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Risk perception and preparedness of backcountry visitors in Australia's Snowy Mountains

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Abstract

Effective management of National Parks requires an understanding of visitors to provide safe and enjoyable visitor experiences. Risk and preparedness of snow-based recreation is not well understood outside of the context of avalanches. This study investigated risk perception and preparedness of snow-based backcountry visitors in the Snowy Mountains of Australia through the theoretical lens of recreation specialisation. The recreation specialisation index was an appropriate tool for segmenting snow-based backcountry visitors into intermediates and experts along behavioural, cognitive and affective dimensions. We identified an overall low perception of risk and discuss the reasons and implications of this. In contrast, level of preparedness was of a high standard among both intermediate and expert snow-based recreationists. This pertained to pre-trip planning and the carrying/use of safety equipment and trip notification behaviour. The findings provide insights for land managers to enhance visitor safety and risk management for snow-based backcountry recreationists.

Keywords: recreation specialisation, segmentation, Kosciuszko National Park, risk management

Introduction

Globally, snow-based alpine recreational activity is undergoing a transformation. Changes in equipment, technology, risk perception, social trends, and marketing are enabling snow experiences in more remote areas (Furman et al. 2010; Temme 2015; Van Tilburg 2010; Wheaton 2010). In the pursuit of untouched snow, visitors are increasingly drawn to the isolation of backcountry locations (Shockey et al. 2008) with implications for their safety and perceived and actual risks (Furman et al. 2010; Pennington 2010; Van Tilburg 2000). This phenomenon is occurring both overseas and in Australia (Dickson & Faulks 2007; Dumas 2016). This raises the issue that risks need to be managed in light of the interplay and potential conflict between public risk responsibility, duty of care and management of public land and an individual's behaviour, self-responsibility and competence (Grant et al. 1996).

Experience and preparedness are important factors influencing visitor risk which in snow-based environments can lead to severe consequences including fatalities. Experience involves a conscious awareness of the spatial and temporal conditions of travelling and underpins discretionary decisions by visitors about when and where to travel (Elands & Lengkeek 2012). However, risk may both persuade and dissuade travellers from backcountry travel (Beedie & Hudson 2003; Silverton et al. 2009). For instance, severe weather warnings may discourage some visitors from travelling but attract others to experience fresh snow. Although preparedness will help with managing risks, a false perception of risk, for instance because of the presence of safety infrastructure, may lead to inappropriate levels of preparedness.

Consequently, management of snow-based backcountry areas requires an understanding of the actual and perceived risks to visitors, their level of preparedness, and how these depend on experience and competence of individuals (or their recreation specialisation). The few studies that have been conducted in this realm (beyond the grey literature) were focussed specifically on avalanches (Haegeli et al. 2012) or a much broader context of outdoor recreation (Grant et al. 1996) and protected areas (Gstaettner et al. 2020). Here we study risk and preparedness accounting for a variety of backcountry activities and their potential risk factors. This study is situated in Australia's Snowy Mountains and centred on its highest peak of Mt Kosciuszko (2,228 masl) in Kosciuszko National Park (KNP), New South Wales (NSW). Snow-based tourism is an important driver for the economy in this region and increasing visitation is identified as a key strategy by the NSW Government (NSW Government Planning and Environment 2017). Any growth in KNP as a tourist destination needs to be balanced with managing risks to visitors engaging in these often remote environments.

The aim of this research was to gain an understanding of the risk perception and preparedness of snow-based visitors to the KNP backcountry through the lens of recreation specialisation theory. The recreation specialisation framework has become a valuable tool for protected area managers to understand visitor diversity within outdoor recreational settings (Bryan 2000; Smith et al. 2014) though to date has had limited application in snow-based recreational contexts with the notable exception of Cattie (2012). Building on Cattie's (2012) study of backcountry skiers in Canadian protected areas, this current study used recreation specialisation theory to understand risk perception and level of preparedness of snow-based visitors accessing the KNP backcountry for snow-based recreation.

Literature review

Backcountry risk and preparedness

Bryan (1977) in a study on backcountry trout fishers found participants of high specialisation were particular in their control and management of environmental variables. From this concept it could be posited that backcountry visitors who have highly developed skills and experience perceive an ability to control risks associated with being in the backcountry, a notion also supported by Mason et al. (2013) and Demirhan (2005). To ascertain current knowledge on these issues, the following sections engage with the literature on risk, preparedness and recreation specialisation and address how risk and preparedness is defined and how they can be influenced by experience and competence of backcountry travellers. We posit that snow-based backcountry travellers can be segmented along a continuum from novice to highly specialised which may determine their experience and competence, and consequently their perception of risk and level of preparedness.

Risk

Risk can be understood as a complex and multifaceted concept with antecedents (or hazards) which contribute to the chance of positive or negative outcomes (Bouleau 2011; McNeill 2014). In the backcountry, antecedents can include a multitude of factors, such as environmental conditions (terrain features, snow stability and weather) mixed with human influences such as behaviour, previous experiences, skills, competence and decision styles and processes (Marengo et al. 2017; Silverton et al. 2009). Antecedents can contribute to negative outcomes such as injury or death (Federiuk & Mann 1999; Tuggy & Ong 2000) through events such as avalanches and hypothermia (Ramachandran 2008; Sbmay 2013). Negative outcomes can also include perceived risks such as psychological uncertainty and personal intangible mindsets where individuals may perceive feelings of disappointment or loss of self-esteem in not reaching a desired goal (McNeill 2014). Conversely, antecedents can also contribute to desired and positive outcomes when participants experience

intrinsic and extrinsic benefits or states of mind for example when events go to plan despite adventure or hardship (Gstaettner et al. 2018; Rickard 2014). Snow-based recreation is identified as an opportunity to control perceived and actual risks and master skills (Morgan & Stevens 2008). Therefore, understanding reasons for undertaking snow-based backcountry travel can contribute to identifying any perceptions of risk.

Perceived risk is believed to be determined and changed by previous experiences (Vagias et al. 2005). For those who are inexperienced or unfamiliar with a backcountry area or the activities involved, their perception of risk is limited and it may be impacted by their expectation and interpretation of what they will experience (McNeill 2014). Decision processes regarding backcountry risks are personal and self-judged. Travellers employ skills and competencies to handle any given situation (Fitzgerald et al. 2016; Silverton et al. 2009; Van Tilburg 2010). Understanding these factors can be viewed on a risk and competence continuum. At one end, visitors experience exploration and experimentation when the risk is controllable, and competence is high. As the risk increases a sense of adventure is experienced with risk and competence in balance. At the other end, when the risk is uncontrollable and competence low, the experience can be negative (Priest 1992).

Preparedness

To manage risks, and therefore control or prevent negative outcomes while recreating in the backcountry, people plan and prepare (McNeill 2014). Planning has been associated with sourcing information on weather and snow conditions (Rutty & Andrey 2014; Verbos & Brownlee 2017), and the use and knowledge of equipment such as maps, compass and communication/GPS devices (Mason et al. 2013; NSW Government 2016). Preparedness has also been associated with the carrying and use of emergency clothing and food, wet and cold weather clothing, fire starter, light, water, knife, first aid kit, spare parts, whistle, and mobile phones for emergencies (Attarian 2002; Mason et al. 2013; Tsaur et al. 2013). A US study of hikers found that a prepared hiker is one who carried greater than seven items from a list of ten identified as essential for hiking (Mason et al. 2013). This list of essential items will generally be dependent on the particular backcountry terrain and setting and for those who travel in snow terrain, the use of personal safety equipment such as helmets and avalanche equipment may also be indicative of preparedness (Haegeli et al. 2012; Ruedl et al. 2010; Thomson & Carlson 2015; Vargyas 2016). Knowledge of terrain (Fitzgerald et al. 2016), trip length and route plan (Mason et al. 2013; Plottel 2014), notification to a third party of travel plans (Mason et al. 2013) and group size also matter for preparedness (Vargyas 2016; Williams 2016; Zweifel et al. 2016).

Recreation specialisation

Recreation specialisation provides a well-developed theory for segmenting outdoor recreation visitors into subgroups and was developed as a tool for resource managers (Bryan 2000) enabling examination of visitors' previous experience and competence to measure specialisation. It is based on the notion that individuals undertaking a similar activity differ in their behaviours and skills. The purpose of segmentation is to identify the similarities or differences within and between groups of individuals (Needham et al. 2013). Studies segmenting outdoor recreationists stretch over almost forty years since Hobson Bryan's seminal work on trout fishers (Bryan 1977), and include activities such as boating (Kuentzel & Heberlein 2006), bouldering (Frauman & Rabinowitz 2011), camping (McFarlane 2004), hiking (Jun et al. 2015; Wöran & Arnberger 2012), hunting (Needham & Vaske 2013) and mountaineering (Dyck et al. 2003). Few authors have used recreation specialisation to segment within snow-based activities, one being the study of backcountry skiing in the Canadian mountain national parks (Cattie 2012). However, recreation specialisation's relative long history in the outdoor recreational sphere provides a strong basis for adopting this framework as a segmentation tool to understand risk perceptions and preparedness of snow-based backcountry visitors in KNP.

In the past, studies have measured specialisation using multiple variables such as past experience, equipment, centrality and commitment (Needham et al. 2013), whilst others have adopted a univariate measure such as years of experience (Ditton et al. 1992). The mixture of multivariate and univariate approaches has meant that comparison of specialisation findings across studies has been problematic (Hawkins et al. 2009). Researchers, however, have placed value on a multidimensional measurement tool with three interrelated areas of behaviour, cognition and affection as the most robust to measure recreation specialisation (Lamont & Jenkins 2013; Needham & Vaske 2013; Scott & Shafer 2001). The affective dimension is concerned with the centrality or importance of the activity to the participant (Shafer & Scott 2013). The behaviour dimension measures the amount of participation in terms of frequency or involvement (Shafer & Scott 2013). The cognitive dimension investigates the acquisition of skills and knowledge as well as location preferences and attributes (McFarlane 2004). The current study drew on Cattie (2012); Lamont and Jenkins (2013) and Thapa et al. (2006) to develop a multivariate measurement tool comprising three dimensions, ensuring relevance to snow-based activity.

As people increase their *experience* by being involved and by gaining skills in an activity, their perceived ability increases their subjective experience of risk decreases (Morgan & Stevens 2008; Morgan 2001) and their ability to prepare appropriately increases. When skills and the ability to judge risk accurately and prepare accordingly match with the challenge recreationists experience

positive feelings (Pomfret 2012) such as perceptions of comfort (Dimmock & Wilson 2009) or rush (Buckley 2012). In this study we measured levels of experience through the behavioural and affective dimensions of recreation specialisation, such as the number of years/trips participating in snow-based backcountry travel (Thapa et al. 2006), and explored the importance (commitment, centrality) of the activity (Shafer & Scott 2013).

Similarly, risk perception and the ability to prepare is also influenced through *competence*. To gain an understanding of this dimension, our study examined where people obtain their formal and informal training and skill development in backcountry travel. Competency in this study was measured with the cognitive index of the recreation specialisation framework. Those at the novice or development stage may possibly rely on others for their safety and preparedness and may be inexperienced in identifying or assessing risks. This group can include those who appear to be less prepared, such as those entering the backcountry from resorts or those undertaking short duration trips (Silverton et al. 2009; Van Tilburg 2010). Issues of low competence and inexperience have been found to be associated with negative outcomes for visitors in backcountry areas. Factors such as inadequate equipment and knowledge as well as travelling in darkness and experiencing fatigue were found to contribute to the need for search and rescue events (Hadley 2014).

Segmenting recreation participants can contribute to understanding further information about participant's activity preferences, practices and behaviours. Recreation specialisation studies have treated segments as an independent variable to investigate associations with dependent variables such as skiers' and boarders' behaviour in Colorado ski resorts (Vaske et al. 2004), or campers' choice of sites (McFarlane 2004). Furthermore, studies have looked at specialisation's relationship with specific activity location attributes such as sound qualities (Miller et al. 2014) or wilderness values (Galloway 2012), or visitors choice of resort attributes such as trail and snow conditions (Won et al. 2008). The following section outlines our approach and describes the study area.

Methods

Study Site

In Australia, snow-based activities occur in the alpine areas of New South Wales, Victoria and Tasmania. Australia's largest snow fields are located in KNP. This area in southeast NSW covers 673,542 ha (Figure 1) with ten peaks above 2,000 metres centred around Mt Kosciuszko on the Main Range area (Gambale, Slattery & Worboys 2020). KNP has significant tourism and recreational values which provide benefits to the region and to the more than one million people who visit this exceptional natural landscape annually (NSW Government Planning and Environment 2017). The

majority of winter visitors are attracted to the recreational opportunities offered by ski resorts located within KNP boundaries (NSW Office of Environment and Heritage 2016).

[Insert Figure 1 about here]

However, some snow-based visitors are drawn to the backcountry areas beyond the resort boundaries, which was the focus of this research study. The backcountry area covers the majority of KNP and is recommended for experienced self-reliant visitors able to manage remoteness, limited accessibility and minimal facilities and route marking (NSW Government Department of Environment and Conservation 2006). Winter backcountry recreational activities include skiing, boarding, snowshoeing, ice climbing, mountaineering and kiting and are undertaken by independent visitors, club, commercial and education groups (Buckley 2012; Walters & Ruhanen 2015).

Questionnaire

A quantitative cross-sectional approach (Scott 2012) using an online questionnaire was applied to collect data in 2016 on snow-based visitors' experience of being in the backcountry of KNP. The survey method was selected as it provided the most effective means of gathering perceptions and behaviours from the sample population and has been a widely used strategy for segmenting or profiling visitors in protected areas (Gideon 2012; Newsome et al. 2012). The data was used to analyse variables associated with the recreation specialisation framework as well as associated risks and levels of preparedness. The survey questions were developed through a review of the literature on recreation specialisation, backcountry visitor characteristics, and risk and preparedness.

Recreation specialisation

Based on the behavioural, affective and cognitive dimensions identified in the literature, the following groups of questions were developed: The behaviour dimension included five questions to identify previous experience. Questions such as number of years participating in snow-based backcountry travel and number of previous trips were based on the work of Thapa et al. (2006). The affective dimension statements addressing commitment and centrality of backcountry travel were drawn from recreation specialisation studies such as Lamont and Jenkins (2013), McIntyre and Pigram (1992) and McFarlane (2004). These questions related to the importance of backcountry travel to an individual and included questions on equipment. Questions relating to the cognitive dimension to capture competency were developed based on work by Cattie (2012) and the competency requirements for training of outdoor recreationists (Australian Government 2013), and through discussion with backcountry visitors.

Visitor characteristics

Variables related to visitor characteristics were drawn from literature on protected area management and included questions on main reason for trip, destination, type of equipment used, activity, group and trip characteristics, demographics and perceptions of wilderness. Demographic questions included age, gender, economic status, relationship status, household type and postcode (Veal 2017). As per other studies in protected area contexts or using recreation specialisation, other questions asked about length of stay, main purpose of trip, group size, spatial patterns such as access and egress locations (e.g. Newsome et al. 2012; Wolf et al. 2015; Jun et al. 2015).

Perception of risk and level of preparedness

To assess perceptions of risk, a closed question was posed about the risk participants thought they were exposed to using an ordinal scale. To assess preparedness, questions relating to the types of equipment carried and used were included in the survey, specifically shelter and food, navigation and communication, personal equipment such as clothing and first aid and repair kits. Questions relating to preplanning to identify respondents' degree of preparedness in entering the backcountry included the types of resources consulted and who they advised of their trip plans.

Data collection

The KNP backcountry visitor population was estimated to be about 400 people per season based on hut logbooks and access point estimations. Purposive sampling or self-selection was adopted to identify the sample population (Lamont & Jenkins 2013), accommodating weather and snow conditions and multiple access points. Specific groups were identified and approached using a variety of recruitment methods, including the creation of a study-focussed website, utilising established websites such as by the NSW National Parks and Wildlife Service (the NSW protected area management agency), targeting known and recommended social media sites, backcountry ski groups, placing postcards/flyers with links to the survey at cafes, gear shops and visitor centres and handing them to skiers and boarders in the field. In addition, network or snowball sampling was used as a means to reach the sample population through known contacts who referred the survey to their contacts who travelled in the backcountry (Brick 2011). This research was approved by the Southern Cross University Human Ethics Committee (approval number ECN-16-202). To ensure informed consent, participants were provided with information about the study before beginning the on-line survey and could opt out at that stage.

The questionnaire was pilot tested with academics, industry representatives and backcountry visitors. Participation in the survey was contingent upon (1) undertaking snow-based recreation in

KNP; (2) being 18 years of age; and (3) travelling as an independent adult and not part of a commercial tour.

Data analysis

A total of 395 surveys were collected of which 73 were excluded as participants were under 18 years of age, did not go backcountry or were on commercial tours. Another 63 respondents did not complete the survey yielding a sample size of 259 or 65% of the estimated annual visitor population. After an initial review and basic checks in the data collection software to identify potential inconsistencies, data was exported into the IBM software Statistical Package for the Social Sciences (SPSS) v22. The data was then checked for completeness and outliers before analysis.

Using SPSS, the recreation specialisation was analysed using a two-step cluster analysis with eighteen items pertaining to the behaviour (previous experience), cognition (centrality and commitment) and affective (competence) dimensions. Two hundred and fifty-eight (258) cases (1 missing) were automatically distributed with no a priori basis, creating two clusters (Lamont & Jenkins, 2013). The SPSS algorithm ranked each item in importance with a score of one being of greatest importance to zero of least importance. The average silhouette measure of cohesion and separation was 0.4 indicating a fair to reasonable measure of similarity and difference within and between the clusters (Lamont & Jenkins, 2013; Tkaczynski, Rundle-Thiele, & Prebensen, 2016). The size ratio of the largest cluster to the smaller cluster was 1.39 with the mean and standard deviation compared for each input variable.

Demographic and trip characteristics which were of nominal and ordinal scales were measured in frequency and percentages. The variables which were of interval scale, such as age and the recreation specialization were measured for mean or measure of central tendency and standard deviation (Long 2007). Cross-tabulations were used to identify associations between the independent variable (cluster membership) and the dependent variables in accordance with the study objectives. Cross tabulations were used descriptively to indicate the strength of any association and inferentially to signify the probability of the association being due to chance (Long 2007). Chi Square Tests were used to determine if the proportions for nominal data was different between the variables. T-test independent samples were used to find differences between two means where the variables were scaled and nominal (Veal 2017). Significance was determined at the five percent level.

Reliability and validity were ensured by using previously tested methodologies, measurement tools and variables to describe aspects of recreation specialisation, visitor characteristics and

299 preparedness (Saunders & Lewis 2012). The design of the on-line questionnaire aimed to reduce
300 validity issues relating to respondent error (Veal 2017).

301 Results

302 Visitor characteristics

303 Demographically, males made up the majority (83.5%) of the population of snow-based backcountry
304 visitors. Respondents ranged in age from 18 to 80 years with a mean age of 42.5 years and median
305 of 40.5 years (Table 1). Grouping the data into age ranges showed bimodal distribution with the
306 majority in the 30-39 age group (26.7%) and the 50-59 age group (23.1%). The data also showed
307 most from a household comprising a couple with a larger proportion married/partnered (74.6%).
308 The majority of respondents were in fulltime paid work (67.2%) and the highest percentage from
309 NSW based postcodes (Table 1).

310 [Insert Table 1 about here]

311 Most respondents were travelling on alpine touring skis (Table 2) with significant difference between
312 clusters ($p \geq .006$). Both clusters indicated they were more likely to travel with friends/relatives in a
313 group size of two (Table 2). When the travel group was analysed in relation to clustering, group
314 travel was important although travelling alone was significant between clusters ($p \geq .027$) with a
315 higher proportion of experts (24%) more likely to undertake this compared to intermediates (13%).
316 Over half were on multiday trips either staying in the backcountry (36%) or outside of the
317 backcountry (20%). Those who were staying in the backcountry were more likely to spend the night
318 at a base camp either in tents or backcountry huts whilst the remainder travelled from place to place
319 using huts or tents for accommodation (Table 2). Motivation for the backcountry trip was asked as
320 an open question and responses classified a priori, with the main reasons being to experience new
321 skills or places and to have enjoyment and fun (Table 3).

322 [Insert Table 2 about here]

323 [Insert Table 3 about here]

324 Recreation specialisation

325 The analysis revealed two clusters for the recreation specialisation. Cluster one had a membership of
326 150 (58.1%) and cluster two 108 cases (41.7.0%). The clusters were distinguishable by the amount of
327 experience in years and frequency of travelling in the backcountry and their perceived level of
328 competence. They were subsequently referred to as experts and intermediates. This differentiation
329 was based on the following: Five of the items relating to the cognitive component appeared to have

higher importance in defining the attributes of recreation specialisation as they were placed toward the top (Table 1) with an importance score between 1.0 and 0.6. The sixth item *I can recognise signs of hypothermia* had less than 0.5 importance (Table 4). The recreation specialisation index showed experts had higher number of trips or years participation, had more experience in terms of trips undertaken in their lifetime and appeared to report as more competent (Table 5).

[Insert Table 4 about here]

[Insert Table 5 about here]

The affective item, *I organise a lot of my life to fit around snow-based backcountry travel* showed a difference between the two clusters with a mean score of 4.0 for experts and 2.8 for intermediates (Table 5) and had some importance at 0.5 in determining cluster specialisation (Table 4). The other mean scores for the affective items also indicated a difference between clusters. The item 'snow-based backcountry travel is very important' a mean of 4.8 for experts and 4.1 for intermediates. This importance to intermediates was also reflected in the item 'snow-based backcountry travel is one of the most enjoyable things I do' (Table 5). Intermediates, however showed less affiliation to the item 'snow-based backcountry travel says a lot about who I am'. The two items relating to equipment indicated some differences between clusters although their importance to the index was relatively low in terms of comparing 'cost to replace equipment' and lower for 'spend in the last 12 months' (Table 4).

Perception of risk

Respondents were asked to rate whether particular factors increased their level of risk that they felt exposed to while on their most recent snow-based backcountry trip on a five-point scale (1 = not at all to 5 = extremely). This pertained to weather, snow conditions, trip length, equipment function, clothing function, health, skill level, injury, terrain, navigation and any 'other' factors. Overall, average risk perception was rated well below 2 except for two items, weather and snow conditions, but even these were rated as less than 3 (Table 6). Also, there was no significant difference in the overall risk perception rating between intermediates (2.0) and experts (1.9) based on an analysis of the clusters and perceived risk using t-TEST independent samples (Table 7). However, almost a quarter (19%) of respondents said there were other factors that increased their level of risk including fitness of party members, being solo, age, and river crossings.

[Insert Table 6 about here]

[Insert Table 7 about here]

Level of preparedness

Pre-trip planning resources

From a list of ten resources, respondents consulted the following in their pre-trip planning: Weather forecasts were most important for both experts (92%) and intermediates (87%). A higher proportion of intermediates (79.6%) referred to maps compared to experts (73.3%). Backcountry snow-based websites/blogs were consulted by both clusters (56.7% experts and 52.8% intermediates). A greater proportion of intermediates (45.4%) consulted friends compared to experts (32.7%). A small proportion of experts (2.0%) and intermediates (3.7%) did not use any resources for planning (Table 8). Respondents who specified the 'other' category, mentioned prior experience, webcams, Google Earth and web-based mapping apps, and Facebook as sources of pre-trip planning.

[Insert Table 8 about here]

Intermediates were more likely to consult the full range of resources compared to experts. The number of resources used was assigned to one of three categories (0-2, 3-5 and 6-8) and cross-tabulated by cluster group. The relationship between the number of resources used and the cluster membership was significant (p = 0.026). More experts used fewer than five sources whilst a higher proportion of intermediates used six to eight resources (Table 8).

Trip intention notifications

A key feature of trip intentions is to notify a 'significant other' such as friends or family when leaving for a backcountry trip. Family/partners and/or family were more likely to be notified by both experts (80%/47%) and intermediates (78%/55%) (Table 9). A small percentage of visitors (4%) did not notify anyone with experts more likely to not notify. As for 'other' types of notifications, lodge managers, PLB/EPIRB registration and clubs were stated. Number of notification types used did not significantly differ between experts and intermediates (Table 9).

[Insert Table 9 about here]

Equipment

Essential safety items

The study found 74% of snow-based backcountry visitors carried more than seven essential items including a tent, emergency shelter and food, waterproof clothing, first aid kit, map and compass, sunglasses and sunscreen. Experts were more likely (32%) to carry/use less than six essential items compared to intermediates (23%) but there was no significant difference between experts (77%) compared to intermediates (69%) carrying/using seven or more essential items (Table 10)

[Insert Table 10 about here]

Shelter and emergency food

Survey participants were asked to provide information on the type of equipment they carried and used. Overall, a higher proportion of participants were more likely to carry emergency food (83%) compared to other items. Experts were more likely to carry emergency shelter compared to intermediates. Furthermore, experts were significantly more likely to carry and use fuel stoves compared to intermediates ($p = 0.046$) (Table 11). A small number used other types of emergency shelter such as emergency space blanket, cord and groundsheets.

[Insert Table 11 about here]

Communication and navigation

The majority of respondents carried or used a mobile phone (97%) whilst the carrying and use of two-way radios was low (16%). The majority of respondents did carry/use a compass (83%) or a map (84%), and more than half of the respondents (57%) carried a GPS or a locator beacon (Table 12). A small number of respondents also indicated they were using online location tracking devices such as SPOT.

[Insert Table 12 about here]

Avalanche

The majority of respondents were not carrying probes (72%) or beacons (75%) but shovels were carried by almost half of respondents (45%) and used by 14%. Shovels were the only avalanche item whose likelihood of use significantly differed between experts and intermediates, with intermediates more likely to carry but experts more likely to use ($p = 0 .009$) (Table 13).

[Insert Table 13 about here]

Personal equipment

Personal equipment including waterproof clothing (99%), sunscreen (94%), first aid kits (84%), sunglasses (92%), torch (81%) and goggles (80%) were more likely to be carried/used than any other items. This was followed by repair kits (66%) and water filters (14%). Respondents commented on the carrying of spare water or fuel to boil water and water purifying tablets. The torch and repair kits were the only items within this group of significance ($p = 0.037$ and $p = 0.000$) with experts more likely to carry and use these two items compared to intermediates. Half of the intermediates did not carry repair kits (Table 14).

[Insert Table 14 about here]

Formal and informal training

Respondents were asked to identify where they received formal and informal training on snow-based backcountry travelling (multiple response). The majority of visitors did not have formal training (55%). Intermediates were more likely to not have formal training (66%) compared to experts (47%). Formal training was most likely to have been obtained as an avalanche certification course (30%) (Table 15). 'Other' types of training included mountaineering courses, search and rescue courses, ski tour leader course and defence training.

[Insert Table 15 about here]

Informal training for both experts and intermediates was predominantly provided by friends (71% and 66%) and/or self-taught (69% and 44%). Intermediates were more likely to have sourced their informal training from family/friends and websites/blogs compared to experts (Table 15). 'Other' sources of training included tour guides (23%), on the job or work training (19%) and books and magazines (15%).

Discussion

Risk perception

Overall, respondents perceived low risk from a range of potential hazards occurring in snow-based backcountry in KNP in the Australian Snowy Mountains. Neither weather, snow conditions, trip length, equipment function, clothing function, health, skill level, injury, terrain, nor navigation increased perceived risk levels. This is surprising given that actual undesirable risks exist and lead to publicly discussed cases such as the coronial inquiry into a lost hiker in KNP in 2013 (State Coroners Court of NSW 2015). This and other reported cases of alpine search and rescue indicate misjudgement of risks such as travelling in adverse or extreme weather, losing bearings, triggering avalanche and snow slides, inadequate knowledge of the terrain and territory, not advising a third person of travel intentions and inadequate clothing contributed to fatalities, rescues and injuries (Alpine Access 2019; Soule et al. 2017; State Coroners Court of NSW 2015).

Methodologically the study found perceived risk in backcountry settings was a difficult variable to measure. Firstly, adverse conditions also constituted positive experiences for some people. Secondly, not all items may have been good indicators of risk. For example, there were two cases where the open-ended results showed that injury had occurred and even rescue and evacuation were required but this did not increase the perceived risk rating. Thirdly, there may have been other risk factors of importance which we did not present to participants, but which were stated in the

'other' category. These should be considered for future studies such as the fitness of party members, travelling solo, age, and river crossings.

Although we used one particular question to understand risk perception, the results of this need to be interpreted in the context of the results for preparedness and recreation specialisation. As researchers such as Haegeli et al. (2012) and Gstaettner et al. (2018) have noted, a single measure is not a viable conduit for understanding risk, it needs to be viewed in relation to the multifaceted aspects of trip preparedness, trip purpose, experience and competence. Gstaettner et al. (2018) further elaborated that backcountry visitors may consider judgements about risk and behaviour in relation to an internal frame of feeling control and safe whilst balancing this with external factors. Our results indicated that perception was not related to specialisation but likely to situational factors of travelling in uncontrollable weather and snow conditions.

Respondents' perceptions for visiting KNP for snow-based activities indicated they take precautions in planning for trips, mitigate for any risks through the carrying and use of safety equipment and their reasons for being there are to experience the social and natural environment and not as an arena for risk taking. The study found respondents were more experienced and competent backcountry visitors and this may have lowered their level of perceived risk. Previous studies have found a link between experienced outdoor recreationists and lower perceived risk (Demirhan 2005; Morgan & Stevens 2008). Therefore, any future comparative study of snow-based backcountry travellers could use the measure of perceived risk from this research to explore if lower specialised participants have a higher perceived risk.

Another factor to be considered when evaluating risk was the relatively high percentage (19%) of visitors who travelled alone in the backcountry. As indicated above, participants did recognise travelling solo as a potential risk factor. The percentage of solo travellers in our study was relatively higher than in the Canadian backcountry study by Cattie (2012) which found only 10% travelled alone compared to 19% in this KNP study. However, it was lower than the 40% of backcountry skiers and boarders in Montana (Sykes et al. 2020) and reported 46% in northeast USA who travelled solo (Delaney et al. 2006). Solo travel may be undertaken for a number of reasons, including to be close to nature through solitude (Coble et al. 2003). Whilst respondents were not probed directly for the main reasons for travelling alone, survey comments indicated to experience solitude was a driver for many visitors. Researchers such as Coble et al. (2003) found people experienced personal control and autonomy, carried aids to minimise potential injury or harm, or they used familiar routes to prevent being lost. This potentially raises concern for peoples' safety in relation to the recommendations made by NSW NPWS to travel with a party of at least three. For future research,

visitors could be studied further to understand their motivation and experience with solo and small group travel and the implications this has for risk and preparedness.

Level of preparedness

More than half of the respondents identified as having no formal backcountry training. This may indicate a lack of consistent pathways for skill development, as well as suggest low utilisation and availability of types of existing backcountry training and certification. It would be important to better understand how novice backcountry recreationists acquire their skills and what pathways exist to facilitate skill development at this early stage that is vulnerable to risk, both formally and informally. The lack of formal training sources can impact the communication of risk management to visitors.

The informal learning process also represented an area for further research to determine what type of information snow-based backcountry travellers seek and acquire and how this impacts their experience. With the continued development of the internet, websites and blogs have become a major source of information sharing and collaboration, emphasizing their increasing importance (Pesonen 2013). The use of snow-based backcountry websites/blogs as sources of skill development was also reflected in their importance as trip planning tools and as a resource to distribute safety messages. Higher specialised visitors showed a greater percentage of use and appeared to be aware of those which were authoritative sources compared to intermediates who searched a larger variety of sources. While a couple of different backcountry information sites were used, all such sources potentially have implications for users in terms of their relevance, currency and trustworthiness (Plank 2016). The question can be asked of who is best placed to provide the current and consistent voice on backcountry conditions and what information is reported. There needs to be a concerted effort to streamline safety messages consistently across various channels such as the official government website for protected areas and the more informal websites which are used just as well. Future survey instruments may want to further identify which factors associated with websites/blogs are perceived as trustworthy and quality information and how these factors contribute to destination choice and preparedness.

Avalanche certification can be viewed as a measure of backcountry preparedness. Survey participants reported that they obtained their formal training from avalanche certification courses rather than elsewhere. This is interesting given that fatalities from avalanches occur relatively seldom compared to overseas snow destinations. For instance, in the study by Cattie (2012) there were five backcountry avalanche fatalities in the 2011 Canadian backcountry season, whilst in Australia in 2016 there were no fatalities although small avalanches were sited and conditions indicated potential for triggering (Haegeli et al. 2012; https://www.snowsafety.com.au/2016.html).

In addition to avalanche training and potential avalanche risk, avalanche equipment was also viewed as an indicator of preparedness (Haegeli et al. 2012). In KNP avalanche beacon and probes were not likely to be carried or used. Interestingly, over half of both day trip and overnight visitors carried shovels instead. However, they were more likely used for activities associated with camping and building snow features for jumping. Future studies may want to identify how items are actually used and consider the inclusion of equipment such as avalanche snow assessment kits, air bags and breathing devices as the technology and use of items develop (Silverton, et al., 2009).

Despite this lack of bringing avalanche equipment, the research found that respondents were generally safety conscious and undertook a range of measures to ensure their actual risk was low. For instance, respondents reported changing trip plans or trip length or destination when confronted with adverse snow and weather conditions. The study found 74% of respondents carried and/or used more than seven of the essential emergency items associated with preparedness, as indicated for alpine backcountry travel in KNP by the NSW National Parks Service. Although the study did not ask about sleeping bags, it included the additional item of first aid kit as recommend by Mason et al. (2013). This level of preparedness far surpassed that reported in the study of backcountry skiers and boarders in north east USA which found that although 82% carried a snow helmet only 5% had a first aid kit (Delaney et al. 2006). This was despite nineteen years of experience on average and a perception of elevated risk in travelling in the backcountry. The difference in mean ages in each study (31-USA and 42-KNP) may have contributed to this disparity of results as preparedness and equipment usage is also based on age.

The likelihood of carrying/using fuel stoves, shovel, torch and repair kits differed between experts and intermediates in our study. Overall a map and compass appeared to be more in use than a GPS reflecting suitable habits and following advice to not solely rely on digital devices for navigation (NSW Government 2016). While the majority of respondents used and carried and used maps on trips, they were found to not be used by the higher specialised cluster as a planning resource. This may reflect the larger number of trips they make compared to the intermediate cluster and may also suggest they visit known places. There were significant differences between the expert and intermediate segments in relation to preparedness. Whilst experts were more likely to consult less pre-trip planning resources than intermediates, experts were more likely to carry and use safety equipment (fuel stoves, shovels, torch and repair kits) than intermediates. This suggests a need to educate on pre-trip planning resources and safety equipment to ensure that this meets the need of recreationists in different stages of the recreation specialisation continuum.

552 The use of technology-enabling location devices presents an opportunity to further research snow-
553 based backcountry use. The study found almost one third of visitors carried devices to track their
554 routes. Despite only a small number of visitors uploading their routes, this presents an opportunity
555 in the future to evaluate route choice in relation to potential hazards. More generally there seems to
556 be great potential to use volunteer geographical information (VGI), GPS tracking and Public
557 Participation Geographical Information Systems (PPGIS) as managerial and planning tools for
558 understanding the visitor safety experience(Sykes et al. 2020; Wolf et al. 2015).

559 In addition to being safety conscious, respondents' pre-trip planning approach also reflected 'good
560 habits' (Haegeli et al. 2012) and impacted their experience positively. The types of planning
561 resources used provided an indication of the planning that took place, with weather forecasts being
562 the most important feature. Almost everyone checked the weather forecast, similar to what was
563 found in other studies of snow-based recreationists (Cattie 2012; Rutty & Andrey 2014) where
564 weather would likely determine the time and length of trip and may impact on the experience
565 (Becken & Wilson 2013).

566 Sound planning and good habits were also noted in relation to trip intention notifications as a
567 recognised safety measure advised by NSW Police and NPWS website when heading backcountry.
568 The majority in both clusters notified a significant other of their intended backcountry trip. This
569 compares favourably with international examples such as a study of backcountry skiers and boarders
570 in the US which found 26% did not notify a responsible person (Delaney et al. 2006). However even
571 the small number of respondents who did not notify of their intention are of concern considering
572 how severe potential negative outcomes of risks experienced in the snow-based backcountry can be
573 and the effort involved in rescue and evacuation missions. Previous researchers have identified that
574 not notifying can occur when people are on a day trip, they are carrying phones, or believe it is
575 unnecessary (Mason et al. 2013). Future research could look at this safety aspect to determine why
576 KNP visitors do not notify of their trip intention.

577 Methodological implications of using recreation specialisation to segment snow-based
578 recreationists

579 The use of recreation specialisation theory to examine snow-based backcountry travel in Australia
580 with regard to risk perception and preparedness is new. While many studies have used the
581 framework to segment recreationists into managerial groups, very few published papers have
582 considered an association with risk and preparedness apart from decision making in avalanche
583 zones. This research study has been formative in developing a survey instrument that can be used
584 elsewhere to investigate risk and preparedness in relation to recreation specialisation.

The study identified two clusters and mapped the backcountry visitors towards the 'intermediate and expert' end of the specialisation spectrum. The formation of two clusters at the higher end of the spectrum was consistent with the study of event cyclists by Lamont and Jenkins (2013), where intermediates clustered in the middle scores and experts in the higher means. In both studies a similar recreation specialisation measurement tool and analysis method were used to segment the survey respondents, although with slight differences in the parameters of the measurement scales to fit the two different activities. The clustering towards the higher end of the specialisation continuum indicated that overall snow-based recreationists were experienced, competent and committed although with differences noted between the two clusters.

The development of skills and competency in relation to snow-based backcountry travel was measured in various ways in this study. Initially, the process of undertaking the data analysis indicated skill and knowledge as measured by formal and informal training were not successful gauges for recreation specialisation. However, these two variables were subsequently used to explore differences between cluster groups in relation to preparedness and safety. The competency index component of the recreation specialisation framework not only indicated specialisation but also suggested respondents had overall strength in backcountry knowledge and skills. This strength appeared to be gained informally through self-directed learning and importantly through friends and websites/blogs.

Specifically, the cognitive or competency variables were the strongest indicator of differences in specialisation between the two clusters. These could be used in the future to successfully determine specialisation of snow-based backcountry travel (Mooi & Sarstedt 2011; Tkaczynski et al. 2009). However, recreation specialisation researchers have noted the problems of measuring skill when it is activity specific (Shafer & Scott 2013), and when there are no established standards to indicate competency or skill level for outdoor recreational activities (McFarlane, 2004) and backcountry activity specifically (Cattie 2012). The high number of snow-based backcountry visitors who had no formal training reflected this lack of standard skills to measure competency. The researcher identified skills from a review of the outdoor recreation training literature. The results suggested these are the types of skills required to develop competency in backcountry travel. However, as this is the first study to adopt these measures, more research should be undertaken to test these within the recreation specialisation index and this activity.

The behaviour and affective dimensions also showed differences between the clusters. The more specialised visitors had a higher amount of previous experience and organised their life around snow-based backcountry activities. This difference between clusters was also reflected in experts'

high participation in interstate and overseas backcountry activities and investment in money and equipment. This indicated a potential match between leisure activity choices and overseas tourism destination choices, with backcountry trips undertaken in Europe, North America and Japan. This may be attributed to the notion that overseas destinations provide more consistent quality snow conditions and a better backcountry experience compared to Australia (Dickson & Faulks 2007). It may also have reflected the life stage of respondents who appeared not to be constrained to undertake overseas travel in regards to their sociodemographic factors (Kattiyapornpong & Miller 2009). It would appear overseas backcountry travel reflected the high level of commitment or affection respondents have for this activity and represented an area for future research.

Conclusions

This study provides an extensive and thorough understanding of perception of risk and preparedness of snow-based backcountry visitors to an Australian alpine area. The study found that the recreation specialisation index was an appropriate tool for segmentation of snow-based backcountry visitors into intermediates and experts and explained in detail the development of this instrument along behavioural, cognitive and affective dimensions.

The findings of our study apply to the full spectrum of travel experiences on a continuum ranging from recreational activity to tourism experiences (McKercher 1996). This study identified a range of risk management issues associated with safe backcountry travel of relevance to management. This included a potential underestimation of risk, solo visitors, those who do not notify any 'significant other' of their backcountry activity and those who are less experienced and equipped. Backcountry visitors participating in commercial tour groups were excluded from the sample, potentially contributing to under-sampling of less specialised visitors given that they are potential training arenas for novices to be guided to develop skills and competence (Hardiman & Burgin 2011). The study identified online channels as potentially effective means to communicate preparedness and safety messages developed in partnerships with existing or new trusted and authentic backcountry leaders. Messages may need to be targeted at specific segments of visitors. Finally, the research identified the potential for tools such as GPS tracking and visitor participation strategies to better understand backcountry risk management issues.

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Table 1. Demographic profile of respondents

Gender				Percentage
Male				84
Female				16
Age at last birthday				
Minimum	Maximum	Mean	Median	Standard deviation
18	80	42.5	40.5	13.94610
Age groups				Percentage
18-29				22.0
30-39				26.7
40-49				15.7
50-59				23.1
60-80				12.5
Household				Percentage
Single Adult				15.2
Single Parent with dependent children				2.8
Couple				36.3
Couple + one dependent child				11.3
Couple + two or more dependent children				22.7
Related Adults/unrelated adults/other				11.7
Economic Status				Percentage
Fulltime Paid Work				67.1
Part Time Paid Work				18.4
Retired				7.8
Other				6.7
Current Relationship Status				Percentage
Married/Partnered				74.6
Single				19.9
Divorced/separated/widowed				5.5
Postcode				Percentage
NSW				64.1
ACT				25.0
VIC/QLD/SA				10.9

Table 2. Differences between clusters for equipment used, travel group and size as well as length of trip and backcountry camp arrangements

Variables	Expert (%) (n = 150)	Intermediate (%) (n = 108)	Combined (%) (n = 258)	X^2
Equipment used to travel around				
Alpine touring skis	38.7	27.8	34.1	
Telemark skis	27.3	13.9	21.7	
Snowshoes	13.3	20.4	16.3	
Snowboard	9.3	18.5	13.2	X^2 (5) = 16.214, ***p*=.006**
Cross country skis	8.0	13.0	10.1	
Other	3.3	6.5	4.7	
Travel Group				
Friends/relatives	52.0	55.6	53.5	X^2 (1) = .319, p=.572
Alone	24.0	13.0	19.4	X^2 (1) = 4.896, ***p*=.027**
Partner	12.7	21.3	16.3	X^2 (1) = 3.431, p=.064
Family (parents and children)	7.3	8.3	7.8	X^2 (1) = .088, p=.767
Other	9.3	5.6	7.8	X^2 (1) = 1.253, p=.263
Work colleagues	2.7	4.6	3.5	X^2 (1) = .719, p=.397
Group size				
1	24.0	13.0	19.4	
2	32.7	39.8	35.7	
3	17.3	15.7	16.7	X^2 (4) = 8.092, p=.151
4	13.3	13.0	13.2	
5 or more	12.7	18.5	15.1	
Backcountry Trip				
Single day	40.7	47.2	43.4	
Multi day overnighting outside of backcountry	20.0	21.3	20.5	X^2 (2) = 1.747, p=.418
Multi day camping in backcountry	39.3	31.5	36.0	
Overnight Trip	(n = 59)	(n = 34)	(n = 93)	
Single base camp returned to each night	69.5	64.7	67.7	
Multiple camps as touring from place to place	30.5	35.3	32.3	X^2 (1) =.226, p=.634
Accommodation	(n = 57)	(n = 32)	(n = 89)	
Tent	71.9	75.0	73.0	
Backcountry hut	28.1	25.0	27.0	X^2 (1) = 0.98, p=.754

Note: Sample number between Overnight trip and accommodation differs as Accommodation numbers do not include respondents who reported Other type accommodation.

Table 3. Themes arising from an open-ended question asked about what was the main reason for undertaking this snow-based backcountry trip by clusters.

Main Reason	Expert (%) (n = 150)	Intermediate (%) (n = 108)	Combined (%) (n = 258)	X^2
Experience new skill or place	32.7	38.0	34.9	
Activity	27.3	15.7	22.5	
Enjoyment/fun	20.7	26.9	23.3	X^2 (5) = 6.582, ***p*=.**254
Share with others	6.7	9.3	7.8	
Event	7.3	4.6	6.2	
Escape from	5.3	5.6	5.4	

Table 4. Result of two-step cluster showing variable input and importance with mean score for continuous items and percentage for categorical items.

Recreation specialisation cluster input items	Item importance	Expert Mean/percent n150	Intermediate Mean/percent n108
I can survive an unexpected night in the backcountry [c]	1.00	4.13	2.44
I can travel confidently on any BC snow terrain [c]	1.00	4.20	2.73
I can interpret impending weather changes in the BC [c]	0.76	3.95	2.58
Approximate number of SB BC trips completed in your lifetime [a]	0.74	36.35	12.62
I can organise my own evacuation [c]	0.72	3.82	2.41
I can navigate using a map and compass [c]	0.62	4.23	3.03
I organise a lot of my life to fit around SB BC travels [b]	0.57	4.03	2.83
Approximate number of SB BC trips in KNP [a]	0.53	28.22	8.78
Snow-based BC travel is very important to me [b]	0.48	4.83	4.19
I can recognise signs of hypothermia [c]	0.46	4.13	3.12
SB BC travel is one of the most enjoyable things I do [b]	0.40	4.74	4.09
SB BC travel says a lot about who I am [b]	0.33	4.07	3.35
Approximate how much cost to replace all SB BC equipment [d]	0.31	4889	2267
Approximate number of years you have participated in SB BC travel [a]	0.30	19.90	8.46
During your lifetime where else have you been on SB BC trips [a]	0.25	88.0%	54.6%
Most recreation activities do not interest me as much as SB BC travel [b]	0.23	3.60	2.84
Excluding this trip, how many SB BC trips this season [a]	0.15	3.73	1.31
Approximately, how much did you spend on SB BC activities in the last 12 months [d]	0.08	2150	969

Note:
a = behavioural components of recreation specialisation index (measurement whole number)
b = affective components of recreation specialisation index (measurement disagree – agree
c = cognitive component of recreation specialisation index (competent/not yet competent)
d = equipment commitment component (measurement amount of dollars)
SB = snow-based; BC = backcountry

Table 5. Mean output for recreation specialisation dimension inputs by expert and intermediate clusters

RC Index	Cluster input	Expert (n150)		Intermediate (n108)		Combined (n258)	
		Mean	SD	Mean	SD	Mean	SD
Behaviour	Approximate number of SB BC trips completed in your lifetime [a]	36.53	17.23	12.62	12.88	26.52	19.52
	Approximate number of SB BC trips in KNP [a]	19.90	14.35	8.46	10.63	15.11	14.08
	Approximate number of years you have participated in SB BC travel [a]	28.22	18.96	8.78	9.2	20.08	18.33
	Excluding this trip, how many SB BC trips this season [a]	3.73	3.26	1.31	1.46	2.72	4.29
	I organise a lot of my life to fit around SB BC travels [b]	4.03	.93	2.83	.90	3.53	1.09
Affective	Snow-based BC travel is very important to me [b]	4.83	.39	4.19	.70	4.57	.63
	SB BC travel is one of the most enjoyable things I do [b]	4.74	.54	4.09	.72	4.47	.70
	SB BC travel says a lot about who I am [b]	4.07	.73	3.35	.79	3.77	.83
	Most recreation activities do not interest me as much as SB BC travel [b]	3.60	1.00	2.84	.97	3.28	1.05
Cognitive	I can survive an unexpected night in the backcountry [c]	4.13	.87	2.44	.93	3.42	1.22
	I can travel confidently on any BC snow terrain	4.20	.71	2.73	.87	3.59	1.07
	I can interpret impending weather changes in the BC [c]	3.95	.85	2.58	.90	3.38	1.10
	I can organise my own evacuation [c]	3.82	.94	2.41	.93	3.23	1.16
	I can navigate using a map and compass [c]	4.23	.77	3.03	1.01	3.73	1.06
	I can recognise signs of hypothermia [c]	4.13	.86	3.12	.90	3.71	1.01
Commitment	Approximate how much cost to replace all SB BC equipment [d]	4889	3479	2267	1780	3791	3165
	Approximately, how much did you spend on SB BC activities in the last 12 months [d]	2150	3617	969	1315	1656	2940

RC Index	During your lifetime where else have you been on SB BC trips [a]	Expert frequency (%)	Intermediate Frequency (%)	Combined Frequency (%)
behaviour	Other place (Victoria, Tasmania, Overseas)	131 (74.0)	50 (26.0)	192 (100)
	Nowhere else	1 (1.5)	64 (98.5)	65 (100)

Note:
a = behavioural components of recreation specialisation index (measurement whole number)
b = affective components of recreation specialisation index (measurement disagree – agree
c = cognitive component of recreation specialisation index (competent/not yet competent)
d = equipment commitment component (measurement amount of dollars)
SB = snow-based; BC = backcountry

Table 6. Perceived level of risk by expert and intermediate clusters

Did any of these factors increase the level of risk you were exposed to whilst on your most recent snow-based backcountry trip? 1 = no negative effect and 5 = extreme negative effect								
	Frequency percentage						Mean	SD
	1	2	3	4	5	N/A		
Weather	35.1	20.5	18.1	18.1	5.4	2.7	2.46	1.40
Snow conditions	34.0	25.5	20.8	14.3	3.1	2.3	2.34	1.29
Trip length	65.6	17.8	9.7	1.9	0.8	4.2	1.67	1.22
Equipment function	63.7	14.3	13.5	3.5	1.9	3.1	1.75	1.23
Clothing function	73.4	13.5	5.0	3.9	1.2	3.1	1.55	1.16
Health	64.9	18.9	8.5	3.1	1.5	3.1	1.67	1.18
Skill level	62.9	21.6	8.5	3.5	0.4	3.1	1.66	1.13
Injury	77.6	11.2	3.9	1.2	1.5	4.6	1.52	1.23
Terrain	62.2	18.1	11.2	4.2	1.2	3.1	1.73	1.20
Navigation	68.7	16.6	7.7	2.7	1.2	3.1	1.60	1.15

Table 7. Mean and standard deviation for perceived negative risk between the two clusters

	N	Mean	SD	Std Error Mean
Expert	150	2.0147	1.02377	.0836
Intermediate	108	1.8796	.91015	.0876

	Levene's Test variance equality		t-Test for Equality of means			
Equal variances	F	Sig	t	df	Sig (2 tailed)	Std Error Difference
Assumed	.633	.427	1.094	256	.275	.12341
Not assumed			1.115	244.836	.266	.12107

Table 8. Types and number of pre-trip resources consulted by expert and intermediate clusters

What pre-trip planning resources did you consult for your most recent snow-based backcountry trip? Select all that apply			
Resource	Experts (%) (n150)	Intermediates (%) (n108)	Combine (%) (n258)
Weather forecasts	92.0	87.0	90.0
Maps	73.3	79.6	76.0
Backcountry website/blogs	56.7	52.8	55.0
Friend	32.7	45.4	38.0
NPWS Website	15.3	32.3	22.5
Backcountry retail/hire shops staff	13.3	25.0	18.2
Guidebooks	14.7	22.2	17.8
National Park Visitor Centre staff	6.7	17.6	11.2
Other	7.3	2.8	5.4
None	2.0	3.7	2.7

Number of pre- trip Resource	Experts (%) (n150)	Intermediates (%) (n108)	Combine (%) (n258)
0 - 2 resources	34.7	26.9	31.4
3 - 5 resources	60.0	58.3	59.3
6 – 8 resources	5.3	14.8	9.3
X^2 (2) = 7.319, ***p*=.026**			

Table 9. Trip intention notification including who was consulted and how many sources consulted by clusters

Who of the following did you advise when leaving for your most recent snow-based backcountry trip? Select all that apply			
Who	Experts (%) (n150)	Intermediates (%) (n108)	Combine (%) (n258)
Friend	46.7	54.6	50.0
Family/partner	80.0	77.8	79.1
National Parks & Wildlife Service	5.3	12.0	8.1
NSW Police	0.7	0.9	0.8
Social media posts	8.7	9.3	8.9
No one	4.7	2.8	3.9
Other	4.0	10.2	6.6

Number of notifications of trip intention	Experts (%) (n150)	Intermediates (%) (n108)	Combine (%) (n258)
No one notified	4.7	2.8	3.9
One notification	58.0	43.5	
Two notifications	26.7	40.7	
Three or more notifications	10.7	13.0	
X^2 (3) = 7.218, *p*=.065			

Table 10. Proportion of essential items carried and/or used by cluster

	Experts (%) (n150)	Intermediates (%) (n108)	Combined (%) (n258)
Less than seven items	22.7	31.5	26.4
Seven and more items	77.3	68.5	73.6
X^2 (1) =2.514, *p*=.113			

Table 11. Proportion of those who carried/used emergency shelter, stove and food by cluster

		Experts (%) (n150)	Intermediates (%) (n108)	Combined (%) (n258)	χ^2 Significance
Tent	Did not carry	62.0	66.7	64.0	X^2 (2) = .903, *p*=.637
	Carried	12.7	9.3	11.2	
	Used	25.3	24.1	24.8	
Bivouac Bag	Did not carry	70.7	75.0	72.5	X^2 (2) =.592[a], *p*=.744
	Carried	26.0	22.2	24.4	
	Used	3.3	2.8	3.1	
Emergency shelter	Did not carry	65.3	75.9	69.8	X^2 (2) =3.340, *p*=.068
	Carried	34.7	24.1	30.2	
	Used	0	0	0	
Fuel Stove	Did not carry	50.7	63.0	55.8	X^2 (2) =6.161, ***p*=.046**
	Carried	15.3	6.5	11.6	
	Used	34.0	30.6	32.6	
Emergency food	Did not carry	14.0	11.1	12.8	X^2 (2) =1.596[b], *p*=.450
	Carried	80.7	86.1	82.9	
	Used	5.3	2.8	4.3	

Bivouac bag: Test invalid as expected count less than 5. The minimum expected was 3.35 outside 20% rule.
Emergency food: Test valid although minimum count 4.60. This was within 20% rule.

Table 12. Communication and navigation equipment carried and used on snow-based backcountry trips by expert and intermediate clusters

Comms and navigation items		Experts (%) (n150)	Intermediates (%) (n108)	Combined (%) (n258)	χ^2 Significance
	Did not carry	4.0	0.9*a*	2.7	
Mobile phone	Carried	60.0	75.9	66.7	X^2 (2) = 7.963, *p*=.019
	Used	36.0	23.1	30.6	
	Did not carry	80.0	88.9	83.7	
Two-way radio	Carried	13.3	8.3	11.2	X^2 (2) =3.874, *p*=.144
	Used	6.7	2.8	5.0	
	Did not carry	40.0	48.1	43.4	
GPS	Carried	40.7	29.6	36.0	X^2 (2) =3.337, *p*=.188
	Used	19.3	22.2	20.5	
	Did not carry	13.3	23.1	17.4	
Compass	Carried	60.7	56.5	58.9	X^2 (2) =4.496, *p*=.106
	Used	26.0	20.4	23.6	
	Did not carry	15.3	17.6	16.3	
Map	Carried	43.3	50.0	46.1	X^2 (2) =2.133, *p*=.344
	Used	41.3	32.4	37.6	
	Did not carry	42.0	47.2	44.2	
EPIRB/PLB	Carried	56.0	52.8	54.7	X^2 (2) =2.667, *p*=.264
	Used	2.0 *a*	0 *a*	1.2 *a*	

a. Mobile phone not carried and EPIRB/PLB used (33.3%) had expected counts of less than 5. The minimum expected count was 2.93 therefore test was invalid.

Table 13. Avalanche equipment carried and used on snow-based backcountry trip by experts and intermediate clusters

Avalanche items		Experts (%) (n150)	Intermediates (%) (n108)	Combined (%) (n258)	χ^2 Significance
Probe	Did not carry	71.3	72.2	71.7	X^2 (2) = 2.961, *p*=.228
	Carried	26.0	27.8	26.7	
	Used	2.7	0.0*a*	1.6	
Beacon	Did not carry	74.0	76.9	75.2	X^2 (2) =0.599, *p*=.741
	Carried	24.0	20.4	22.5	
	Used	2.0*a*	2.8	2.3*a*	
Shovel	Did not carry	37.3	45.4	40.7	X^2 (2) =9.418, ***p*=.009**
	Carried	42.7	48.1	45.0	
	Used	20.0	6.5	14.3	

a. Probe and beacon used (33.3%) had expected counts of less than 5. The minimum expected count was 1.67 therefore test was invalid.

Table 14. Personal and other equipment carried and used on snow-based backcountry trip by experts and intermediates

Personal and other		Experts (%) (n150)	Intermediates (%) (n108)	Combined (%) (n258)	χ^2 Significance
Waterproof clothing	Did not carry	0.7a	1.9a	1.2a	
	Carried	34.0	36.1	34.9	X^2 (2) = 0.945a, *p*=.623
	Used	65.3	62.0	64.0	
Sunscreen	Did not carry	5.3	8.3	6.6	
	Carried	18.7	17.6	18.2	X^2 (2) =0.928, *p*=.629
	Used	76.0	74.1	75.2	
Sunglasses	Did not carry	6.0	10.2	7.8	
	Carried	18.7	14.8	17.1	X^2 (2) =1.966, *p*=.374
	Used	75.3	75.0	75.2	
Goggles	Did not carry	16.7	24.1	19.8	
	Carried	42.7	28.7	34.1	X^2 (2) =3.382, *p*=.184
	Used	45.3	47.2	46.1	
Helmet	Did not carry	59.3	57.4	58.5	
	Carried	8.0	12.0	9.7	X^2 (2) =1.184, *p*=.553
	Used	32.7	30.6	31.8	
Torch	Did not carry	13.3	25.9	18.6	
	Carried	48.7	42.6	46.1	X^2 (2) =6.611, *p*=.037
	Used	38.0	31.5	35.3	
Repair kits	Did not carry	22.0	50.0	33.7	
	Carried	66.0	44.4	57.0	X^2 (2) =22.522, *p*=.000
	Used	12.0	5.6	9.3	
First aid kit	Did not carry	12.0	21.3	15.9	
	Carried	76.7	70.4	74.0	X^2 (2) =4.312, *p*=.116
	Used	11.3	8.3	10.1	
Water filter	Did not carry	87.3	84.3	86.0	
	Carried	9.3	9.3	9.3	X^2 (2) =1.407, *p*=.495
	Used	3.3	6.5	4.7	

a. Waterproof clothing not carried (33.3%) had expected count of less than 5. The minimum expected count was 1.26 therefore test was invalid.

Table 15. Sources of formal and informal training in snow-based backcountry skills for expert and intermediate clusters

	Experts (%) (*n* = 150)	Intermediates (%) (*n* = 108)	Combined (%) (*n* = 258)	X^2
Sources of formal training				
None of the below	46.7	65.7	54.7	
Avalanche certification	37.3	18.5	29.5	
Other	16.0	10.2	13.6	
Professional certification	7.3	1.9	5.0	X^2 (7) = 32.785, ***p*=.001**
TAFE Certification course	4.7	3.7	4.3	
Diploma Course	2.7	0.9	1.9	
High School subjects	0.7	3.7	1.9	
University course	2.7	0.0	1.6	
Sources of informal training				
Friends	70.7	68.5	69.8	
Self-taught	69.3	43.5	58.5	
Websites/blogs	31.3	37.0	33.7	
Outdoor recreation club	30.7	25.9	28.7	
Family/partner	17.3	29.6	22.5	
Commercial tour groups	19.3	13.9	17.1	X^2 (10) = 35.751, ***p*=.001**
Scout/guide group	11.3	14.8	12.8	
Other	16.7	5.6	12.0	
Social media sites	12.7	8.3	10.9	
School	5.3	5.6	5.4	
None of the above	0.7	1.9	1.2	

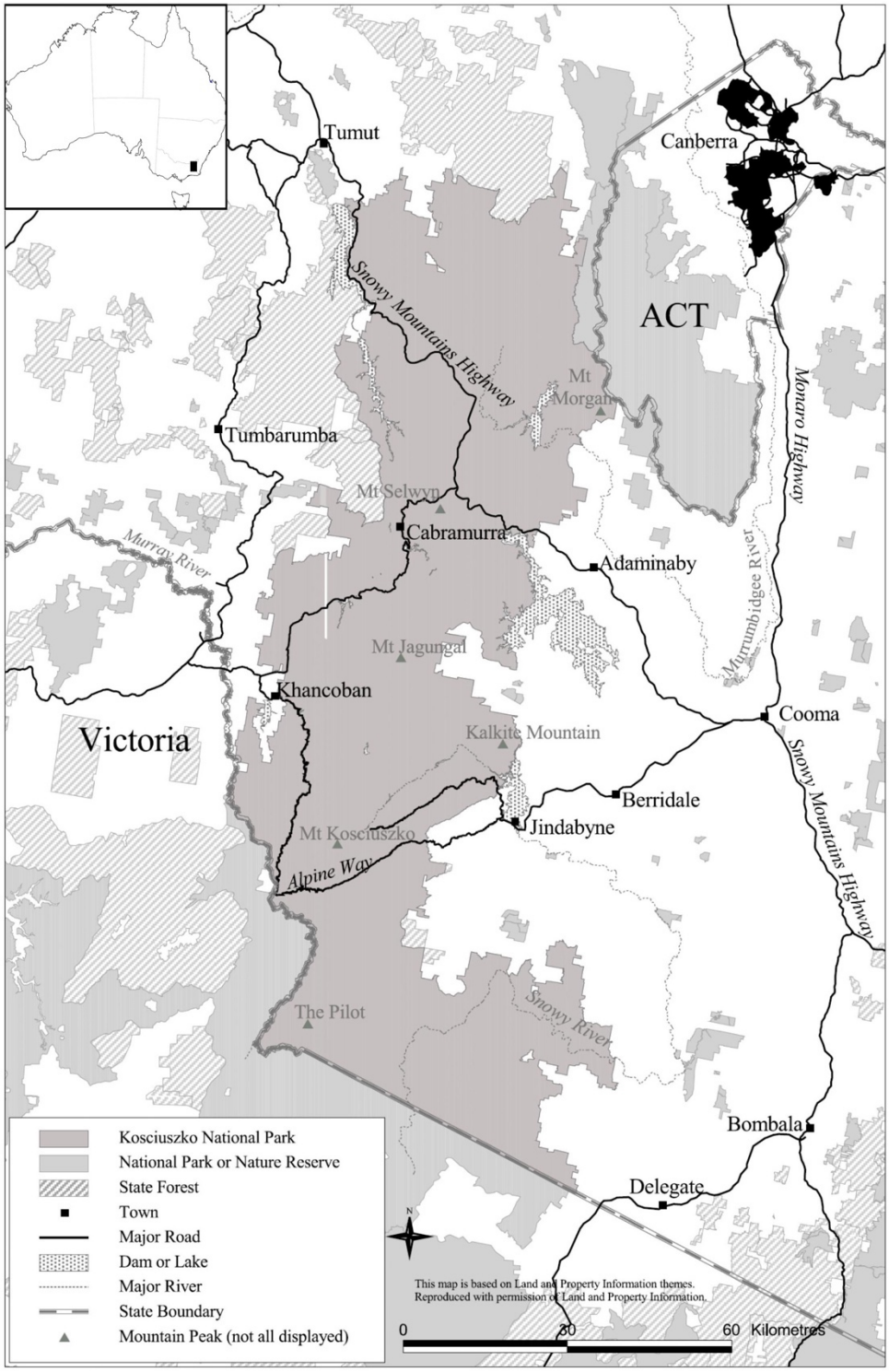

Figure 1. Location of Kosciuszko National Park in south east New South Wales, Australia (adapted from NSW Government Department of Environment and Conservation 2006).