

# The geography of skier adaptation to adverse conditions in the Ontario ski market

Michelle Rutty

Department of Geography & Environmental Management, University of Waterloo

Daniel Scott

Department of Geography & Environmental Management, University of Waterloo

Peter Johnson

Department of Geography & Environmental Management, University of Waterloo

Eric Jover

Observatori de la Sostenibilitat d'Andorra, Sant Julià de Lòria, Andorra

Marc Pons

Observatori de la Sostenibilitat d'Andorra, Sant Julià de Lòria, Andorra

Robert Steiger

MCI Tourism Business Studies, Innsbruck, Austria

## Key Messages

- Spatial patterns of skiers may vary as a result of snow conditions.
- This study examined where and how far skiers in Ontario (Canada) are willing to travel in response to local lack of snow.
- Majority of respondents (59–60%) would travel to five key resorts in Ontario; an additional 11–15% of respondents opted to travel to Quebec or the state of New York.

*Weather and climate directly influence ski season length, the quality of snow conditions, and skier visits. Inter-annual climate variability, which is expected to become more pronounced under future climate change, poses an increased risk for the ski tourism industry. Using a survey (n = 2448), this study examines where and how far skiers in Ontario (Canada) are willing to travel if their ski resort was to temporarily or permanently close due to a lack of snow. The majority of respondents ( $\geq 59\%$ ) would travel to five key resorts in Ontario, with the largest share ( $\geq 27\%$ ) selecting Blue Mountain Resort. An additional 11–15% of respondents would leave Ontario, opting to travel to Quebec or the state of New York. Overall, this paper presents the first empirical evidence on the geographical patterns skiers may engage in as a result of marginal snow conditions, in addition to providing information on travel distance and time thresholds. This research is fundamental for assessing contemporary climate risk and can inform how future climate change could alter demand patterns in regional ski marketplaces. Future research needs are identified to further appraise the consequences and future viability of individual ski resorts in Ontario and the ski industry more generally.*

Keywords: climate variability, climate change, ski tourism, adaptation, substitution

Correspondence to/Adresse de correspondance: Michelle Rutty, Department of Geography & Environmental Management, University of Waterloo, 200 University Avenue West, Waterloo, ON N2L 3G1. Email/Courriel: mkrutty@uwaterloo.ca

## La géographie de l'adaptation des skieurs aux conditions défavorables sur le marché du ski de l'Ontario

*Les phénomènes météorologiques et climatiques exercent une influence majeure sur la durée de la saison de ski, la qualité des conditions de neige et la fréquentation par les skieurs. La variabilité climatique interannuelle, que l'on prévoit être plus marquée suite aux changements climatiques dans les prochaines années, présente un risque accru pour l'industrie touristique du ski. Une enquête (n = 2448) a été menée dans le cadre de cette étude afin d'explorer où et jusqu'où les skieurs de l'Ontario (Canada) étaient prêts à se déplacer si leur station de ski devait cesser ses activités de façon temporaire ou permanente en raison d'un manque de neige. La majorité des répondants (≥59%) se rendraient à cinq des plus importantes stations ontariennes, et la plupart d'entre eux (≥27%) privilégieraient la station Blue Mountain. Quelques 11 à 15% des répondants quitteraient l'Ontario et se déplaceraient vers le Québec ou l'état de New York. Dans l'ensemble, cet article établit pour la première fois les tendances géographiques des choix d'alternatives des skieurs qui doivent composer avec de mauvaises conditions de neige, en plus de fournir des informations sur la valeur des seuils de distance et de temps de déplacement. Cette recherche a réalisé une évaluation du risque climatique actuel et apporte un éclairage sur l'ampleur des changements climatiques futurs et de leur incidence sur les tendances de la demande dans les marchés de ski régionaux. À l'avenir, il faudra mener des recherches afin de réaliser des évaluations plus poussées sur les effets que ces changements entraîneront sur chacune des stations de ski de l'Ontario et leur pérennité et, de manière plus générale, sur l'industrie du ski.*

Mots clés : variabilité climatique, changements climatiques, tourisme du ski, adaptation, substitution

### Introduction

The growth of tourism has been virtually continuous over the past 60 years (UNWTO 2013). Tourism has become one of the largest global economic sectors, contributing significantly to national and local economies (Coles and Hall 2008). In Canada, international tourism demand generated \$81.9 billion in 2012. Together with an additional \$66.4 billion generated through domestic tourism (CTC 2012), this accounts for 1.8% of the nation's GDP (CTC 2012). An important sub-market of the Canadian tourism sector is the alpine ski and snowboard industry. The Canadian ski industry receives 19 million visitors per season (December–April), over 16 million of which are domestic visitors (CSC 2014). In 2009, ski tourism in Canada generated operating revenues of \$923 million (CSC 2009). The largest share of visits occur in the provinces of Quebec (34%) and British Columbia (32%), followed by Ontario ski resorts, which receive 18% of the national skier market (CSC 2014). More specifically, the Ontario ski market hosts over 3 million annual skier visits, generating an estimated \$228 million in total revenues during the 2011–12 season (OSRA 2012). Ontario also has the largest market of active alpine skiers in Canada, with 1.9 million participants (CSC 2014).

A fundamental resource that influences both the supply and demand of winter sports tourism is weather and climate. Due to its reliance on specific climatic conditions for both natural snow and snowmaking, temperatures below freezing are a prerequisite for ski operations and related recreation and tourism. The impact of inter-annual climate variability on ski season length, the quality of conditions, and skier visits, is evidence of this climatic dependency. In Canada, during the marginal snow season of 2001–02, declines in average season length and visitation occurred in both the Ontario and Quebec ski market (7% and 15%, respectively), compared with a climatically normal winter (1961–90) (Scott 2006; Scott et al. 2012). More recently, the warm winter conditions of 2011–12 decreased skier visits in Ontario by 10% compared to the previous season due to the delayed start of the ski season, followed by an early end to the season (OSRA 2012). Similar climatic impacts have been observed in seasonal markets in the United States (US) (e.g., Dawson et al. 2009).

Inter-annual climate variability is expected to become more pronounced under future climate change (IPCC 2013), thereby posing an increased risk for the ski tourism industry. A few consecutive warm winters could not only cause substantive economic losses for the regional ski market in

Ontario, but the losses may be greater than what smaller operations are able to absorb (Scott et al. 2012). The supply-side vulnerability of the ski industry to climate change has been widely studied in the tourism literature, with results from every regional market assessment (Alps, Australasia, North America, Eastern and Western Europe, Japan) indicating shorter and more variable ski seasons, increased snowmaking requirements, and a contraction in the number of operating ski areas (Scott et al. 2003, 2006, 2007, 2008; Abegg et al. 2007; Hamilton et al. 2007; Hennessy et al. 2008; Dawson et al. 2009; Dawson and Scott 2013; Steiger 2010, 2011; Hendrikx et al. 2013; Steiger and Stötter 2013; Pons et al. 2014). These regional comparisons, whereby the climatic suitability of resorts is evaluated relative to one another, have offered insight into possible “winners” and “losers” at the destination and community scale. As such, the relative vulnerability of a ski resort is spatially contingent, with the concept of scale vitally important to such vulnerability assessments (Hopkins et al. 2013).

To better evaluate the relative vulnerability of regional ski markets, it is imperative to understand the perceived attractiveness of various ski resorts relative to their competitors. In other words, we need to understand how demand will respond to supply-side variability and contraction. To date, very little is known with respect to how skiers respond to climatic variability, poor snow conditions, and ski resort closures (Scott and McBoyle 2007; Scott et al. 2008, 2012; Shih et al. 2009; Pickering et al. 2010; Dawson et al. 2011, 2013; Putz et al. 2011; Steiger and Abegg 2013; Hopkins 2014; Pons et al. 2014; Rutty and Andrey 2014; Rutty et al. 2015). The objective of this article is to critically explore the geography of demand-side spatial

substitution in the Ontario ski industry. Specifically, where and how far will skiers travel to if their preferred resort is closed due to marginal snow conditions? This question is explored in the context of the Ontario ski market to better understand how far individuals would be willing to travel to participate. This research is fundamental for assessing contemporary climate risk and can inform how future climate change could alter demand patterns in regional ski tourism marketplaces; adaptation that will be a decisive factor in the vulnerability of ski tourism destinations (Scott and McBoyle 2007; Scott et al. 2012; Dawson et al. 2013; Hendrikx et al. 2013; Steiger and Abegg 2013; Pons et al. 2014; Rutty et al. 2015).

### Skier substitution

Skiers can engage in three types of substitution if they are no longer able to ski at their preferred resort due to marginal snow conditions: (1) spatial substitution (i.e., travel to a different ski resort), (2) temporal substitution (i.e., ski at a different time), and (3) activity substitution (i.e., stop skiing and participate in another leisure activity) (Iso-Ahola 1986). A limited number of studies have examined how skiers may respond to future climatic conditions, with the results indicating that the majority would significantly adapt their skiing behaviour (Table 1). For example, König (1998) found that 31% of Australian skiers would ski less often if their region experienced “very little natural snow in the next five years” (cited in Scott et al. 2012, 327) with 38% willing to travel outside of their region and 6% indicating they would stop skiing altogether. In a follow-up survey, Pickering et al. (2010) found an increase in the proportion of Australian skiers

**Table 1**  
Behavioural substitution of skiers due to climatic conditions (percentage of respondents)

Sample Region	Temporal (Ski less)	Spatial (Ski elsewhere)	Activity (Stop skiing)	Source
Australia	31	38	6	König (1998)
Australia	69	16	5	Pickering et al. (2010)
Switzerland	11	49	4	Behringer et al. (2000)
Austria	–	68	25	Unbehaun et al. (2008)
USA (Northeast)	34	39 <sup>a</sup>	–	Dawson et al. (2013)
Canada (Ontario)	31–36	48–61	0–3	Rutty et al. (2015)

<sup>a</sup>39% elsewhere in the Northeast and 39% outside the Northeast.

that would alter their ski participation behaviour, with 69% indicating they would ski less, 16% would ski outside of their region, and 5% would stop skiing. Asking the same questions of Swiss skiers, Behringer et al. found 49% would ski at a different resort if “the next five winters would be snow deficient” (2000, 336) 11% would ski at the same location but less often, and 4% would stop skiing. Unbehaun et al. found 68% of Austrian skiers would travel farther to a snow-reliable destination if there were “several consecutive years of snow deficiency” (2008, 40) and 25% would stop skiing. A notable limitation of these studies is the use of descriptive scenarios of future ski seasons and snow conditions, which may be interpreted differently by survey respondents. As outlined by Scott et al. (2012), does “snow deficient” or “little snow” mean the ski resort is only partially open (e.g., a portion of the trails or a portion of the season), that the resort is entirely open but with poor conditions and heavy reliance on snowmaking, or perhaps the ski season was shortened, but was fully operational during that reduced season? Depending on the respondents’ interpretation of these descriptive scenarios, their behavioural response may vary substantially. Moreover, the types of substitution (i.e., spatial, temporal, activity) are presented as mutually exclusive within these early surveys (i.e., respondents can only select one “most frequent” behavioural substitution), when in reality, skiers may engage in multiple substitution options. For example, a respondent may opt to ski less often (temporal substitution) and to also ski somewhere else (spatial substitution), and this decision may vary depending on the scenario/snow conditions.

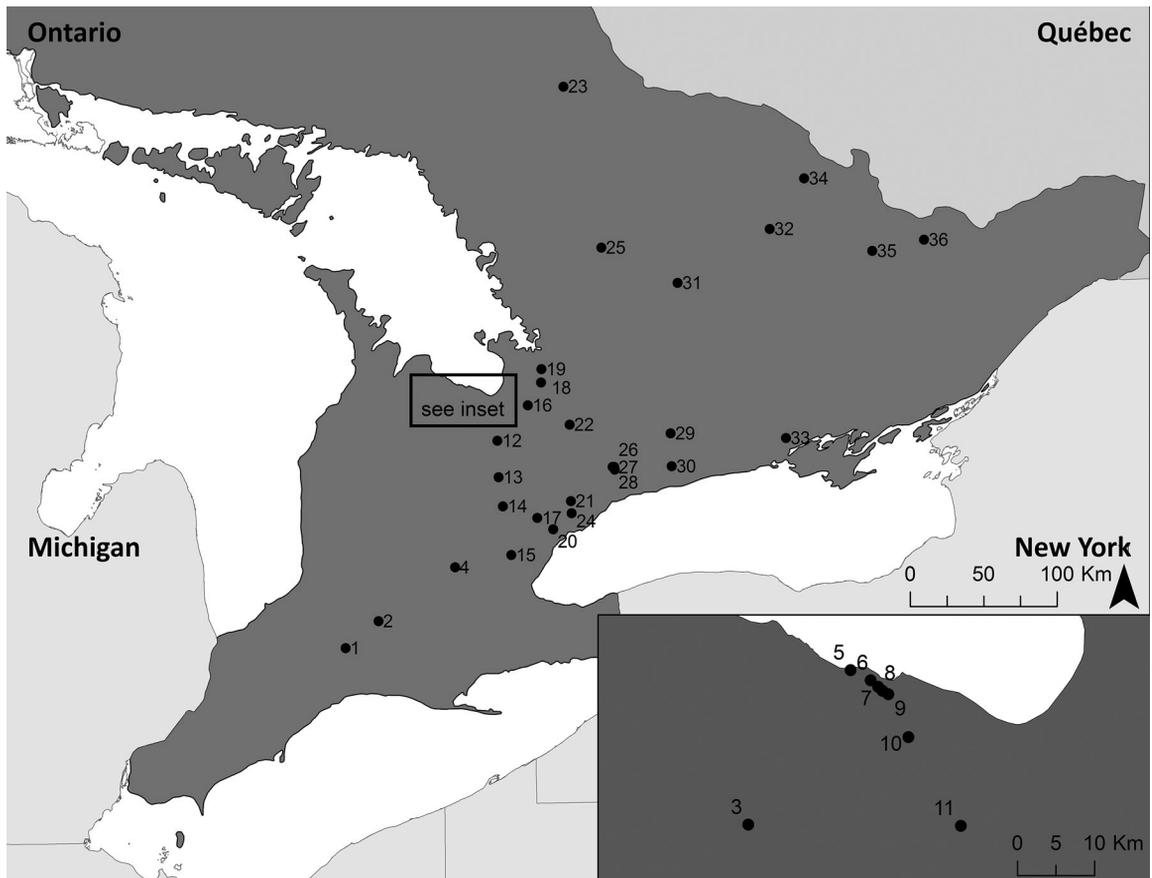
To overcome these limitations, Dawson et al. (2013) asked skiers in the US Northeast to reflect on how they responded to marginal snow conditions in the past and asked how they might react if similar marginal conditions occurred in the future. The results show that 39% of respondents would travel to another resort in the Northeast and 39% would travel outside the Northeast region, while 34% would ski less often. Rutty et al. (2015) asked Canadian skiers in Ontario what they would do if their preferred ski resort was “closed until mid-season due to marginal snow conditions” and found that 48% of skiers would travel to another resort, 31% would ski less and none of the respondents indicated they would stop skiing. The survey also asked what skiers would do if their resort

was to “close permanently due to marginal snow conditions,” with 61% indicating they would travel to another resort, 36% would ski less, and 3% would stop skiing altogether.

In all of the demand-side studies, except Pickering et al. (2010), the results indicate that the largest share of skiers will engage in spatial substitution (38–68%) in future seasons with marginal snow conditions versus temporal (11–36%) or activity substitution (0–25%). However, these studies do not provide any insight into where and how far skiers are willing to travel in order to continue participating in the sport. In Behringer et al. (2000), it is ambiguous whether skiers would stay within their current region (i.e., Central Switzerland) or travel more broadly (e.g., Austria). In König (1998) and Pickering et al. (2010), respondents indicated they would ski outside of their region, but it is unclear how far outside of their current region they are willing to go and the distances they are willing to travel to continue skiing. Dawson et al. (2013) provides some insight, differentiating those skiers that are willing to travel within and outside of the Northeast US ski region, but it is unclear what resorts skiers would switch to. Similarly, Unbehaun et al. (2008) indicated that the majority (50%) of Austrian skiers would travel an additional two hours to ski at a snow reliable destination. To better understand the vulnerability of regional ski resorts relative to one another, identifying where snow resort(s) skiers would plan to go is a prerequisite. It is important to identify the perceived attractiveness of various resorts to skiers, relative to their competitors. This will provide insight into which resorts (and nearby communities) may be possible “winners” and “losers” as a result of climatic variability and change. It will also provide insight into the implications for system capacity and crowding or declining demand if available ski areas are beyond the spatial substitution limits deemed acceptable to most skiers. Collectively, this provides new insight into the geography of climatic adaptation of ski tourists.

#### Study area and methods

There are 63 operating ski resorts in Ontario, which represent 23% of the national total (CSC 2014). Of these resorts, 44 are alpine (i.e., downhill), with 36 located in Southern Ontario (Figure 1). Ten resorts were selected to be representative of the Ontario



**Figure 1**

Map of Southern Ontario ski resorts ( $n=36$ ). Key: 1-Boler Mountain, 2-Cobble Hills, 3-Beaver Valley, 4-Chicopee, 5-Georgian Peaks Club, 6-Alpine Ski Club, 7-Craigleith, 8-Toronto Ski Club, 9-Blue Mountain Resort, 10-Osler Bluff Ski Club, 11-Devil's Glen Country Club, 12-Mansfield Ski Club, 13-Hockley Valley, 14-Caledon Ski Club, 15-Glen Eden, 16-Snow Valley, 17-Mount Chinguacousy, 18-Horseshoe, 19-Mount St. Louis Moonstone, 20-Centennial Park, 21-Uplands Ski Club, 22-Georgina ROC, 23-Laurentian Ski Hill, 24-Earl Bales, 25-Hidden Valley Highlands, 26-Skyloft, 27-Lakeridge, 28-Dagmar, 29-Devil's Elbow, 30-Brimacombe, 31-Sir Sam's, 32-Madawaska Mountain, 33-Batawa Ski Hill, 34-Pembroke Ski and Snowboard Club, 35-Calabogie, 36-Mount Pakenham.

alpine ski market based on geographic location and proximity to major urban markets: Blue Mountain Resort (BMR), Brimacombe, Calabogie, Chicopee, Craigleith, Glen Eden, Lakeridge, Mount Saint Louis Moonstone (MSLM), Sir Sam's, and Snow Valley. These are both important factors for this study area, as the majority (78%) of Canadian skiers live in large cities with populations greater than 100,000 (CSC 2014), but also because the majority (85%) of Ontario ski areas (and subsequently total share of provincial skiers) are concentrated in Southern Ontario. Another important consideration was the size of the resort, which plays an important role in

season length, as smaller resorts often have less investment in snowmaking equipment with management decisions that differ from those of larger ski areas or ski resort conglomerates (Scott et al. 2008; Dawson et al. 2009; Dawson and Scott 2010, 2013). Given that the topography of ski resorts across Southern Ontario does not vary greatly, the vertical drop was not an important consideration when selecting resorts to participate.

BMR and MSLM are classified as large ski resorts in the region, with a large number of groomed ski trails ( $\geq 40$ ) and skiable acres ( $\geq 170$  acres), as well as a large uphill capacity ( $\geq 12$  chairlifts and t-bars) and

substantial investment in snowmaking. Craigleith is a private ski resort, with high membership costs (e.g., CAD\$25,000 for a single membership) and annual dues to ski on-site. The remaining resorts are classified as small, with Brimacombe, Chicopee, Glen Eden, Lakeridge, and Snow Valley representative of urban feeder resorts (i.e., small ski resorts close to urban centres). Calabogie and Sir Sam's are also considered small resorts, but they are further away from urban centres, with the former located close to the Quebec border and the latter surrounded by rural communities.

A self-administered survey, which received research ethics clearance at the University of Waterloo (Canada) and was pretested in December 2013, was distributed to skiers at the 10 selected ski resorts throughout February and March (2014). These are key months for the Ontario market, as January and February account for more than two-thirds of annual skier visits (62–72%) and March accounts for an additional 10–15% (OSRA 2012). The surveys were delivered electronically on tablets while skiers were inside resort chalets and cafeterias. A total of 2448 surveys were filled out, with 19 considered invalid/incomplete and not used in the analysis. The final sample was 2429, with 1,491 (61%) collected at seven small-sized resorts (as classified by the Ontario Snow Resorts Association [OSRA]), 790 (33%) at two large-sized resorts, and 148 (6%) at one private ski resort. The overall response rate was approximately 60–65% at the 10 resorts.

Building on Rutty et al. (2015), which examined skiers' behavioural adaptation to marginal snow conditions (i.e., temporal, spatial, or activity substitution), this study examines where skiers would go if their resort were to close (temporarily or permanently) and how far they are willing to travel (distance and time). Specifically, the survey asked respondents how they would respond if their in-situ resort was closed today, closed until mid-season (i.e., mid-January), or closed permanently due to a lack of snow. Those respondents that indicated they would travel elsewhere to ski, i.e., spatial substitution, were provided a list of the 36 alpine resorts in Southern Ontario (Figure 1), plus the option to select a ski area in the neighbouring province of Quebec or the US states of Michigan and New York. The respondents were also asked to state the maximum number of hours (round-trip) they are willing to travel for a ski trip. In addition, travel distance was calculated based on respondents' home location

(first three digits of postal code) and the location of their preferred resort by using ArcGIS Geographic Information System (GIS) software. A network analysis was conducted using the Ontario road network to calculate not only the distance, but approximate driving time from origin to destination for each respondent. This analysis took into account the varying speed limit of roads/highways, and should be considered to represent a best case travel time, free from traffic or weather-related delays. One-way analysis of variance (ANOVA) was used to determine whether there were any significant differences between the travel distance patterns and skier market segments (e.g., age, skill level, ski frequency, resort type) at the significance level of 0.05.

It is important to note that the survey focused on current weather variability rather than projected climate change scenarios. This is an approach that has been advocated in the tourism literature as some tourists may have a negative emotional connection to the issue of climate change and associate it with threat scenarios or pessimism, which may bias responses (e.g., Saarinen and Tervo 2010; Tervo-Kankare 2011; Trawöger 2014). In so doing, this study also limits interpretation errors that may result from providing respondents with descriptive future climate scenarios because depending on how a respondent perceives a scenario, their (behavioural) response could be very different (Scott et al. 2012; Dawson et al. 2013).

## Results

When respondents were asked where they would go if their in-situ ski resort was closed today due to poor snow conditions, almost two-thirds (60%) indicated they would go to one of five key Ontario resorts (Table 2). The largest share of respondents (27%) indicated that they would travel to BMR, which includes almost half of the respondents from Craigleith (49%) and MSLM (47%). More than one-third of the respondents from Chicopee and Snow Valley also stated that they would travel to BMR if their resort was not open today. MSLM ranked second, with 14% of the total sample indicating they would travel to this resort. A significant number of respondents (11%) stated that they would leave Ontario and travel to Quebec to go skiing, including more than half of the respondents (69%) from Calabogie. Between 6% and 9% of skiers would travel

**Table 2**

 Top resorts ( $\geq 5\%$ ) respondents would travel to if their in-situ resort was closed today (percent of respondents)

Resort Substitution		Survey Sample										
Rank		BMR	Brimacombe	Calabogie	Chicopee	Craigleith	Glen Eden	Lakeridge	MSLM	Sir Sam's	Snow Valley	Total Sample
1	BMR	N/A	23	0	39	49	29	10	47	11	34	27
2	MSLM	27	6	3	1	11	17	3	N/A	13	18	14
3	Quebec	9	0	69	0	16	2	7	1	6	2	11
4	Horseshoe	11	6	0	4	0	8	3	21	15	18	9
5	Dagmar	0	25	0	1	0	2	52	1	11	4	8
6	Glen Eden	6	0	0	29	0	N/A	0	4	0	4	6

to Horseshoe Valley, Dagmar or Glen Eden, with more than half of the respondents (52%) from Lakeridge stating they would travel to Dagmar and nearly one-third of respondents (29%) from Chicopee stating they would travel to Glen Eden. The remaining survey respondents (29%) were spread across the other 31 alpine resorts in Southern Ontario ( $\leq 4\%$  per resort), with no skiers indicating they would travel to a resort in the state of Michigan if their in-situ resort was closed today.

When respondents were asked where they would go if their in-situ resort was closed until mid-season, the results were similar, with almost two-thirds (59%) indicating that they would go to the same five key Ontario resorts (BMR, MSLM, Horseshoe Valley, Glen Eden, Dagmar) (Table 3). Slightly more respondents (28%) indicated they would travel to BMR, with more respondents from Calabogie, Lakeridge, Sir Sam's, and Snow Valley stating they would travel to BMR if their resort was closed. Conversely, slightly

fewer skiers would travel to MSLM (11%), with fewer respondents from BMR, Calabogie, Craigleith, Glen Eden, and Sir Sam's opting to travel to MSLM. Instead, more respondents stated they would travel outside of the province to go skiing, with 15% indicating they would travel to Quebec and 8% would travel to the state of New York. Skiers from BMR are particularly more likely to travel outside of the province when comparing ski closures today versus mid-season, with a doubling of skiers from BMR to Quebec and to the state of New York (increasing from 9% and 7% to 18% and 13%, respectively). Once again, the majority of skiers (71%) from Calabogie would travel to Quebec. The same number of respondents indicated they would travel to Horseshoe Valley (9%) or Glen Eden (6%), while slightly fewer said they would travel to Dagmar (5%). The remaining respondents (18%) were spread across the other 31 alpine resorts in Ontario ( $\leq 4\%$  per resort), with 1% stating they would

**Table 3**

 Top resorts ( $\geq 5\%$ ) respondents would travel to if their in-situ resort was closed until mid-season (percent of respondents)

Resort Substitution		Survey Sample										
Rank		BMR	Brimacombe	Calabogie	Chicopee	Craigleith	Glen Eden	Lakeridge	MSLM	Sir Sam's	Snow Valley	Total Sample
1	BMR	N/A	21	3	37	46	27	16	39	33	35	28
2	Quebec	18	9	71	6	19	1	3	7	10	4	15
3	MSLM	18	11	2	4	6	16	5	N/A	9	18	11
4	Horseshoe	11	3	1	2	0	7	6	20	10	17	9
5	New York	13	2	4	12	2	11	1	7	3	3	8
6	Glen Eden	5	0	0	26	2	N/A	0	5	0	2	6
7	Dagmar	1	15	0	0	0	1	41	1	1	3	5

travel outside of the province to the state of Michigan if their in-situ resort was closed until mid-season.

When skiers were asked where they would travel to if their in-situ resort closed permanently due to poor snow conditions, nearly two-thirds (60%) would travel to the same five key Ontario resorts, 17% would travel outside of the province, and the remaining 23% would travel to the other 31 resorts across Southern Ontario ( $\leq 3\%$  per resort) (Table 4). Once again, BMR ranked first as the most likely resort skiers would travel to if their resort was to close (28%), with more than one-third of respondents from Chicopee (40%), Craigeleith (35%), Glen Eden (40%), and MSLM (44%) selecting BMR. Although Quebec ranked second, skiers were less likely to travel outside of the province if their current resort was to close permanently versus closed until mid-season, with both Quebec and New York down from 15% and 8% to 10% and 5%, respectively.

The distance between respondents' home location and their preferred ski resort was also calculated. For all three closure scenarios (today, mid-season, permanently), travel distance was almost identical at 94km, 99km and 99km, respectively. Therefore, regardless of whether respondents' in-situ resort was to close temporarily or permanently, skiers' willingness to travel scarcely varies. For all three scenarios, there were no statistically significant differences ( $p > 0.05$ ) between travel distances and age, skill level (i.e., beginner, intermediate, expert), ski frequency (i.e., infrequent, occasional, core), or between families with children taking lessons versus not taking lessons. However,

statistically significant differences were recorded based on survey location for permanent closure ( $p = 0.00$ ). Respondents from Sir Sam's were more likely to travel further distances to go skiing if their resort was to close permanently (an average of 109km one-way), along with respondents from Glen Eden (109km one-way), Chicopee (108 km one-way), and BMR (106 km one-way).

To explore whether trip type influences travel behaviour, respondents were also asked how far they would be willing to travel to go on a day trip, weekend trip (i.e., one or two overnight stays), or a ski holiday (i.e., three or more overnight stays) (Table 5). For a day trip, the majority (53%) of respondents indicated they would be willing to travel up to two hours one-way to go skiing (four hours round-trip), with an additional 22% stating they would travel one hour one-way and 18% three hours one-way. The results also show that skiers are willing to travel further distances for a weekend trip, with more than half (60%) of respondents indicating that they are willing to travel between three to four hours one-way to go skiing (six to eight hours round-trip). Relatedly, respondents were willing to travel the furthest for a ski holiday, with the majority of respondents (62%) stating they would travel six or more hours (12+ hours round-trip) to go skiing.

## Discussion

The findings from this study underscore that if skiers' in-situ resort were to close temporarily or permanently due to marginal snow conditions, a select few resorts in Ontario are likely to have the

**Table 4**

Top resorts ( $\geq 5\%$ ) respondents would travel to if their in-situ resort was closed permanently (percent of respondents)

Resort Substitution		Survey Sample										
Rank		BMR	Brimacombe	Calabogie	Chicopee	Craigeleith	Glen Eden	Lakeridge	MSLM	Sir Sam	Snow Valley	Total Sample
1	BMR	N/A	14	2	40	35	40	16	44	20	31	28
2	Quebec	16	6	68	0	16	3	6	2	9	2	12
3	MSLM	17	6	2	3	5	10	5	N/A	14	17	10
4	Horseshoe	14	4	1	3	0	7	8	21	6	28	10
5	Glen Eden	4	0	0	29	1	N/A	1	4	1	2	6
6	Dagmar	2	21	0	0	1	2	33	2	6	3	6
7	New York	10	1	5	8	4	5	0	5	3	1	5

**Table 5**

Maximum hours (one-way) willing to travel for a ski trip (percent of respondents)

	Day Trip	Weekend Trip	Ski Holiday
1 hour	22	3	2
2 hours	53	18	3
3 hours	18	37	10
4 hours	4	23	11
5 hours	1	1	12
6+ hours	2	18	62
Total	100	100	100

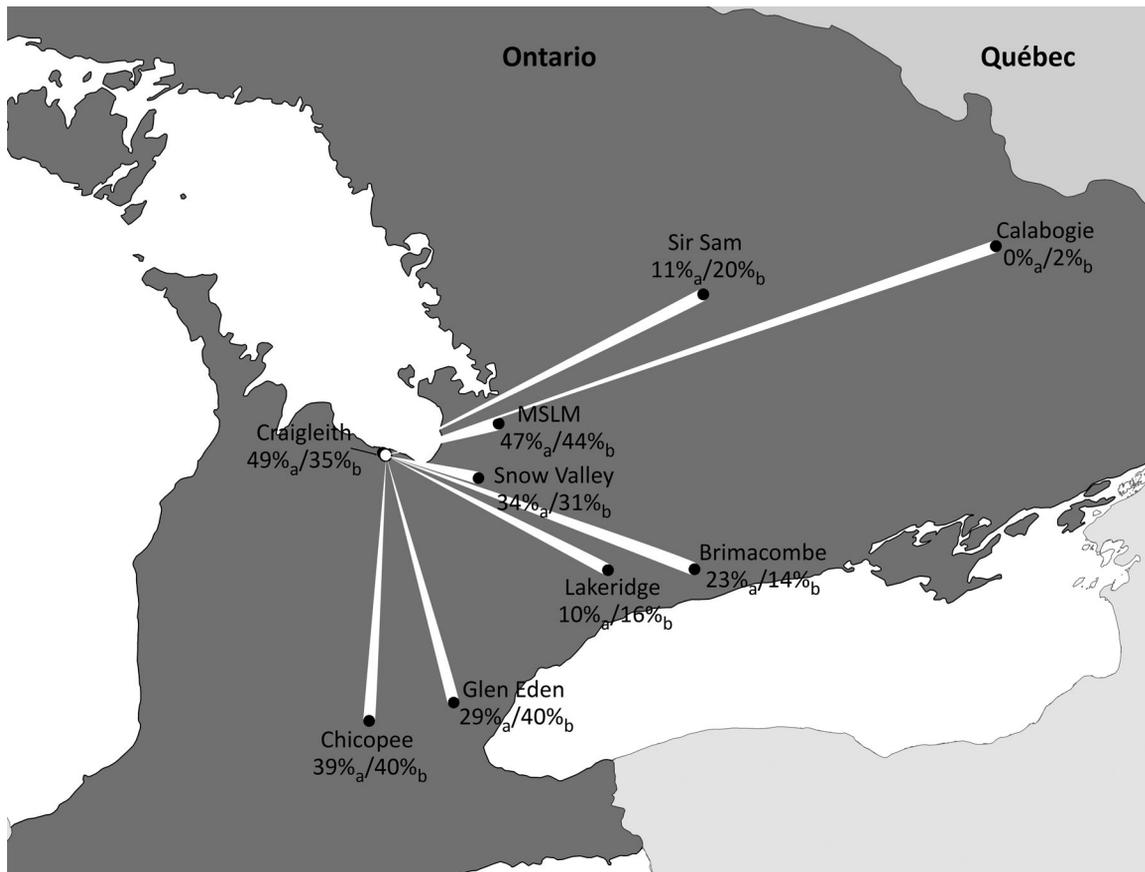
opportunity to take advantage of increased visitation (market share). The results indicate that the majority (59–60%) would travel to just five of the 36 available alpine resorts in Southern Ontario, including BMR, MSLM, Horseshoe Valley, Glen Eden and Dagmar. Importantly, the findings show that BMR would be the clear ‘winner’ in terms of increased market share, perhaps because of its reputation for advanced snowmaking and ski village tourism environment. As shown in Figure 2, five of the resorts selected BMR as their top choice if their in-situ resort were closed today, including Craigleith (49%), MSLM (47%), Chicopee (39%), Snow Valley (34%), and Glen Eden (29%). This market share would increase further if other resorts experienced a delayed start to the ski season and were closed until mid-season. In this scenario, seven of the resorts selected BMR as their top choice, including Craigleith (46%), MSLM (39%), Chicopee (37%), Snow Valley (35%), Sir Sam’s (33%), Glen Eden (27%), and Brimacombe (21%).

Figure 2 similarly illustrates the large increase in market share BMR would receive if other resorts in Southern Ontario were to close permanently. The high prevalence of spatial substitution towards BMR raises an important concern. If the stated proportion of skiers begins to concentrate at BMR when adverse conditions occur, visitor experience may be negatively impacted through increased crowding and congestion. Development pressures associated with the clustering of skiers to one resort could result in overcrowded slopes, lift line jams, limited space in ski chalets, as well as insufficient parking and other services. This would require sufficient adaptation measures, including ski terrain expansion (i.e., more skiable trails and acres) and infrastructure investments such as transportation

infrastructure (e.g., increasing parking spaces and widening roadways) and improved lift capacity (e.g., building new lifts and/or increasing existing chair speeds and sizes) to ameliorate the increase in skier visits.

The findings from this research also show that there is a risk of lost regional market share, as many skiers spatially substitute their Ontario resort for a resort outside of the region. At Calabogie, 68–71% of skiers would leave Ontario and travel to Quebec. This is understandable given the close proximity of this resort to the Quebec border (Figure 1). However, a large share of skiers from BMR and Craigleith would also travel to Quebec to go skiing if conditions were marginal in Ontario (9–19%), particularly if there was a delay to the ski season until mid-January (18% and 19%, respectively). The state of New York was also selected by many respondents, particularly if the season was delayed in Ontario (8%). Travel outside of the province can be considered a worst-case scenario for the Ontario ski industry, as the lost market share would hinder the viability of the industry through lost skier visits and associated declines in revenues. However, it is also possible that Ontario may gain skiers from Quebec and New York if skiers in these surrounding regional markets experienced marginal snow conditions and similarly substituted their resort for an Ontario resort.

Respondents indicated that for a day trip skiing, the majority (75%) would travel two or less hours (one-way) to a ski resort, which is consistent with the findings of Unbehaun et al. (2008). Based on calculated distances between skiers’ residential location and their selected resorts, skiers are willing to drive an average of 94–99km. These two findings corroborate each other, suggesting that this ski sample has a strong awareness of resort locations and distances across the province. While there were no statistically significant differences between travel distance preferences and market segments ( $p > 0.05$ ), there were differences recorded based on sample location. Respondents at BMR and Sir Sam’s were both more willing to travel greater distances to go skiing if their in-situ resort were to close permanently compared to respondents at small urban resorts, such as Chicopee and Glen Eden. The location of Sir Sam’s (Figure 1) is relatively isolated from other resorts in Southern Ontario, thereby leaving fewer surrounding options, requiring greater driving distances. Glen Eden and Chicopee can be



**Figure 2**  
Travel to Blue Mountain Resort if surrounding resorts were to close today (a) and permanently (b).

considered feeder resorts, with limited facilities (e.g., no onsite accommodation, fewer trails and chairlifts), but with close proximity to large urban centres (e.g., Kitchener, Milton, Toronto). Perhaps respondents at these more urban resorts understand that if their resort were to close as a result of marginal snow conditions, they would need to travel further distances north to continue skiing (e.g., to BMR). With the exception of Calabogie, respondents at BMR had travelled the farthest to go skiing (an average of 140km one-way) and were the most willing to leave Ontario to continue skiing (Table 4). This indicates that these respondents are already amenable and committed to travelling longer distances to participate in the sport. This willingness to travel also supports the findings of Rutty et al.

(2015) that skiers at large resorts (e.g., BMR) are statistically more likely to engage in spatial substitution compared to skiers at small resorts (e.g., Chicopee, Glen Eden) if their resort was to close permanently. Moreover, BMR is the largest resort in Ontario, with onsite accommodations, restaurants, and a wide range of non-ski activities (e.g., spa, swimming, shopping, skating), thereby lending itself to a weekend trip versus a day trip to the smaller urban resorts. This corresponds to the finding that skiers are willing to travel further distances (or for a longer time) for a weekend trip or ski holiday (Table 5), which supports the findings of Vivian (2011). It is possible that BMR respondents may have been engaged in a multi-day ski trip at the time of the survey, with additional research needed

to further explore the relationship between behavioural substitution and trip length in days.

The evidence presented here shows that ski resort closures due to marginal snow conditions, whether temporary or permanent, will lead to increased reliance on larger resorts (e.g., BMR) or on resorts outside of Ontario (e.g., Quebec and the state of New York). This geographic pattern of substitution may have important implications regarding greenhouse gas (GHG) emissions for travel behaviour if skiers cumulatively travel greater distances to continue participating in the sport, particularly if they substitute nearby ski resorts in the Ontario market for long distance trips to other regional markets like the Rocky Mountains. Transportation is the major source of anthropogenic carbon dioxide emissions for tourism (Scott et al. 2008) and hence directly linked to the climatic changes that will negatively impact the ability for ski resorts to remain open and operable. As such, a paradox lies in the environmental implications of such travel; the release of climate altering GHG via vehicle travel contributes to climate change and thereby the deterioration or closure of the destination being visited (Dawson et al. 2010). This positive feedback will perpetuate the very need to engage in spatial substitution.

#### Future research and conclusions

This article presents the first empirical evidence on the geographical patterns skiers may engage in as a result of marginal snow conditions, in addition to providing information on travel distance and time thresholds. As evidenced, five key resorts are projected to be “winners” as a result of ski resort closures, with increased market share, particularly at BMR. While an increase in market share would bring added revenue for the resort and surrounding communities, the concentration of skiers around a select few resorts also raises concerns for capacity and development pressures, as well as attendant community impacts. Specifically, overcrowded facilities could deter skiers and subsequently impact opportunities to harness an increase in skier visits. Skiers may be unwilling to endure long queues at ski lifts, in the parking lots, or inside the chalets and may choose to no longer ski at that resort or perhaps opt not to ski at all if suitable alternate ski areas are unavailable. While the literature has focused on snow availability to define relative vulnerability (i.e., supply-side assessments), skiers’ subjective

perceptions and experiences remain poorly understood (Gössling et al. 2012; Scott et al. 2012; Dawson et al. 2013). It is unclear how skiers will respond to increased congestion as a result of supply-side contraction and whether or not large resorts such as BMR can cope with an increase in skier visits in the longer term. This is an important consideration that warrants future research if we are to further our understanding of demand-side vulnerability.

The impact of vehicular use for ski tourism is another important area for future inquiry. The results suggest that skiers may drive greater distances to go skiing both within (e.g., BMR) and outside of Ontario (e.g., Quebec, New York State). This would necessitate an increase in vehicle use and thereby fuel consumption and associated emissions. As such, it would initiate a positive feedback loop, furthering the negative impacts of climatic variability and change on the ski industry. The impact of road transport-related tourism is a largely neglected area of tourism research, yet it remains a primary planning problem for natural environments, including ski resort communities (Hall and Page 2006; Martin-Cejas et al. 2010; Ruttly et al. 2014). Energy audits for tourism vehicle fleets have yet to be inventoried or analyzed, but necessitate an important way forward to generate quantitative information on tourism’s contribution to GHG emissions and how skiers’ carbon footprints may vary (increase) in the future (Ruttly et al. 2014).

Perhaps the most important area for future research is to apply a comprehensive systems approach to assess the synchronous supply- and demand-side responses of the ski market to climatic variability and change (Gössling and Hall 2006; Scott et al. 2008, 2012). This study examined demand-response on a resort-by-resort basis, thereby assuming that if respondents’ in-situ resorts were closed, all other resorts would be open. In reality, the supply-side response to marginal snow conditions in Ontario would be more homogenous because of limited climatic and terrain (i.e., elevation) differences. This is particularly true among those resorts of similar size that are clustered together. For example, if Lakeridge or Chicopee was closed, Dagmar and Glen Eden would likely be closed as well. BMR, given its size and snowmaking capacity, is likely to be the most resilient to climatic variability, which means when other resorts are closed, BMR may remain open. This would imply that the spatial substitution for BMR may be even

greater than found in the current study, with more skiers travelling to this resort. Climatic variability and change will not only influence the state of snow conditions, but also the location and extent of consumption. There needs to be an allowance for a realistic representation of both skiers' and resort operations that can respond to feedback between supply and demand (Soboll and Schmude 2011). Both supply- and demand-side need to be coupled in order to create an integrated model that is capable of simulating the evolution of operating ski areas and evolving patterns of skier demand.

The risks posed by climate change to the ski industry has received considerable attention, which is both understandable and even strategic, as this sub-sector of tourism is the most directly and most immediately affected by climatic change (Scott et al. 2012). The growing research on demand-side adaptation underscores the inherent complexity of understanding behavioural adaptation among skiers and tourists/recreationists more broadly. Overall, the findings of this study offer decision support to ski resort operators and managers concerned with how their visitors will respond to changing climatic conditions, with key research needs identified to appraise the consequences and future viability of individual ski resorts in Ontario and the ski industry more generally.

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