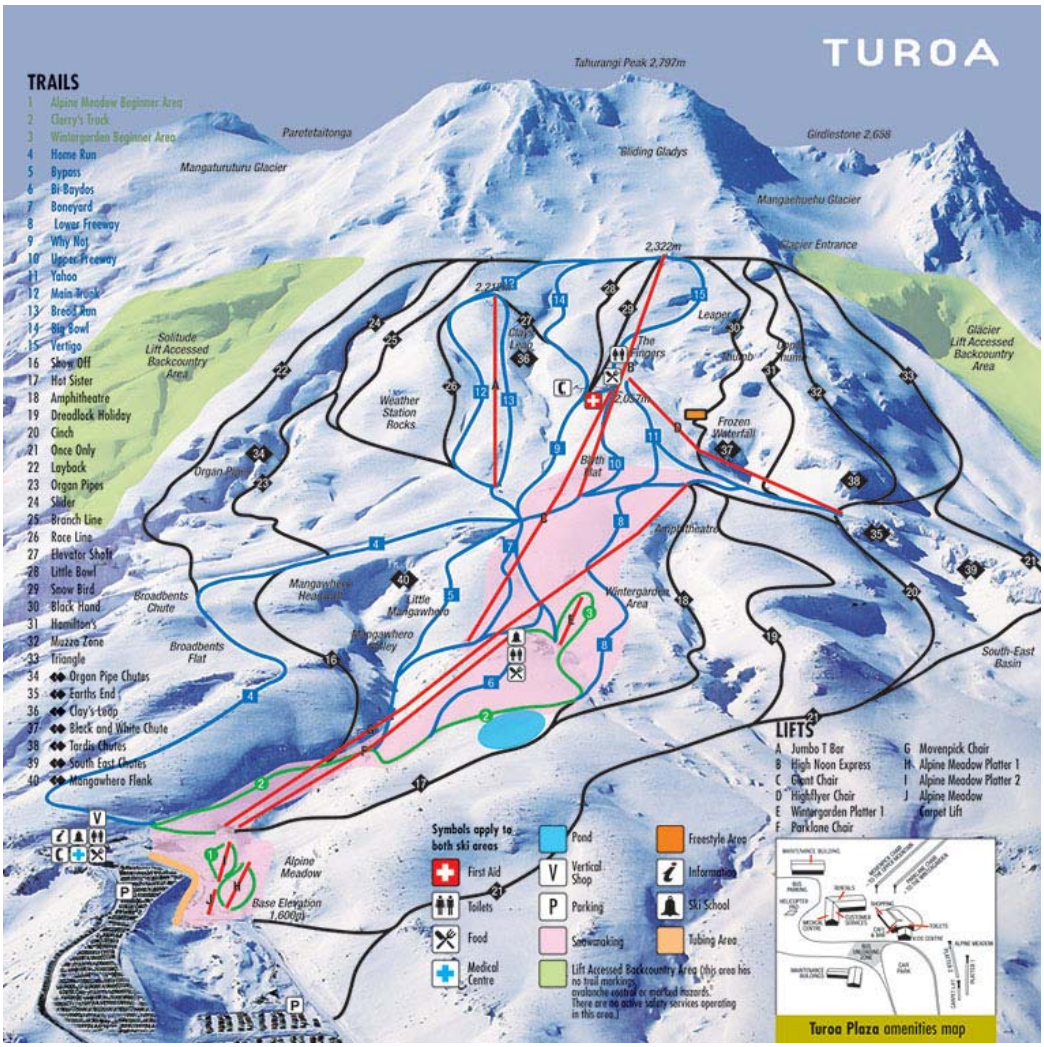

Figure 2.3 Turoa ski area trail map (Source: Brown Bear Ski, 2009).

This study does not cover the Tukino ski area as it is a club owned area with considerably smaller visitor numbers although actual skier numbers are not available (B. McGregor, personal communication, January 22, 2010). Tukino has been protected from lahars in the past due to its distance from the Crater Lake and the effects of the local topography (Leonard *et al.*, 2008).

The development of both Whakapapa and Turoa has been reinforced by gradual upgrading of lift facilities, better access and faster transport (McLay, 1995). In 2006 Turoa's base area cafe and retail complex was more than tripled in size, snowmaking capacity was tripled and a new 1.4km 6-seat detachable express chairlift was built to replace the High Noon T-Bar (Louisson, 2007). The two ski areas continue to plan developments. In RAL's recent Annual Report it was stated that they plan to:

- Develop the recently purchased Victoria University Ski Club Lodge at Whakapapa into a child care facility; and
- Assist with funding for a new 2-way bridge at the 9km mark on the Ohakune Mountain access road, improving and making safer visitor access to Turoa.

The improved facilities will increase visitor numbers and expose greater numbers to the volcanic and non-volcanic hazards Mt Ruapehu potentially presents. As more people visit the mountain within the same limitations upon terrain there is greater chance for collision, and increased numbers of visitors would prove more difficult to educate about possible volcanic hazards. Specific hazards at Mt Ruapehu will be discussed later in the chapter. User statistics for both ski areas are located below (Table 2.1, Table 2.2). Table 2.1 shows the percentage of each ski area classified as beginner, intermediate and advanced terrain as well as the percentage of the ski areas that receive snow-making.

Table 2.1: Terrain statistics for Whakapapa and Turoa (Ruapehu Alpine Lifts, 2009c)

	Whakapapa	**Turoa**
Beginner (Green)	25%	20%
Intermediate (Blue)	50%	55%
Advanced (Black)	25%	25%
Groomed Trails	30	22
Snow-making	20%	10%

Table 2.2: Whakapapa and Turoa statistics (Ruapehu Alpine Lifts, 2009c).

	Whakapapa	Turoa
Typical season duration	Late June – Early November	Mid June – Mid November
Chairlifts	5 Double, 2 Quad	1 Six-seater, 2 Quad, 2 Triple
T-bars	4	1
Platters	2	2
Learners' tows	1	0
Learners' carpet conveyor	0	1
Base area altitude	1630m	1600m
Highest point	2300m	2322m
Area	550 hectares	500 hectares
Access road	6 kilometres, sealed	17 kilometres, sealed

2.4 HAZARDS TO WINTER VISITORS FOUND ON MT RUAPEHU

A natural hazard is the threat of an event which will have a negative effect on people or the environment. According to the European Environment Agency a natural hazard is the 'probability of occurrence, within a specific period of time in a given area of a potentially damaging phenomenon of nature' (European Environment Agency, 2010) which may cause loss of life or injury, property damage, social and economic disruption or environmental degradation (Lavigne, 1999; Reynolds, 2009). As the majority of New Zealand's visitor attractions are located in natural environments, visitors potentially face a number of natural hazards (Espiner, 1999). The rugged and scenic features that attract visitors to Mt Ruapehu are often the features that place visitors at increased levels of risk (Dingwall, Fitzharris & Owens, 1989). The congregation of people on the flanks of this active volcano and high alpine environment makes people much more susceptible to hazards. Although inherent risks may be evident to managers and experienced visitors, the extent to which casual visitors perceive natural hazards has important influence over (and implications for) both individual visitor behaviour, and the hazard management style adopted at specific visitor sites.

2.5 MANAGEMENT OF HAZARDS

Visitor management at Mt Ruapehu is undertaken by the combined efforts of DoC, RAL and GNS. DoC, RAL and GNS are responsible for the safety of visitors to Mt Ruapehu ski fields and safety information reaching visitors. RAL holds a concession to operate Whakapapa and Turoa and their supporting activities within the licensed boundaries. As concessionaire, RAL must meet a range of Ski Area Management Safety Guidelines. According to the Tongariro National Park Management Plan (Department of Conservation, 2006), while skiers and snowboarders are ultimately responsible for their own safety the ski area must be accountable for providing safety services and structure that reasonably protects visitors from hazards. Both Whakapapa and Turoa are hazardous areas by nature due to the bluffs, cliffs and irregularities formed by geomorphic processes. The human ability to restrain these natural forces is limited and even when there may be the technical ability to do so National Park policy states that 'natural processes in National Parks should, where practicable, continue to function unhampered' (New Zealand Conservation Authority, 2005:35). RAL works to reduce the risk and exposure of hazards to acceptable levels while visitors are participating in activities within the two ski areas.

RAL is required to maintain a safety plan which is to be approved by DoC prior to each winter season. This focus on safety and accountability means there is pressure for the parties involved to use the best available visitor management practices. The two DoC objectives in regard to visitor safety in the ski area are:

- To take all reasonable precautions for the safety of ski area visitors.
- To promote safe and responsible attitudes toward the use of ski areas through educational and interpretive means (Department of Conservation, 2006).

When Whakapapa and Turoa are not open for winter snowsports, the land is administered by DoC as part of the Tongariro National Park. Any development of either ski area must be in line with DoC policy "maintaining the highest possible quality while minimising the effects of the operation on natural resources, historical and cultural heritage, and national park values, both within and beyond the boundaries" (Department of Conservation, 2006:198).

2.6 HAZARDS SPECIFIC TO MT RUAPEHU

There are many potentially dangerous hazards for winter mountain users at Whakapapa and Turoa associated with the interactions of the atmosphere, alpine environment and the volcano. Hazards can be in the form of earth surface processes like snow and/or rock avalanches, rockfalls, debris flows, lahars, glacial lake outburst floods (GLOFs) and other types of flood (Price, Jansky & Iatsenia, 2005). Other natural hazards include weather hazards and the mountainous climate hazards including ice, avalanche, cliff and rock dangers as well as other mountain users (Ruapehu Alpine Lifts, 2009). These hazards all pose danger to mountain visitors and can potentially threaten lives. This study focuses on several specific visitor hazards at Mt Ruapehu. These are not the only hazards that can be found or described in the area but are the hazards this study focuses on following advice from GNS and RAL.

- Volcanic hazards
- Avalanches
- Weather related hazards
- Terrain related hazards
- Ice and rocks
- Other mountain users
- The mountain roads

2.5.1 VOLCANIC HAZARDS

While there are numerous other ski areas around the world located on volcanoes (e.g. Kusatsu-Shirane, Honshu, Japan; Mammoth Mountain, California, USA), Mt Ruapehu is unique in New Zealand due to the fact that it is the only active volcano in New Zealand with a technical system for the direct warnings of volcanic hazards. Mt Ruapehu is unique internationally as the lahars on the mountain are produced by water from the Crater Lake being deposited onto snow and ice (Christenson, 2006). Whakapapa, on the northern slopes of Mt Ruapehu, is at risk from several volcanic hazards depending on the size of eruption and seasonal weather conditions, while Turoa's upper lifts are within range of ballistic bombs or lahars in the case of a medium or larger eruption (Leonard *et al.*, 2008) (Figure 2.4).

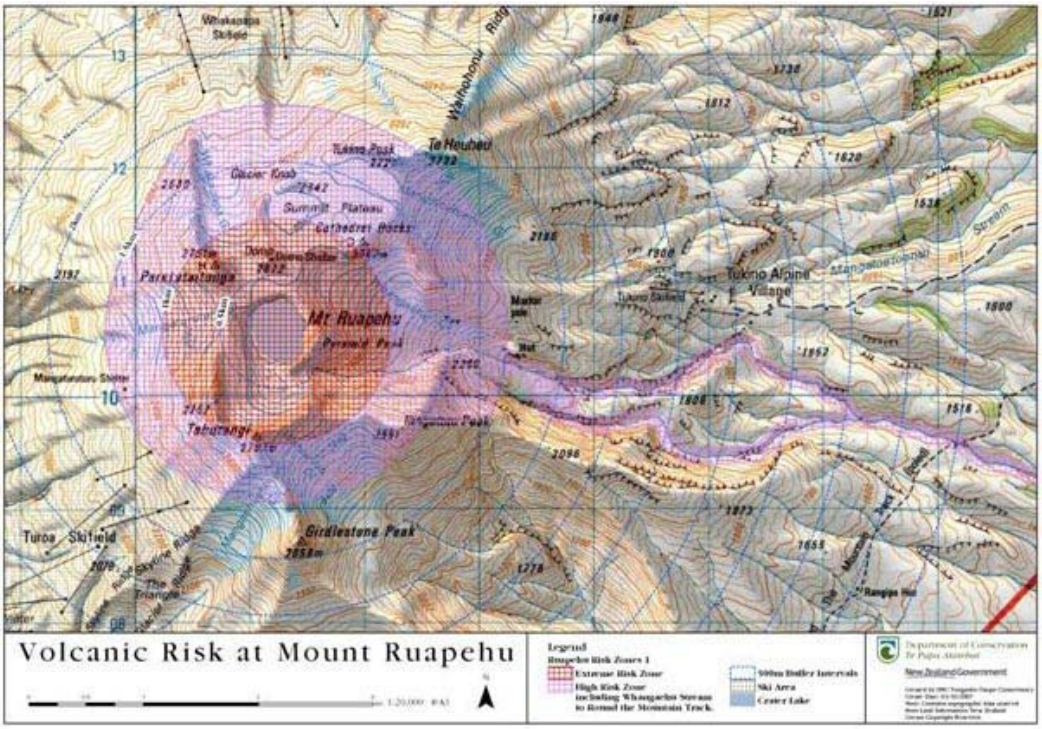

Figure 2.4 Volcanic risk at Mt Ruapehu (Source: Department of Conservation, 2007).

Mt Ruapehu is in an interesting position to be studied due to the warning systems in place and the high likelihood of volcanic events occurring. The fact that tests of the lahar warning system are conducted annually and volcanic events have occurred in recent years and have been widely reported on in the media ("Mt Ruapehu strikes again", 2007; "Scientists confirm 'small scale' Mt Ruapehu eruption", 2006; "Ruapehu eruption risk remains high", 2007; Rowan, 2008; Louisson, 2007) means that the public should be well informed on the dangers of skiing on an active volcano and should know the actions to take in the case of an event.

A series of eruptive events occurred throughout 1945 at Mt Ruapehu (Johnston, Houghton, Neall, Ronan & Paton, 2000) which included explosive phases which dispersed ash over much of the North Island for several months. Since the 1945 eruptions there has been increased use of the Mt Ruapehu area; three ski areas are now in place, as well as significant changes in the public perception of natural areas including National Parks and the perceptions of hazards within these areas (Department of Conservation, 1996). More recently Mt Ruapehu erupted through 1995 and 1996 where physical effects were felt similar to the 1945 events but with considerably greater social and economic impacts (Miller, Paton & Johnston, 1999). The 1995 eruption modified the crater rim and Whangaehu River valley which has implications for the size and path of future lahars (Hancox *et al.,* 1997;

Cronin *et al.*, 1999). Since the events in the mid ‘90s there have been changes in the perception of hazards and the expectations of public and individual safety as well as increased media interest in the volcanic activity.

Several other volcanic events have occurred since the 1995-1996 eruptive sequences (Hancox *et al.*, 1997; Department of Conservation, 1996; “Scientists confirm 'small scale' Mt Ruapehu eruption”, 2006). Lahar events have occurred as recently as 2007. In March 2007 a medium sized lahar occurred due to a break in the tephra dam holding back the Crater Lake, which passed down the Whangaehu River. The Crater Lake had been filling gradually since 1996, and a rainstorm on 18 March caused a slumping of debris, triggering an overflow and shortly after a full dam collapse (Massey *et al.*, 2009; Proctor *et al.*, 2010). This breakout lahar had been anticipated, due to the 9m of tephra deposited on the south crater rim in 1996 which blocked the former outlet of the lake (Proctor *et al.*, 2010).

Later in September 2007 a hydrothermal eruption occurred without warning (Kilgour *et al.*, 2010; Jolly, Jousset & Sherburn, 2008; Manville *et al.*, 2008; Richardson & Brook, in press). Three separate flows resulted from this small phreatic eruption (Cole, Cronin, Sherburn, & Manville, 2008) (Figure 2.5). Two of these flows were snow-dominated, resulting directly from the eruption, while the third flow was watery and occurred around an hour afterward. One of the snow-rich lahars entered Whakapapa ski area (Manville *et al.*, 2008). Concerns have been raised by Manville *et al.* (2008) that the geophone-based lahar warning systems that are currently in place may not be sensitive enough to detect and provide warning for ice-slurry based flows. The potential of ice-slurry lahars must be considered in hazard assessment and mitigation at snow-capped mountains due to the high mobility compared to other types of volcanic and nonvolcanic gravitationally driven ice flows (Lube, Cronin, & Procter, 2009). In 2008 Mt Ruapehu experienced increased Crater Lake temperatures and toxic gasses (Rowan, 2008).

Figure 2.5 The September 2007 eruption-related lahar (Source: Radio New Zealand, 2007).

Lahars are the main volcanic hazard in the early stages of an eruption and pose the highest threat to people on Mt Ruapehu during and after an eruption. A lahar is 'a stream of mud, rocks and water that is ejected from the mountain and proceeds down the mountain following valley floors at a speed of around 69-90 kilometres per hour' (McLay, 1995: 10). They can travel from the Crater Lake to ski areas in as little as 2-3 minutes (Department of Conservation, 1996). They are formed with a combination of ejected rocks and lake water with snow and may occur during an eruption or as a secondary event following an eruption. It is possible for lahars to also occur through an overflow of the Crater Lake (Christianson, 2006). There are two main types of lahar hazard at Mt Ruapehu: (1) lahars draining out of the Crater Lake into the Whangaehu River; and (2) eruption generated lahars in other catchments (including the Whakapapaiti and Whakapapanui valleys) (Rosenberg, 2000). Lahars have not occurred within the Turoa ski area, but cannot be ruled out there in future. Tukino ski area is unlikely to receive lahars in all but the largest summit eruptions as it is farther away, and is not in a direct drainage path from the mountain summit. Other potential volcanic hazards at Mt Ruapehu include ash falls, pyroclastic flows, erosion, rock falls, crevassing, toxic gasses and ballistic bombs.

Reviews were undertaken following the 1995 and 1996 eruptions and GNS recommended that due to the Crater Lake instability a trench should have been excavated to reduce lahar hazards from barrier collapse. Making adjustments to

the Crater Lake is no simple task however, due to the National Park status of Mt Ruapehu, the sensitivity of the sacredness of the peaks to the tangata whenua and the potential impacts for public safety (Department of Conservation, 1996). Because of these various issues DoC recommended that there should be no engineering intervention at the tephra barrier in the Crater Lake following the eruptions in the 1990s (Department of Conservation, 1996). In 1999 DoC did recommend that a warning and response system be developed, that there be a revision of land-use within lahar zones and a levee ('bund') should be considered near the spill-over point of the Whangaehu River into the Tongariro River (Figure 2.5) (Leonard *et al.*, 2008).

The bund (shown in yellow, Figure 2.6) was built out of material recovered from the Whangaehu Riverbed, constructed to prevent a lahar spilling over the Whangaehu River into the Waikato Stream (Department of Conservation, 2010). The bund is 285m long, 20m wide and up to 4.6m high. This bund was completed in 2002 and the Government did not deem it necessary for intervention at the Crater Lake ("Government reviews and rejects Ruapehu intervention", 2004).

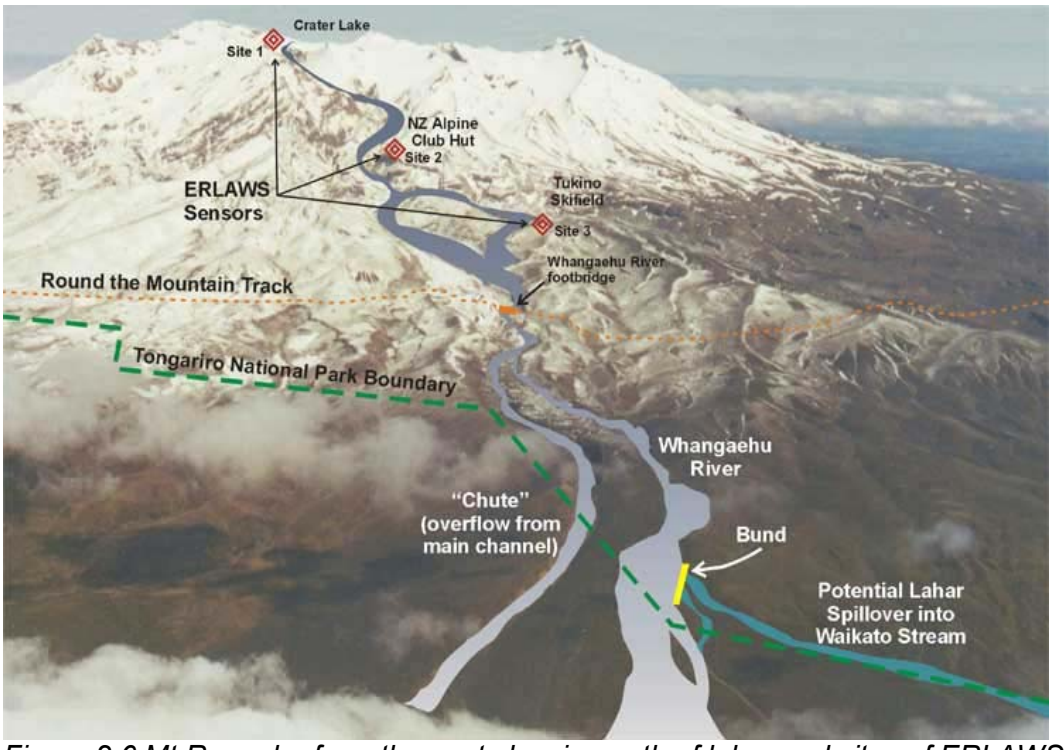

Figure 2.6 Mt Ruapehu from the east showing path of lahar and sites of ERLAWS sensors and bund (Source: Galley, Leonard, Johnston, Balm & Paton, 2004).

Approaches to lahar mitigation in New Zealand are sensitive to the many factors listed above, in comparison with approaches taken by other countries. An engineering solution to the potential lahar problem is unsatisfactory due to Mt

Ruapehu's national park status as part of the Tongariro National Park and as a World Heritage site. In Nepal lake dams are dynamited, syphons are set up, or moraine dam walls are simply bull-dozed (or hit by rockets from fighter jets) (Thouret, 1999) and in Chile current government authorities do not allow any economic or social development in Las Cascadas village built on a laharic fan near Osorno volcano (Delgado-Granados *et al.*, 2009). While National Park policy requires all structures be built out of lahar paths or if not, be strong enough to withstand lahars, large scale manmade changes to the crater rim would never be considered at Mt Ruapehu due to DoC and the Government's sensitive approach to management. The Crater Lake is a site of natural, cultural and scientific significance and modification of this feature is unacceptable to iwi as well as conservationists, scientists and recreationalists. This approach in New Zealand has led to the Crater Lake refilling to critical levels at a point where a lahar event was imminent.

WARNING SYSTEMS

Seasonal and daily fluctuations in visitor numbers makes the management of lahar and other risks a very complex problem and was a key contributing factor in the decision to develop a lahar warning system. Since 1995 GNS, DoC and RAL have been working together to improve the public and organisational response to eruption warning systems. Their work includes:

- Hazard analysis.
- Public education development/evaluation.
- Working with responding agencies (e.g. Civil Defence).
- Gap analysis of current training.
- On-site monitoring of warning system simulations.

(Leonard *et al.*, 2008)

GNS constantly monitors the stage level of the Crater Lake with a view towards detecting signals impending eruptive activity (Manville, 2007) as nearly all major eruptive episodes have historically produced lahars draining into valleys around the summit (Nairn & Ruapehu Surveillance Group, 1996). There are two lahar warning systems at Mt Ruapehu. The first warning system to be installed at Mt Ruapehu was the Lahar Warning System (LWS) in 1984. This system had significant flaws and as a result the warning alarm to broadcast a message of possible impending lahar was not triggered in the eruption in September 1995 (Christianson, 2006). Following this episode, the LWS was renamed the Eruption

Detection System (EDS) and was redesigned to allow an earlier warning for visitors on upper Whakapapa slopes in the event of a lahar. GNS was commissioned to do this work. The Eastern Ruapehu Lahar Alarm and Warning System (ERLAWS) was installed following the 1995-1996 eruptions and successfully detected and warned about the March 2007 lahar (Leonard *et al.*, 2008). ERLAWS is intended to provide warning of heavy outflows from the Crater Lake to the Whangaehu River or other neighbouring catchments. Breakout lahars (monitored by ERLAWS) do not pose a threat to any of the ski areas. The second warning system, the EDS, monitors lahars and broadcasts automated warning message across Whakapapa. The systems are both operated and monitored by DoC, GNS and GeoNet. The EDS uses seismometers on the mountain to measure volcanic tremor and air pressure sensors to detect sound waves if material is ejected from the crater ("Making Mt Ruapehu safer for skiers", 2002). The EDS has been a collaborative project with joint funding from RAL, mountain club lodges, the Whakapapa Village business community, and DoC, and has been developed by GNS.

In the event of the EDS being triggered a siren and loud speaker announcement is broadcast warning people to move out of the lahar path and out of the valleys. The EDS has also been linked to a pager system which informs Turoa staff that the system has been triggered (Christenson, 2006) and Turoa staff are able to inform Turoa users that an eruption is taking place. Skiers and snowboarders may have as little as 90 seconds to clear lahar paths (Leonard *et al.*, 2004). GNS carries out annual blind tests of the EDS to gauge people's reactions to the warning and whether they knew how to react to the possibility of a lahar.

RAL has risk management plans to mitigate the risk caused by volcanic hazards. Risk management is made more difficult due to the transient nature of the mountain population. In many hazard locations there is a stable population to whom risk management strategies can be communicated and developed over time. The nature of ski areas is that they have a visiting population which can change daily. This makes it difficult to communicate messages around hazards particular to Mt Ruapehu and places great responsibility on the staff who work at the ski area. This will be discussed further in the literature review.

The risk management plans for active volcanoes in other countries are similar with either a plan for restricting access during periods where the volcano may be active, or have warning systems. Walker (1997) looked at volcanic management plans across ski resorts at seven selected volcanoes. He found that Whakapapa

was the only area with a specific hazard management strategy but the success of the strategy is dependent on an acknowledgement of the hazard and acceptance by users of the mountain area. The only other ski area in the world with a direct warning system for volcanic hazards is Kusatsu-Shirame in Japan (Keys, 1997). Keys (1997) located 25 volcanoes worldwide that have developed ski areas. The only skier fatalities from volcanic-related activity were located in Japan, where over half the world's ski areas sited on volcanoes can be found. Many of the fatalities were related to high levels of carbon dioxide from eruptions and volcanic vents causing asphyxiation (Hill, 2000).

2.5.2 AVALANCHES

While loss of life due to snow and ice avalanches ranks relatively low on a global list of natural hazards, avalanches can be a hazard throughout the winter ski season at both Whakapapa and Turoa (Prowse, Owens, & McGregor, 1981; Dignan, 2008; Dignan, 2009; Hendrikx, 2007). There have been recent steady increases of avalanche fatalities relating to the increasing number of mountain recreationists both domestically and internationally (Fitzharris, Lawson & Owens, 1999; Keiler, Zischg, Fuchs, Hama & Stötter, 2005). Thirty-seven avalanche fatalities have occurred on New Zealand mountains between 1981 and 1998 and there have been fatalities at Whakapapa due to avalanche in the past (Irwin, MacQueen, & Owens, 2002). In the past year three avalanche deaths have occurred while visitors have been skiing and snowboarding in New Zealand (Smith, 2009). All three deaths occurred in the South Island.

Avalanches are created through weather systems, which create avalanche potential, causing an avalanche release. Avalanches are classified according to the volume of material involved in a single event and the amount of vertical descent (Richardson & Reynolds, 2000). The three main parts of the avalanche are shown in Figure 2.7c, showing the starting zone, track and runout-deposition zone. There are two main types of avalanche: loose snow avalanche and slab avalanche, categorised by the type of initiation mechanism and starting zone failure patterns (Richardson & Reynolds, 2000).

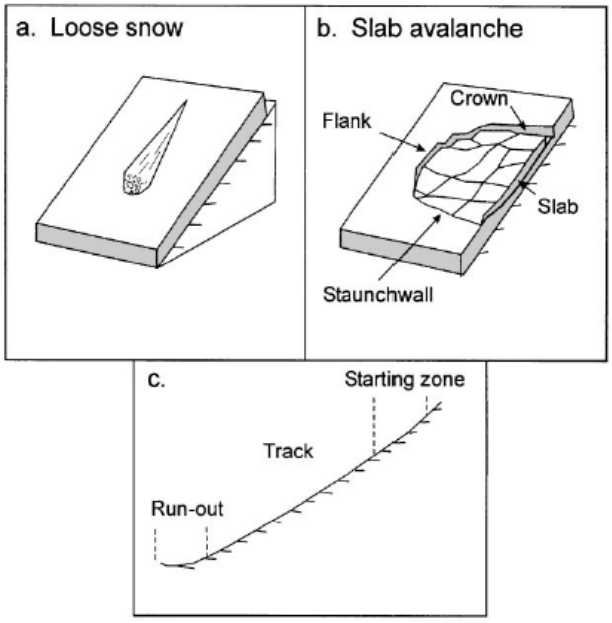

Figure 2.7 Types and formation of avalanches: (a) loose snow and (b) slab avalanches, with (c) the starting zone, track and run-out zone in profile (Source: Reynolds, 1992).

Avalanches occurring on Mt Ruapehu are largely wind slab, forming on lee slopes during or within 24 hours of a significant snowfall. Snow is carried over ridges and dropped on lee slopes, building a thick, unstable layer of dense snow. Sunny slopes stabilise more quickly and shady slopes in early winter can take much longer (Irwin *et al.*, 2002). Avalanches due to volcanic eruption are a possibility if wet slabs are triggered on steep parts of the mountain therefore the risk of an avalanche hazard is increased by eruptions (Department of Conservation, 1996).

During the weekend in the winter, from one hundred to upward of a thousand ski area visitors may leave the Mt Ruapehu ski area boundaries (Hjelde, 2009). This is of considerable concern to ski area management as many of these visitors do not have adequate skills, knowledge and basic self-rescue equipment to deal with the possibility of an avalanche.

Multiple avalanche mitigation plans may be employed in areas of avalanche risk (deScally & Gardner, 1994). The National Institute of Water and Atmospheric Research's Snow and Ice Network have been testing snow around New Zealand for water content, important information for assessing the stability of the snow and predicting avalanches (Hendrikx, 2008). At Whakapapa and Turoa, avalanche management includes detailed terrain analysis of possible avalanche

paths, forecasting, restriction of access to hazardous areas, artificial release of dangerous avalanches by ski patrol, stabilisation by compaction and maintenance of an effective search and rescue system (Ruapehu Alpine Lifts, 2009a; McNulty, 1984; Prowse *et al.*, 1981).

Figure 2.8 Avalanche at Turoa (Source: Ruapehu Alpine Lifts, 2007).

The Mt Ruapehu snow safety team is commissioned by DoC to provide a daily Backcountry Avalanche Advisory for the Tongariro National Park (Ruapehu Alpine Lifts, 2009a). Figure 2.8 shows Turoa ski slope following a patrol controlled release. Ski Patrol maps the possible avalanche control routes (Figure 2.9, Figure 2.10, Figure 2.11), monitors the weather and snow conditions and performs avalanche control with explosives including avalauncher guns and hand charges (Prowse *et al.*, 1981). While advancements have been made in the modification of avalanche hazards, human adjustments have only been successful in modifying avalanche release (Prowse *et al.*, 1981; McClung, 2002; Keylock, 1997). Mt Ruapehu ski terrain is all above the tree line therefore increasing the avalanche risk (Grímsdóttir & McClung, 2006). Caution must be observed when skiing out of bounds or outside operation hours when avalanche control by the patrol does not operate (McLay, 1995). Minimum safety practices for visitors entering avalanche prone or unpatrolled backcountry areas include travelling with a partner, carrying an avalanche beacon and carrying a shovel (Silverton, McIntosh & Kim, 2007).

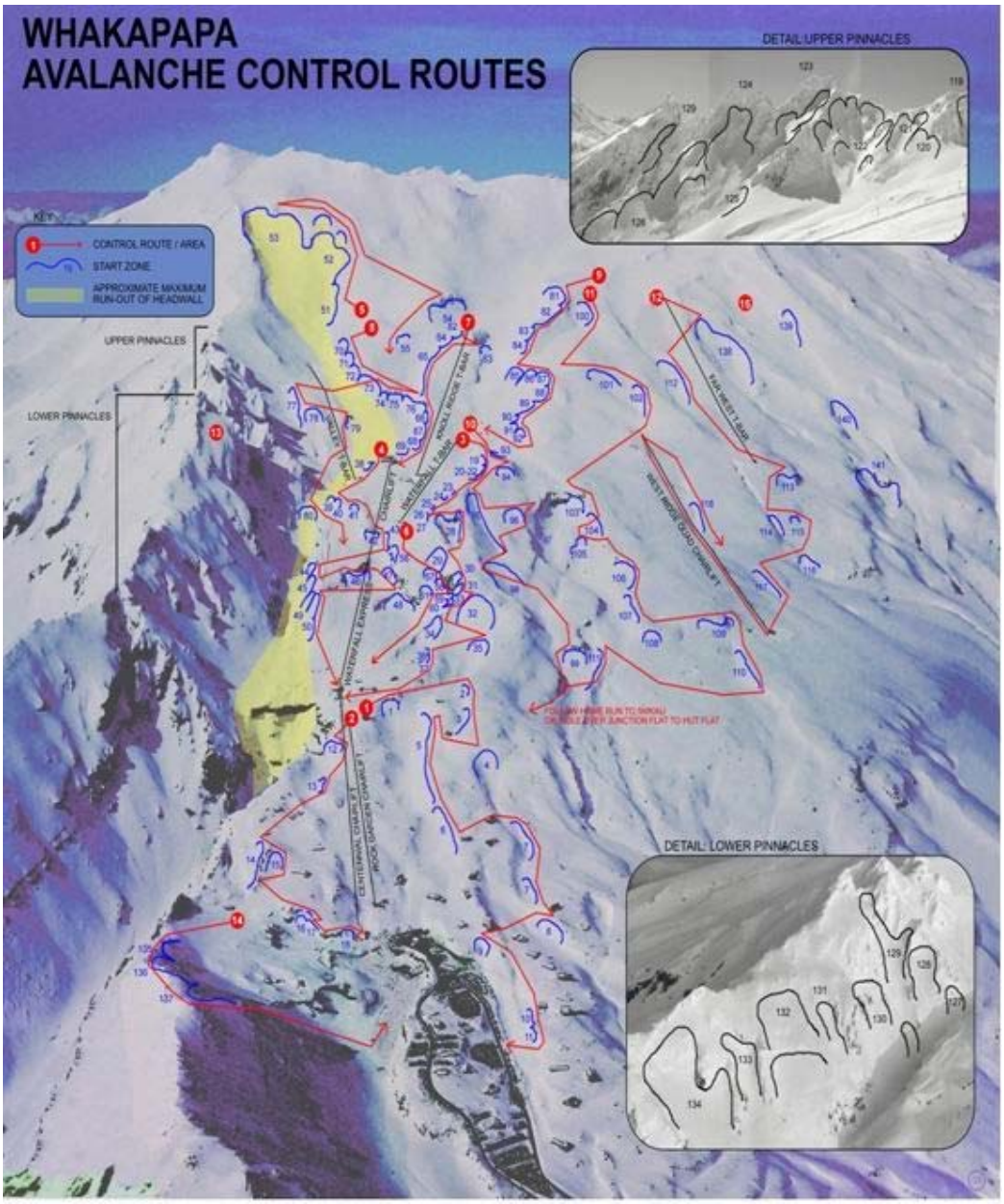

Figure 2.9 Whakapapa Avalanche Control Routes (Source: Ruapehu Alpine Lifts, 2008a).

A large avalanche triggered by Ski Patrol avalanche control work occurred at Turoa in September 2003 ("Avalanche was 'freak' of nature", 2003) within the ski area boundary and during open hours. The blast on the upper mountain moved a top layer of snow and sent lower layer of hard snow sliding into the public ski area. The avalanche started approximately 500m from the summit and travelled about 4km down the mountain, forcing the ski area to close ("Ski slopes closed after avalanche", 2003).

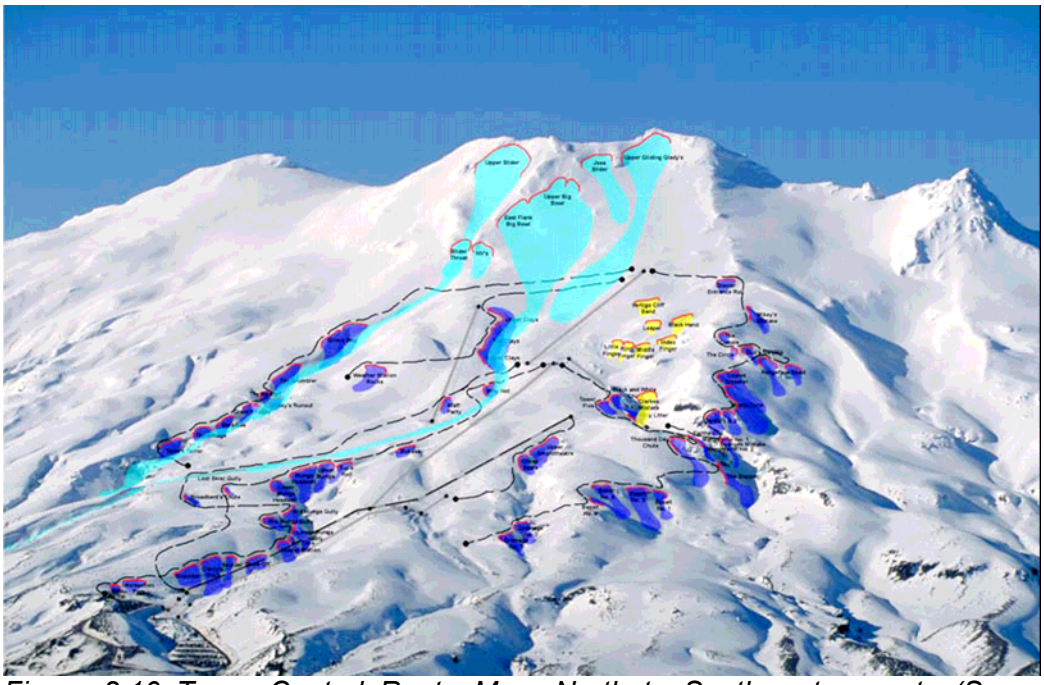

Figure 2.10 Turoa Control Route Map: North to Southwest aspects (Source: Ruapehu Alpine Lifts, 2007).

While considerable work is done to prevent avalanches occurring it is impossible to eliminate all risk associated with this hazard. It is not known at present how the public perceives the threat of avalanche at Mt Ruapehu.

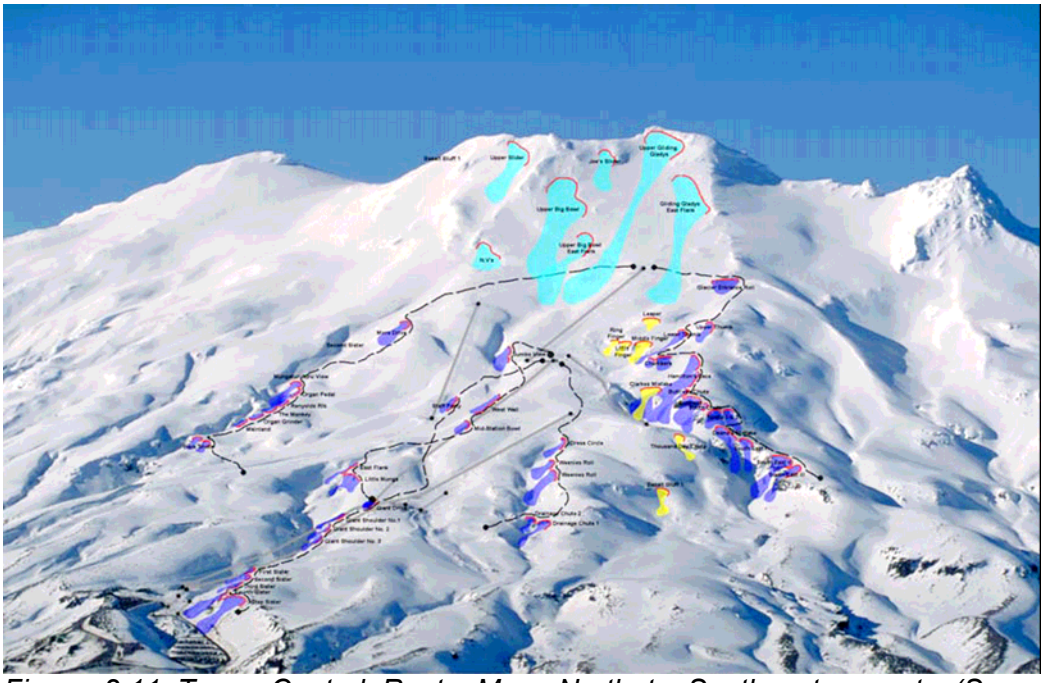

Figure 2.11 Turoa Control Route Map: North to Southeast aspects (Source: Ruapehu Alpine Lifts, 2007)

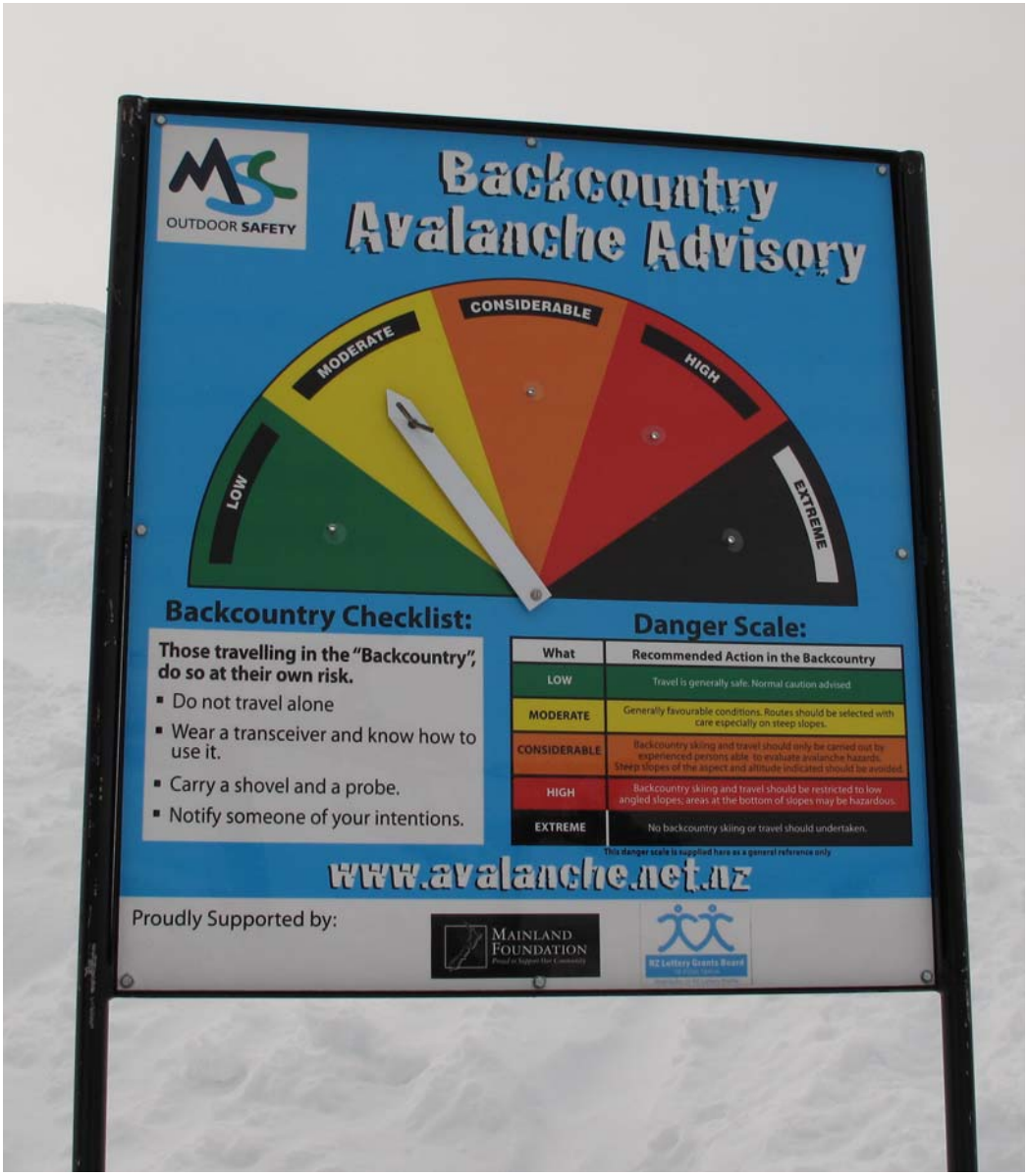

Plate 2.2 Backcountry Avalanche Advisory Turoa.

2.5.3 WEATHER

Mountain weather is highly variable and can be incredibly dangerous. The weather at Mt Ruapehu can be extreme and RAL ensures that staff and visitors are dressed appropriately for the environment. According to Thomson (2006), Mt Ruapehu's weekend skiers learn to ski such varied snow in high winds and near white-out visibility. Winds accelerate around the mountain and white-outs are common. Mt Ruapehu is open to weather and storm cycles, which leaves the alpine environment extremely susceptible to cloud and fog layers. When these cloud and fog layers exist, the visibility range naturally decreases. These factors along with full snow cover can create very low visibility. RAL staff monitor the visibility at all times, comparing the different altitudes, ranges and sharpness of penetrating light (Ruapehu Alpine Lifts, 2009a) and use isolation strategies to

limit access to dangerous areas during the adverse weather conditions, place advisory signage advising people to stick to the main trails and update snow reports throughout the day.

2.5.4 ICE, CLIFFS, ROCKS, OTHER PEOPLE AND THE MOUNTAIN ROAD

There is little information known about the perceived risk of ice, cliffs, other visitors to the mountain and the mountain road itself besides the information included within Mt Ruapehu's Terrain Hazard Control Plan (Ruapehu Alpine Lifts, 2009a). Because of the lack of information on how visitors to Mt Ruapehu perceive these hazards, it is in this study's interest to cover hazards like icy slopes, cliffs and rocks, other people and the mountain road.

The slopes at Whakapapa and Turoa are notoriously icy. The ice falls under three categories at Mt Ruapehu; rime ice, rain groomed and freeze-thaw surface conditions (Ruapehu Alpine Lifts, 2009a). These conditions produce a slippery snow surface, which may cause the snow user to slide uncontrollably down the slope, endangering themselves and other mountain users. The ski areas employ a number of strategies for dealing with icy surfaces in order to maintain acceptable levels of risk. While icy surface hazards can be lessened through grooming, isolated through fencing or minimised through signage, the hazard cannot be removed completely and conditions often deteriorate throughout the day. The ski areas also contain a number of dangerous cliffs due to the jagged volcanic terrain within bounds that are marked (Ihaka, 2009). Cliff hazards are marked with catch fencing, barriers or signage. Hazard protection, like fencing and signage, is provided if the cliff or drop off is over one metre.

Other mountain users are another major hazard at Mt Ruapehu ski areas. Collisions are the cause of around 15% of snow user injuries at Turoa (C. Emmett, personal communication, October 23, 2009). The system RAL uses to manage this hazard focuses on generalised areas where speed and the chance of collision can increase the risk of an accident. Control features in these areas are subject to change as conditions change due to increased or decreased snow levels, or as the trail widens the risk level may lower (Ruapehu Alpine Lifts, 2009a). This hazard is managed through 'slow' and 'trails merge' signs and catch netting.

2.7 CHAPTER SUMMARY

In order to assess public understanding of hazards at Mt Ruapehu a brief introduction to Whakapapa and Turoa ski areas and background to the potential hazards within these areas must be reviewed. Mt Ruapehu is an interesting place to study the public's perceptions of these particular hazards, including lahar awareness and preparedness, as well as perceptions of safety and risk. While there is existing research on the nature of the hazards, there is a need for more information on how visitors to the study site perceive risk and safety.

CHAPTER THREE
LITERATURE REVIEW

Plate 3.1 Turoa ski area from High Noon Express.

3.1 INTRODUCTION

There have been a number of studies at Mt Ruapehu looking at visitor response to the Eruption Detection System as well as a number of projects on visitor perception of hazards in various tourist locations around New Zealand. This study intends to go further than one particular type of hazard, e.g. lahars, to look across many potential hazards to visitors within Whakapapa and Turoa ski areas. In addition to this, this literature review intends to show that although studies have been done on hazards and risk these are mostly site specific and intend to control and reduce behaviour. The present study seeks to investigate awareness of hazards from the visitor's perspective. This section will cover a number of these research projects as well as look into the area of risk and hazard perception.

A hazard reflects a source of danger or the potential for harm (Cutter, 2006) and includes risk, impact and contextual elements. Natural hazards are those potential hazards occurring in the physical environment, which are harmful to man and destructive to the environment (Burton & Kates, 1963) and may be geologic, hydrological, climatic or atmospheric. It is only when people and their activities become vulnerable to natural processes that there is considered to be hazard risk (Richardson & Reynolds, 2000). Petak and Atkisson (1982) define

natural hazards as naturally occurring phenomena including avalanches, earthquakes and landslides which cause human suffering and loss. For the purposes of this study, natural hazards will encompass the traditional 'natural hazards' including lahars and avalanches, but will also stretch to include events such as ski patrol triggered avalanches and dangers from other skiers and snowboarders at Mt Ruapehu because they are hazards occurring within the natural setting, therefore are natural hazards. The intensity of a natural hazard event depends on the number of people and structures exposed to it, effectiveness of pre-event awareness and planning to protect people and property from hazard forces (Godshalk, Beatley, Berke, Brower & Kaiser, 1999). A natural hazard according to the Resource Management Act 1991 is:

> any atmospheric or earth or water related occurrence (including earthquake, tsunami, erosion, volcanic and geothermal activity, landslip, subsidence, sedimentation, wind, drought, fire, or flooding) the action of which adversely affects or may adversely affect human life, property, or other aspects of the environment. (p.45)

Many studies have looked at natural hazard mitigation (Godshalk *et al.*, 1999; Cutter, 2006; Petak & Atkisson, 1982; Stroesell, 2004) with little focus on the public's perception of the potential hazards. This study will focus in on public perception of these natural hazards at Whakapapa and Turoa ski areas. Studies have been carried out at Mt Ruapehu examining the public perceptions of volcanic hazards (Leonard *et al.*, 2004; Christianson, 2006; Paton *et al.* 2008) as well as visitor reactions to hazard warning systems and the hazards themselves (Leonard *et al.* 2008; Paton, Johnston & Houghton, 1998; Ward *et al.* 2003). The current study looks broader than just volcanic hazards and attempts to understand the extent to which visitors demonstrate awareness of natural hazards at Mt Ruapehu, and the effectiveness of existing warning signs. Leonard *et al.* (2008) tested awareness of the Whakapapa EDS in 2000 and then again in 2003 by observing the test in action and surveying visitors. They found that awareness decreased between tests. The current study does not assess visitor knowledge of EDS response when an actual trial is occurring as GNS already undertakes this work but does look to understand people's preparedness if a lahar were to occur on the mountain. This study will add to GNS knowledge of public awareness.

Ward *et al.* (2003) also focussed on lahar response awareness, looking at areas of training and education needing to be addressed to increase public safety in the event of a lahar. This study focussed on staff training and their interactions, rather than the visitor response to this training. Paton, Smith, Daly and Johnston (1998) reviewed the organisational response to the 1995 Mt Ruapehu eruption by surveying organisations with leading roles in the eruption crisis. They found that the response to the eruption by the various agencies including GNS and Civil Defence was not optimal; the present study offers an opportunity to see whether the public is more aware of what actions to take during volcanic events as a result of changes implemented following the 1995 events.

At Mt Ruapehu there are volcanic hazards like lahars, ash falls and pyroclastic flows as well as the EDS response to lahars, highlighted to the public through posters and public communication methods. GNS has done much study on the public response to lahar warnings, including work on public perceptions of the warning system (Leonard *et al.*, 2004), a review of the training issues around the EDS (Ward *et al.*, 2003), and Tongariro Crossing visitor perceptions of volcanic hazard danger (Coomer & Leonard, 2005). In understanding people's decision-making and response to warnings, warning messages must be received in a timely manner and there must be a relationship between warnings and the capacity to respond (Leonard *et al.*, 2004).

Espiner (1999), Hayes (2008) and Brook and Holland (2009) analysed the effectiveness of hazard warning signs at Franz Josef and Fox Glaciers, in the Southern Alps. They analysed the safety of visitors to a largely unmodified visitor attraction while preserving the significance of the outdoor experience. Espiner found that visitors' hazard awareness of visitors is moderate due to 'ambiguous hazard warning signs; unrealistic visitor goals and expectations; moderately high visitor perceptions of safety; a low level of visitor centre use prior to glacier access; and the phenomenon of social facilitation' (1999:5). Hayes (2008) performed a very similar study in 2008 looking at the levels of visitor compliance and the drivers behind non-compliant behaviour at hazardous sites. Brook and Holland (2009) looked only at Fox Glacier and explored glacier hazard awareness and visitor compliance with warning signs. The current study will look beyond visitor perceptions of hazards at a National Park where visitors are largely hikers, to a dangerous ski area where visitors are exposed to signage and asked to comply.

3.2 PREVIOUS STUDIES OF VISITORS AND HAZARDS

Winter mountain users are exposed to a number of natural hazards while they are at a ski field. While some may say that winter sports are inherently hazardous there are many ways for the ski area operator, in collaboration with a number of other organisations, to minimise risk. According to McLay (1995), RAL strives to ensure that under no circumstances should customers be exposed to dangerous situations or hazardous conditions. The safety of mountain guests holds the utmost importance with RAL therefore the best efforts are made to reduce risk and increase safety. However there is a balance that must be managed to protect the environment and visiting guests while making provision for enjoyment (Herremans, 2006). RAL is committed to the protection of their employees and guests from accidental injury or damage. Employees must observe safe work practices as the safety culture within the workplace determines actual safety (McLay, 1995). The ski industry is also required to meet the policies of the Health and Safety in Employment Act 1992.

Johnston *et al.* (1999) surveyed the residents of Hastings and Whakatane to measure their understanding of volcanic hazards in 1995. This was repeated in November 1995 following the Mt Ruapehu eruptions. The eruption provided a unique opportunity to test its effects on perceptions of natural hazards and to compare post event responses. The study looked at the implications for two communities and the different effects of threat knowledge, risk perception and preparatory adjustment. For survey respondents, knowledge of a volcanic threat was related to the proximity to Mt Ruapehu, levels of past damage and degree of contact with hazard information sources. Perceived risk has been linked to the proximity to the volcano, perceived likelihood of future disasters and level of impact and past experiences with volcanic disasters. The communities were asked about the perceived risk of several hazards including earthquakes, volcanic eruptions, floods, high winds, scrub fires and landslides and were explored in relation to perceived threat to personal safety and to daily life. The authors found these communities see natural hazards as a significant community issue and that only direct experience with the event appears to enhance threat knowledge and risk perception. Understanding a community's perceptions of risk is an important part of any decision making process and should be considered an essential component in natural hazard management (Finnis, Johnston, & Paton,

2004), although understanding why these perceptions are held is equally important.

Paton *et al.* (2008) have studied the way people's perception of their experiences with volcanic hazards and public education programmes influences their risk perception. They also looked at whether people adopted measures to mitigate their risk. Paton *et al.* (2008) found that informing people through distribution of pamphlets does not encourage people to educate themselves on how to prepare for hazards and how to cope with their consequences in their study in Auckland. Four hundred and five people were surveyed before and after a pamphlet drop and no increase in risk perception or preparedness were observed. People often overestimated their knowledge of hazards, which meant they were less receptive to new information and therefore less likely to alter the level of perceived risk they attributed to a hazard (Paton *et al.* 2008). Importantly, Paton *et al.* (2008: 183) state 'simply making volcanic hazard information available to people may not motivate people to prepare, is consistent with findings from research on other natural hazards', and those who have actually experienced a volcanic hazard may not be motivated to prepare for future volcanic crises. The present study seeks to understand people's perceptions of current hazard information at Mt Ruapehu and whether this makes a difference to people's preparedness. It will help GNS, DoC and RAL understand what the public interprets from the presented hazard information and may help them cater better to the public's needs.

Ward *et al.* (2003) wrote a report on the areas of training and education that need to be addressed by RAL to increase public safety in the event of a lahar at Mt Ruapehu. In 2004, Leonard *et al.* looked at the need for increased public awareness of what to do when the lahar warning system sounds at Mt Ruapehu. At that point there was no public training regarding the EDS but posters and brochures had been distributed to the public. The study looked at the audibility and response of the practise EDS and the observed actions of the staff and public. To gauge public awareness of volcanic hazards and the EDS, GNS interviewed randomly selected customers at cafes at Whakapapa. In their 2000 and 2003 surveys they found that almost all participants knew that Mt Ruapehu was an active volcano. More that 91% of respondents expected volcanic events within the ski field. While there were high levels of awareness of volcanic activity there was considerably lower awareness of lahar hazards. The present study

seeks to explore whether this is still the case and whether people take notice of measures to increase awareness of hazards (e.g. signs). In addition, the current study also seeks to investigate visitor awareness of other hazards like ice, cliffs and other mountain users.

A pilot study conducted to examine the implications of the Mt Ruapehu eruptions for GNS, DoC, the Ministry of Civil Defence (MoCD) and RAL by Paton *et al.* (1998) looked at the roles that different organisations played during the mid-1990s eruption crises. GNS monitored the eruption, set the "Scientific Alert Level", and provided scientific information to the MoCD and other organisations (Paton *et al.*, 1998). The MoCD provided information to the Government, district and regional councils. This work stressed the importance of developing and sustaining integrated emergency management capability and also looked at the implications of decision-making processes and group dynamics for response effectiveness. This study found a lack of clear responsibility for coordination, inadequate communication with other organisations, lack of appropriately trained personnel, management and media issues as well as problems communicating with community members all being reported as being problematic by at least 25% of those surveyed (Paton *et al.*, 1998). Those surveyed thought more work should have been put into pre-hazard preparation rather than ad hoc demands of crises when they occur. The demand from local and international media created significant stresses on organisations during volcanic events. Following the response to the 1995 Mt Ruapehu eruption, organisations felt well prepared to deal with future events.

There have been a number of related studies looking at visitor perceptions of volcanic hazards in Iceland (Bird *et al.*, 2009, 2010; Gudmundsson *et al.*, 2008; Jóhannesdóttir & Gísladóttir, 2010). This recent work focussed on permanent residents and visitors threatened by jökulhlaups, sudden bursts of meltwater from a glacier, near the Katla volcano in southern Iceland and were the first studies looking at visitor perceptions of volcanic hazards in the region. Mitigation strategies have been put in place including an early warning system and emergency response procedures. Researchers found that the public response during a volcanic event depends on the public knowledge of the evacuation plan and their knowledge and perception of possible hazards (Bird *et al.*, 2009). They also discovered that many of the residents did not perceive their homes to be in danger from a jökulhlaup and would not evacuate if warnings were issued. Tourists to the area lacked hazard knowledge and did not adopt preparedness

measures to deal with the consequences of a jökulhlaup (Bird *et al.*, 2010). These studies share similarities with the visitors to Whakapapa and Turoa ski areas, which both have local and tourist populations. Bird *et al.* (2010) found that providing people with information on how to respond during a volcanic event does not ensure they will respond correctly, and this may be the case at Mt Ruapehu ski areas as well.

Maclaren's (2006) investigation into risk assessment and management of holidays in the Canadian backcountry looked at three factors: (1) the perceived degree of risk in undertaking an activity, use of product or service; (2) the degree of confidence in the operator and that they have minimised and considered risks; and (3) the risk minimisation controls in place. Ways for the tour operator to control risk in this study of the backcountry include staff training, guest education and equipment maintenance. The current study will look at visitor awareness of ski area boundaries and people's preparedness when leaving the boundaries.

Many fields other than recreation management have examined human perceptions of and responses to hazards and risks (McCool & Braithwaite, 1992). Mitchell (in McCool & Braithwaite, 1992) found that factors that influence a person's perception of a hazard include the magnitude and frequency of the hazard, the recency of the individual's experience with the hazard, the importance of the hazard to the person's income, personality factors, and attitudes towards nature.

3.3 RISK

Risk is the potential to gain or lose something of value (Haddock, 2004). In any activity people accept a certain level of subjectively estimated risk to their health, safety and the other things that they value in exchange for the benefits they hope to receive from that activity (Maclaren, 2006). It is difficult to make a confident assessment of acceptable risk, particularly in an inherently dangerous place like an active volcano. Society does not expect people to experience serious injury or death in recreational activities. In an activity like skiing, it is impossible to eliminate all hazards without destroying the activity.

Social science research has found that technical experts and laypeople differ in their conclusions about the risk and benefits of hazards (Siegrist & Cvetkovich, 2000). For laypeople, like the mountain users at Mt Ruapehu, decisions and judgements are guided by social trust. Research indicates that social trust of

those who manage a hazard is strongly correlated to judgements about the hazard's risks and benefits. The perceived risk of a hazard is an individual's subjective assessment of the amount of risk present at any time and varies from person to person (Haddock, 1993). This differs from the real risk, which DoC, RAL, Mountain Safety Council and GNS attempt to minimise. Real risk is the amount of risk that actually exists at a given moment and is the amount of risk adjusted by safety controls (Haddock, 1993). This will be explored in the current study through a series of statements around perceptions of risk and attitudes of individual safety while using the ski areas.

In 2009, a five year-old child almost died when he fell 90m down a marked cliff at Whakapapa (Ihaka, 2009). A 29-year-old snowboarder died in 2008 at Turoa when she fell through a narrow hole in an area called the Organ Pipes. She had been trying to climb back up the slope to avoid the hazard after feeling unsafe traversing across melting snow, when she slid back down into the 'waterfall hole'. Warning signs were present near the hazard, but the area had not been roped off (Hudson, 2008). Incidents like these and subsequent articles published in national newspapers create a profile for hazards at Mt Ruapehu and may have an effect on public awareness of hazards, in turn having an effect on the present study.

3.4 HAZARD PERCEPTION

3.4.1 IDENTIFICATION AND CONTROL OF HAZARDS

The identification of hazards is not simple and has become more difficult as the depth of technology has increased (McLay, 1995) and because hazards involve the consideration of human subjects (Cerny & Schneider, 2009). There is no single way to identify and control hazards; however there are procedures to keep risks and losses within an acceptable range. In extreme outdoor sports people know they are pushing adventure to the extreme and no amount of preparation, equipment and expense can eliminate all risk (Herremans, 2006). Humans choose hazardous areas because they often offer benefits but the activity can exacerbate hazards (Bryant, 2005). While ski area managers cannot control hazards, e.g. a cliff cannot be removed, through managing visitor behaviour around the hazards risk can often be reduced (McCool & Braithwaite, 1992).

Visitor management must be diverse at Mt Ruapehu to deal with the numerous hazards and the widely ranging demographics of guests. According to McCool and Braithwaite (1992) there are four components to managing hazards: (1)

hazards must first be identified and described; (2) hazard managers may reduce or eliminate the hazard; (3) impose a barrier between the hazard and visitors; and (4) regulate visitor behaviour, or use persuasive messages. Whakapapa and Turoa ski areas use all of these methods of hazard management. The most apparent to visitors to the ski area are the signs used to warn skiers and snowboarders of cliffs, slow areas, out of bounds, etc. McCool and Braithwaite (1992) note their concerns about the effectiveness of warning signs influencing and modifying human behaviour due to its passive model of communication. To be effective, signs must be read, accepted and acted upon. In some cases, the actions taken by management are seen as being 'over cautious' and consequently hazard warning signs are ignored (Brook & Holland, 2009). McCool and Braithwaite (1992) raise other concerns about eliminating or reducing hazards. DoC is under an increasing legal and moral obligation to ensure high levels of visitor safety, however, elimination and reduction of hazards in National Parks are sometimes not possible because of the inability to modify public land and the inconsistency with DoC management objectives (Brook & Holland, 2009). Where features are modified there may be immediate hazard reduction but no long-term consequences for visitor education or behaviour change. The regulation of visitor behaviour is also seen as unappealing because of the intrusion into the recreation experience, to remove all hazards from the outdoor experience at Mt Ruapehu would be impossible and would 'take away much of its aesthetic beauty as well as its appeal as a vigorous mountain experience' (Penniman, 1993: 215).

3.4.2 RISK PERCEPTION

Despite the numerous studies of the perception of risk in other tourist destinations in New Zealand (Espiner, 1999; Hayes, 2008; McCleave, Espiner, & Booth, 2006; Brook & Holland, 2009) the work that has been done at Mt Ruapehu is largely about awareness of lahar/volcanic hazards (Leonard *et al.*, 2008; Christianson, 2006; Finnis *et al.*, 2004). Existing work has been about what hazards the public consider to be most worrying to their safety rather than about how people perceive risks at the ski areas. While Coomer and Leonard (2005) looked at perceptions of the volcanic hazard danger by Tongariro Crossing visitors, this study will examine ski area users and how much responsibility visitors to the ski areas assume for their own safety while using the mountain.

Hazard adjustment has been related to perceived risk, the amount of protective information received, level of past damage, volcanic hazards as a problem

related to other hazards, and the level of threat knowledge (Johnston, Bebbington, Lai, Houghton & Paton, 1999). Perceived vulnerability is an important issue in understanding how people think about natural hazards. People who perceive they are vulnerable are more likely to respond to warnings (Johnston *et al.*, 1999). Bird *et al.* (2010) found that in order to increase levels of preparedness in at-risk populations, education campaigns must emphasise the individual's personal responsibility for safety

Hazard awareness is a consequence of a number of factors including unclear hazard signs and unrealistic visitor goals and expectations. Having a high perception of safety can affect hazard awareness as well as social facilitation, a process whereby people respond to the behavioural cues of others (Espiner, 1999). People's understanding of risk and response to risk is not determined only by available scientific information or direct physical consequences, but by the interaction of psychological, social, cultural, institutional and political processes (Finnis *et al.*, 2004). An example of social and cultural processes coming into play would be groups of young male snowboarders engaging in more risky practices, using areas of the mountain above their ability level and where they are more likely to be injured.

3.4.3 WINTER MOUNTAIN USERS

In studies examining hazard awareness of winter mountain recreationalists, the ability of the skier or snowboarder is highly relevant. Recent work has established that beginners suffer far more injuries than more experienced skiers (Sulheim, Ekeland, & Bahr, 2007). Skiing ability is the most important risk factor in itself for winter mountain users. Other risk or protective factors to consider like helmet use are also important when looking at skiing ability and number of accidents. Aschauer, Ritter, Resch, Thoeni, and Spatzenegger (2007) examined injury rates in snow sports. Over 6 weeks, 57 different criteria according to accident, person and circumstances from 3512 skiers and snowboarders were gathered and collected in a database. The authors also noted information regarding frequency of transportation, weather and trail conditions. In their study they found the injury rate for piste sports is 0.7%. The largest influence on risk was bad weather conditions. The study also found unsurprisingly that young people represent a risk group. Aschauer *et al.* (2007) compared their results with a wide range of sports and found that skiing and snowboarding are among the safest sports because of improved material and trails. They found that 18% of skiing accidents are collisions and 14% of all skiers do not know the FIS rules of conduct

(equivalent to the New Zealand Snow Responsibility Code (Mountain Safety Council, 2010). At Mt Ruapehu, 10% of all 2008 Whakapapa accidents were caused by collisions (Ruapehu Alpine Lifts, 2009d) and 14% of all 2007 accidents at Turoa (Ruapehu Alpine Lifts, 2008b).

Skiers and snowboarders must coexist on the same slopes. There are some who believe snowboarders should be confined to a particular mountain or trail but they are in the minority (Chon & Hudson, 2002). According to Chon and Hudson (2002), worldwide there are 70 million skiers with 77% skiers, 16% snowboarders and the rest cross-country skiers. Skiing tends to be a very white, middle class pursuit (Gibson, 2006). The serious skier may have to persevere through fear, expense and the need to travel long distances to participate. The current study will look at whether skiers and snowboarders are equally aware of hazards. Results may help ski area staff cater safety material for a particular audience.

3.4.4 MOTIVATIONS FOR WINTER MOUNTAIN USERS

It is necessary to look at why skiers and snowboarders (and others) use natural areas and what motivations they may have for using these areas. This may help to better understand their views and perceptions of mountain hazards. Winter mountain users are inherently risk-taking recreationists and understanding their motivations will give background to these particular groups of people. Serious skiers and snowboarders belong to a clearly identifiable group with its own norms, values, behaviours and even language. The motivations for skiing are multiple and that dangerous skiing is a complex, social phenomenon (Hudson, 2000). People ski for personal achievement, social reasons, enjoyment of nature, escape and thrill and the most popular reason for not choosing to ski is the lack of appeal and the expense factor (Hudson, 2000).

The strong sense of social identification engendered by many serious leisure activities and their concomitant subcultures is useful to explain the continued commitment to continue participating (Gibson, 2006). The benefits of participation must outweigh the cost of taking part. A skier with a fear of heights or dislike of the cold may negotiate those constraints as they feel the thrill of the activity outweighs these factors. Some individuals may be tied to the activity of skiing or snowboarding by the expectations and needs of others. People also seem to identify with the group as a way to maintain and enhance social identity; non-members are often viewed in negative terms (Gibson, 2006). Recreational activities often function as a form of social release in which participants can

behave in a way not constrained by usual customs and protocol. Many people may be involved in skiing for non-athletic reasons since the social benefits may be more powerful primary motivators. Third, for many non-athletic people skiing often functions metaphorically in that one can pretend to be a vigorous mountain person coming to grips with risk and danger. Many skiers are more concerned with safety and ambience than athletic challenge or risk (Hudson, 2000).

In any activity people accept a certain level of subjectively estimated risk to their health, safety and the other things that they value in exchange for the benefits they hope to receive from that activity (Herremans, 2006). People review the amount of risk they feel they are exposed to and compare this with the level of risk they are willing to accept and try to eliminate any difference between the two.

3.4.5 NON-COMPLIANT BEHAVIOUR

Hayes (2008) looked at the motivating factors of non-compliance in visitors to Franz Josef and Fox Glaciers. He presented three reasons why visitors to recreational areas may not comply with management measures to protect safety. Situational factors or circumstances may encourage or justify non-compliant behaviour – people may rationalise their non-compliant behaviour based on the behaviour of others; unfamiliarity with hazards may lead to low hazard awareness due to minimal exposure to hazards; visitors may have unrealistic goals and expectations; or visitor reaction against over-cautious approach taken by management in recreational areas. Information retrieval and using communications-based strategies have been found to be successful in some contexts in managing visitors' awareness of hazards (Espiner, 1999; Hayes, 2008). Behaviour may also be influenced by the judgements visitors form toward a situation. For example at Franz Josef and Fox Glaciers hazard warning signs are located in areas where there may be no perceivable risk, giving the impression that warning signs are not to be taken seriously (Hayes, 2008).

3.5 COMMUNICATING RISK

3.5.1 MANAGEMENT TECHNIQUES FOR COMMUNICATING RISK

Management of natural areas have the ability to increase preparedness of visiting populations, therefore decreasing vulnerability (Hegglin & Huggel, 2008). While there are a number of ways for management to communicate risk and reduce non-compliant behaviour these practices can be grouped based on whether they act directly or indirectly on visitor behaviour (Figure 3.1) (Manning, 1999). Direct management actions can be defined as rules and regulations imposed around

visitor actions. These can involve limitations and restrictions as well as activity zoning. Direct management techniques are used widely within ski areas to restrict visitors from entering hazardous areas. In comparison, indirect management techniques influence decision factors on which visitors base their behaviour by encouraging voluntary changes. Indirect techniques are implemented through visitor interpretation and education, for example in a ski area setting through signage on the back of bathroom stalls, and on chairlift pylons. Hayes (2008) found mixed results when looking at the success of either technique but confirmed that when visitors are made aware of the link between actions and their consequences rule breaking behaviour decreases.

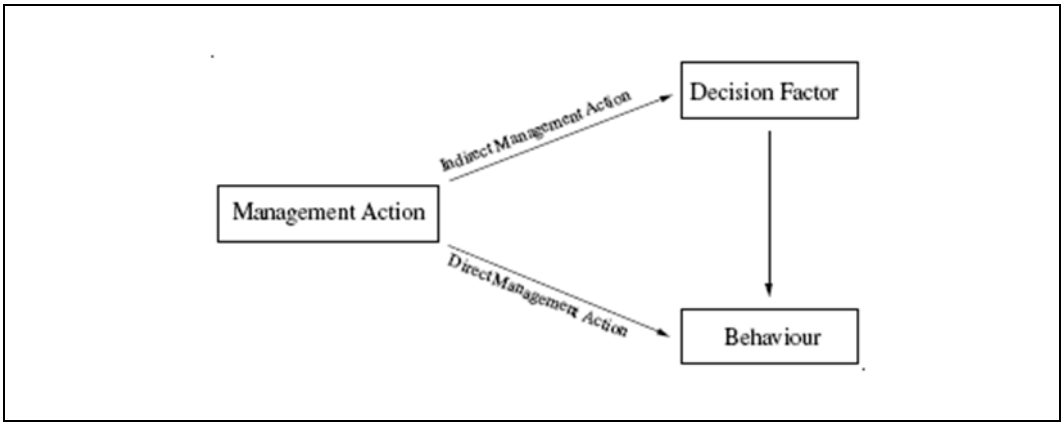

Figure 3.1 Diagram of direct versus indirect management techniques (Source: Manning, 1999).

There is a strong campaign driven by support from the Ruapehu Mountain Clubs Association around promotion of mountain safety (Leonard *et al.*, 2008). Local clubs help to develop, display and explain education materials. RAL focuses on trail marking, boundary signage and backcountry advisory in accordance with their agreement with DoC. A range of ski area signs are shown below (Figures 3.2, 3.3 & 3.4).

Figure 3.2 Advanced ability only sign, Danger cliff sign, Keep out hazardous area sign, Closed avalanche danger sign (Source: Ruapehu Alpine Lifts, 2009a).

Figure 3.3 Caution ice sign, Caution rocks sign, Caution trails merge sign, Warning ski area boundary sign (Source: Ruapehu Alpine Lifts, 2009a).

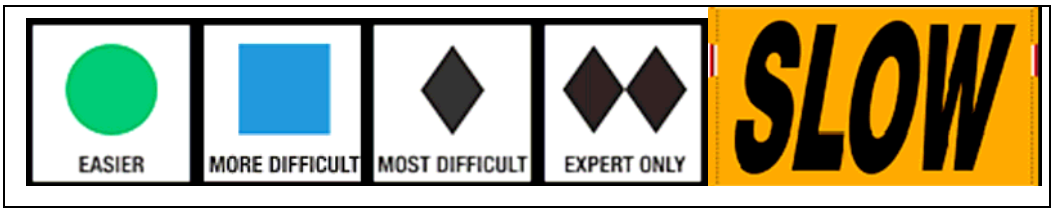

Figure 3.4 'Easier' terrain sign, 'More difficult' terrain sign, 'Most difficult' terrain sign, 'Expert only' terrain sign, Slow banner (Source: Ruapehu Alpine Lifts, 2009a).

GNS monitors eruption-warning systems and assists DoC and RAL to promote mountain safety related to volcanic hazards. The Mountain Safety Council is also involved with the publication of pamphlets and other communication on hazards like ice and weather. It is important for the success of the risk communication for it to be supported at both the management and operational levels. The public's understanding of risk and their response to risk are determined by the interaction of psychological, social, cultural, institutional and political processes as well as the available scientific information and direct physical consequences (Finnis *et al.*, 2004). The understanding of volcanic risk by residents needs improving. In order to change people's risks perceptions future work should not only concentrate on providing scientific information on the hazards but also the possible social, cultural and physical effects of the hazards (Finnis *et al.*, 2004).

The risk management system for lahars at Mt Ruapehu is a combination of warning systems, risk perceptions and human response. DoC takes on a specific role during a volcanic event. They coordinate management of the hazard within Tongariro National Park and issue public information and media communications. They deal with the DoC head office and political consequences as well as deal

with external agencies and local communities (Department of Conservation, 1996).

In blind tests at Mt Ruapehu, visitors displayed minimal awareness of the correct actions to take during a lahar warning (Leonard *et al.*, 2008). It was noted by Leonard *et al.* (2008) that the ability and awareness of the staff to react correctly is a critical factor in the success of an emergency drill. Well-informed staff is the key to educating a largely transient visitor population. Christianson (2006) looked at the staff response and knowledge of procedures in volcanic events. The introduction of education material and staff training strategies has greatly increased knowledge of correct procedures and has created blind tests with greater success (Leonard *et al.*, 2008). Local populations also need to be educated about mountain hazards. The neighbours of protected areas and their interests and needs must be considered in the management of these areas (McCleave *et al.*, 2006).

One of the main difficulties in communicating risk at Mt Ruapehu is the transient visitor population. To enable effective and quick responses to warning situations relationships need to be developed for fast and accurate transmission. These communications must be tested and the communications plan must also include material to educate a changing mountain population. This includes ongoing training for staff with high turnover (Leonard *et al.*, 2008). Lahar events come in two categories: events where warning signs may occur and 'blue sky events' which occur 'out of the blue' (Ward *et al.*, 2003). Due to the possibility of 'blue sky' volcanic events, staff and guests need to be prepared for volcanic activity at any time.

There are two main populations to consider in mountain risk management: those working as part of on-hill operations and the skiing public who are far more dependent on the response of emergency workers (Leonard *et al.*, 2008). The work in educating people about lahar warnings is much more than a warning system notifying the public that there is a hazard. People need to know what to do when they hear the EDS. Staff must react quickly and effectively and comprehensive training and education will allow this. In 2003 the training programme included staff induction, a video and a staff handbook (Ward *et al.*, 2003).

There is some evidence that suggests public education initiatives increase people's knowledge of hazards and how to respond (Leonard *et al.*, 2008). Paton

et al. (2008) noted that public education must be delivered during periods of quiescence. Hystad and Keller (2008) have reiterated the need for long term studies of disaster planning and awareness education. A wide range of media and communication channels outlining warning systems and appropriate responses must be used to reach the broadest audience and educational materials must be catered to the community (Paton *et al.*, 2008). A transient tourist would respond quite differently than someone who worked on the mountain. A mountain employee would be looked to for direction in an emergency. this is why both tourists and mountain employees are surveyed.

Signs and maps with hazard zones and safe zones are used at Mt Ruapehu. All staff must be able to answer questions and be exposed to training videos and lectures and mountain staff must receive further training on emergency actions to take in the event of a lahar. The roles that mountain staff are required to play are defined below (Table 3.1). GNS run lahar warning simulations twice yearly. Staff are advised of the first simulation and the second is blind. In 2005, Christianson observed both simulations focussing on staff response to the EDS. She found the pre-warned test results to be varied, and then moderate awareness of actions to take in the event of a lahar in the blind test. Christianson (2006) concluded that while staff were adequately prepared, the reaction time of both staff and customers could be improved across all areas of Whakapapa.

Table 3.1 Roles of RAL staff in the event of a lahar (Source: Ward et al., 2003).

	Role: Pre-lahar	Role: During lahar	Role: Post lahar
Ski Patrollers	• Provide accurate information to any customers enquiring about this hazard	• Sweep of high risk areas • Move customers to safe areas and assure they stay there, reassure them of their safety	• If near shelter in safe area, move there • Provide information about location and status of customers to Ski Patrol Manager • Attend to those injured • Take instructions from Area Two Controller on evacuation of mountain. May also have to take control of a sub-area (see DoC Eruption Response Plan)
Lift Operators	• Provide accurate information to any customers enquiring about this hazard	• Clear lift, stop lift • If in safe area, stay there. Otherwise, move customers to safe area and ensure they stay there, reassure them of their safety	• If near shelter in safe area, move there • Provide information about location and status of customers to lift operations supervisor • Attend to those injured if able, or ensure they are warm and comfortable until help arrives • Take instruction from either supervisor or evacuation coordinator on evacuation of mountain.
Snow School	• Provide accurate information to any customers enquiring about this hazard	• If in safe area, stay there. Otherwise, move customers to safe area and ensure they stay there, reassure them of their safety	• If near shelter in safe area, move there • If able (e.g. by radio), provide information about location and status of customers • Attend to those injured if able, or ensure they are warm and comfortable until help arrives • Take instruction from either supervisor or evacuation coordinator on evacuation of mountain.
Customer Services	• Provide accurate information to any customers enquiring about this hazard	• If customers are around in a safe area, make sure they stay there, reassure them of their safety • Begin a register of customers present/missing	• Provide up to date information on the status of the mountain and those on it • Will likely receive calls from those with friends and relatives on the mountain, need to try and reassure these people as best as possible • Avoid making false/uncertain statements
Food and Beverage	• Provide accurate information to any customers enquiring about this hazard	• Make sure customers in cafes in safe areas stay there, reassure them of their safety • Stop serving food, as this may be required to be rationed if evacuation of the mountain is delayed for some time	• Provide shelter to those stranded on the mountain • Provide food to those stranded on the mountain • Begin a register of customers present/missing • Provide information about customers present/missing to those coordinating evacuation
Rental/ Workshop/ Retail	• Provide accurate information to any customers enquiring about this hazard	• If customers are around in a safe area, make sure they stay there, reassure them of their safety	• Provide shelter to those stranded on the mountain • Begin a register of customers present/missing • Provide information about customers present/missing to those coordinating evacuation
Groomers	• Less likely to be on mountain during operating times, but must be aware of dangers in order to protect themselves		

Figure 3.5 Volcanic Hazards at Whakapapa poster (Source: Geonet, 2009a).

Customer education recommendations include moving to higher ground. This message is communicated on signs on the back of toilet stalls, on the back of lift tickets, in ticket and rental queues, on lift pylons and in cafes (Figure 3.5, Figure 3.6). RAL, GNS and DoC have worked with local clubs and lodges to promote safety material. There are concerns that if the public is told too much they may be deterred from using the mountain (Ward *et al.*, 2003), although Cohn, Hendricks and Chavez (2008) found fear appeals are likely to be more effective than moral appeals due to greater consequence to self. Gramann, Christensen and Vander Stoep (1992) showed that early interpretive messages that give justification for

acting as recommended are likely to be more effective at encouraging people to comply with rules than vague statements of suggestions.

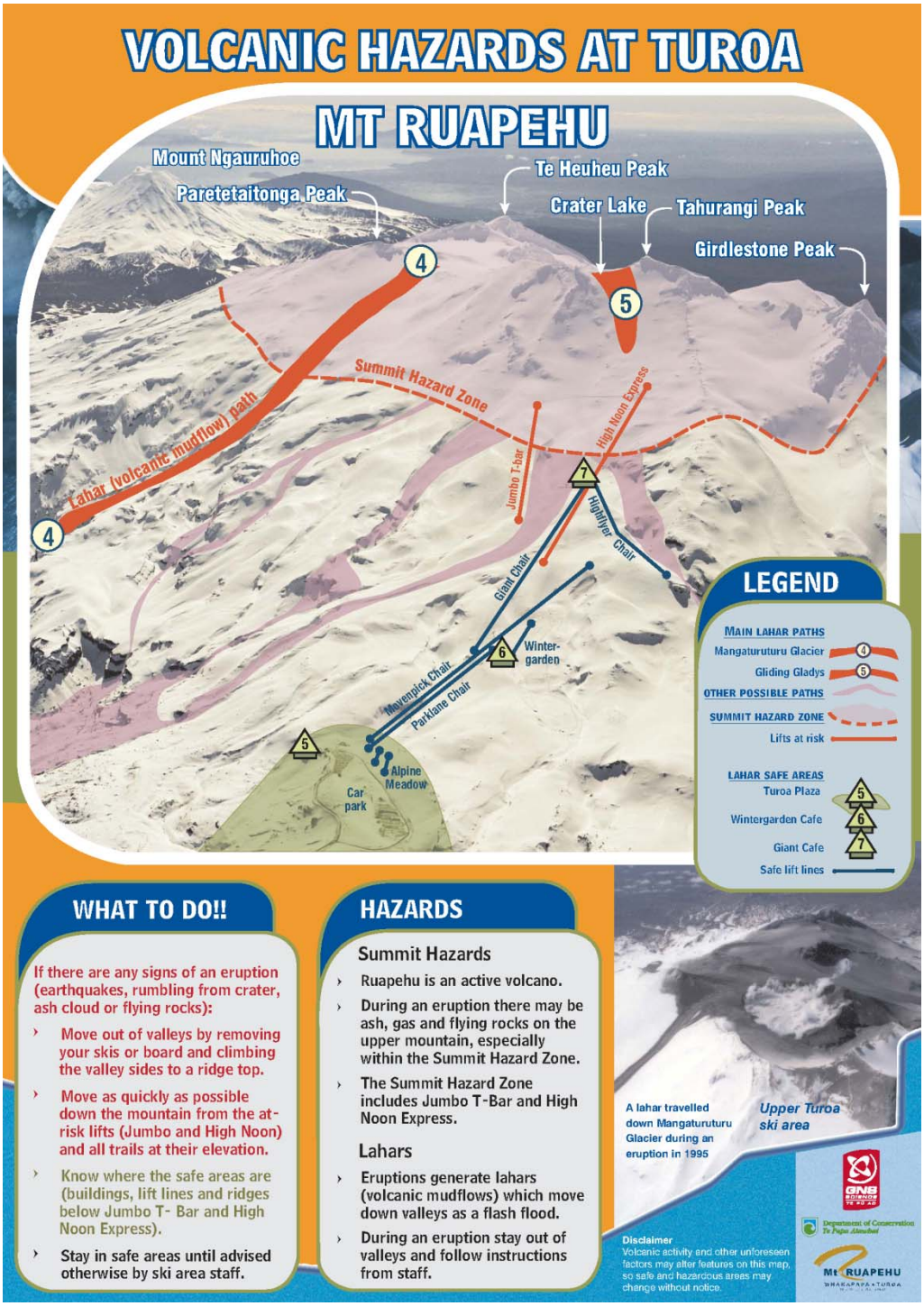

Figure 3.6 Volcanic Hazards at Turoa poster (Source: Geonet, 2009b).

The effect of this signage and communication needs to be evaluated through the current study due to limited evaluation by GNS (volcanic awareness) and RAL (customer awareness) annually. A broader study of the way people perceive risks and the extent to which they assume responsibility for their own safety is critical to better managing hazards. Experience and knowledge of hazards does not guarantee the adoption of protective actions (Paton *et al.*, 2008). Decisions on how to act during a hazardous event are determined by how people interpret

information and whether the information is meaningful to them. In past studies it has been found that if people overestimate their knowledge or expertise they will be less receptive to new information. Simply making information available to people may not motivate them to prepare (Paton *et al.*, 2008) therefore improvements are needed in the field of communication to reduce the impact of future hazard events (Nothinger & Elasser, 2004).

3.6 CHAPTER SUMMARY

The literature review has provided an overview of the range of work on natural hazards and hazard perceptions at Mt Ruapehu. A great deal of the research has been done relating to the eruptions at Mt Ruapehu in the mid 1990s and while there has been some work done on the response to volcanic hazards, response rates have not improved significantly, and other hazards at Mt Ruapehu have been ignored in the literature. This study aims to fill a gap in existing knowledge by focusing on a range of volcanic hazards, specifically lahars, and the awareness of warning systems, and understand the public's perception of hazards at Mt Ruapehu. The present study will delve further than volcanic hazards to look at avalanche, cliff, adverse weather conditions and other mountain user hazards to increase the understanding of how individuals perceive risks from natural hazards and the factors related to risk perception. This work, not studied before at Mt Ruapehu, may be used to create better practices around informing the public of mountain hazards.

The work cited in this literature review has shown the importance of understanding visitor's perceptions of hazards in the event of an emergency. Their knowledge and perceived risk will allow them to make decisions regarding actions to take. This review has shown clearly the lack of study around the area of visitor perception and awareness of hazards at Mt Ruapehu (outside of lahar awareness). While GNS conducts annual studies of visitor awareness and reaction to the EDS, these studies have been done on the EDS event day.

This study aims to further expand on Espiner's (1999) work on visitor perception of hazard signs and broaden the scope to include hazards that the visitors themselves may not have considered. This study will evaluate awareness of hazards of visitors to Mt Ruapehu ski areas through surveys and will add to existing research a broad overview of hazard perception. This information may help to inform management whether current practices undertaken by RAL, DoC and GNS to educate the public and staff in the potential mountain and human hazards at Mt Ruapehu are working.

CHAPTER FOUR
METHODOLOGY

Plate 4.1 Turoa ski area from the top of the Giant Chairlift.

4.1 INTRODUCTION

The aim of this study is to assess visitor perceptions of hazards at Mt Ruapehu ski areas. Different research tools were used to gauge these perceptions and the mixed-method approach allowed the researcher to gain an understanding of visitor knowledge and perception of hazards at Mt Ruapehu ski areas. Quantitative data were collected to gain an understanding of the public's perception of hazards at Mt Ruapehu. Quantitative methods produce detailed data, but qualitative data are also necessary to provide the depth and understanding of the survey results. With qualitative data it is possible to look at survey results and the public's suggested awareness and compliance of hazard mitigation measures from the perspective of Whakapapa and Turoa safety staff. Interviews were conducted to gain an overview of the controls that are in place related to the hazards and how the organisations involved work together. Safety staff at RAL were interviewed about their understanding of the public perception of risk, and how accurately aligned the survey results are with the actions of the public.

This chapter presents the rationale for choosing the study site, the methods used for gaining the quantitative data and information regarding the interviews with DoC, GNS and RAL. Data analysis processes and ethical considerations are summarised. Lastly, the observations from survey days are outlined, along with any potential issues and limitations with the study methods.

4.2 RATIONALE FOR CHOOSING STUDY SITE

The study measures visitor perceptions of hazards at Mt Ruapehu. It looks at visitor perceptions, the publics' attitudes and behaviours toward hazards and management controls of the hazards within a national park. While management collects information on the number of accidents occurring at the study site, there is little information on perception of hazards within the areas. The number of accidents suggests a low level of compliance with management recommendations.

The study areas are protected natural areas, located within Tongariro National Park, and hazards within this area are managed by RAL, DoC and GNS. By studying two locations, Whakapapa and Turoa, the presence of similar physical characteristics and the awareness of mountain users in both areas are able to be compared. Whakapapa and Turoa are ideal sites for studying perception of hazards as they are two relatively similar study sites with hazards that require ongoing hazard mitigation strategies from RAL and GNS.

4.3 QUANTITATIVE SURVEYS

Research was largely comprised of surveying mountain users at both Whakapapa and Turoa. A survey was created, influenced by Espiner's (1999) study of perception of hazards, as well as the annual GNS study of the public's awareness of the EDS system at Whakapapa. Espiner (1999; 2001) used surveys to determine public perceptions and analyse the effectiveness of hazard warning signs at Franz Josef and Fox Glaciers. The survey used in the present study was designed to address parts of all four of the research objectives, aiming to gauge mountain users' perception and knowledge of hazards of Mt Ruapehu; with a view to help appreciate public awareness of dangers and how to better educate people of the potential dangers. The method used to survey was anonymous, self-completion by winter mountain users at cafeterias at Whakapapa and Turoa. Self-administered surveys were used for the ease of

measuring variables with numerous values and response categories and the ability to investigate opinions that are not observable (Nardi, 2002). The surveys were completed on site and handed back to the researchers.

Surveys were chosen as the most appropriate method to quantitatively assess visitor risk perceptions and to assess the effectiveness of existing hazard warning signs at the ski areas, addressing research objectives one (examine public awareness of natural hazards on Mt Ruapehu), two (analyse the specific hazards to which visitors feel they have been exposed), three (looking at basic visitor characteristics and use patterns for the two ski resorts) and four (assess the effectiveness of current hazard sign system in communicating the actual hazards to visitors).

Self-administered surveys provide a way to elicit attitudes, perceptions and beliefs from many people and are easily administered (Bickman & Rog, 2008). Using some questions from previous research studies (Espiner, 1999; 2001; Leonard *et al.*, 2004), responses obtained from the surveys are able to be compared to results from other organisations using the same instrument (Bickman & Rog, 2008). Simmons (1984) and Simmons and Berno (1995) discussed the virtues of integrated methods in the study of tourist areas and concluded that formal surveys can enhance all stages of less structured work, especially with regard to the representativeness of cases (Espiner, 2001). Surveys are convenient and are easily replicated.

There were a total of 20 questions, incorporating demographics (skier/snowboarder, ability level, years skiing/snowboarding, Turoa/Whakapapa, home city/country, gender and age), safety (NZ and ski area), restriction of access, awareness of various hazards (lahar, ski area boundaries, avalanches), perceptions of management control of hazards and personal accountability. Statements for question 19, where participants were asked to rate their agreement or attitude on a seven-point scale were drawn from Espiner's (1999) study to allow for direct comparison. The aim of the Likert-type scale was to look at three aspects of visitor perception:

- The extent of visitor hazard awareness within the ski area;
- The extent of safety within the ski area; and
- Extent of responsibility for own safety within the ski area.

A copy of the survey can be found in Appendix 1. Draft survey versions were subjected to review by Martin Brook (Massey), Graham Leonard (GNS), Andy Hoyle (RAL) and Chris Emmett (RAL).

4.3.1 PARTICIPANTS

Participants of the survey were mountain users, including skiers, snowboarders, climbers and non-skiers, on 27 and 28 September 2008. Approximately 200 people were surveyed at Turoa ski area on Saturday 27 September 2008 from 8a.m. to 10.30a.m, and then 200 people surveyed at Whakapapa on Sunday 28 September 2008 from 8.30a.m. to 11.00a.m. Most people were surveyed before they headed out to the slopes for the day, ensuring that all respondents had to use their recall from previous visits to the ski areas in their survey answers. It should be emphasised that the sample of 400 respondents is intended to represent visitors to the Whakapapa and Turoa ski areas during the weekend of 27-28 September, and is not necessarily representative of annual visitation to the region.

4.3.2 PARTICIPANT SELECTION

Participants were randomly selected, using a method suggested by GNS. Participants were selected using spatial sampling. This procedure is used when people are temporarily congregated in a space (ski area cafeteria). Due to the nature of the population, staying indoors for only a short amount of time, there are neither sampling frames nor enough time to allow the use of other methods (Sarantakos, 2005). With this survey method the researcher addresses the person who happens to be immediately in front of them, then moves forward to ask the next person to complete the survey. Those surveyed constitute the sample for this study. The survey was administered by the researcher, and participants were asked to complete the survey while seated in the cafeteria. This meant the number of surveys returned was almost 100%, however some surveys were only partially completed.

Participants were approached by the researcher and were advised the survey would take approximately 10-15 minutes. They were then left to complete the survey in their own time and it was returned to the researcher. Participants were advised that if they did not feel comfortable answering any question they could leave it blank. Participation was voluntary, and almost all people approached were happy to complete the survey. Approximately five people at either ski area did not want to fill out a survey, citing time as the main reason. The survey stated that all answers were confidential. Participants did not provide names or contact information, however several people were so interested in the result of the survey that they left their contact details on their survey paper therefore they were sent a summary of the research when it was completed.

Approximately 20 surveys were usually being completed at any one time. These were staggered when handed out so they would not all be finished at the same time. A number of people completed the first or first and second page only, likely due to the length of the survey. This meant that some of the questions on the second and third pages of the survey may have only been filled out by people interested in the survey or with strong feelings on hazard awareness and self responsibility within the ski areas, and skewed the results one way or the other. One field assistant, Dale Shirtliff, provided assistance in distributing surveys.

4.3.3 Location of Study

The surveys were conducted in cafeterias in both ski areas. On Saturday 27 September 2008, the surveys were distributed at Turoa Plaza (Figure 4.1), at the top of the car park (base of the ski area) beginning at 8a.m. On Sunday 28 September 2008 the surveying began at the Top o' the Bruce Cafe at 8.30a.m. (Figure 4.2). Mountain users were preparing to move up the mountain for the day. The surveying then moved to the Knoll Ridge Cafe at 9.30a.m.

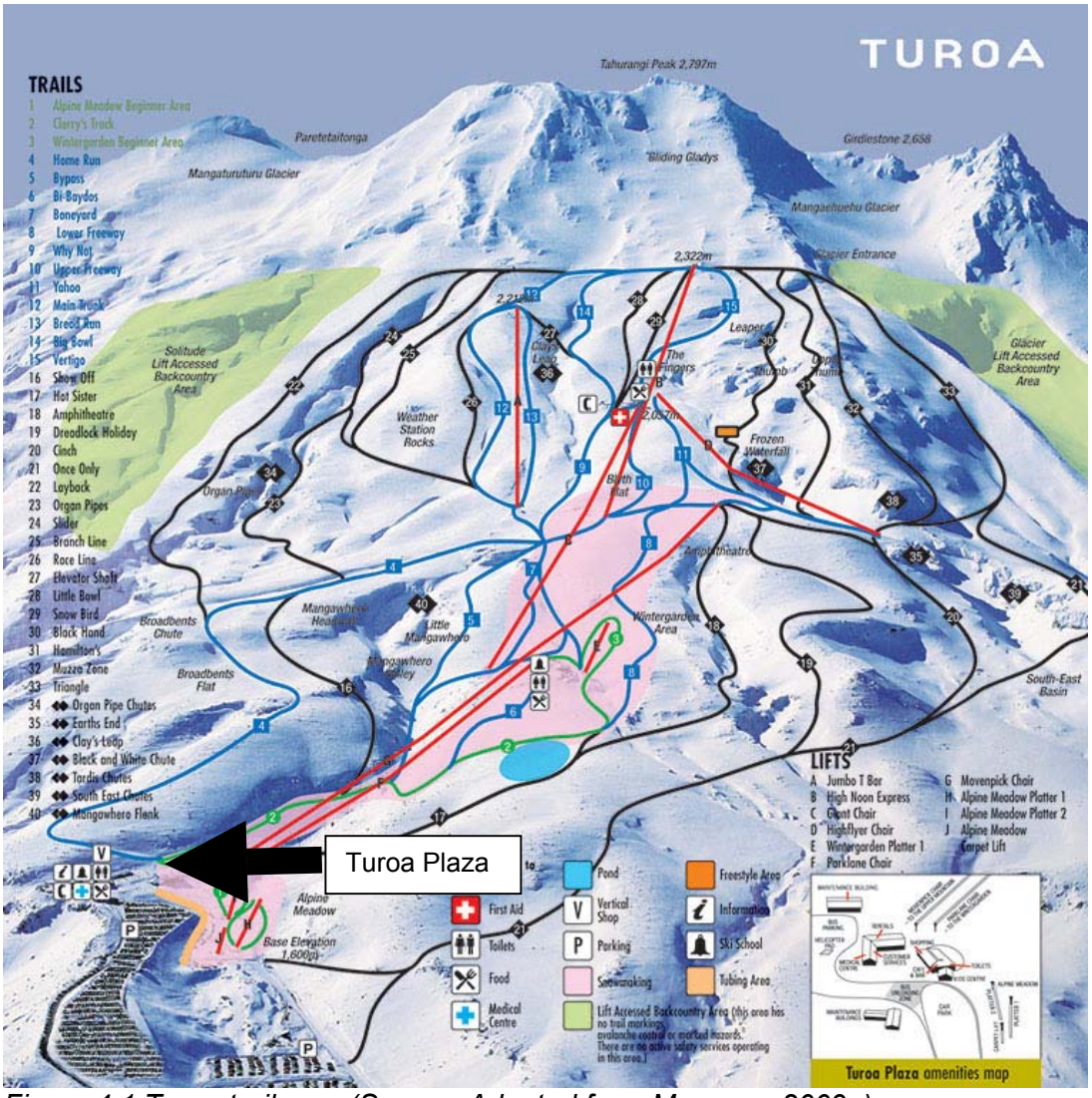

Figure 4.1 Turoa trail map (Source: Adapted from Mappery, 2009a).

Cafeterias were selected as the most appropriate place to conduct the surveys due to the fact that participants were already seated, had their gloves off (worn outside while skiing) and in a situation where they were able to fill out a survey when provided with a pen. The indoor location was protected from the cold weather conditions outside and people were able to take their time and think carefully about their responses to the survey questions.

Figure 4.2 Whakapapa trail map (Source: Adapted from Mappery, 2009b).

4.3.4 WEATHER

The weather on the 27th at Turoa was snowy and with poor visibility. Due to weather conditions, the cafeteria was incredibly busy. This not only provided a large group of people to sample, but also a range of demographics that would not normally be seen in the cafeteria on a sunny day at Turoa. Beginner, intermediate and advanced skiers and snowboarders could all be found in the Turoa Plaza cafeteria. Ski reports for both days are included in Appendix 2. The following day at Whakapapa was slightly different. The weather was cold and breezy with clear skies and icy snow conditions. Due to the early iciness of the

slopes, many people were sitting at both the Top o' the Bruce Cafe and the Knoll Ridge Cafe in the morning when the survey was distributed.

4.4 QUALITATIVE INTERVIEWS

Qualitative methods can add to the success and depth of formal investigations (Simmons, 1984) and using multiple techniques within a single project can be advantageous in research design, data collection and analysis (Sieber, 1973). The present study applied grounded theory through semi-structured interviews because, 'the development of rich, relevant data rests on the interviewer's ability to understand, interpret, and respond to the verbal and nonverbal information provided by the informant' (Given, 2008). Grounded theory is described in further detail in section 4.5.2 below. Using a mixed-method approach of both quantitative and qualitative research involves collecting and analysing both types of data in a single study (Cresswell, 2003), in this case combining interviews and traditional surveys. The theory behind combining both methods is that the biases inherent in either method may neutralise or cancel the biases of the other (Sieber, 1973). Additionally, the results from either method may help to develop or inform the other method (Greene, Caracelli & Graham, 1989).

Research within this study included interviews providing qualitative data with RAL Safety Services managers Andy Hoyle (Whakapapa) and Chris Emmett (Turoa), DoC Public Safety Officer Blake McDavitt and GNS Scientists Graham Leonard and David Johnston. It is important to have these points of view as they illustrate the relationship between a wider social context and those involved with safety in a ski area/National Park setting.

These interviews were conducted to enable better understanding of existing hazard mitigation plans and visitor responses to these strategies. Visitor behaviour, hazard perception and attitudes toward hazards were also discussed. Through these interviews the perceptions and beliefs of the various organisations with regard to risk and hazard could be captured, and the ways in which risk is presented to ski area visitors was able to be explored. The interviews were included to address parts of all four objectives because, while the surveys fulfilled part of this purpose, the context of risk management within the ski areas is also considered important.

Before the interview, respondents were clearly informed of the purpose of the research. The interviews in this study were conducted in a semi-structured

format. The semi-structured interview gives an opportunity for the researcher to engage with members of each organisation and learn about critical areas that are not easily assessed through standardised questionnaires (Bickman & Rog, 2008; Sarantakos, 2005; Denscombe, 2005), including management hazard control processes, relations with ski area visitors and strategies to mitigate ski area hazards. This allowed for control over topics discussed with no fixed responses for any questions. An interview outline was prepared in advance of the interviews with key areas being touched on to ensure specific research objectives were addressed while freedom to expand on topics raised by the interviewee was allowed (Sarantakos, 2005). Participants were interviewed to saturation, which is the point at which they were no longer able to add anything further to the question. Each interview was developed independently and in the context of the interviewee's expertise and experience. Questions and topics of discussion were tailored to individual participants in the study. Interviews ranged from 25 minutes to an hour. Informants were initially contacted by electronic mail, interviews conducted by telephone or in person and contemporaneous notes were made. Field notes were also taken documenting useful summary material on the interviewee themselves. Once all the supplementary material was combined, it was examined through thematic analysis. Unobtrusive data in the form of ski area safety reports and annual reports were also obtained. All participants were spoken to, and communicated with by email on multiple occasions as issues arose, therefore email texts were analysed. Interviews were conducted separately. An interview outline can be found in Appendix 3.

4.5 ETHICAL CONSIDERATIONS

The Massey University Ethics Committee was consulted before surveying was undertaken and the project was approved. The survey stated that all answers provided were strictly confidential.

4.6 DATA ANALYSIS

4.6.1 QUANTITATIVE DATA ANALYSIS

Survey data was entered into Microsoft Excel (2007), SPSS (SPSS Inc: SPSS for Windows, 2007) and PASW (PASW Statistics 18, Release Version 18.0.0, 2009) for analysis. The data were subjected to several analyses. Statistical manipulation included simple descriptive statistics and cross tabulations (non-parametric). The data are analysed both as a single ski areas visitor sample, and as site-specific (Whakapapa and Turoa) sub-samples. It was considered valid to

approach the analysis in this way due to the many similarities in visitor classification, visitor activities undertaken, and the physical and managerial nature of each of the two locations.

4.6.2 Qualitative Data Analysis

Grounded theory emerged in the 1960s as a method of qualitative study allowing theories to be generated into data (Glaser & Strauss, 1967). Grounded theory is when a researcher seeks to derive a general, abstract theory of a process, action or interaction which is grounded in the views of participants in a study (Cresswell, 2003) and is particularly useful in content analysis when looking at values, attitudes and perceptions. The researcher works with his or her participants to actively piece together the data and move beyond a static analysis to multiple layers of meaning (Gray, 2004). The theory produces information that is 'discovered, developed and provisionally verified through systematic data collection and analysis of data pertaining to that phenomenon' (Strauss & Corbin, 1998:23).

Grounded theory starts with a clear and broad research question with new ideas given the possibility to emerge and take the researcher in unexpected directions (Charmaz, 1994; Christianson, 2006). Grounded theory calls for constant comparison of the data with emerging categories as well as the theoretical sampling of different groups to amplify the similarities and differences between information (Cresswell, 2003). The process involves a number of stages of data collection, refinement and interrelationship of categories, themes and information (Strauss & Corbin, 1990; Lacey & Luff, 2001), forming a base for emerging theory.

Themes are developed from the interview data. Themes occur when similar issues and ideas are brought together by the researcher into a single category (Lacey & Luff, 2001) and stand for the way ideas are organised in the minds of the people studied (Gomm, 2008). Through these themes a coding order will appear with all relevant items able to be categorised and constant comparisons occurring. This coding in the methodology of grounded theory requires giving labels to the data and 'some of the labels become categories, which later become saturated with qualities' (Konecki, in Silverman, 2010: 244). Although there are some difficulties in telling when theoretical saturation has been reached and no further categories may be drawn from the data, the benefits of being able to develop categories into a more general analytic framework with relevance outside the current setting make grounded theory suitable for the present study.

Interviewing allows the researcher to come to better understand the beliefs, attitudes and perceptions of the interviewee (Denscombe, 2005). Interviews were not recorded however detailed notes were taken. Interviews were conducted with open-ended questions allowing participants to elaborate until the point of saturation (Glaser & Strauss, 1967). Notes were examined and indexed by theme, using numerical and colour codes to represent roles, responsibilities and recurrent ideas of participants (Cresswell, 2003). Familiarisation with data continued and recurring themes were noted. Triangulation was used to identify relationships between themes. The data were then used to illustrate aspects of the quantitative results, and to create a coherent account of how risk and safety is perceived and communicated by those responsible for the management of New Zealand's natural attractions.

4.7 OBSERVATIONS AND LIMITATIONS OF THE METHODS

There were several observations from survey days that are relevant to the data set. It should be noted that weather conditions were inclement on Saturday 28 September 2008, therefore beginner skiers and snowboarders may have been deterred from coming up the mountain. This absence of beginners may have distorted data as beginner mountain users are likely to be less aware of hazards. If surveys were done at the Giant Café at Turoa which is further up the mountain and therefore less accessible to beginners, results may have been different. Chris Emmett from Turoa Safety Services noted fewer accidents occurred on inclement weather days, due to increased caution and decreased speed. Another point to note is that surveys were distributed to visitors in cafeterias while not all people that visit the mountain use the cafeterias. The time of day, weather conditions, and the fact that the weekend was the first weekend of the school holidays (among other factors) could have an influence on the awareness of hazards by the mountain users. In addition other summer and winter mountain users besides skiers, snowboarders and non-skiers within the ski areas were not surveyed.

4.8 CHAPTER SUMMARY

In this research project, various data sources were analysed, such as semi-structured interviews and surveys. Using data from more than one source gives the researcher a wider perspective on the study. Quantitative data through

surveys indicated what perceptions were held by the visitors to Mt Ruapehu, and the influence of hazard warning signage was able to be explored. The qualitative material obtained through the semi-structured interviews added depth to the survey data. The interviews gave an insight into safety management views of public perceptions, why visitor compliance might be an issue and why visitor behaviour may differ from the expressed attitudes. The results in the following chapter will show how the methods outlined here produced informative data.

CHAPTER FIVE
VISITOR AND VISITATION CHARACTERISTICS

Plate 5.1 Signs at Turoa ski area near Giant café.

5.1 INTRODUCTION

This chapter presents details from the surveys conducted at Whakapapa and Turoa in September 2008. It looks into the demographics and characteristics of the visitors at the ski areas on the 27th and 28th September.

5.2 CHARACTERISTICS OF VISITORS AND VISITATION

5.2.1 GENDER

The survey results show that the gender split at both Whakapapa and Turoa was fairly even. Across both areas 54% of participants were male and 46% of participants were female (Figure 5.1). These results fit with the broader trend of males being slightly overrepresented in onsite visitor surveys (Espiner, 2001; Booth & Peebles, 1995). Other studies in national parks and other outdoor recreational areas found similar proportions of males to females (Hayes, 2008;

Espiner, 2001) of around 60% males to 40% females. This ratio was found to be more pronounced at Whakapapa (57.1% men and 42.9% women) than at Turoa (51% men and 49% women).

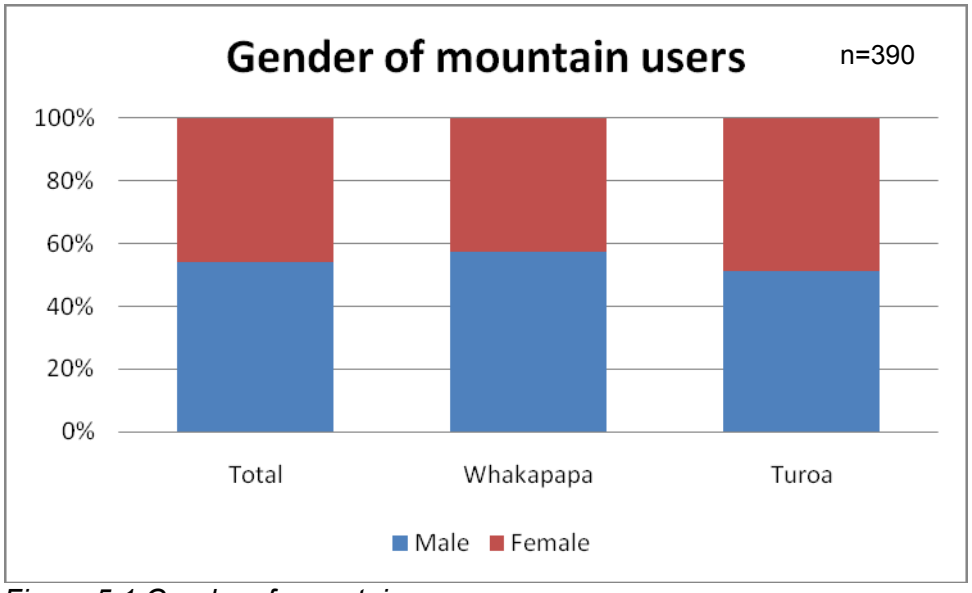

Figure 5.1 Gender of mountain users.

5.2.2 AGE

The survey showed a reasonably even spread across ages of mountain users at Whakapapa and Turoa. Across both ski areas, the most common visitor age group was those less than 20 years of age (25.1%). 22.3% of users were between the ages of 20 and 29, and 21.1% of those surveyed were between 40 and 49 years old (Figure 5.2).

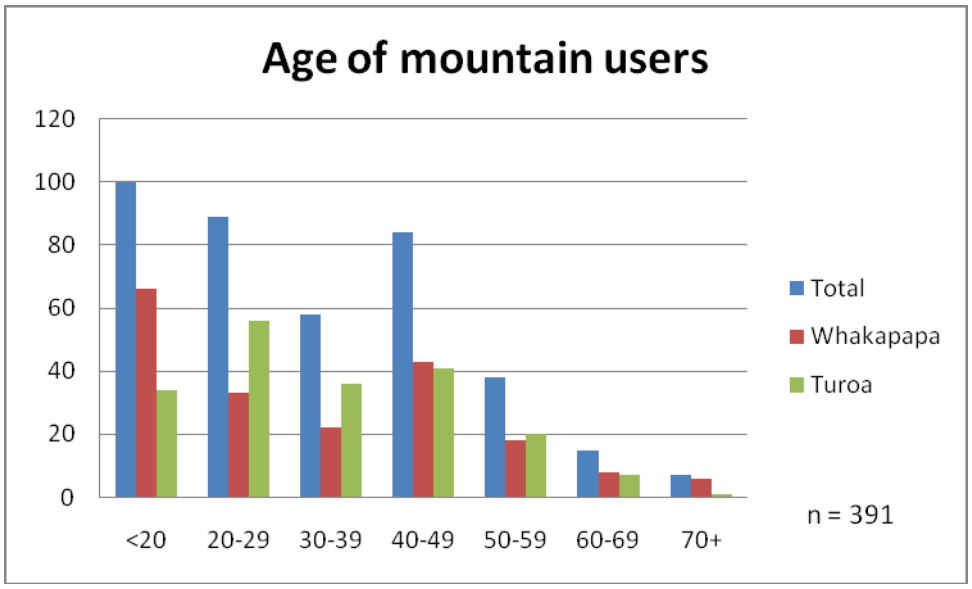

Figure 5.2 Age of visitors at Whakapapa and Turoa.

The numbers of under 20 year old users and those between 40-49 suggests that there were a number of families at the ski areas on the days of the surveys

although the presence of dependent children was not queried in the survey. This is implied by the dates of surveying falling in the first weekend of the domestic school holidays and the researchers noticed many families with children when conducting the surveys. Hayes (2008) found the same trend in his study at Franz Josef and Fox Glaciers, which was conducted during a school-holiday period and had similar patterns of family groups.

5.2.3 City and Country of Origin

The majority of mountain users on the days of surveying were from New Zealand (94%) with 71% originating from Auckland and Wellington. This is likely to be due to the time of surveying, at the beginning of the domestic school holidays with many families having their annual ski holiday at that time of year, as well as the central location of Mt Ruapehu to the main centres. 54% of all respondents were from the Auckland area, 17% from Wellington and 9% were locals from the Central Plateau (Figure 5.3). The remaining mountain users came from Waikato, Bay of Plenty and 'Other NZ', which comprised of Northland, South Island, Gisborne, Wairarapa, Hawkes Bay, Taranaki, Kapiti, Manawatu and Whanganui.

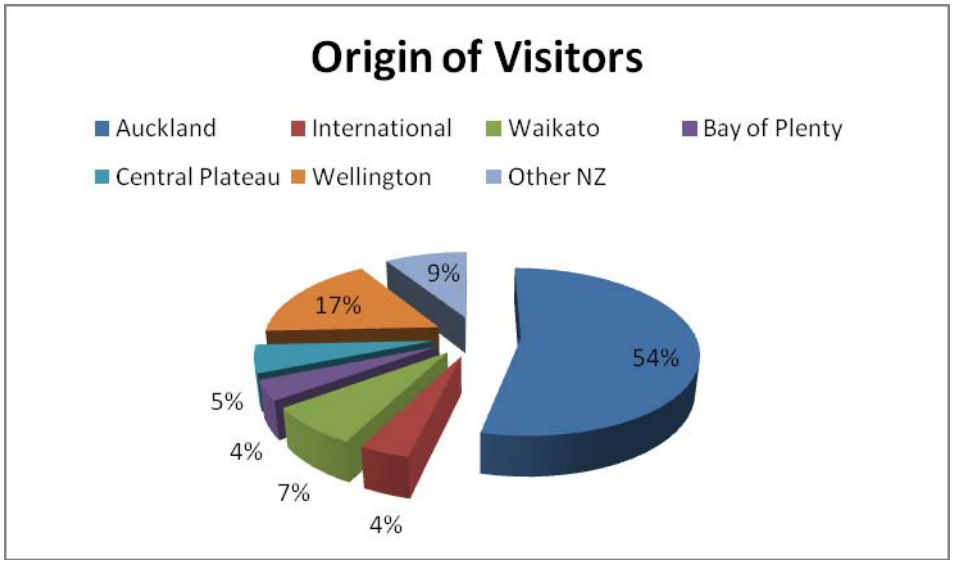

Figure 5.3 Origin of visitors to Whakapapa and Turoa.

There were 15 international visitors surveyed: 4 from the United Kingdom, 3 from the United States and Canada, 2 from Europe and 6 from the Pacific/Australia. International visitors to Mt Ruapehu surveyed only comprised 4% of participants; these participants appeared to be individual travellers, not part of any organised tours/groups. It is likely that visitors as part of organised tours and groups are underrepresented in this study as those as part of a group may not visit the cafeteria on their way to ski on the mountain. This is a consequence of the chosen sample frame (surveyed at ski area cafeterias) rather than a bias.

5.2.4 *Skiers and Snowboarders*

Across both Whakapapa and Turoa, there were far more skiers than snowboarders. 67% of respondents claimed to be skiers with 25% snowboarders (Figure 5.4). A small number of participants considered themselves to be non-skiers (4%) and a number of staff were surveyed and were unable to classify themselves as public skiers or snowboarders.

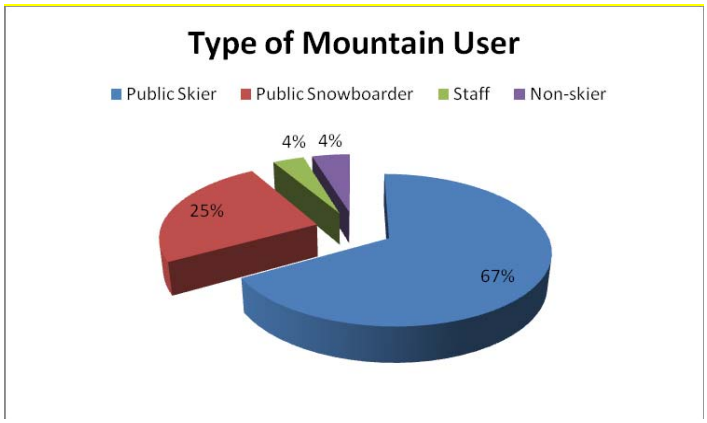

Figure 5.4 Type of mountain user at Mt Ruapehu.

58% of survey respondents at Turoa considered themselves to be skiers, while 32% were snowboarders. The division at Whakapapa was considerably wider with 73% claiming to be skiers and only 17% snowboarders (Figure 5.5). Chris Emmett from Turoa Safety Services indicated in his interview that surveys undertaken by RAL found similar proportions of skiers to snowboarders across the two ski areas to the present study. The only staff who were surveyed were those using the cafeteria at the time of survey, because of this staff may not be accurately represented in the survey.

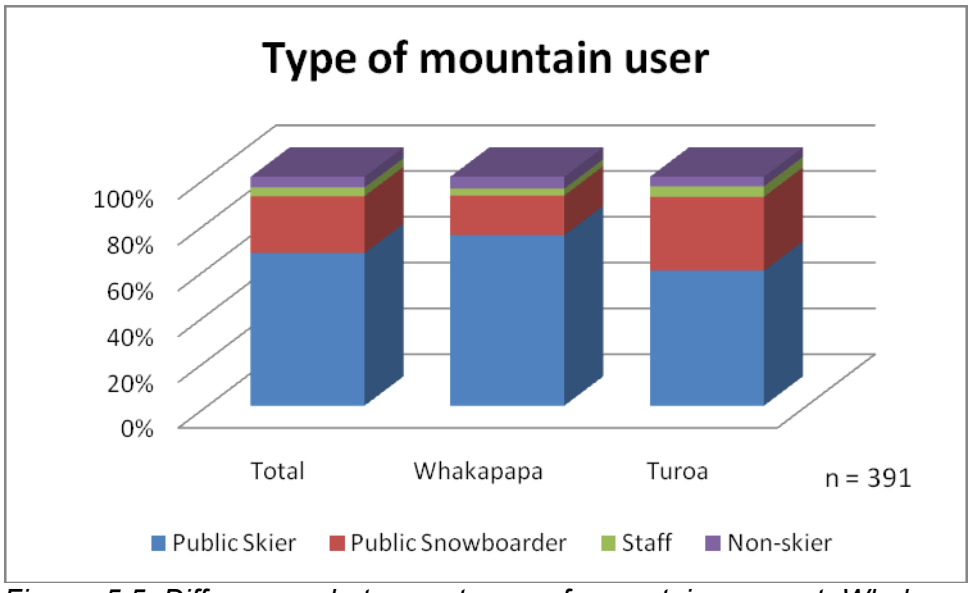

Figure 5.5 Differences between types of mountain user at Whakapapa and Turoa.

5.2.5 *Ability and number of years skiing/snowboarding*

Only 3% of those surveyed considered themselves to be most comfortable on Green/beginner trails. 36% of respondents were comfortable on Blue/intermediate trails and 58% comfortable on Black/advanced trails (Figure 5.6).

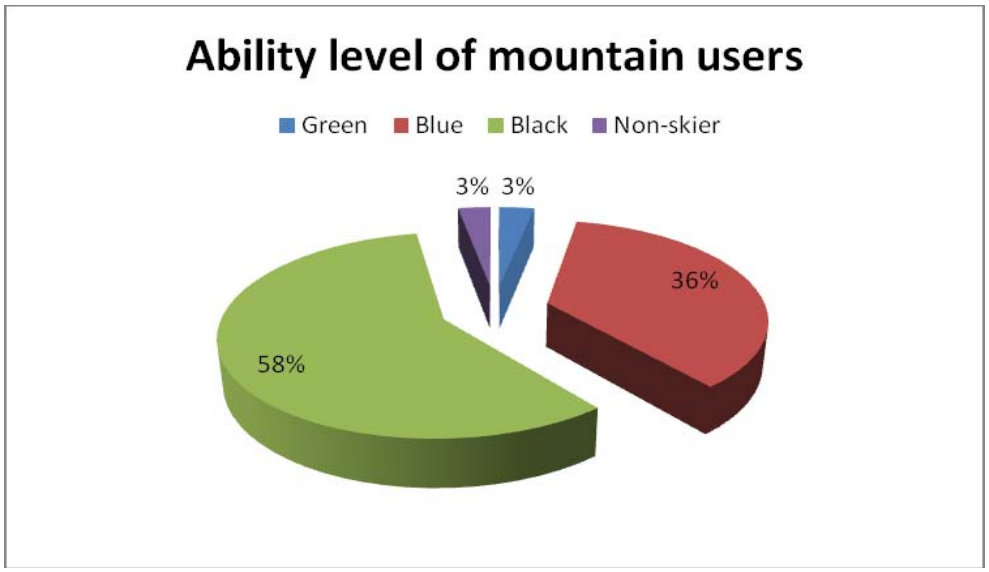

Figure 5.6 Ability levels of mountain users.

These figures correspond to the results for the number of years visitors have been skiing and snowboarding at Mt Ruapehu. Naturally the longer people spend using ski areas, the better skiers they become. 41.4% of respondents said that they have been skiing or snowboarding for 11 or more years. 16.8% of respondents had been at Mt Ruapehu for 6-10 years, and 25.1% for 2-5 years (Figure 5.7). These results imply that visitors to the ski areas are experienced mountain users and are familiar with natural environments.

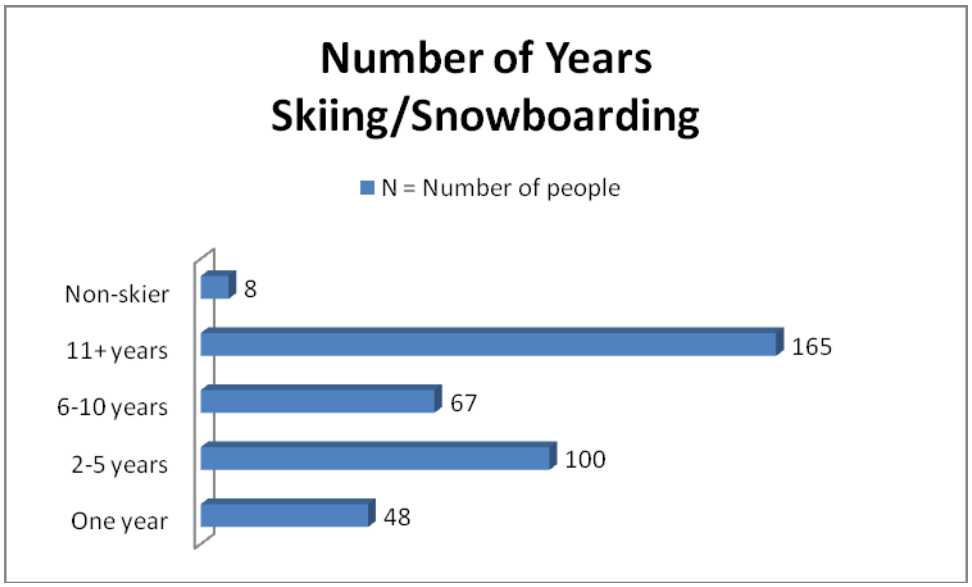

Figure 5.7 Number of years skiing/snowboarding.

5.2.6 MT RUAPEHU SKI AREAS USED

39.8% of people responding to the survey at Mt Ruapehu indicated that they used both Whakapapa and Turoa ski areas. 24.6% of people use Whakapapa only and 31.3% Turoa only (Figure 5.8). Turoa ski area users were more likely to just use that ski area, with 60% indicating that they only skied/snowboarded at Turoa, compared with 49.5% of Whakapapa survey respondents only using Whakapapa ski area.

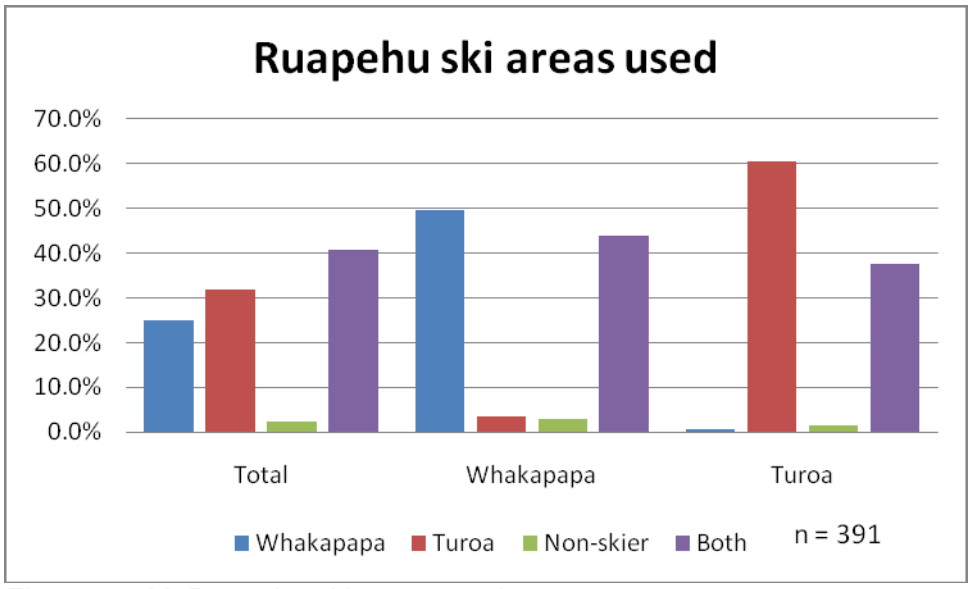

Figure 5.8 Mt Ruapehu ski areas used.

5.3 CHAPTER SUMMARY

Visitors to Whakapapa and Turoa are typical of other natural attractions in New Zealand (Espiner, 2001; Hayes, 2008; Booth and Peebles, 1995), except in regard to the number of domestic visitors. The overwhelming number of domestic visitors is likely to be due to Mt Ruapehu's proximity to Auckland and Wellington. The fact that 39.8% of visitors use both Whakapapa and Turoa ski areas stresses the value of consistent hazard management strategies across both areas. Management of hazards at either site has the potential to affect behaviour and awareness at the other site.

CHAPTER SIX
MOUNTAIN USERS AND RISK: PERCEPTIONS, ATTITUDES AND BEHAVIOUR

Plate 6.1 Trail signage at Turoa at the top of the High Noon.

6.1 INTRODUCTION

The main objectives for this part of the research were to investigate visitor awareness of natural hazards, and explore the extent to which visitors felt safe and responsible for their own safety while at Whakapapa and Turoa ski areas. Results are compared with other related studies, including Espiner (2001), and Hayes (2008), where relevant. The quantitative data are drawn from 391 visitors to Whakapapa and Turoa over the two days, giving a response rate of 98%. The results are presented in 5 sections. The first is visitor characteristics; including gender, age, origin, level of experience. The next sections look at the attitude dimensions considered by this study: hazard awareness, perception of safety and individual responsibility and then an integrated summary.

6.2 VISITORS' PERCEPTIONS OF NATURAL HAZARDS AND RISK

The perception of risk includes the individual's assessment of the likelihood of loss in a given situation as outlined in the literature review. Concepts affecting the individual's assessment of risk include the nature of the physical and social

environments, previous exposure to information about the hazard or risk, and the individual's personality. This study assessed visitors' perceived risk by looking at awareness of natural hazards, and feelings of safety at Whakapapa and Turoa. This section looks at hazard awareness. Safety perceptions among visitors are then discussed, and visitor perceptions of risk are estimated.

6.2.1 Awareness of Hazards

Visitors' awareness of hazards at Whakapapa and Turoa ski areas was determined by recording the specific hazards identified by respondents, applying a hazard awareness scale, and calculating the total number of hazards identified.

6.2.1.1 Listing the hazards at Mt Ruapehu

Participants were asked to list the hazards and dangers they had been aware of while visiting the ski areas. Participants were provided six spaces to enter their hazards. Some people listed no hazards and some entered more than six. The hazards were classified into 10 groups:

- Skiers
- Snowboarders
- Cliffs/Rocks
- Ice
- Other Mountain Users
- Volcanic Hazards
- Weather
- Avalanches
- Mountain Road/Drivers
- Other (including hypothermia, t-bar paths, bad lift operators, few safety checks, poor grooming).

The total numbers of people answering within each category are shown below (Figure 6.1). One in five visitors (19.4%) did not report any hazards. Espiner (2001) found the same proportion of visitors not reporting any hazards (19.3%). Of those who identified as least one hazard (80.6%), 32.2% of visitors identified cliffs and rocks as a hazard. Other commonly reported hazards were ice (29.4%), other mountain users (27.9%) and volcanic hazards, including lahars and volcanic eruptions (28.6%). When looking at the two sites independently (also Figure 6.1) some clear differences become apparent. Turoa ski area users appear to be slightly more knowledgeable about hazards with all but one category Turoa visitors recalling more hazards than Whakapapa.

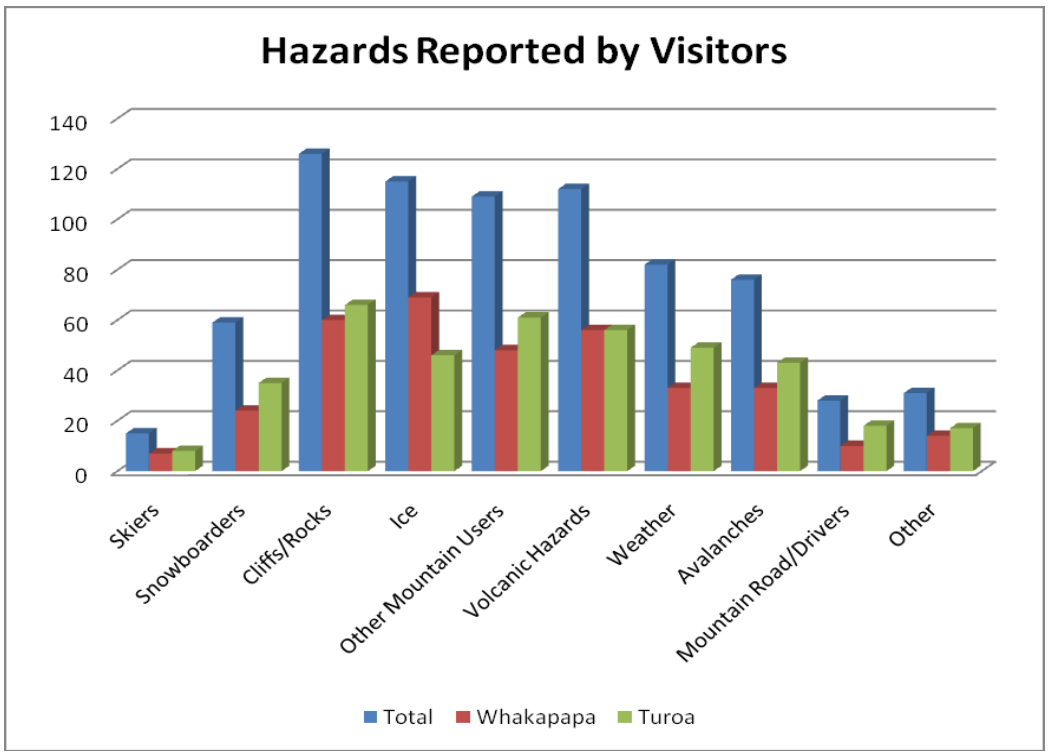

Figure 6.1 Hazards reported by visitors.

Turoa users listed the hazards 'skiers', 'snowboarders', cliffs/rocks', 'other mountain users', 'weather', 'avalanches', 'mountain road/drivers', and 'other' in higher numbers than Whakapapa users. Whakapapa visitors listed 'ice' as a hazard in higher numbers than Turoa visitors. Equal numbers of visitors listed 'volcanic hazards' across both Whakapapa and Turoa. These results are consistent with those obtained by Espiner (2001) and Hayes (2008) results. Espiner (2001) found 80.7% of participants were able to recall at least one hazard however less than a third were able to identify more than one hazard despite descriptive hazard warning signs being present throughout his study area. Similarly, Hayes (2008) found that the majority of his respondents were able to identify at least one or two hazards but few were able to identify a range.

6.2.1.2 Hazard Awareness Scores

The extent that visitors reported awareness of hazards was calculated using Espiner's (2001) Hazard Awareness Scale (HAS). This scale was comprised of four items. High levels represent a high level of hazard awareness (Table 6.1). The scale ranged from 1 (completely agree) to 7 (completely disagree). Espiner (2001) found slightly higher awareness of hazards through his hazard awareness scores (mean = 4.45). The findings of the present study, of only moderate awareness of hazards, are consistent with Espiner (1999, 2001) and Hayes (2008).

Table 6.1 Hazard awareness scores.

Scale items		MIN	MAX	RAW MEAN	ADJUSTMENT OF MEAN	MEAN
HAS	This natural area appears to be stable and predictable.	1	7	3.26	3.26	
	While here, I have often thought about hazards to which I might be exposed.	1	7	3.17	3.83	
	There are dangers at this ski area which are obvious to me.	1	7	2.2	4.8	
	A little danger is an accepted part of visiting a natural area like this.	1	7	1.82	5.18	
Total					**17.07**	4.26

Adjusted mean represents those items whose anchors have been reversed to reflect their direction of influence on the scale

In reviewing hazard identification and hazard awareness scores it is concluded that visitors are fairly knowledgeable about hazards. 80.6% of respondents identified at least one hazard. An explanation for the awareness of hazards could be the signs and public warnings implemented by RAL. These will be discussed in depth later in the chapter. The hazard awareness scores tell a slightly different story. High scores represent a high level of awareness. Scores for hazard awareness ranged from 3.26 – 5.18, mean = 4.26. This indicates only modest awareness of hazards.

6.2.1.3 RATING PARTICULAR HAZARDS ON A SCALE

Participants were asked about various mountain hazards and their views on how safe or hazardous they perceived them to be, rating them on a 7-point Likert scale from very safe to very hazardous. Up to 7% of respondents did not answer these questions. In this section:

1 = very safe

2 = moderately safe

3 = slightly safe

4 = neither safe nor unsafe

5 = slightly hazardous

6 = moderately hazardous

7 = very hazardous.

INCLEMENT WEATHER CONDITIONS

In general, most skiers and snowboarders thought that inclement weather conditions were slightly to very hazardous (5-7) while at Mt Ruapehu (Figure 6.2). Across both sides of the mountain, 69.1% of participants gave ratings of 4 – 7; similar ratings were given for males and females. 7% of survey respondents did not complete this question, higher than the non-response for other questions; this could be due to the word 'inclement' and participants being less familiar with this term.

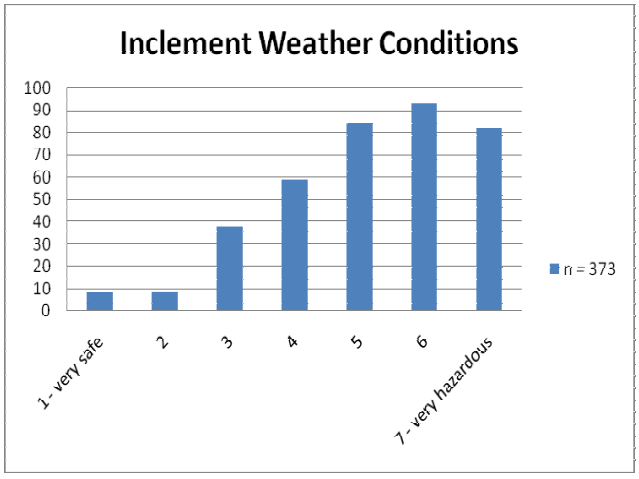

Figure 6.2 Inclement weather conditions.

ICE

Ice as a hazard gave similar figures across the demographics as the inclement weather conditions above. Seventy percent of skiers, snowboarders, staff and non-skiers thought ice as a hazard was slightly hazardous (5) to very hazardous (7) (slightly hazardous, 21.1%; moderately hazardous, 23.3%; very hazardous, 20.6%). Males and females indicated similar safety ratings across the scale, they are shown in percentages in the graph below (Figure 6.3) due to the difference in numbers of male and female visitors to Mt Ruapehu (179 Female/211 Male).

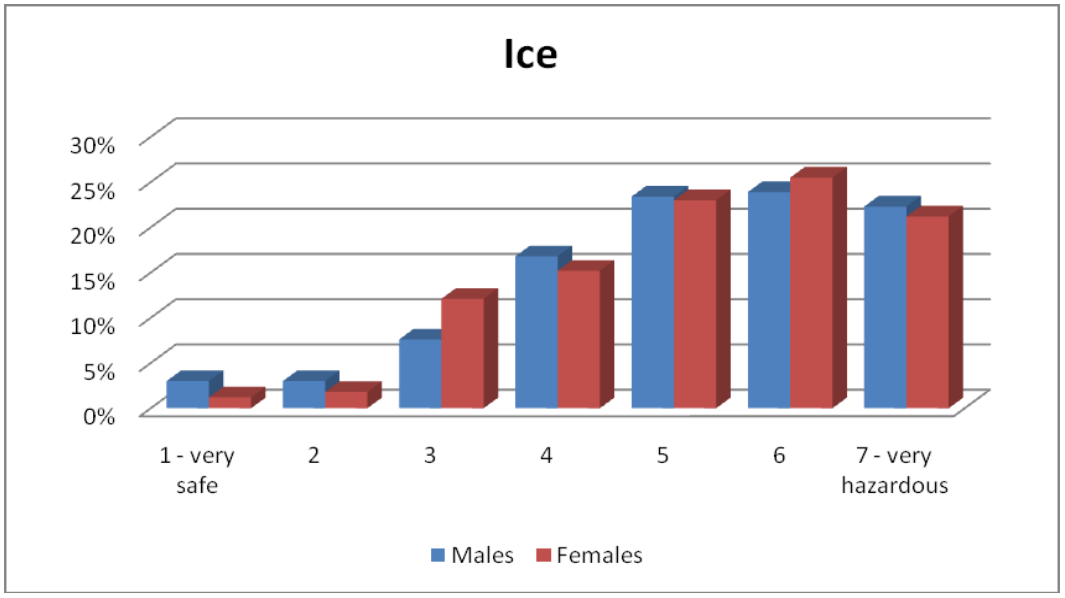

Figure 6.3 Perceptions of ice as a hazard.

CLIFFS

Cliffs were perceived as being hazardous at both Whakapapa and Turoa. Thirty-four percent of skiers and snowboarders thought cliffs were very hazardous (7), with 76% indicating cliffs as a hazard were slightly hazardous (5) to very hazardous (7). The numerous cliffs at both sides of Mt Ruapehu are visible to the full range of mountain users, even around learners' slopes. Cliffs as a hazard are present in any given day, unlike some of the other hazards discussed; therefore this could explain the higher awareness rating given by many. Similar patterns were found in looking at cliffs as hazards across Whakapapa, Turoa and both areas. Seventy-seven percent of males and females thought cliffs were slightly hazardous (5) to very hazardous (7). Males and females had similar feelings about the danger of cliffs at Mt Ruapehu.

LAHARS

Approximately 32% of skiers and snowboarders at Mt Ruapehu thought that the possibility of lahars was very hazardous. Forty-seven percent of those at Turoa surveyed rated lahars as neither safe nor hazardous or less (4 or lower on the scale), compared to 28.6% at Whakapapa. Turoa users rate lahars as slightly less hazardous than at Whakapapa. This could be due to the fact that lahars are far less likely to occur at Turoa. Posters indicating what to do in case of lahar are present at both sides of Mt Ruapehu. Comparing public safety ratings of lahars vs. volcanic eruptions (Figure 6.4), almost half of the survey respondents believed the threat of volcanic eruptions to be minimal. Lahars as a hazard were rated between 11%–17% across all levels of the scale.

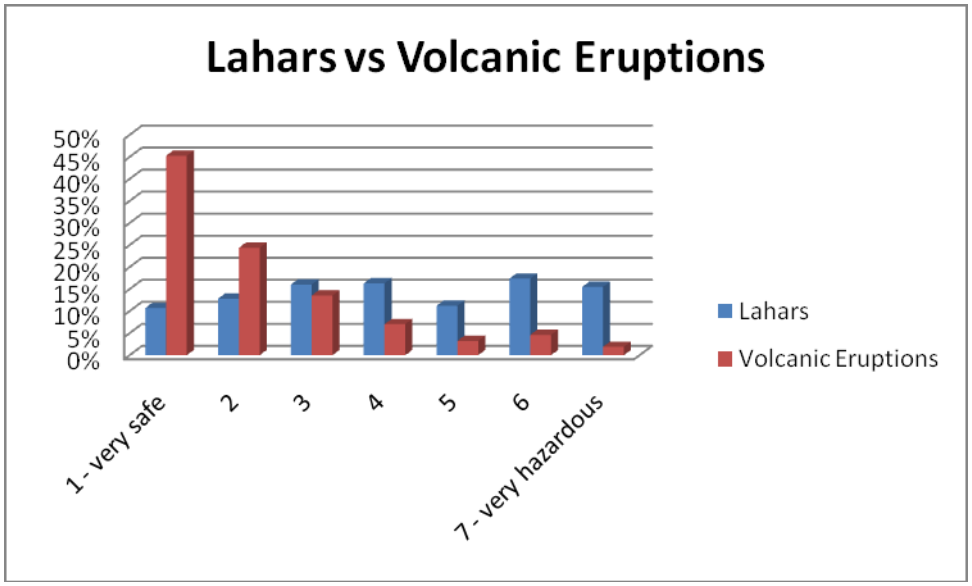

Figure 6.4 Perceptions of lahars compared with volcanic eruptions.

VOLCANIC ERUPTIONS

Forty-five percent of all respondents viewed volcanic eruptions as very safe (7) (Figure 6.4). Across gender, age and location, almost 50% of participants indicated they were very safe from volcanic eruptions.

AVALANCHES

Around 30% of skiers and snowboarders thought avalanches as a hazard were very hazardous (7). However comparing Whakapapa and Turoa (Figure 6.5), 49.5% at Turoa thought avalanches were neither safe nor hazardous (4) and lower compared to 31% at Turoa. 43.6% of females rated avalanches as very hazardous (7), compared to 25.4% of males.

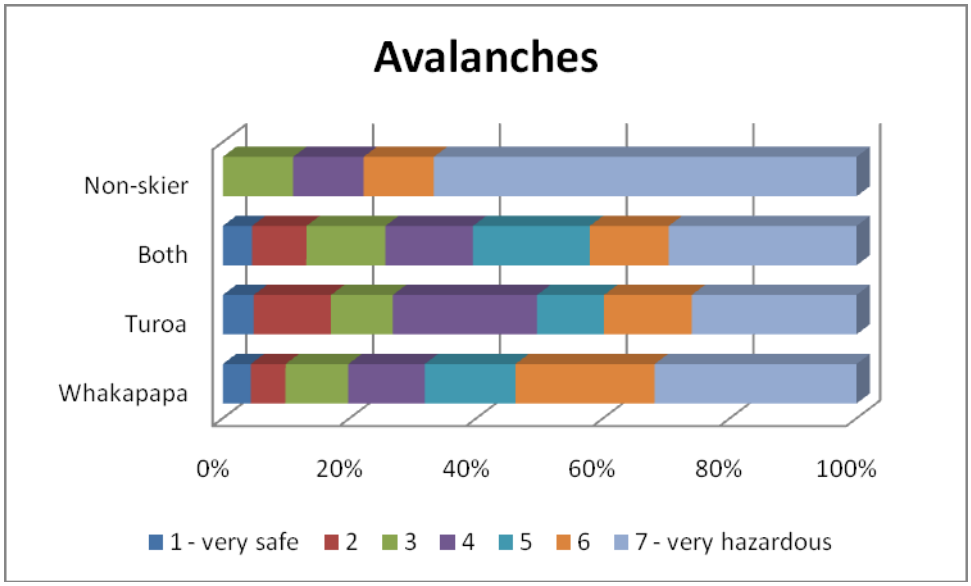

Figure 6.5 Comparison of perception of avalanches as hazards.

OTHER PEOPLE

Other people on the mountain are considered to be one of the greatest hazards according to respondents of this survey. When asked to list hazards or dangers that people are aware of while visiting Turoa or Whakapapa, other skiers and snowboarders using the mountain was one of the most common responses. Sixty-four percent of skiers, snowboarders, non skiers and staff members thought that other mountain users were 'slightly hazardous' (5) to 'very hazardous' (7) (Figure 6.6). Thirty percent of visitors across both Whakapapa and Turoa saw other people as being 'very hazardous' (7), compared to Turoa (28%) and Whakapapa (23%) alone.

The respondents using both sides could be more experienced mountain users and see the potential for accidents and may have witnessed such events over their time skiing at Mt Ruapehu. Two thirds of males and females surveyed rated

other people as being slightly hazardous or more, with little difference between gender. Visitor awareness of other mountain users as hazards will be discussed further in Chapter 7.

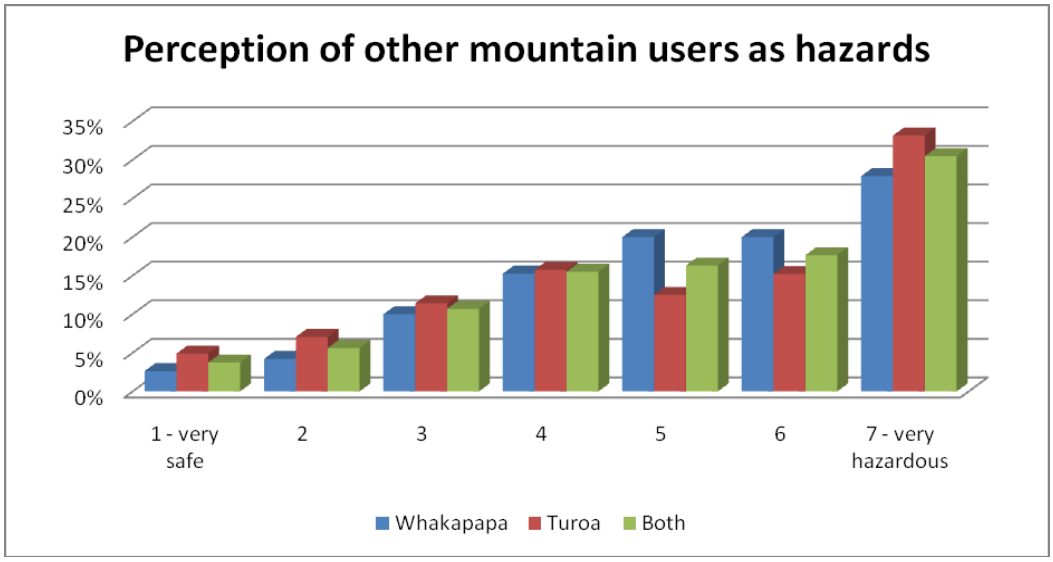

Figure 6.6 Perception of other mountain users as hazards across Whakapapa and Turoa.

Mountain Road

Visitors to both Whakapapa and Turoa viewed the mountain road as being relatively safe. Some 80.9% of Whakapapa, Turoa, both and non-skiers thought that the mountain road was 'neither safe nor unsafe' (4) or safer. Both males and females equally thought the mountain road was safe.

Across all hazards participants were asked to rate in this section of the survey, only the mountain road was considered somewhat safe. Similar results were found between the categories across where participants ski/snowboard, gender and skiers or snowboarders. Non-responses totalled 6% of all surveys for this question.

6.3 KNOWLEDGE OF HAZARDS

6.3.1 Signage

An important part of this study was to determine the effectiveness of warning signs at Whakapapa and Turoa ski areas which caution visitors against mountain hazards. In order to assess this, visitors were asked to recall whether they were aware of warning signs at the ski areas. Ninety-three percent of visitors to both ski areas were aware of signs within the boundaries. The signs reported are shown below in Figure 6.7.

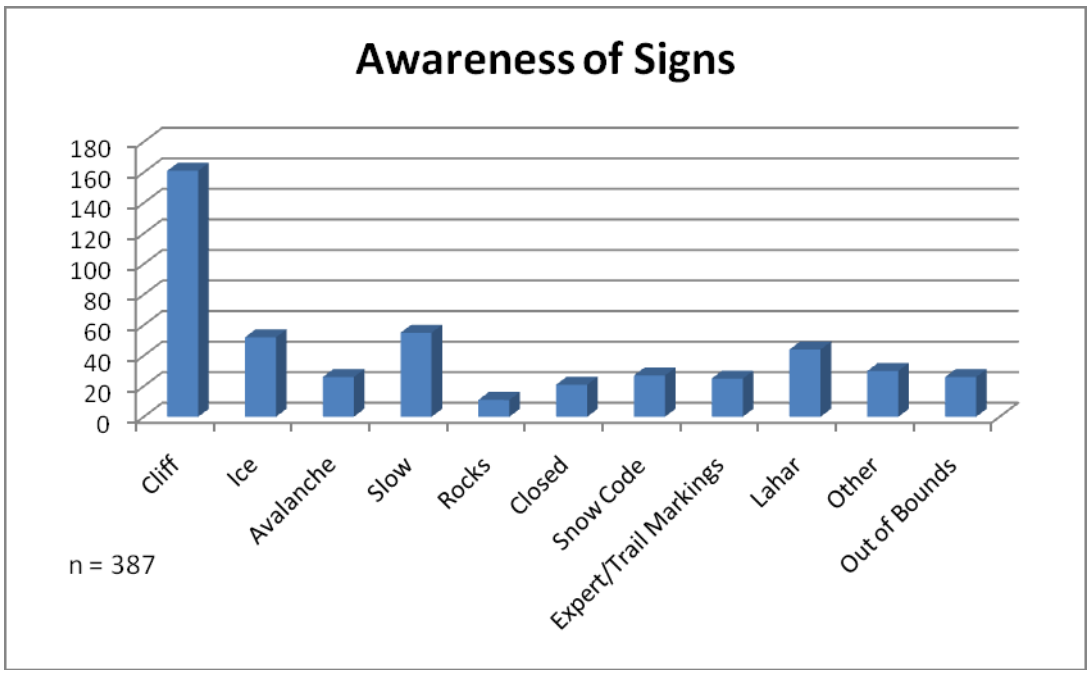

Figure 6.7 Awareness of signs.

The awareness of hazard warning signs echoed the pattern of awareness of hazards (Figure 6.1), indicating that signage does create more awareness of hazards. Across the board, visitors to both Whakapapa and Turoa were aware of signs posted around the ski areas. There were slight variations between several of the demographic factors, but almost all visitors were generally well informed as to the existence and location of safety signs. Awareness of signage does not necessarily mean compliance of hazard warnings.

The signs most commonly reported were ‘cliffs’, ‘ice’ and ‘slow’. This pattern of signs reiterates Espiner’s (2001) continuum of recognition, from the most spectacular to the least, implying the idea of ‘cognitive and affective salience’, and an element of understanding to work out the significance of each. Men reported awareness of cliff signs more often than women (men 44.5%, women 37.4%), and Whakapapa visitors more often than Turoa visitors (Whakapapa 44.5%, Turoa 36.2%). At Whakapapa and Turoa, the volcanic terrain means there are considerable cliff hazards. The Turoa (Ruapehu Alpine Lifts, 2009e) and Whakapapa Terrain Hazard Atlas (Ruapehu Alpine Lifts, 2009f) identify 97 cliff areas, while Whakapapa identifies 49 cliff areas. The prevalence of cliffs at either ski area explains the common cliff sign reporting although the high number of cliff hazards at Turoa and the lower reporting numbers (36.2%) from Turoa are concerning.

The incidence of awareness of signs and structures restricting access to parts of the mountain were also high. Non-skiers indicated less awareness of restricted areas but they are not likely to be accessing places where restricted access is a

possibility. Ninety-one percent of skiers indicated awareness of restricted areas, with snowboarders indicating slightly lower at 84.5%. Similar figures were also found across both ski areas, across sex and age groups (between 85-90% of respondents).

When respondents were asked if they ever leave the ski area boundary there was some deviation from the high awareness and compliance trend. Overall, 59% of visitors said that they have left ski area boundaries. Sixty percent of skiers indicated they leave the ski area boundary, with 51% of snowboarders and 86.7% of staff at either ski area (Figure 6.8). Turoa users indicated higher numbers leaving the ski area with 59.7% of respondents saying they leave the ski area boundary, compared to 46.1% at Whakapapa.

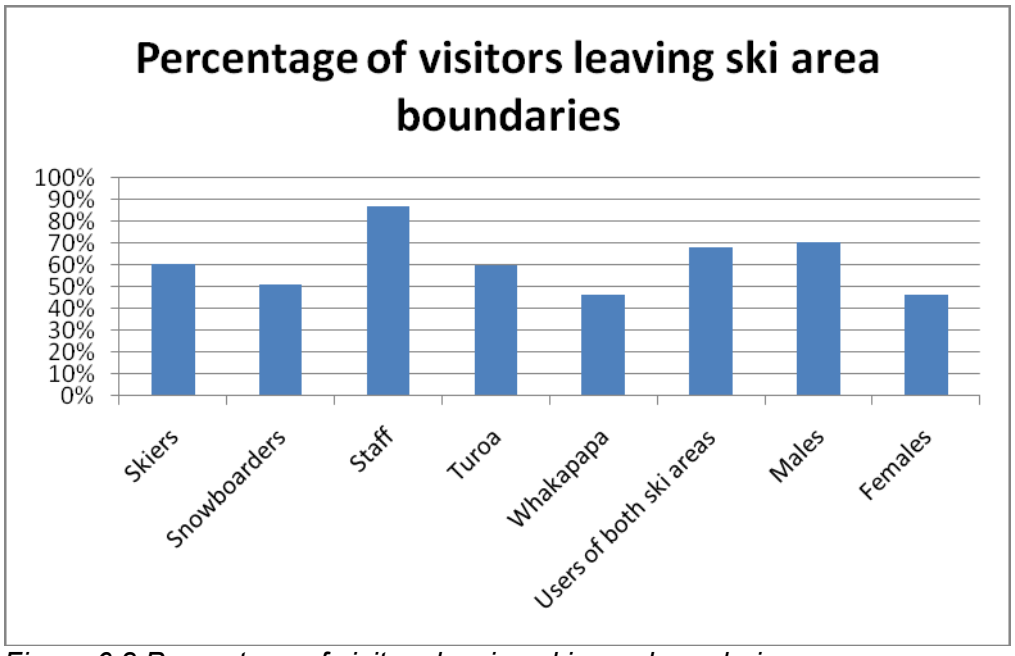

Figure 6.8 Percentage of visitors leaving ski area boundaries.

Of those who ski at both Whakapapa and Turoa, 68% say that they leave the ski area boundary. Much higher numbers of males reported venturing outside of ski area boundaries, 70.1% compared with 46.4% of female mountain users. The spread of these people leaving the ski area boundary was fairly even across age groups. Of the 248 people that answered the age and compliance questions, 78.2% of those indicated they leave the ski area boundary. Of these only 14.1% of people say they carry safety equipment, including shovel, probe and beacon .The age group with the highest percentage indicating they carry safety equipment when outside of ski area bounds was the 30-39 age group, with 22%.

Across the various measures, people indicated awareness of signs and ski area boundaries. Whether they take notice and comply is another matter. People may take notice of signs and choose not to comply with messages. Andy Hoyle (Whakapapa Safety Services) and Chris Emmett (Turoa Safety Services)

described the fine balance between having enough signs to prevent an accident occurring and having so many signs that people start to ignore them.

6.3.2 Volcanic Events

Survey participants were asked about their awareness of recent volcanic events and the eruption detection system (EDS).

6.3.2.1 Awareness of recent events

Survey respondents were asked whether they were aware of any recent volcanic events at Mt Ruapehu. Volcanic events were not defined and no examples were given so the participants had to interpret this term on their own. Of the staff surveyed, 86.7% were aware of recent volcanic events and public skiers (79.8% of the total skier population) and public snowboarders (70.8% of the total snowboarder population) coming in slightly less aware. It is assumed that staff would be most aware of recent volcanic activity due to their training and daily exposure to volcanic hazards. Men and women were found to be equally aware of volcanic events. Survey participants were asked to list the volcanic events they were aware of (Figure 6.9). Many people noted the 1995 and 1996 eruptions and the 2007 and 2008 lahars. The 2007 lahar events were highly publicised, with a lahar occurring in March 2007, followed by an eruption and two lahars in September. A climber was injured in the September event when a rock crashed into Dome Shelter near the Crater Lake ("Ruapehu eruption risk remains high", 2007), creating much media coverage. Visitors to Mt Ruapehu appeared to be well aware that Mt Ruapehu is an active volcano.

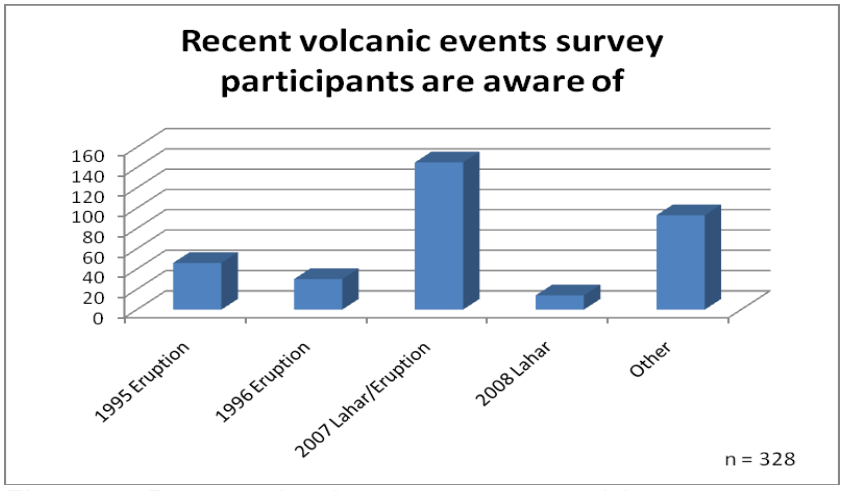

Figure 6.9 Recent volcanic events survey participants are aware of.

6.3.2.2 *Eruption Detection System*

Visitors were asked whether they were aware of any lahar warning or eruption detection systems for the ski area. There is no eruption detection system at Turoa, due to the low possibility of a lahar occurring through that ski area.

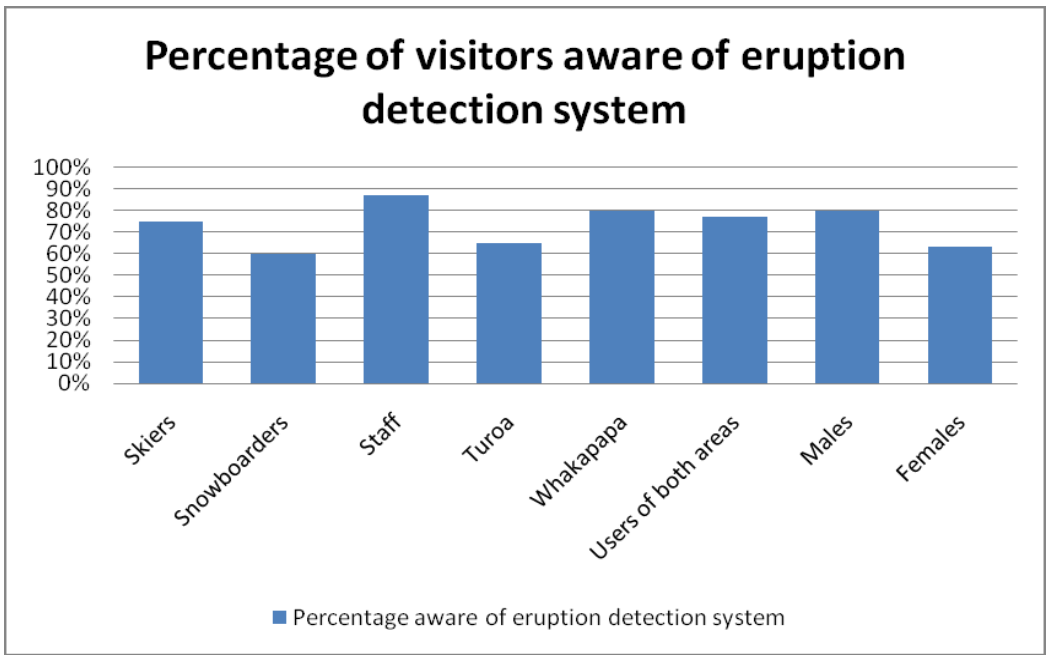

Figure 6.10 Percentage of visitors aware of eruption detection systems.

Across the different mountain users over both ski areas, 75.1% of skiers were aware of a lahar warning system and 59.8% of snowboarders (Figure 6.10). This could be due to the younger demographic of snowboarding being less aware of existing systems in place. Eighty-seven percent of staff were aware of the lahar warning system, which left 13.3% (or one person) who was working at the mountain who was either unaware of the system or did not understand the question. As would be expected, Whakapapa users surveyed were more aware of the Eruption Detection System than Turoa users. Eighty percent of those surveyed knew about the EDS at Whakapapa, 64.5% at Turoa and 77% at both. Men were more aware of lahar warning systems (80.6%) than women (64.5%). Under 20 year olds were well aware of the existence of a warning system (72.2%), but outside of that figure the older people were the more likely the survey respondent was to be aware of the eruption detection system. The number of people indicating they were aware of the EDS (outside of the under 20s) increased incrementally with each age group surveyed.

Participants were also asked if they knew what to do in the incidence of a lahar. They were also asked to list the actions they would take in the case of a lahar. The correct actions to take in the event of a lahar are to move out of the valleys, especially those which are known lahar paths, and to move to safe areas which include ridges, lift lines and buildings. People generally scored well with

knowledge of what to do in a lahar. Seventy-eight percent of skiers indicated they knew what to do, and 65% of snowboarders. One staff member did not know what action to take in the case of a lahar. As to be expected, more Whakapapa visitors (83.1%) knew what to do in the case of lahar than Turoa visitors (68.5%). Those who use both ski areas also had good knowledge of what to do in the case of a lahar (80.4%). Overall, 87.5% people who answered that they knew what to do in the case of a lahar gave the correct instructions of the actions they should take in the event of a lahar.

The fact that tests of the lahar warning system are conducted annually and volcanic events have occurred in recent years and have been widely reported on in the media ("Mt Ruapehu strikes again", 2007; Rowan, 2008; "Ruapehu eruption risk remains high", 2007; "Scientists confirm 'small scale' Mt Ruapehu eruption", 2006) means that, in theory, the public should have the potential to be well informed on the dangers of skiing on an active volcano and should know the actions to take in the case of an event. This is particularly relevant to Whakapapa and Turoa ski areas where 94% of visitors surveyed were from New Zealand.

6.3.3 AVALANCHE

Mountain users at Whakapapa and Turoa were asked if they were aware of any recent avalanche events at Mt Ruapehu. One third of public skiers indicated that they were aware of recent events compared with 21.6% of snowboarders. Viewed across Whakapapa and Turoa users, 31% across both areas indicated that they were aware of recent events.

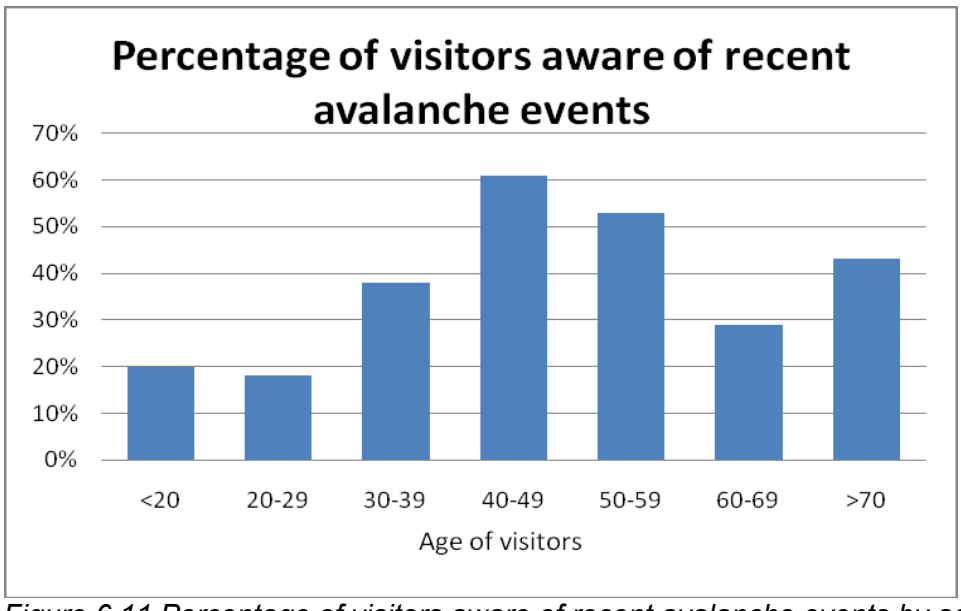

Figure 6.11 Percentage of visitors aware of recent avalanche events by age.

Figure 6.11 shows the percentage of each age group confirming awareness of recent avalanche events. Under 20 year olds (20%), 20-29 year olds (18%) and

60-69 year olds (29%) were the least aware of recent avalanche occurrences, with the most aware being the 40-49 year old age group. Sixty-one percent of 40-49 year olds were aware of recent avalanche events, followed by 50-59 year olds (53%), over 70s (43%) and 30-39 year olds (38%). Males (33%) had slightly higher awareness of recent avalanche events than females (26%).

The respondents were also asked to name the recent events they were aware of (Figure 6.12). A number of people commented on the regular control work done by ski patrollers, as well as the avalanche in 2003 through the 'Why Not' valley at Turoa. A definition of 'recent' was not provided. Nineteen people said that they were aware of avalanche events but did not list any (17%).

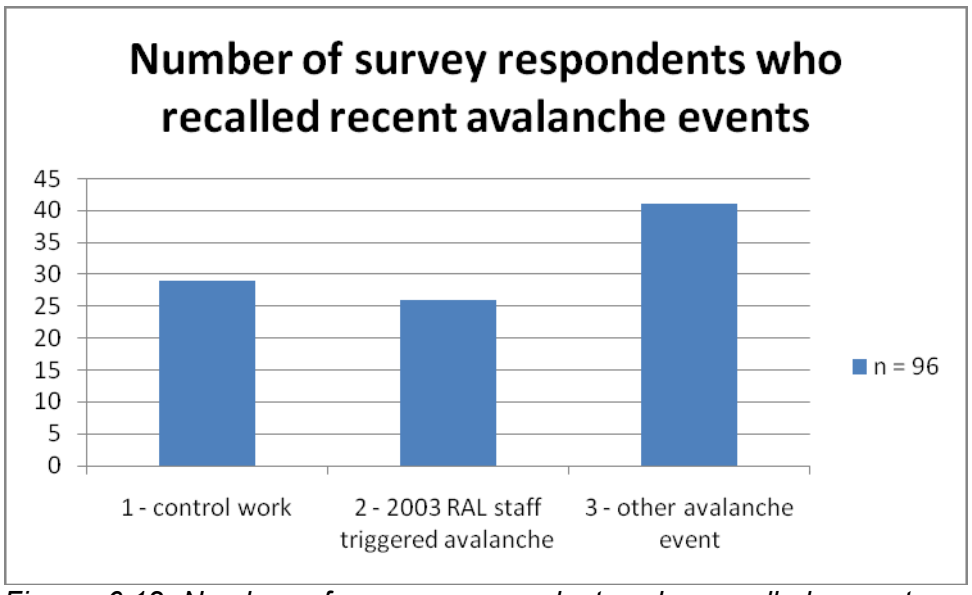

Figure 6.12 Number of survey respondents who recalled recent avalanche events.

6.4 PERCEPTIONS OF SAFETY

The present study looked at visitor perceptions of safety and attempted to determine the extent to which visitors to Mt Ruapehu ski areas felt safe in the immediate surroundings. This was examined by scoring two different locations (New Zealand and Mt Ruapehu) on a safety scale, and by using Espiner's (2001) perception of risk scale (PRS).

6.5.1 New Zealand and Mt Ruapehu as safe tourist destinations

Survey respondents were asked to rate New Zealand and Mt Ruapehu on a 5-point safety scale. Consistent with other survey measures, respondents rated both places as safe-very safe. Most people surveyed either thought New Zealand as a destination for tourists was either very safe (38.7%) or safe (52.4%) (Figure 6.13). Seven percent of people indicated that New Zealand is neither safe

nor unsafe, and only two people surveyed thought that New Zealand was unsafe, or very unsafe as a place to visit. In the following question looking at Mt Ruapehu as a tourist destination, 14% of visitors indicated that Mt Ruapehu is neither safe nor unsafe. The number of respondents indicating very safe or safe remained high. Twenty-one percent thought Mt Ruapehu as a tourist destination was very safe, and 59.1% consider it safe. Three percent of survey respondents thought Mt Ruapehu unsafe, and three survey respondents (0.8%) thought Mt Ruapehu very unsafe. The moderate perception of safety at Mt Ruapehu is likely to be related to the news and tourism promotion media influence on risk perceptions.

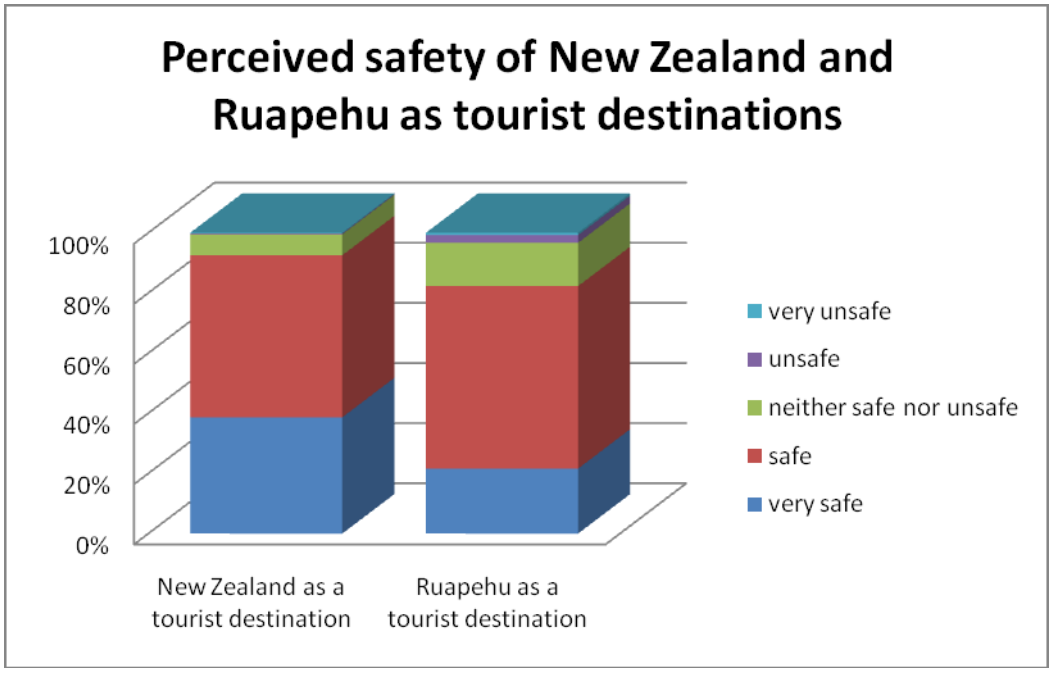

Figure 6.13 Perceived safety of New Zealand and Mt Ruapehu as tourist destinations.

In comparison to Espiner's (2001) study at Franz Josef and Fox Glaciers in the South Island, where there were predominantly international visitors with moderate perceptions of safety, the predominately New Zealand survey population in this study express high levels of safety. This may be because they believe they can make up their own mind about conditions and whether a site is safe or not. The fact that visitors perceive the ski areas to be safe areas should remain a concern to ski area management as perceptions of safety and security can lead to over-confidence and inappropriate actions. In perceiving natural areas to be 'safe', visitors may pay less attention to hazard warning signs (Espiner, 2001).

6.5.2 Perceptions of Risk

Assessing Whakapapa and Turoa visitors' perceived levels of safety is an important part of the present study. Again, visitors' perceptions were examined

using a Likert scale. The scale ranged from 1 (completely agree) to 7 (completely disagree), with a high score indicative of strong feelings of safety. Results from this part of the survey are consistent with other measures of visitor safety perception. Visitors had moderate overall perceptions of safety (mean = 4.42) (Table 6.2), though considerably lower than Espiner (2001) found in his study at Franz Josef and Fox Glaciers (mean = 5.5). The difference between the two locations may be explained in the population at either site. Mt Ruapehu mountain users were mostly domestic, with many years experience of visiting the ski areas, and good awareness of hazards. Knowledge of a site or activity is likely to affect visitor perceptions. Visitors to Franz Josef and Fox Glaciers were predominately from overseas (80.4%), and were more likely to overestimate safety because of their expectations of New Zealand as a tourism destination and the often highly regulated societies the visitors hail from (Espiner, 2001).

Table 6.2 Safety perception scores.

Scale items		MIN	MAX	RAW MEAN	ADJUSTMENT OF MEAN	MEAN
SPS	This seems like a safe place to visit.	1	7	2.36	4.64	
	As a visitor to this ski area I feel as though I am exposing myself to physical danger.	1	7	4.19	4.19	
Total					**8.83**	4.42

Adjusted mean represents those items whose anchors have been reversed to reflect their direction of influence on the scale

ATTITUDES OF INDIVIDUAL RESPONSIBILITY

The survey tested the extent to which visitors to Whakapapa and Turoa felt responsible for their individual safety while visiting the ski areas. Again, respondents' attitudes were investigated using a Likert scale through the individual responsibility scale (IRS). Higher scores indicate higher levels of responsibility for individual safety. The eight questions asking about perceptions of safety were averaged (Table 6.3). The overall mean of 3.51 (1=completely agree to 7=completely disagree) shows moderate level of safety perceptions. The mean for each question on this scale ranged from a very low 2.43 ('those who manage this area have an obligation to inform me about all things which might affect my safety') to a much more aware 4.91 ('as a visitor to this site, I feel responsible for my own safety'. The extent of individual responsibility varied between each question in the scale. Visitors are very happy with how management controls potential hazards at the ski areas. Eighty-three percent of visitors agree that hazards are well controlled by management.

Table 6.3 Individual responsibility scores.

Scale items		MIN	MAX	RAW MEAN	ADJUSTMENT OF MEAN	MEAN
IRS	As a visitor to this site, I feel responsible for my own safety.	1	7	2.09	4.91	
	Visitors should be held more accountable for their actions in natural areas like this one.	1	7	2.41	4.59	
	Managers should do more to protect visitors from harm in natural areas.	1	7	4.2	4.2	
	Management should prevent access to areas which might be dangerous.	1	7	3.27	3.27	
	I should be allowed to decide where it is safe to go.	1	7	4.37	2.63	
	I would like to see more obvious evidence of management at this ski area.	1	7	4.33	4.33	
	Those who manage this area have an obligation to inform me about all things which might affect my safety.	1	7	2.43	2.43	
	Any hazards here seem to be beyond the control of management.	1	7	4.24	2.76	
Total					**31.63**	3.51

Adjusted mean represents those items whose anchors have been reversed to reflect their direction of influence on the scale

However when asked if hazards are beyond the control of management, the responses were fairly evenly spread from 'Completely agree' to 'completely disagree'. Approximately a third of visitors surveyed thought that managers should be doing more to protect visitors from harm, but in contradiction; just over half of those surveyed indicated they do not want to see more obvious evidence of management within the ski area. Almost all survey participants indicated that a little danger is an accepted part of visiting a natural area like Turoa or Whakapapa, but they also thought that those who manage the area have an obligation to inform about things which may affect safety while using the area. Most people thought that visitors should be held more accountable for their actions in natural areas to some degree and they also largely felt responsible for their own safety while in the ski area. Most people were highly aware of the obvious dangers within the ski area.

These results are in line with results discussed throughout the chapter indicating moderate awareness/perception of safety. While conducting the surveys, researchers experienced strong reactions from respondents that visitors should

be more responsible for their own safety while visiting ski areas. Most people who visit the areas accept that there is an element of risk involved in skiing and snowboarding and there are limitations on what RAL can do to minimise hazards in the ski areas, and many people visit Mt Ruapehu because of the element of risk. Espiner (2001) found a similar perspective in the South Island and attributed this to New Zealand's 'she'll be right' attitude and the negative attitude to warnings and over-management. The quantitative findings demonstrate a moderate sense of individual responsibility. People's feelings about the IRS may relate to signs and restriction and not liking being told what not to do in their own environment.

6.5 CHAPTER SUMMARY

Visitors to Whakapapa and Turoa ski areas respond to hazard warning signage and form perceptions of risk based on their individual assessment of the physical and social conditions and credibility of mountain signage. Perceptions of hazards are informed by previous experiences, knowledge, expectations, attitudes toward risk, the way the hazards are presented by management and their own cultural context.

In reviewing hazard identification, it was concluded that visitors to Whakapapa and Turoa ski areas are fairly knowledgeable about hazards with 80.6% of survey respondents identifying at least one hazard. Hazard awareness scores showed only modest awareness of hazards. Visitors were asked to rate hazards on a 7-point Likert scale. Across each of the categories (except 'Mountain Road') between 65-80% of survey respondents rated the hazards between slightly hazardous to very hazardous. Eighty-one percent of respondents thought the mountain was between very safe (1) and neither safe nor unsafe (4). These results echoed the hazards recalled in hazard identification.

To determine the effectiveness of warning signs at Whakapapa and Turoa ski areas respondents were asked to recall whether they were aware of warning signs in the area, as well as indicate awareness of ski area boundaries, volcanic events, the eruption detection system and recent avalanche events. Cliff signs were the most commonly reported signs, in line with hazards recalled in the hazard identification section. Participants were also asked about their awareness of recent volcanic and avalanche events. Forty-four percent of participants were able to recall the 2007 lahar/eruption events. Respondents were asked if they were aware of an eruption detection system on the mountain and 72% of people indicated that they were aware. When asked whether they knew the correct

actions to take if a lahar occurred at warning systems were triggered, 75% of people indicated that they knew the correct procedure, although when asked to write the correct action to take only 88% of those gave the right answer (to move out of the valleys to the ridges).

Visitor perceptions of safety were high at both ski areas and visitors did not perceive either ski area to be a particularly dangerous place to visit compared with New Zealand as a tourist destination. In their perception of the ski areas as safe, visitors may hold the belief that their experiences are being well managed and that they are immune to hazards. This should be of concern to management as people who perceive they are vulnerable are more likely to respond to warnings; therefore those who feel they are invulnerable to hazards are less likely to respond to warnings (Johnston *et al.,* 1999; Espiner, 2001). Management needs to be aware that low risk perception and belief in immunity has consequences for risk management and communication. Visitors who perceive themselves as being at little risk while using the ski areas may be less receptive to hazard warning signs and other hazard warning information.

At Whakapapa and Turoa ski areas, there appeared to be only modest levels of responsibility for individual safety. This needs to be interpreted within the context of the other results, for example hazard awareness and perception of risk were both higher than the attitude toward individual responsibility for safety. These perceptions are likely to affect the extent to which responsibility is accepted by the individual. The lower attitude toward individual responsibility is in contrast with historic assumptions in New Zealand that those who visit natural areas assume the risks they find there (Martin, 2000), although New Zealand legislation protects agencies from court action and compensates individuals for accidents and injuries.

Visitors to Whakapapa and Turoa ski areas feel safe and perceived few risks. They accept only a modest degree of personal responsibility for their own safety while visiting these sites. This should be of concern to ski area management and suggests that visitors either do not believe the messages on warning signs or are prepared to take chances to realise their expectations. The next chapter looks at visitor perceptions of hazards from a ski area management point of view.

CHAPTER SEVEN
MANAGEMENT OF HAZARDS AND DISCUSSION

Plate 7.1 High Noon express chairlift at Turoa ski area.

7.1 INTRODUCTION

The purpose of this chapter is to examine the key themes from the present study. These themes are drawn from interviews with key stakeholders and the survey results from the previous chapter. This chapter will look at the wider themes of the study relating the perceptions of RAL management, DoC staff and GNS researchers back to visitor perceptions and awareness of hazards. Those interviewed were asked whether they saw any differences between visitor hazard perceptions and responses at Whakapapa and Turoa, as well as between other demographic groups (gender, age etc), addressing objective 1. Objective 2 was also attended to with interviewees being asked to explain what they felt were the most concerning hazards within the ski areas and why these may differ from what the visiting public may perceive. Interviewees were asked to assess the effectiveness of the current hazard sign system and explain how they felt it could be improved (Objective 3). The information gained from conversations with RAL, DoC and GNS staff has been integrated into the key themes from the surveys addressing objective 4, examining and understanding current public perception and awareness of natural hazards at Mt Ruapehu.

Interviews were conducted with Andy Hoyle (Whakapapa) and Chris Emmett (Turoa), RAL Safety Services managers; Blake McDavitt from DoC; and David Johnston and Graham Leonard (GNS scientists) were spoken to numerous times throughout the project. In speaking to these representatives of the stakeholders, organisational views on why the public act and think the way they do about hazards were able to be examined. Their roles as hazard communicators were also discussed.

7.2 CONTEXT FOR RISK AND HAZARD MANAGEMENT AT THE SKI AREAS

In order to put visitor perceptions of hazards into context it is important to analyse the relationship between safety managers within the ski area and national park setting, and the social environment. This brief overview is relevant to the discussion because it is within this administrative context that hazard management at the study site occurs. The links between the individual visitor, RAL and DoC hazard management and the wider social context is important because of the potential risks within these natural settings. Hazard and risk mitigation strategies are influenced by safety manager's own perceptions of risk, the extent of accountability and the social and political environment of the ski areas management. Whakapapa and Turoa ski areas are located within Tongariro National Park (see Chapter 2) and are therefore subject to the provisions of the National Parks Act 1980 and the Conservation Act 1987. RAL also operates under the Resource Management Act 1991 and the Health and Safety in Employment Act 1992 (Ruapehu Alpine Lifts, 2010a).

RAL holds a DoC concession to operate Whakapapa and Turoa ski areas and their supporting facilities within Tongariro National Park. RAL is therefore required to meet a range of safety services and strategies largely within the licensed boundaries, although a limited number of services do extend past the boundaries. The primary focus of these services is on everyday ski area patrons, 'with the exception of Ski Area Boundary signs there is no provision for alpine or rock climbers and 'extreme skiers' who choose to pursue their recreation within the ski area boundary' (Ruapehu Alpine Lifts, 2009e).

A number of strategies are employed to reduce risk to visitors. These include daily hazard assessment by Ski Patrol of ski area conditions, signs warning of specific hazards and installment of ropes and barriers restricting access to hazardous areas with the option of closure. The strategies to identify and manage hazards demonstrate a commitment by RAL to reduce risk. Processes governing

the management of natural hazards at the ski areas are documented in the Terrain Hazard Control Plan (Ruapehu Alpine Lifts, 2009a), which is updated annually. Management of hazards and risk is carried out through Ski Patrol who have the job of identifying and isolating hazards. The hazards and risks are recorded through a series of safety documents: Risk Management Plan (Ruapehu Alpine Lifts, 2010a), Terrain Hazard Control Plan (Ruapehu Alpine Lifts, 2009a), Terrain Hazard Atlas – Whakapapa (Ruapehu Alpine Lifts, 2009f) and Terrain Hazard Atlas – Turoa (Ruapehu Alpine Lifts, 2009e). These are organisational documents and not available to the public.

The Terrain Hazard Control Plan (Ruapehu Alpine Lifts, 2009a) outlines the hazard rating and risk zone system and a strict set of operating procedures employed by RAL. It also identifies and describes particular hazards and the management techniques to be used depending on the severity of the hazard. Within the specific ski area terrain atlases, hazards are identified and located on a map. They are specified in terms of their location, the hazard frequency and consequence, type of hazard, the measures used to control, and their hazard rating after the controls have been put in place. Figure 7.1 below shows Whakapapa terrain hazard zones, Figure 7.2 shows Turoa.

Figure 7.1 Whakapapa terrain hazard zones (Source: Ruapehu Alpine Lifts, 2009f).

A considerable amount of work goes into preparing the ski areas for visitors. RAL Safety Managers explained that preparation for a ski day begins a week prior. This means there is constant preparation for future ski days. Ski Patrol begins looking at weather and snow conditions five or six days out from the ski day and planning for the day begins the day before. On the day before, Ski Patrol makes plans for the following day, reviews the weather for the last time at around 3p.m., organises staff, decides whether control work is necessary depending on snowfall and makes a decision on what time to open based on weather.

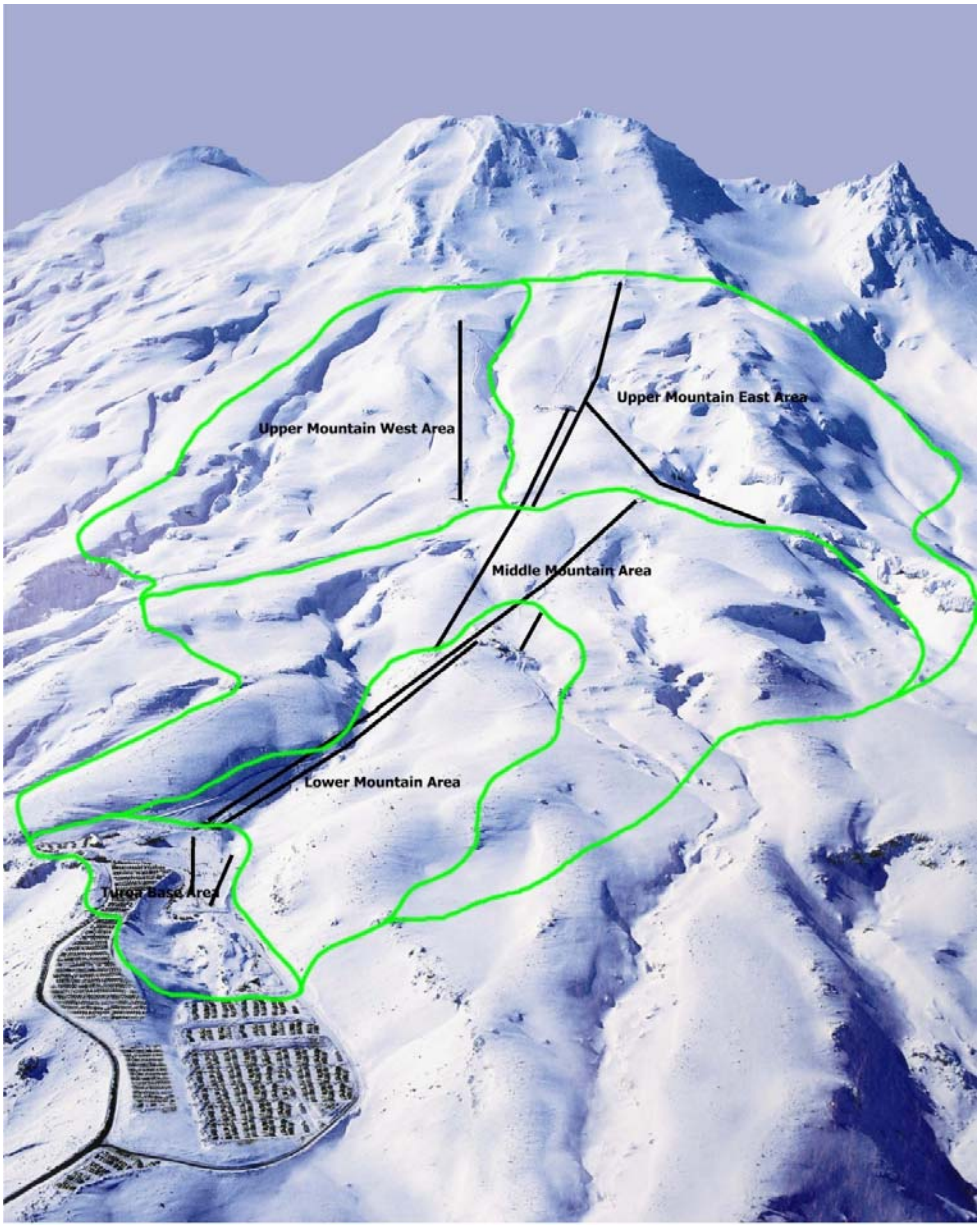

Figure 7.2 Turoa terrain hazard zones (Source: Ruapehu Alpine Lifts, 2009e).

To communicate ski area hazards Safety Services, comprised of a skilled team of Ski Patrol, gives safety talks to various interested parties including ski clubs and school groups. Safety Services maintains a presence on the Mt Ruapehu webpage (Ruapehu Alpine Lifts, 2010b). RAL also has a Trail Safety crew who works with Ski Patrol on hazard prevention. They have the right to confiscate

passes when they see dangerous visitor behaviour. This contributes to stemming the flow of potential accidents. In addition to these measures, a national Ski Patrol network comes together at the end of each winter season in October to skill share. There is a great deal of collaboration across New Zealand ski area safety staff due to the similar problems faced.

7.3 THEMES FROM THE RESEARCH

The following key themes were drawn from the interviews with key hazard management staff and are related back to the results gained from the ski area surveys. In order to better educate the public their perceptions of hazards need to be well understood by providers.

7.3.1 COLLABORATIVE APPROACH TO HAZARD MANAGEMENT

All interviews highlighted the value that RAL, GNS and DoC place on their collaborative work to mitigate hazards. The safety documents outlined in section 7.2 undergo constant re-evaluation by RAL Safety Services. There are also agreements, formal and informal, between the main stakeholder agencies around Mt Ruapehu including DoC, GNS, New Zealand Police, Register of Outdoor Safety Auditors (ROSA) and the Outdoor Pursuit Centre as outlined by Paton *et al.* (1998). They believe that with their combined approach, each from slightly different organisational perspectives and with different strengths, create a more comprehensive approach to hazard management. Utilising the strengths of each organisation and maintaining free and open communication with each other is likely to be most beneficial for visitors to Mt Ruapehu, as gaps in hazard management not identified by one group are likely to be picked up by another. It is the author's opinion that a limitation to this approach may be that if each organisation is being assessed on their contributions to the hazard management plans separately, reporting on the entire network and the way they respond as an entity may be being overlooked. This overall approach was tested in the 1995-1996 eruptive sequence (Paton *et al.,* 1998), but over 10 years later many aspects of the relationships are likely to have changed and a reassessment of this structure would prove useful.

7.3.2 RISK MANAGEMENT AND COMMUNICATION PROVIDED BY RAL, DOC AND GNS

RAL, DoC and GNS utilise traditional safety measures, including safety signs (as shown in Figures 3.5 and 3.6). In addition, the Mt Ruapehu website is maintained with current safety material (Ruapehu Alpine Lifts, 2010b). Public safety information is used to present messages to visitors to Whakapapa and Turoa ski

areas and these are specifically targeted to adult mountain users. These are presented in several mediums including snow, weather and facility status reports; short and medium range weather forecasts; backcountry avalanche advisories; safety signage definitions; snow user responsibility codes; volcanic hazard maps and information; and trail and amenities information. This information is available through the Mt Ruapehu website, on the radio, in some Central Plateau shops, in pamphlets, by snow phone, posters, by text message and by on-mountain staff.

RAL employs ski area signage strategies used in the United States and Canada, where extreme caution is taken in ski areas due to the litigious nature of their societies. Whakapapa spend approximately $65,000 each year on safety signage and equipment, trying to find the balance between being over the top and maintaining a consistent approach to managing risk. Emmett from Turoa confirmed that safety policies are consistent across both ski areas but that their next step is consistent application of the policies at both ski fields. While safety signs seem to be the main way ski area management alerts the visiting public to potential hazards, sign recall in the survey conducted shows limited recollection. Ninety-three percent of visitors were able to recall one or more sign but very few people recalled signs other than 'cliffs'. 'Slow' signs are present in many locations across both ski areas, but visitors may come to see signs as part of the landscape and not take heed of the messaging. Concerns have already been raised by McCool and Braithwaite (1992) about signs as a passive model of communication and their limited ability to influence and modify behaviour. The results of the present study confirm this statement. RAL, GNS and DoC may need to consider more innovative ways of educating the public of potential hazards. Simply making hazard information available does not necessarily motivate people to prepare themselves for natural hazards and in order for signs to be effective they need to be read, accepted and acted on (McCool & Braithwaite, 1992; Paton *et al.*, 2008).

Hazard managers were not surprised to learn that public knowledge of the EDS was only moderate. Existing literature supports their views (Leonard *et al.*, 2004; Paton *et al.,* 2008). Similarities can be drawn between the present study population and Johnston *et al.*'s (1999) study of Hastings and Whakatane residents interviewed about hazards in the wake of the 1995-1996 Mt Ruapehu eruptive sequence. They found that only direct experience with the hazardous events increased threat knowledge. This may be why Hoyle stated that Whakapapa ski area's cliffy terrain increases people's awareness of hazards as they need to take caution around these obvious hazards. In the current study older mountain users at Mt Ruapehu were generally better informed about

previous volcanic and avalanche events. Factors that influence people's perceptions of hazards include the magnitude and frequency of the hazard and the recency of the individual's experience with the hazard (Mitchell in McCool & Braithwaite, 1992). The older, more experienced domestic population would have been exposed to more information about Mt Ruapehu's volcanic activity and are therefore more aware of these hazards.

7.3.3 *HAZARD FOCUS*

One of the overarching themes from the interviewees and from survey respondents was that people visiting the mountain pose a greater hazard than the physical hazards within the ski areas. Maintaining visitor awareness is an ongoing problem for safety staff. Interestingly, lahar and volcanic hazards were not shown to be of huge concern to ski area safety staff. This contrasts with the majority of existing research at Mt Ruapehu which has focused almost exclusively on awareness of volcanic hazards (Leonard *et al.*, 2004; Christianson, 2006; Paton *et al.*, 2008; Ward *et al.*, 2003; McLay, 1995). There may be a number of reasons for this. Lahar events occur infrequently, so the safety management staff are likely to be focussed on more pressing hazards that affect the day to day running of the ski area. The work that has been published on volcanic hazards has been largely undertaken by Massey University and GNS scientists focussing on the geomorphic processes, and the public responses to these processes rather than the study of general behaviour and perceptions of mountain users.

7.3.4 PUBLIC ATTITUDES AND RESPONSE TO HAZARDS

Education of visitors to the ski areas is of primary concern to safety managers. When looking at particular demographics of concern to Safety Services Managers, both Emmett and Hoyle highlighted males as being more susceptible to injuries. Male snowboarders between the ages of 18 and 30 are most difficult for ski area staff to educate due to their relationship between confidence and competence. Overestimating ability and tendency to take risks provide unique challenges in communicating risks to these people. These sentiments were echoed by Leonard and Johnston from GNS who highlighted the difficulty in educating this demographic about the possible dangers from lahar events. Data from the surveys showed similar patterns with males between 18 and 30 having reasonable knowledge of the existence of a hazard warning system (72%) but only 56% of males 18-30 years demonstrated awareness of the actions to take during the alarm. This indicates that this demographic is aware of the EDS but do not know the actions to take, or falsely indicated that they did understand the actions to take when they really did not. The lack of knowledge in this particular

group will remain a concern as skiing and snowboarding continue to be popular winter sports for young people (Gibson, 2006; Aschauer *et al.*, 2007).

Moderately high numbers of survey participants were aware of the EDS (Figure 6.10). However two demographic areas of concern not raised by interviewees were female mountain users and snowboarders. These two groups showed the least awareness of the detection system. The repercussions of this may be that, if ski area management are focussed on the education of males, 18-30, they may not be targeting other less aware groups. RAL and GNS will need to consider how to reach out to these specific groups who show lack of awareness.

All parties interviewed were aware of the largely domestic population at Mt Ruapehu ski areas, and this has been confirmed by literature (Bentley *et al.*, 2003). The consequence of this is that while the public is largely from outside of the Central Plateau and from either Auckland (54%) and Wellington (17%), these people are still likely to be exposed to volcanic events that occur at Mt Ruapehu through news media and communications. Improved hazard awareness would require targeted communication to these particular visitor populations, although as mentioned earlier, simply providing information to the public does not mean that they are prepared for hazards (Ward *et al.*, 2003).

The limitation of the present study is that the actual response of the public to the EDS was not examined, although this has been covered before by Leonard *et al.* (2004), Christianson (2006) and Paton *et al.* (2008). The response itself is difficult to test, as Leonard and Johnston indicated to the interviewer. The public present at trial EDS alarms may be aware that the test is a trial and not take the appropriate actions (move to higher ground). Future research will try to counteract this effect by having test observers ski directly to those not responding to the EDS alarm to ask them specific questions relating to their awareness information and demographic. This future research will help RAL and GNS to understand non-respondent behaviour and motivations.

Both Emmett and Hoyle noted the avalanche control work done by Ski Patrol to minimise risk of avalanche. With so much emphasis and publicity being given to volcanic hazards at Mt Ruapehu, it is surprising that 30% of survey respondents consider avalanches to be very hazardous. Visitors over the age of 30 were generally well aware of avalanche dangers and were able to give recent examples. Those under 30 were less likely to be concerned about avalanches while at Mt Ruapehu. Although risk from avalanche is minimised through active risk mitigation by Ski Patrol, RAL is not required to do control work outside of ski area boundaries. Fifty-nine percent of visitors to Mt Ruapehu say that they have

left ski area boundaries before, and in leaving ski area boundaries people are exposing themselves to considerable risk as articulated by Dignan (2008), Dignan (2009) and Hendrikx (2007). DoC and RAL may need to be more active in educating people about the control work that occurs at the ski areas to prevent visitors from avalanche dangers so that they are able to fully understand the risks of leaving ski area boundaries.

7.3.5 PUBLIC AWARENESS AND ACTUAL RESPONSE

Emmett, Hoyle and McDavitt hold strong views about the extent of dangers within ski area boundaries at both Whakapapa and Turoa ski areas. There are a range of possible reasons for these views which could include managers' previous experiences in the outdoors, access to information related to natural hazard events, a sense of obligation to visitors and personal observation (Espiner, 1999). These beliefs support the need for the detailed Terrain Hazard Control Plan (Ruapehu Alpine Lifts, 2009a). This document may enable managers to deflect criticism that management is complacent in the case of an accident.

Hoyle and Emmett noted visitor safety expectations are high and recent injuries and deaths on Mt Ruapehu ("Avalanche was 'freak' of nature", 2003; Hudson, 2008; Ihaka, 2009; "Ruapehu eruption risk remains high", 2007; "Skiers scurry as storm rages over Ruapehu", 2008) means there is increased pressure to regulate these natural areas further. The Terrain Hazard Control Plan (Ruapehu Alpine Lifts, 2009a) is crucial in demonstrating to ski area management that something is being done to impose a degree of control on the situation. This may work negatively on the public, however, as visitors may come to assume that risks have been removed or that absence of signs signifies the absence of hazards or risks.

RAL safety managers perceive there to be moderately high levels of risk at Mt Ruapehu, although their concern about risk is not related to physical hazards so much as the risk of so many mountain users combined with high speeds and lack of experience and ability. Hoyle and Emmett indicated that the biggest hazard to skiers and snowboarders within the ski areas is individual ability. The less ability and experience an individual has, the more hazardous they are to themselves. This is echoed in the question where respondents were asked to list hazards. Twenty-four percent of all hazards reported were related to other people using the mountain ('skiers', 'snowboarders' and 'other mountain users').

In contrast, Hoyle stated that getting lost and falling off terrain and cliffs are major concerns at Whakapapa. Hazards can only be managed to within an acceptable level and not completely eliminated, therefore Safety Services takes a risk

management approach. Turoa has a different problem; they are hampered by a single access trail to the base area which means different ability level users are coming together causing collisions. Turoa are working to minimise this potential hazard. Except for the base access trail Turoa is generally well graded, keeping different ability users separate. Emmett noted a particular problem of collisions within Turoa ski area due to the nature of the terrain. With wide open trails, speeds are increased therefore collisions become far more common. Turoa are in a position where it is limited with what it can do to further improve safety outside of higher end strategies like trail design.

When asked if RAL is responsible to control hazards at Mt Ruapehu both Safety Services Managers indicated that RAL is responsible to control hazards to an acceptable level within ski area boundaries while balancing the visitor's freedom of experience and not controlling them. Both safety managers are keen to work on strategies that increase the public awareness of shared responsibility in the outdoors, although overall the strategies employed by RAL appear to maintain moderate levels of hazard awareness among ski area visitors (see Chapter Six).

7.3.6 OVERESTIMATION OF ABILITY

The present study found that 54% of visitors considered themselves to be Black/expert skiers and snowboarders. These results are likely to be grossly overstated as people were rating themselves. Believing that one is of greater ability than in actuality may lead to complacency and lessened awareness of hazards and perceptions of individual responsibility. There are two key groups of visitors when looking at individual responsibility at Whakapapa and Turoa ski areas. There are those who believe that it is RAL's responsibility to manage hazards and there are those with a strong sense of individual responsibility when using the areas. This idea was supported by conversations with visitors as the surveys were being distributed as well as with ski area safety staff. Relating to visitor perception of their own ability and hazards Hoyle stated that as:

> "skill level increases, confidence increases and awareness [of hazards] decreases, and we get false positives".

This means that as visitor ability increases, their awareness of hazards initially increases but then decreases as people become comfortable in their environment and begin to overestimate their safety. This is backed up by survey responses in that non-skiers rated almost all hazards (except the mountain road) as being more hazardous than all other survey respondents. This is probably due to their lack of familiarity with the mountain environment. This attitude is preferable to ski

area management as these non-skiers are unlikely to overestimate their own ability and safety within the natural setting.

Related to this, visitors were asked to rate Mt Ruapehu and New Zealand on a scale of safety to visit. Over 50% of survey respondents thought Mt Ruapehu to be a 'safe' place to visit. Hoyle and Emmett admitted the tension that they must weigh up in being safety managers at ski areas. Ski area management wants to encourage as many people as possible to visit as the area is a business; however the job of Safety Services is to protect people from harm when visiting the area. If people feel safe when they are visiting Mt Ruapehu, they are less likely to take notice of signs and more likely to overestimate their ability. This means they may not be taking individual responsibility for their own safety and may become complacent. Mountain users' decisions and judgements are guided by social trust, and the social trust of those communicating information about the hazard is correlated to the hazard's risks and benefits (Siegrist & Cvetkovich, 2000). If visitors to Mt Ruapehu perceive there to be greater benefits from behaving in a reckless manner than acting safely, they may take little notice of signs presenting safety information. This can be seen in the present study when looking at the number of people admitting to have left ski area boundaries without correct safety equipment (14.1%). The potential benefits from the activity of leaving the ski area boundaries have outweighed the potential hazard through visitor calculations of real and perceived risks (Haddock, 1993). Visitors seemed to have a false sense of safety around out of bounds usage (Chapter 6), possibly related to Maclaren's (2006) notion that society does not expect people to experience serious injury or death while participating in recreational activities.

Public perceptions of risk obtained through the survey were only moderate. Safety Services managers indicated that the mountain, if used wisely, is a safe place to visit and enjoy. Hoyle said 'if you are on the mountain, and adhering to the rules, it's a pretty safe place'. The Safety Services managers were both very receptive to new ideas and while they have done much to improve visitor safety within the ski areas through signage and other forms of communication and education they admit that there is always room for improvement.

Risk exists at Mt Ruapehu because of the attendance of people in areas where natural hazards are present. Management faces complicated decisions on how significant risk is and how to manage it. This research establishes that visitors to Whakapapa and Turoa ski areas have only modest awareness of hazards and do not have high perceptions of risk. Visitors have a moderate understanding of hazards present at Mt Ruapehu but this was not recognised in their perceptions of

risk and safety. This raises ethical issues about the degree to which it is necessary to inform visitors of risks and hazards within the ski areas.

7.4 CHAPTER SUMMARY

The motivation behind the present study was to delve into the current public awareness of natural hazards at Mt Ruapehu, this stemmed from observation that visitors to Mt Ruapehu ski areas were exposed to an array of hazards, but the uncertainty of whether the visitors were fully aware of the potential dangers. These observations led to the formation of questions around the extent that visitors to Whakapapa and Turoa ski areas were aware of hazards, the effectiveness of the current warning system, the difference in awareness of different demographic groups and analysis of the specific hazards visitors feel they have been exposed. The extent to which visitors accepted personal responsibility for safety and their perceived feeling of safety at the ski areas were also investigated.

This chapter has outlined the perceptions of representatives from RAL, GNS and DoC with regard to natural hazards within Whakapapa and Turoa ski area boundaries. Throughout this chapter several clear themes have emerged. The collaborative approach to hazard management employed by stakeholders showed the similarities in perception of hazards among these interviewees. Those interviewed believe that the ski areas are only moderately hazardous due to the nature of the terrain, but made considerably more dangerous with the addition of thousands of people using the slopes. Safety managers indicated that the behaviour and actions of the people visiting the mountain are often of greater concern than the physical hazards within the ski areas and the maintenance of visitor awareness is an ongoing problem for safety staff. Survey respondents also considered ‘other mountain users’ to be as potentially injurious as other natural hazards like lahars, ice and cliffs. This shows that the public does perceive other mountain users as being a considerable hazard at the ski areas but whether this affects actions taken has not been tested in the present study.

The interviews also highlighted differences between the beliefs held about hazards and actual behaviour, for example, mountain users express awareness of ski area boundaries and often leave them despite considerable risks in participating in this behaviour. A clear difference between public knowledge and public response to hazard communication has been observed by interviewees. While people demonstrated some knowledge of hazards through the survey in the present study management believe that many visitors choose to ignore

hazard advice. Difficulties in educating mountain users to remain aware of hazards were noted by all interviewees, particularly in regard to advanced and young male mountain users. Despite this considerable work done to inform mountain users, many visitors remain unaware or ignore hazard warning signs.

CHAPTER EIGHT
CONCLUSION

Plate 8.1 View from Knoll Ridge, Whakapapa.

8.1 CONCLUDING SUMMARY

The intention of this research was to investigate how the public perceives hazards at Whakapapa and Turoa ski areas at Mt Ruapehu, and look at the particular hazards to which visitors feel they have been exposed. These study sites were chosen as they provided an ideal setting in which to study hazard management and visitor awareness of hazards. This is due to the nature of the potentially hazardous environment, an expectation from visitors of safety and the number of agencies working together (DoC, RAL, GNS). DoC and RAL are responsible for informing the public about potential hazards and keeping them from harm. As a result a research question was posed, looking at the extent to which visitors to Whakapapa and Turoa ski area demonstrate an awareness of hazards and the effectiveness of hazard warning signs and public information media in creating appropriate visitor awareness and behaviour.

The study area chapter gave an introduction to Whakapapa and Turoa ski areas and some background to the potential hazards within these areas. The literature review gave an overview of studies done at Mt Ruapehu, mostly around visitor awareness of volcanic hazards. Additionally the concepts of risk and risk perception were explored.

In relation to the first research objective, the study presented a basic demographic profile of visitors to Whakapapa and Turoa ski areas, effectively identifying a target audience for management. Findings indicated that visitors to Whakapapa and Turoa ski areas are mostly domestic; meaning that ongoing education of hazards and risk is a possibility. Young males were identified as being a demographic of concern through survey results and by study interviewees. Younger people are less informed about hazards probably due to having had less exposure to them (Mitchell in McCool & Braithwaite, 1992). The problems of communicating risk to this population in terms of their tendency to overestimate ability and take significant risk will continue to prove problematic for ski area safety staff. According to Aschauer *et al.* (2007) and Gibson (2006) lack of knowledge will remain a concern for this particular group as skiing and snowboarding continue to be popular winter sports for young people. A large number of visitors to Mt Ruapehu use both ski areas and are experienced mountain users, so lack of knowledge may be attributed to complacency. Ski area managers admitted that consistent safety policies across both ski areas exist but more consistent application of safety policy may help to create safer behaviour and improve visitor awareness.

Chapters six and seven addressed research objectives two, three and four. These were achieved through specific questions about hazards encountered and awareness of safety signage. Survey respondents were also asked to indicate awareness of ski area boundaries, volcanic events, the eruption detection system and recent avalanche events. Regarding the second objective, results showed that four out of five survey respondents recalled at least one hazard although visitors showed only modest awareness of hazards through the hazard management scale. One of the most commonly reported hazards was ‘other mountain users’. Ski area Safety Services also consider ‘other mountain users’ to be the greatest hazard to visitors to Mt Ruapehu ski areas. This is a key theme from the study as there appears to be no existing academic literature in this area besides the current research. Visitor perceptions of ‘other mountain users’ warrants further research in the future, possibly looking at other ski areas in New Zealand or overseas. The present study has also added to the body of study on perceptions of avalanches as hazards in that younger people were found to have

less knowledge and awareness of the potential danger of avalanches. This lack of knowledge provides useful information to organisations like the Mountain Safety Council and their reporting on hazards (Dignan, 2008; Dignan, 2009; Hendrikx, 2007), potentially informing their research. Mountain users showed moderate awareness of volcanic hazards, in line with results from interviews and past work done by Leonard *et al.* (2004), Ward *et al.* (2003) and Coomer and Leonard (2005). These results add to the existing work on hazard perceptions by the provision of a large scale survey of winter mountain users focussing on a range of hazards in a way that has not been done before in a ski area.

Concerning the third objective, Whakapapa and Turoa ski areas respondents were asked to recall whether they were aware of warning signs in the area. Risk communication in the form of safety signage is undertaken to inform visitors of natural hazards and to encourage appropriate behaviour. Despite the attempts by Safety Services to present the message of risk, evidence shown in Chapter Six shows that not all survey respondents recalled safety signage, therefore remain ignorant to the dangers present. The identification of signage was largely limited to one type of sign ('cliffs'), meaning that other signs had been forgotten or ignored. The present study confirms McCool and Braithwaite's (1992) assertion about signs as a passive model of communication and their limited ability to influence and modify behaviour. This mode of communication may not be sufficient to get messages across to the public, therefore RAL may need to consider alternate methods.

With regard to the fourth and overall objective, the analysis showed that public awareness of natural hazards at Mt Ruapehu was only moderate, and perceived safety was slightly higher. Consistent with the moderate awareness of hazards, individual responsibility for safety was also moderate, although for risks to be accepted they first need to be recognised. This information adds to the existing work by Espiner (2001), showing that the moderate awareness of hazards in National Park visitors is not limited to Franz Josef and Fox Glaciers or a mostly international population. The present study showed that some visitors hold the belief that their experiences are being well managed and that they are immune to hazards. This is concerning because people who perceive they are vulnerable are more likely to respond to warnings; therefore those who feel they are invulnerable to hazards are less likely to respond to warnings and other hazard warning information (Johnston *et al.,* 1999; Espiner, 2001).

At Whakapapa and Turoa ski areas, there appeared to be only modest levels of responsibility taken by the public for individual safety. This needs to be

interpreted within the context of the other results, for example hazard awareness and perception of risk were both higher than the attitude toward individual responsibility for safety. These perceptions are likely to affect the extent to which responsibility is accepted by the individual. Visitors to the ski areas do not hold the cautious or safety conscious attitudes that may have been expected.

8.2 AVENUES FOR FUTURE RESEARCH

Through this study, utilising quantitative survey responses of visitors and qualitative data from interviews, this research project sought to address an apparent gap in existing knowledge by looking at visitor perceptions of hazards at Whakapapa and Turoa ski areas at Mt Ruapehu. The present study has addressed the objectives set out at the beginning of the research, considering the extent to which visitors to Whakapapa and Turoa demonstrate awareness of hazards and examining the effectiveness of hazard warning signs in creating appropriate visitor awareness and behaviour. The current research has found that while there is moderate awareness of hazards, there is plenty of room for further visitor education by area management. The present study has raised a number of areas for potential research in the future which would add to the present work and existing literature. Avenues for future research may include an investigation into the types of communication that may be used to convey safety information at ski areas. Other opportunities for future research may involve comparisons of hazard perceptions between other ski areas in New Zealand and overseas, based on the method used in the present study allowing for direct comparisons to be made.

REFERENCES

Aschauer, E., Ritter, E., Resch, H., Thoeni, H., & Spatzenegger, H. (2007). Verletzungen und Verletzungsrisiko beim Ski- und Snowboardsport. *Der Unfallchirurg*, 110(4), 301-306. doi: 10.1007/s00113-007-1263-1.

Avalanche was 'freak' of nature. (2003, September 3). *TVNZ*. Retrieved from http://tvnz.co.nz.

Bentley, T., Page, S. J., & Laird, I. (2003). Managing tourist safety: the experience of the adventure tourism industry. In J. Wilks and S.J. Page, (Eds.) *Managing Tourist Health and Safety in the New Millennium*. Oxford, UK: Pergamon, Elsevier Science, 85-100.

Bickman, L., & Rog, D. J. (Eds.). (2008). *The SAGE Handbook of Applied Social Research Methods*. United States of America: SAGE.

Bird, D. K., Gísladóttir, G., & Dominey-Howes, D. (2009). Resident perception of volcanic hazards and evacuation procedures. *Natural Hazards and Earth System Sciences* 9: 251-266.

Bird, D. K., Gísladóttir, G., & Dominey-Howes, D. (2010). Volcanic risk and tourism in southern Iceland: Implications for hazard, risk and emergency response education and training. *Journal of Volcanology and Geothermal Research,* 189, 33-48.

Booth, K.L., & Peebles, C.J. (1995). Patterns of use. In P.J. Devlin, R.A. Corbett, & C.J. Peebles (Eds.), *Outdoor recreation in New Zealand Vol. 1: A review and synthesis of the research literature*. Wellington: Department of Conservation and Lincoln University, 31-59.

Burton, I. and Kates, R.W. (1964). The perception of natural hazards in resource management. *Natural Resources Journal 3(3)*: 412-441.

Brook, M. S. & Holland, J. (2009). Glacier hazards and tourism at Fox Glacier, South Westland, New Zealand. Glacier Hazards, Permafrost Hazards and GLOFs in Mountain Areas: Processes, Assessment, Prevention, Mitigation, 10-13 November 2009, Vienna.

Brown Bear Ski. (2009a). *Whakapapa ski area,* digital image. Retrieved from http://www.brownbearski.co.nz

Brown Bear Ski. (2009b). *Turoa ski area,* digital image. Retrieved from http://www.brownbearski.co.nz

Bryant, E. (2005). *Natural Hazards*. Cambridge, UK: Cambridge University Press.

Cerny, M. & Schneider, J. F. (2009). *Glacial hazards in central Asia.* Glacier Hazards, Permafrost Hazards and GLOFs in Mountain Areas: Processes, Assessment, Prevention, Mitigation, 10-13 November 2009, Vienna.

Charmaz, K. (1994). 'Discovering chronic illness: Using grounded theory. In B.G. Glaser (Ed.), *More grounded theory methodology: A reader.* United States of America: Sociology Press.

Chon, K. S., & Hudson, S. (2002). *Sport and Adventure Tourism* (1st ed.). Routledge.

Christianson, A. N. (2006). *Assessing and Improving the Effectiveness of Staff Training and Warning System Response at Whakapapa and Turoa Ski Areas, Mt. Ruapehu: A Thesis Submitted in Partial Fulfilment of the Requirements for the Degree of Master of Science in Hazard Management at the University of Canterbury*. Master's thesis, The University of Canterbury, Christchurch, New Zealand.

Cohn, S. S. Hendricks, W. W., & Chavez, D. J. (2008). Visitor Compliance with Fire Restrictions: an observational study using verbal messages and symbolic signage. In, J. Chavez. J. Absher & P. Winter (Eds.), *Fire Social Science Research from the Pacific Southwest Research Station.* General Technical Report. United States Department of Agriculture Forest Service.

Cole, S. E., Cronin, S. J., Sherburn, S., & Manville, V. (2009). Seismic signals of snow-slurry lahars in motion: 25 September 2007, Mt Ruapehu, New Zealand, *Geophys. Res. Lett.*, 36, L09405. doi:10.1029/2009GL038030.

Conservation Act. (1987). No 65 (as at 01 November 2008), Public Act administered in the Department of Conservation.

Coomer, M. A. & Leonard, G. S. (2005). *Tongariro crossing hazard awareness survey: public perceptions of the volcanic hazard danger.* GNS Science, Lower Hutt, New Zealand.

Cutter, S. L. (2006*). Hazards, vulnerability and environmental justice.* London and Sterling, VA: Earthscan.

Cresswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed method approaches.* United States of America: Sage Publications, Inc.

Cronin, S. J., Neall, V. E., Lecointre, J. A., Palmer, A. S. (1999). Dynamic interactions between lahar and stream flow: A case study from Ruapehu volcano, New Zealand. *Geological Society of America Bulletin*, 111(1), 28-38.

Cronin, S. J., Neall, V. E., & Palmer, A. S. (1996). Geological history of the north-eastern ring plain of Ruapehu volcano, New Zealand. *Quaternary International,*34-36, 21-28. doi: 10.1016/1040-6182(95)00066-6

de Scally F. A. & Gardner, J. S. (1994). Characteristics and mitigation of the snow avalanche hazard in Kaghan Valley, Pakistan Himalaya. *Natural Hazards,* 9, 197-213.

Delgado-Granados, H., Julio Miranda, P., Yepes, H., Moreno, H., Cáceres, B., Pulgarin, B., & Guevara, E. (2009). *Monitoring and evaluating hazards related to volcano-ice interactions.* Glacier Hazards, Permafrost Hazards and GLOFs in Mountain Areas: Processes, Assessment, Prevention, Mitigation, 10-13 November 2009, Vienna..

Denscombe, M. (2005). *The good research guide for small-scale social research projects,* (2nd ed.). England: Open University Press.

Department of Conservation. (1996). *Eruption debriefing: a workshop to discuss the management of the 1995 eruptions*. Turangi, New Zealand.

Department of Conservation. (2006). *Tongariro National Park Management Plan Te Kaupapa Whakahaere mo Te Papa Rēhia o Tongariro 2006 – 2016.* Retrieved from http://www.doc.govt.nz

Department of Conservation. (2007). *Volcanic risk at Mount Ruapehu,* digital image. Retrieved from http://www.doc.govt.nz.

Department of Conservation. (2010). Whangaehu River bund: Mt Ruapehu crater lake lahar threat response. Retrieved from http://www.doc.govt.nz

Dignan, A. (2008). 2007 Avalanche accident and damage summary. *The Crystal Ball,* 16, 11-14.

Dignan, A. (2009). 2008 Avalanche accident and damage summary. *The Crystal Ball,* 17, 1-7.

Dingwall, P. R., Fitzharris, B. B., & Owens, I. F. (1989). Natural hazards and visitor safety in New Zealand's national parks. *New Zealand Geographer,* 45(2), 68-79.

Espiner, S. (1999). *The Use and Effect of Hazard Warning Signs: Managing Visitor Safety at Franz Josef and Fox Glaciers*. Wellington, New Zealand: Department of Conservation.

Espiner, S. R. (2001). *The Phenomenon of Risk and Its Management in Natural Resource Recreation and Tourism Settings: A Case Study of Fox and Franz Josef Glaciers, Westland National Park, New Zealand: A Thesis Submitted in Partial Fulfilment of the Requirements for the Degree of Doctor of Philosophy at Lincoln University*. Doctoral dissertation, Lincoln University, Lincoln, New Zealand.

European Environment Agency. (2010). *Multilingual Environmental Glossary*. Retrieved from http://glossary.eea.europa.eu

Finnis, K., Johnston, D. M., & Paton, D. (2004). *Volcanic hazard risk perception in New Zealand*. Retrieved from http://www.civildefence.govt.nz

Galley, I., Leonard, G., Johnston, D., Balm, R., & Paton, D. (2004). The Ruapehu lahar emergency response plan development process: An analysis, *The Australasian Journal of Disaster and Trama Studies,* 1. Retrieved from http://www.massey.ac.nz/~trauma/issues/2004-1/galley.htm

Geonet. (2009a) *Whakapapa poster,* digital image. Retrieved from http://www.geonet.org.nz

Geonet. (2009b) *Turoa poster,* digital image. Retrieved from http://www.geonet.org.nz

Gibson, H. (2006). *Sport tourism : concepts and theories*. London: Routledge.

Given, L. M. (Ed.)(2008). *The Sage Encyclopedia of Qualitative Research Methods*. Thousand Oaks, California: Sage Publications.

Glaser, B. & Strauss, O. (1967). *The discovery of grounded theory.* London: Weidenfield and Nicolson.

Godschalk, D., Beatley, T., Berke, P., Brower, D., & Kaiser, E. J. (1998). *Natural hazard mitigation: recasting disaster policy and planning.* Washington D. C.: Island Press.

Gomm, R. (2008). *Social research methodology: A critical introduction.* Basingstoke: Palgrave Macmillan

Government reviews and rejects Ruapehu intervention. (2004). *Beehive.govt.nz, the official website of the New Zealand Government.* Retrieved from http://www.beehive.govt.nz

Gramann, J. H. Christensen, H. H., & Vander Stoep, G. A. (1992). Indirect Management to Protect Cultural and Natural Resources: Research, ethics and social policy. In H. Christensen. D. Johnson & M. Brooks (Eds.), *Vandalism: Research, prevention, and social policy management*. US Department of Agriculture Forest Service, Portland, Oregon, 251-264.

Gray, D. E. (2004). *Doing research in the real world.* Great Britain: Sage Publications Ltd.

Greene, J. C., Caracelli, V. J., & Graham, W. F. (1989). Toward a conceptual framework for mixed-method evaluation designs. *Educational Evaluation and Policy Analysis,* 11(3), 255-274.

Grímsdóttir, H. & McClung, D. (2006). Avalanche risk during backcountry skiing - an analysis of factors. *Natural Hazards*, 39, 127 -153

Gudmundsson, M.T., Larsen, G., Höskuldsson, Á., & Gylfason, A. (2008). Volcanic hazards in Iceland. *Jokull*, 58, 251-268.

Hackett, W.R., & Houghton, B.F. (1989). A facies model for a Quaternary andesitic composite volcano: Ruapehu New Zealand. *Bulletin of Volcanology*, 51(1), 51-68.

Haddock, C. (1993). *Managing risks in outdoor activities*. Wellington: New Zealand Mountain Safety Council Inc.

Haddock, C. (2004). *Outdoor Safety: Risk management for outdoor activities.* New Zealand: Mountain Safety Council.

Hancox, G.T., Nairn, I.A., Otway, PM., Webby, G., Perrin, N.D., Keys, H.R. (1997). Stability assessment of Mt Ruapehu crater rim following the 1995-1996 eruptions. Institute of Geological and Nuclear Sciences Client Report 43605B.

Hayes, D. G. (2008). *An Investigation of Visitor Behaviour in Recreation and Tourism Settings: A Case Study of Natural Hazard Management at the Glaciers, Westland National Park, New Zealand: A Dissertation Submitted in Partial Fulfilment of the Requirements for the Degree of Master of Applied Science at Lincoln University*. Master's thesis, Lincoln University, Lincoln, New Zealand.

Health and Safety in Employment Act. (1992). No 96 (as at 03 March 2010), Public Act administered in the Department of Labour.

Hegglin, E. & Huggel, C. (2008). An Integrated Assessment of Vulnerability to Glacial Hazards. *Mountain Research and Development,* 28(3/4), 299-309.

Hendrikx, J. (2007). 2006 Avalanche accident and damage summary. *The Crystal Ball,* 15, 1-6.

Hendrikx, J. (2008). Snow and Ice Network recording huge winter snows. *Water & Atmosphere,* 16, 4-4.

Herremans, I. M (Ed.). 2006. *Cases in sustainable tourism: An experiential approach to making decisions*. Binghamton: Harworth Press.

Hill, P.M. (2000). Possible asphyxiation from carbon dioxide of a cross-country skier in eastern California: a deadly volcanic hazard. *Wilderness and Environmental Medicine*, 11, 192-195.

Hjelde, H. (2009). Tongariro National Park - Ruapehu Region. *The Crystal Ball,* 18(3), 3-4.

Hudson, A. (2008, November 9). Woman dies on ski slopes. *The New Zealand Herald.* Retrieved from http://www.nzherald.co.nz

Hudson, S. P. (2000). *Snow Business: A Study of the International Ski Industry*. London: Cassell.

Hystad, P. W. & Keller, P. C. (2008). Towards a destination tourism disaster management framework: Long-term lessons from a forest fire disaster. *Tourism Management,* 29(1), 151-162.

Ihaka, J. (2009, September 9). Max unbroken after 90m cliff fall. *The New Zealand Herald.* Retrieved from http://www.nzherald.co.nz

Irwin, D., MacQueen, W. & Owens, I. (2002). *Avalanche accidents in Aotearoa - New Zealand.* Mountain Safety Council.

Jóhannesdóttir, G. J. & Gísladóttir, G. (2010). People living under threat of volcanic hazard in southern Iceland: vulnerability and risk perception. *Natural Hazards Earth System Sciences*, 10, 407-420.

Johnston, D. M., & Bebbington. M. S., Lai,C., Houghton,, B. F., & Paton, D. (1999). Volcanic hazard perceptions: comparative shifts in knowledge and risk. *Disaster Prevention and Management,* 8(2), 118-126, DOI: 10.1108/09653569910266166

Johnston, D. M., Houghton, B. F., Neall, V. E., Ronan, K. R., & Paton, D. (2000). Impacts of the 1945 and 1995–1996 Ruapehu eruptions, New Zealand: An example of increasing societal vulnerability. *Geological Society of America Bulletin*, 112(5), 720-726.

Jolly, A.D.; Jousset, P.; Sherburn, S. (2008). *Modelling VLP sources for the 25 September 2007 Ruapehu eruption*. Abstract V51E-2081 In: 2008 AGU Fall Meeting, 15-19 December, San Francisco : abstracts. Eos 89(53:supplement)

Keiler, M., Zischg, A., Fuchs, S., Hama, M., & Stötter, J. (2005). Avalanche related damage potential - changes of persons and mobile values since the mid-twentieth century, case study Galtur. *Natural Hazards and Earth System Sciences,* 5, 49-58.

Keylock, C. (1997). Snow avalanches. *Progress in Physical Geography,* 21, 481-500.

Keys, H. J. R. (1997). Active volcanoes with skifields. *Tongariro,* 6, 65-69.

Keys, H. J. R. (2007). Lahars of Ruapehu Volcano, New Zealand: risk mitigation. *Annals of Glaciology,* 45, 155-162.

Kilgour, G., Manville, V., Della Pasqua, F., Graettinger, A., Hodgson, K. A., & Jolly, G. E. (2010). The 25 September 2007 eruption of Mount Ruapehu, New Zealand: Directed ballistics, surtseyan jets, and ice-slurry lahars. *Journal of Volcanology and Geothermal Research,* 191(1-2), 1-14.

Lacey, A. & Luff, D. (2001). *Trent focus for research and development in primary health care: An introduction to qualitative analysis.* Trent Focus Group.

Land Information New Zealand. (2009). *Map of Ruapehu area*, digital image. Retrieved from http://www.linz.govt.nz/

Lavigne, F. (1999). Lahar hazard micro-zonation and risk assessment in Yogyakarta city, Indonesia. *GeoJournal*, 49(2), 173-183. doi: 10.1023/A:1007035612681.

Lecointre, J., Hodgson, K., Neall, V., & Cronin, S. (2004). Lahar triggering mechanisms and hazard at Ruapehu volcano, New Zealand. *Natural Hazards,* 31, 85-109.

Leonard, G., Johnston, D., Paton, D. (2004). *Mitigating the lahar risk at Whakapapa Ski Area, Mt Ruapehu: Public perceptions and the effectiveness of*

the new warning system. Institute of Geological & Nuclear Sciences science report 2004/02. GNS Science, Lower Hutt, New Zealand.

Leonard, G. S., Johnston, D. M., Paton, D., Christianson, A., Becker, J., & Keys, H. (2008). Developing effective warning systems: Ongoing research at Ruapehu volcano, New Zealand. *Journal of Volcanology and Geothermal Research*, 172(3-4), 199-215.

Louisson, S. (2007, April 3). We have lift-off at Turoa. *The New Zealand Herald.* Retrieved from http://www.nzherald.co.nz

Lube, G., Cronin, S., & Procter, J. (2009). Explaining the extreme mobility of volcanic ice-slurry flows. *Geology*, 37(1), 15-18. doi: 10.1130/G25352A.1

Maclaren, F. T. (2006). Canadian mountain holidays: risk assessment and management. In I. M Herremans, (Ed.), *Cases in sustainable tourism: An experiential approach to making decisions* (pp 99-122). Binghamton: Harworth Press

Making Mt Ruapehu safer for skiers. (2002, June). *Geonet News.* Retrieved from http://www.geonet.org.nz

Manning, R, E. (1999). *Studies in Outdoor Recreation: Search and research for satisfaction.* (2nd ed.). Oregon State University Press, Corvallis.

Manville. (2007). *Modelling the predicted break-out lahar from the Crater Lake of Mt. Ruapehu, North Island, New Zealand, 2007/03. Institute of Geological & Nuclear Sciences science report 2007/03*. GNS Science, Lower Hutt, New Zealand.

Manville, V., Graettinger, A., Hodgson, A., Mountain, B., Cronin, S.J., & Lube, G. (2008). Ice-slurry lahars: insights from the 25 September eruption of Ruapehu. Abstract in R. Wysoczanski, (Ed), Geological Society of New Zealand Miscellaneous Publication 124A.

Mappery (2009a). *Turoa Ski Trail Map,* digital image. Retrieved from http://www.mappery.com

Mappery (2009b). *Whakapapa Ski Trail Map,* digital image. Retrieved from http://www.mappery.com

Martin, A. (2000). *Clarifying the legal framework for natural hazard management in areas of high conservation value*. Unpublished report, research contract 55.799, Massey University, New Zealand.

Massey, C. I., Manville, V., Hancox, G. H., Keys, H. J., Lawrence, C., & McSaveney, M. (2009). Out-burst flood (lahar) triggered by retrogressive landsliding, 18 March 2007 at Mt Ruapehu, New Zealand - a successful early warning. *Landslides,* Retrieved from http://www.springerlink.com/content/y3574k47668kn754

McCleave, J., Espiner, S., & Booth, K. (2006). The New Zealand People–Park Relationship: An Exploratory Model. *Society & Natural Resources*, 19(6), 547-561.

McClung, D. M. (2002). The elements of applied avalanche forecasting part I: the human issues. *Natural Hazards,* 25, 111-129.

McCool, S.F. & Braithwaite, A.M. (1992). Persuasive messages and safety hazards in dispersed and natural recreation settings. In M.J. Manfredo (Ed.), *Influencing human behavior: Theory and applications in recreation, tourism, and natural resources management* (pp 293-326). Sagamore Publishing Inc., Champaign, Illinois.

McLay, A. (1995). *The evaluation and assessment of the health and safety management systems of Ruapehu Alpine Lifts Whakapapa skifield : a research report completed for the paper 26.499,* Massey University.

McNulty, D. (1984). *Broken River snow safety and avalanche control programme.* Protection Forestry Division, Forest Research Institute, Rotorua, N.Z.

Miller, M., Paton, D., & Johnston, D. (1999). Community vulnerability to volcanic hazard consequences. *Disaster Prevention and Management,* 8(4), 2555-260.

Montgomery, R.L. and Keys, J.R. *(1993)*. *Volcanic hazard management in Tongariro National Park***.** Department of Conservation Science & Research Series 61.

Mountain Safety Council. (2010). *Snow responsibility code* . Retrieved from http://www.mountainsafety.org.nz/

Mt Ruapehu strikes again. (2007, 26 September). *Manawatu Standard.* Retrieved from http://www.stuff.co.nz

Nairn, I. A., & Ruapehu Surveillance Group. (1996). Volcanic eruption at a New Zealand ski resort prompts reevaluation of hazards. *EOS*, 77, 189–191.

National Parks Act. (1980). No 66 (as at 01 November 2008), Public Act administered in the Department of Conservation.

Nardi, P. M. (2002). *Doing Survey Research: A Guide to Quantitative Research Methods* (1st ed.). Boston: Allyn & Bacon.

New Zealand Conservation Authority. (2005).

Nöthiger, C. & Elsasser, H. (2004). Natural hazards and tourism: new findings on the European Alps. *Mountain Research & Development,* 24, 24-27.

Paton, D., Johnston, D., Houghton, B. (1998). Organizational response to a volcanic eruption. *Disaster Prevention and Management*, 7 (1), 5-13.

Paton, D., Smith, L., Daly, M., & Johnston, D. (2008). Risk perception and volcanic hazard mitigation: Individual and social perspectives. *Journal of Volcanology and Geothermal Research*, 172(3-4), 179-188. doi: 10.1016/j.jvolgeores.2007.12.026.

Petak, W. J. & Atkisson, A. A. (1982). *Natural hazard risk assessment and public policy: anticipating the unexpected.* New York: Springer-Verlag.

Penniman, D. (1993). The custom and practice for identification and mitigation of common hazards at US ski areas. In R. J. Johnson, C. D. Mote Jr., & J. Zelcer (Eds.), *Skiing trauma and safety: Ninth international symposium ASTM STP 1182*. Philadelphia: American Society for Testing and Materials, 215-228.

Pickering, C. M., Harrington, J., & Worboys, G. (2003). Environmental Impacts of Tourism on the Australian Alps Protected Areas. *Mountain Research and Development,* 23(3), 247-254.

Pierson, T.C. (2002). *Evaluation of Lahar Mitigation Proposals at Mt. Ruapehu: New Zealand Dept. of Conservation, DoC Science Internal Series,* vol. 63.

Price, M. F., Jansky, L. F., & Iatsenia, A. A. (2005). *Key Issues for Mountain Areas*. Tokyo: United Nations University Press.

Procter, J.N., Cronin, S.J., Fuller, I.C., Lube, G., Manville, V., 2010: Quantifying the Geomorphic Impacts of a lake-breakout flood, Mt. Ruapehu, New Zealand. *Geology*, 38(1), 67-70, DOI: 10.1130/G30129.1

Prowse, T. D., Owens, I. F., & McGregor, G. R. (1981). Adjustment to avalanche hazard in New Zealand. *New Zealand Geographer,* 37(1), 25-31. doi: 10.1111/j.1745-7939.1981.tb00936

Radio New Zealand. (2007). *Mt Ruapehu, with the lahar path streaming off to the right*, digital image. Retrieved from http://www.radionz.co.nz

Resource Management Act. (1991). No 69 (as at 08 December 2009), Public Act administered in the Ministry for the Environment.

Reynolds, J.M. (1992). The identification and mitigation of glacier-related hazards: examples from the Cordillera Blanca, Peru. In G.J.H. McCall, D.J.C. Laming and S.C. Scott (Eds.), *Geohazards.* London: Chapman & Hall, 143–157.

Reynolds, J. M. (2009). *Criteria for geohazard assessment.* Glacier Hazards, Permafrost Hazards and GLOFs in Mountain Areas: Processes, Assessment, Prevention, Mitigation, 10-13 November 2009, Vienna.

Richardson, J. M. & Brook, M. S. (2009). *Ablation of debris-covered ice: some effects of the 25 September 2007 Mt Ruapehu eruption.* Unpublished.

Richardson, S. D. & Reynolds, J. M. (2000). An overview of glacial hazards in the Himalayas. *Quaternary International*, 65-66, 31-47.

Rosenberg, M.D. (2000). The Whakapapaiti lahar : a snow-rich debris flow from the 23rd September 1995 eruption of Mt Ruapehu. *Institute of Geological & Nuclear Sciences science report 2000/30*. GNS Science, Lower Hutt, New Zealand.

Rowan, J. (2008, July 1). Scientists fear more eruptions on Mt Ruapehu. *The New Zealand Herald.* Retrieved from http://www.nzherald.co.nz

Ruapehu Alpine Lifts. (2007a). *Turoa Avalanche Atlas*. [Unpublished]

Ruapehu Alpine Lifts. (2008a). *Whakapapa Avalanche Control Routes*. [Unpublished]

Ruapehu Alpine Lifts. (2008b). *Accident rate graphs and data*. [Unpublished]

Ruapehu Alpine Lifts. (2009a). *Terrain Hazard Control Plan*. [Unpublished]

Ruapehu Alpine Lifts. (2009b). *Ruapehu Alpine Lifts Limited Annual Report 2009.* Retrieved from http://www.mtruapehu.com.

Ruapehu Alpine Lifts. (2009c). *Mt Statistics.* Retrieved from http://www.mtruapehu.com.

Ruapehu Alpine Lifts. (2009d). *2008 Customer accidents at Whakapapa Ski Area.* [Unpublished]

Ruapehu Alpine Lifts. (2009e). *Turoa Terrain Hazard Atlas.* [Unpublished]

Ruapehu Alpine Lifts. (2009f). *Whakapapa Terrain Hazard Atlas.* [Unpublished]

Ruapehu Alpine Lifts. (2010a). *Risk Management Document.* Retrieved from http://www.mtruapehu.com.

Ruapehu Alpine Lifts. (2010b). http://www.mtruapehu.com/winter/mountain-safety/

Ruapehu eruption risk remains high. (2007, October 3). *Department of Conservation.* Retrieved from http://www.doc.govt.nz/

Sarantakos, S. (2005). *Social Research* (3rd ed.). Hampshire, United Kingdom: Palgrave Macmillan.

Scientists confirm 'small scale' Mt Ruapehu eruption. (2006, October 7). *The New Zealand Herald.* Retrieved from http://www.nzherald.co.nz

Sieber, S.D. (1973). The integration of field work and survey methods. *The American Journal of Sociology,* 78(6), 1335-1359.

Siegrist, M., & Cvetkovich, G. (2000). Perception of Hazards: The Role of Social Trust and Knowledge. *Risk Analysis: An International Journal*, 20(5), 713-720. doi: 10.1111/0272-4332.205064.

Silverman, D. (2010). *Doing qualitative research* (3rd ed.). Great Britain: Sage Publications Ltd.

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

Simmons, D. (1984). Integrating formal and informal research methods. *Les Cahiers du Tourisme No.44.* Centre des Hautes Etudeo Touristiques, Universitie de Droit, Dreconomie et des sciences Aix-en-provence.

Simmons, D. & Berno, T. (1995). Research methods. In P.J Devlin, R. A. Corbett, & C. J. Peebles. (Eds.), *Outdoor recreation in New Zealand, Volume 1A: A review and synthesis of the research literature* (pp 175-189). Department of Conservation and Lincoln University.

Ski slopes closed after avalanche. (2003, September 4). *The Sydney Morning Herald.* Retrieved from http://www.smh.com.au.

Skiers scurry as storm rages over Ruapehu. (2008, July 27). *The Dominion Post.* Retrieved from http://www.stuff.co.nz

Smith, G. (2009). 2009 Introduction. *The Crystal Ball,* 18(3), 1-2.

SPSS Inc: SPSS for Windows. (2007). Release 16.0. Chicago: SPSS Inc.

Strauss, A. L., & Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and techniques* (2nd ed.). Thousand Oaks, CA: Sage.

Strauss, A. L. & Corbin, J. (1998). *Basics of qualitative research* (2nd ed.). Thousand Oaks, CA: Sage.

Stroessell, F. (2004). Integrated disaster reduction: the approach developed by the Swiss Agency for Development and Coooperation. *Mountain Research & Development,* 24, 76-77.

Sulheim, S., Ekeland, A., & Bahr, R. (2007). Self-estimation of ability among skiers and snowboarders in alpine skiing resorts. *Knee Surgery, Sports Traumatology, Arthroscopy*, 15(5), 665-670. doi: 10.1007/s00167-006-0122-x.

Thomson, R. (2006). *Tongariro : a climbing guide to Tongariro National Park : summer and winter alpine routes, ski-mountaineering and rock climbing.* Christchurch: New Zealand Alpine Club.

Thouret, J. C. (1999). Urban hazards and risks; consequences of earthquakes and volcanic eruptions: an introduction. *GeoJournal,* 49(2), 131-135. doi: 10.1023/A:1007118027266.

Ward, R., Paton, D., Johnston, D. M., & Becker, J. (2003). *Whakapapa Ski Field, lahar warning system, Ruapehu : a review of training issues. Institute of Geological & Nuclear Sciences science report 2003/07*. GNS Science, Lower Hutt, New Zealand.

Walker, M. S. (1997). *An investigation of volcanic hazard management plans for ski resorts on selected active volcanoes.* Lancaster University.

APPENDIX 1

SKI AREA VISITOR SURVEY 2008

PLEASE HELP BY COMPLETING THIS SURVEY NOW

I am interested in your views about hazards and safety in this area. I need to learn more about how you feel about the hazards in this area so management is better able to cater to user needs. This survey is part of a thesis being undertaken in 2008.

Many of the questions ask you to rate your opinion on a scale. You can do this by choosing the number that most closely matches your view. **All answers are valued and strictly confidential. Please answer all questions according to your own perceptions only. There are no wrong answers.**

1. What is your main activity on the mountain today?
   ☐Public Skier ☐Public Snowboarder ☐Staff ☐Non-Skier

2. Which ski runs are you most comfortable skiing/snowboarding?
   ☐Green ☐Blue ☐Black ☐Non-Skier

3. How many years have you been skiing/snowboarding at Ruapehu?
   ☐one year ☐2-5 ☐ 6-10 ☐11+ ☐non-skier

4. Which Ruapehu areas do you ski at?
   ☐Whakapapa ☐Turoa ☐non-skier

5. Where do you normally live?

   Town/City:.....(specify)
Country/Nation:.....(specify)

6. Are you: ☐ Male ☐Female

7. Which of these categories describes your age?
   ☐<20 ☐20-29 ☐30-39 ☐40-49 ☐50-59 ☐60-69 ☐70+

8. In your opinion, how safe is NZ as a tourist destination?
   ☐very safe ☐safe ☐neither safe nor unsafe ☐unsafe ☐very unsafe

9. How safe is this mountain as a tourist destination?
   ☐very safe ☐safe ☐neither safe nor unsafe ☐unsafe ☐very unsafe

10. What hazards/dangers (if any) have you been aware of while visiting this ski area? Please list

11. While visiting this ski area have you been aware of signs or messages warning you of hazards or dangers?
☐ yes (**Please say where below**) ☐ no

If yes, can you recall what these signs or messages have warned you about and where these signs were? (**Please list**)

_____

12. While visiting this ski area, have you been aware of signs and structures which have restricted your access to parts of the mountain?
☐ yes ☐ no
If yes, did you enter these areas?
☐ yes ☐ no

13. Are you aware of the ski area boundaries?
☐ yes ☐ no

14. Do you ever leave the ski area boundaries?
☐ yes ☐ no
If yes, do you carry avalanche safety equipment?
☐ yes ☐ no

15. Are you aware of any recent volcanic events at Ruapehu?
☐ yes ☐ no
If yes, please list the events you are aware of:

_____

16. Are you aware of any 'lahar warning' or 'eruption detection' systems for the ski area(s)?
☐ yes ☐ no

17. Do you know what action to take if there is a lahar (volcanic mudflow) at Ruapehu?
☐ yes ☐ no
If yes, please list the actions you would take in the case of a lahar:

_____

18. Are you aware of any recent avalanche events at Ruapehu?
☐ yes ☐ no
If yes, please list the events you are aware of:

_____

19. Please show how much you agree or disagree with the statements provided. On the scale, the number 1 = complete agreement with (or support for) the statement, while the number 7 = complete disagreement with (or no support for) the statement.

Statement	**Circle the number which shows your view**

This seems like a safe place to visit.	Completely Agree 1 2 3 4 5 6 7 Completely Disagree
This natural area appears to be stable and predictable.	Completely Agree 1 2 3 4 5 6 7 Completely Disagree
Any hazards at this ski area seem to be well controlled by management.	Completely Agree 1 2 3 4 5 6 7 Completely Disagree
As a visitor to this ski area I feel as though I am exposing myself to physical danger.	Completely Agree 1 2 3 4 5 6 7 Completely Disagree
While here, I have often thought about hazards to which I might be exposed.	Completely Agree 1 2 3 4 5 6 7 Completely Disagree
There are dangers at this ski area which are obvious to me.	Completely Agree 1 2 3 4 5 6 7 Completely Disagree
Any hazards here seem to be beyond the control of management.	Completely Agree 1 2 3 4 5 6 7 Completely Disagree
As a visitor to this site, I feel responsible for my own safety.	Completely Agree 1 2 3 4 5 6 7 Completely Disagree
Visitors should be held more accountable for their actions in natural areas like this one.	Completely Agree 1 2 3 4 5 6 7 Completely Disagree
Managers should do more to protect visitors from harm in natural areas.	Completely Agree 1 2 3 4 5 6 7 Completely Disagree
Management should prevent access to areas which might be dangerous.	Completely Agree 1 2 3 4 5 6 7 Completely Disagree
I should be allowed to decide where it is safe to go.	Completely Agree 1 2 3 4 5 6 7 Completely Disagree
I would like to see more obvious evidence of management at this ski area.	Completely Agree 1 2 3 4 5 6 7 Completely Disagree
A little danger is an accepted part of visiting a natural area like this.	Completely Agree 1 2 3 4 5 6 7 Completely Disagree
Those who manage this area have an obligation to inform me about all things which might affect my safety.	Completely Agree 1 2 3 4 5 6 7 Completely Disagree

20. How dangerous do you believe the following hazards to be while at Ruapehu?

(a)Inclement weather conditions	very safe 1 2 3 4 5 6 7 very hazardous
(b)Ice	very safe 1 2 3 4 5 6 7 very hazardous
(c)Cliffs	very safe 1 2 3 4 5 6 7 very hazardous
(d)Lahars (volcanic mudflows)	very safe 1 2 3 4 5 6 7 very hazardous
(e)Avalanches	very safe 1 2 3 4 5 6 7 very hazardous
(f)Volcanic Eruptions	very safe 1 2 3 4 5 6 7 very hazardous
(g)Other People on the Mountain	very safe 1 2 3 4 5 6 7 very hazardous
(h)Mountain Road	very safe 1 2 3 4 5 6 7 very hazardous

Thank you for completing this survey.

APPENDIX 2

Saturday 27 Sep 2008
SNOW REPORTS

WHAKAPAPA

Updated 07:42 AM
Ski Area OPEN from 7:30am to 4:00pm

WEATHER

It is a fine and clear blue-sky morning here at Whakapapa!! Come on up early as the weather is forecast to deterioate later this afternoon.

	Lower Mountain	Upper Mountain
Wind:	Light - Mod Southwesterly	Mod - Strong Southwesterly
Vis:	Unlimited	Unlimited
Temp:	1.0°C	-2.0°C

SNOW

Spring conditions - Hard and fast in the morning, but will soften during the day for some superb skiing and boarding.

Base (Upper Mountain):	*355cm*
New Snow:	*0cm*

FACILITIES OPERATING

Lower Mountain	
Happy Valley Beginners:	☐ Open
Rockgarden Chair:	☐ Open
Centennial Chair:	☐ On hold: Crosswinds
Hut Flat Tow:	☐ Open
Upper Mountain	
Waterfall Express Chair:	☐ Open
Waterfall T-Bar:	☐ Open
Valley T-Bar:	☐ Open
Moro Terrain Park:	☐ Open
Moro Half Pipe:	☐ Open
National Chair:	☐ Open
Knoll Ridge T-Bar:	☐ Open
West Ridge Chair:	☐ Open
Far West T-Bar:	☐ Open

BRUCE RD ***OPEN***

INFORMATION

Lift facilities here at Whakapapa are OPEN.

The Centennial Chair is ON HOLD due to strong wind. Other lifts will also be run at a reduced speed due to crosswinds.

TUROA

Updated 07:52 AM
Lift operating times 8.30am to 4pm

Conditions are current at time of reporting and can change quickly

WEATHER

There is cloud passing through the area affecting visibility at times. The wind has increased and is now strong on the Upper Mountain.

	Lower Mountain	Upper Mountain
Wind:	Moderate - Strong Northwesterly	Strong Northwesterly
Vis:	1000m - 2000m	100m - 1000m
Temp:	1.0°C	-1.0°C

SNOW

Hard at first but will soften to Turoa's awesome spring snow. The spring skiing and riding is awesome.

Base (Upper Mountain):	*475cm*
New Snow:	*0cm*

FACILITIES OPERATING

Lower Mountain	
Alpine Meadow Beginners:	☐ Open
Wintergarden Platter:	☐ Open
Parklane Chair:	☐ Open
Upper Mountain	
Movenpick Chair:	☐ Open
Giant Chair:	☐ Open
High Flyer Chair:	☐ Open
Jumbo T-Bar:	☐ Open
High Noon Express:	☐ Open
Moro Terrain Park:	☐ Open

MOUNTAIN RD ***OPEN***

INFORMATION

All facilities are OPEN!!

A further reduction in visibility or increase in wind strength may affect the operation of some facilities.

MOUNTAIN PRODUCTS & SERVICES

Spring passes are on sale from the 1st of October. Adult $299, youth $199.

Lorenzo's Bar and Cafe is open tonight for the first of the Ski Clubs' quiz nights from 7:30pm.

EVENTS

The K National Finals are on from 28th September to 2nd October, check out the website or come in and see customer services for more info.

Whakapapa Snow Report Ph: 083 222-182

www.mtruapehu.com

MOUNTAIN PRODUCTS & SERVICES

The Flyers programe are meeting at the Wintergarden at 9.30am. The Masters programe is running today.

The Yeti Kids School Holiday Programe for skiers is FULL for the first week of the holidays. We do have limited spots available for snowboarders in week 1 and skiers and snowboarders in week 2.

EVENTS

The Rip Curl K2 Bikini Downhill is on today. Entry is at the top of the course on Yahoo at 10am and is just $5.00. There will also be a fundraising BBQ for breast cancer and all riders have the chance to win fantastic prizes from Rip Curl, K2, Smith Optics and Mt Ruapehu .Bikini's compulsory!!

Turoa Snow Report Ph: 083 222-180

WHAKAPAPA

Updated 09:14 AM

Ski Area OPEN from 8:30am to 4:00pm

Conditions are current at time of reporting and can change quickly

WEATHER

Presently it is fine and clear with a strong southerly. The forecast is for the wind to ease throughout the day.

	Lower Mountain	Upper Mountain
Wind:	Light-Mod Southerly	Strong Southerly
Vis:	Unlimited	Unlimited
Temp:	0.0°C	-2.0°C

SNOW

Firm on and off trail with a dusting of fresh snow!

Base (Upper Mountain): *355cm*

New Snow: *0cm*

FACILITIES OPERATING

Lower Mountain

Happy Valley Beginners:	Open
Rockgarden Chair:	Open
Centennial Chair:	Open
Hut Flat Tow:	Open

Upper Mountain

Waterfall Express Chair:	Open
Waterfall T-Bar:	Open
Valley T-Bar:	Open
Moro Terrain Park:	Open
Moro Half Pipe:	Open
National Chair:	Open
Knoll Ridge T-Bar:	On hold: Strong wind
West Ridge Chair:	Open
Far West T-Bar:	On hold: Strong wind

BRUCE RD ***OPEN***

INFORMATION

TUROA

Updated 09:06 AM

Lift operating times 8.30am to 4pm

WEATHER

The cloud has lifted and it is now fine and clear here this morning. The winds are strong and temperatures are cool so please dress warmly. Winter is back!

	Lower Mountain	Upper Mountain
Wind:	Moderate - Strong Southerly	Moderate Southerly
Vis:	Unlimited	Unlimited
Temp:	-2.0°C	-5.0°C

SNOW

We have received a dusting of fresh snow overnight bringing machine packed powder on trail and variable conditions off trail. There will be pockets of wind blown powder.

Base (Upper Mountain): *475cm*

New Snow: *0cm*

FACILITIES OPERATING

Lower Mountain

Alpine Meadow Beginners:	Open
Wintergarden Platter:	Open
Parklane Chair:	Open

Upper Mountain

Movenpick Chair:	Open
Giant Chair:	Open
High Flyer Chair:	Open
Jumbo T-Bar:	Open
High Noon Express:	Open
Moro Terrain Park:	Open

MOUNTAIN RD ***OPEN***

Caution - slippery patches above 14km.

INFORMATION

Lift facilities here at Whakapapa will OPEN from 8.30am once de-icing is completed.

The Knoll Ridge T and Far West T are ON HOLD due to strong winds. We hope to open these lifts throughout the morning in accordance with the forcasted drop in wind.

MOUNTAIN PRODUCTS & SERVICES
Spring passes are on sale from the 1st of October. Adult $299, youth $199.

EVENTS
The K National Finals are on today. Racers and race officials will have chair access from 8.30am once deicing is completed. The anticipated race start time for today is 10.30am in the Valley.

Whakapapa Snow Report Ph: 083 222-182
www.mtruapehu.com

All facilities are OPEN

There will be a slight delay in opening the High Noon Express and the Jumbo T-Bar to allow for the completion of de-icing. This will be approx 10.30am

MOUNTAIN PRODUCTS & SERVICES
The Flyers are to meet at 9.30am at the Wintergarden.

Turoa OPEN until November 16th! Spring Passes available from Oct 1st. Adults $299 and Youths $199

EVENTS
The Rip Curl K2 Bikini Downhill is ON at 12.pm. Entry will be at the top of the course on Yahoo and is just $5.00. There will also be a fundraising BBQ for breast cancer at the course and all riders have the chance to win fantastic prizes from Rip Curl, K2, Smith Optics and Mt Ruapehu .Bikini's compulsory!!!

Turoa Snow Report Ph: 083 222-180

APPENDIX 3

Hazards:

1. What do you consider to be the biggest hazards to a mountain user at Ruapehu?
2. Do you think there are any particular demographic groups that have more or less awareness of hazards on the mountain? (e.g. sex, age, ability, home city)
3. Is there a difference in awareness of hazards between Whakapapa and Turoa?

RAL/DoC/GNS and Hazards:

4. Do you think RAL/DoC/GNS is responsible to control hazards at Ruapehu?
5. What does RAL/DoC/GNS do to control/create more awareness of hazards?
6. Are there areas for improvement to make the area safer for mountain users? Should RAL/DoC/GNS be doing more to protect visitors from harm?
7. What management plan do you have? How often is it updated/reviewed? Can I have a copy of it?
8. What hazard maps do you have? How often do you update your hazard maps? Is it part of a GIS database? Who maps the hazards, how often, and how?
9. How are hazards (snow avalanches) mitigated? Do you measure snow with a penetrometer, or any other type of equipment to assess snowpack stability? How often do you do this? Do you drop charges to set of avalanches? How often do you do this, who makes the decisions, and on what basis would you do this? At night, in morning before it opens etc, and what part of the skifields?

Safety:

10. How safe do you think this mountain is as a tourist destination? In comparison, how safe do you think New Zealand is as a tourist destination?
11. 28% of Turoa users say that they venture into areas restricted by signs and structures, vs only 18% of Whakapapa users. Do you have any comments on this? 36% of users who ski on both sides venture into these restricted areas.
12. Are you surprised that 69% of male mountain users indicated that they leave the ski area boundary, while only 45% of women users did? What do you think explains this difference?

Lahar mitigation

13. Do you think the EDS and actions to take when a lahar occurs are well known to the public? 73% of skiers knew about the system, while only 60% of

snowboarders were aware. Are you concerned that only 87% of the staff surveyed knew were aware of the EDS?

14. Would you be surprised to learn that 80% of male mountain users knew the correct procedure in the case of a lahar, but only 66% of women did? What do you think explains this difference?

15. How does the EDS partnership work?

16. Who runs the EDS trials/exercises, how often, how do you measure their effectiveness? How do users of the park respond? and how do you measure their response and how effective the EDS is? Do you have reports/data on this?