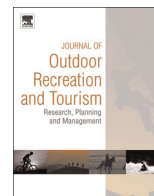




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Contents lists available at ScienceDirect

Journal of Outdoor Recreation and Tourism

journal homepage: www.elsevier.com/locate/jort

Behavioural adaptation of skiers to climatic variability and change in Ontario, Canada

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ARTICLE INFO

Article history:

Received 16 September 2014

Received in revised form

1 July 2015

Accepted 2 July 2015

Keywords:

Climate variability

Climate change

Skiing

Adaptation

Substitution

ABSTRACT

Increasing research highlights the vulnerability of the alpine ski sector to climatic variability and change. The literature has focused predominantly on supply-side vulnerability, with limited insight into tourists' behavioural response to marginal snow conditions and ski resort closures. Using an in-situ survey ($n=2448$), this study examines how skiers in Ontario (Canada) would change their participation patterns if their preferred ski resort were closed due to a lack of snow. The survey focuses on current behavioural responses, rather than decisions based on future scenarios of climate change. Results show that substitution behaviours (i.e., spatial, temporal, activity) differ pending whether the resort is closed for the day, closed until mid-season or closed permanently, with differences ($p < 0.05$) recorded based on skier market segments. The results also indicate that beginner and infrequent skiers, as well as parents with children enrolled in ski lessons, are more likely to either ski less and/or stop skiing altogether, while experienced and core skiers are more likely to engage in spatial substitution. Season pass holders and those at large resorts were also more likely to engage in spatial substitution. Managerial implications as a result of a likely shift in ski demand patterns in Ontario are discussed, with future research needs identified to appraise the differential community-level consequences and future climate adaptation strategies of ski tourism.

MANAGEMENT IMPLICATIONS

The behavioural response of skiers to changing climatic conditions will be a decisive factor in the vulnerability and sustainability of ski tourism. Fundamental to assessing the contemporary climate risk of the multi-billion dollar ski industry, as well as to estimate how future climate change could alter demand patterns in regional ski tourism marketplaces, is to understand skiers' behavioural adaptation to inter-annual climate variability. As skiers engage in behavioural substitution (temporal, spatial, activity), a shift in ski demand patterns is likely. Skiers will concentrate at resorts that remain climatically operable, which will have important management implications with respect to individual resort capacity, visitor experience (e.g., crowding), and consequent impacts on surrounding ski area businesses and communities. Climatically advantaged ski areas and communities will need to prepare for development pressures, including investments in ski terrain expansion and infrastructure to increase snowmaking capacity (including water access and storage), as well as ease increased crowding on trails, in parking lots, inside chalets and lift lines. The results from this study offer decision support to ski resort operators and local tourism officials concerned about how their visitors will respond to changing climatic conditions and the implications for local economic development and real-estate.

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1. Introduction

Winter sports tourism is reliant on temperature and snowfall conditions, with inter-annual climate variability impacting the length and quality of ski seasons and thereby skier visits and

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associated revenues. The vulnerability of the international ski industry to climate variability and change has garnered considerable attention, with more than 30 studies in over a dozen countries (Scott, Gössling, & Hall, 2012). The focus on skiing and winter sports tourism is strategic considering this tourism subsector is most directly and most immediately affected by climate change (Scott, 2011). This literature has predominantly focused on supply-side vulnerability, initially aiming to understand the impact of increased average temperature and changing natural snow availability on ski operations, including the reliability of the ski tourism product, operational costs, and sustainability. These studies have consistently found the ski industry to be at risk to climate change, with ski seasons projected to become shorter on average and more variable due to a decrease in natural snow cover (i.e., natural snow reliability), while increased snow-making requirements (and thereby operating costs) will need to occur with decreased opportunities for snow-making (i.e., technical snow reliability) (e.g., Abegg, Agrawala, Crick, & De Montfalcon, 2007; Dawson & Scott, 2013; Hamilton, Brown, & Keim, 2007; Hendrikx, Zammit, Hreinsson, & Becken, 2013; Hennessy et al., 2008; Pons, Johnson, Rosas, & Jover, 2014; Scott, Dawson, & Jones, 2008; Scott, McBoyle, & Mills, 2003; Scott, McBoyle, Mills, & Minogue, 2006; Scott, McBoyle, & Minogue, 2007; Steiger, 2010; Steiger & Stötter, 2013). In every regional ski market assessed (Australasia, North America, Eastern and Western Europe, Japan), the result is a continued contraction in the number of operating ski areas. The implications of this contraction of operating ski areas for community tourism and economic development have only begun to be explored (Scott, Dawson, & Jones, 2008; Dawson & Scott, 2013).

To lengthen ski tourism seasons and improve the reliability of snow-based tourism products globally, snowmaking has become an integral climate adaptation of the ski industry (Scott et al., 2012). Studies have found that through the production of snow, the vulnerability of winter sports, particularly during winters with high temperatures and low snowfalls, has decreased substantially since the mid-1980s (Pickering, 2011; Rutty, Scott, Steiger, & Johnson, 2014; Scott & McBoyle, 2007; Steiger & Stötter, 2013; Töglhofer, Eigner, & Pretenthaler, 2011). While this indicates a 'decoupling' of the ski industry from natural snowfall where widespread snowmaking is implemented (Steiger & Stötter, 2013), winter sports tourism remains highly dependant on sufficiently cold temperatures for making snow. Even in regions with extensive snowmaking capacity, the impact of inter-annual climate variability on ski season length and skier visits remains evident. For example, in eastern North America where snowmaking covers nearly 100% of skiable terrain (Scott, Hall, & Gössling, 2012), the anomalous warm winter of 2011–12 led to a 10% decrease in skier visits in Ontario compared to the previous season "due to lack of snow early in the season, no major snow falls, and an early end to the season" (Ontario Snow Resorts Association [OSRA], 2012). During the marginal snow season of 2001–02, declines in average season length and visitation occurred in the Ontario (7%), Quebec (15%) and northeast US ski markets (11%) compared with a climatically normal winter (for the 1961–90 period) (Dawson, Scott, & McBoyle, 2009; Scott, 2006; Scott, Hall et al., 2012). In Austria, an 11% decrease in ski-lift ticket sales was recorded for the record warm winter of 2006–07 compared to the previous three year average (Steiger, 2011). In Australia, the number of visitor days decreased by 69% during the warm and dry year of 2006 compared to the previous nine years (Pickering, 2011). These results are consistent with the findings of Shih, Nicholls, & Holecek (2009) in Michigan (USA) that weather variables (e.g., temperature, snow depth, wind chill) have statistically significant impacts on downhill ski lift tickets. Importantly, these analogue studies indicate a differential vulnerability within the regional ski markets, with smaller ski areas at greater risk to marginal weather seasons

compared to the large ski area operations with greater capital and snowmaking capacity (Dawson et al., 2009; Scott, Hall et al., 2012). Therefore inter-annual climate variability, which is anticipated to become more pronounced under future climate change (IPCC, 2013), remains an important present risk for the ski tourism industry, particularly for the smaller operators that may not be able to absorb substantive economic losses from consecutive warm winters.

Comparatively little is known with respect to the influence of weather and climate on skier demand, including tourists' behavioural response to past or projected climatic variability, poor snow conditions, and ski resort closures (Dawson, Havitz, & Scott, 2011; Dawson, Scott, & Havitz, 2013; Pickering, Castley, & Burt, 2010; Pons, Johnson, Rosas, & Jover, 2014; Putz et al., 2011; Rutty & Andrey, 2014; Scott et al., 2008; Scott, Hall, et al., 2012; Scott & McBoyle, 2007; Shih et al., 2009; Steiger & Abegg, 2013). This limitation exists more broadly with respect to tourist response to climatic and environmental change and was identified as a priority research area by Gössling, Scott, & Hall (2012). Using an in-situ survey, this study examined how skiers in Ontario (Canada) stated they would change their participation patterns if their preferred ski resort were closed due to a lack of snow. Specifically, the survey focused on how individuals would engage in spatial (i.e., travel to a different ski resort), temporal (i.e., alter their frequency of participation) or activity substitution (i.e., switch from skiing to another leisure activity) under three different conditions: (1) if their preferred ski resort was not open on the day of the trip (i.e., "not open today"), (2) had a delayed start to the season (i.e., "not open until mid-January") or (3) was to cease ski operations (i.e., "close permanently"). Similarities and differences in substitution strategies were also examined among segments of the skier market, including socio-demographics (i.e., age), experience (i.e., skill level), participation rates (i.e., frequency of trips) and resort type (i.e., small, large, private). The study aims to provide insight into skiers' behavioural adaptation to inter-annual climate variability and the implications of adverse future conditions for ski demand. This question is fundamental to assessing contemporary climate risk, as well as to estimate how future climate change could alter demand patterns in regional ski tourism marketplaces. Such skier adaptation will be a decisive factor in the vulnerability and sustainability of ski tourism (Dawson et al., 2013; Hendrikx et al., 2013; Pons et al., 2014; Scott, Hall et al., 2012; Scott & McBoyle, 2007; Steiger & Abegg, 2013).

2. Literature review

A limited number of studies have used a survey-based method to understand how skiers may adapt their behaviour in the future due to more frequent marginal snow conditions as a result of climate change. These international studies conducted in Australia, Austria, Switzerland, and the US suggest that the majority of skiers would significantly alter their behaviour. König (1998) found that 75% of respondents in Australia would alter their ski behaviour if the region experienced 'very little natural snow in the next five years', including 31% who would ski less often, 38% who would ski at an overseas location instead, and 6% who would stop skiing altogether. Using the same survey instrument a decade later, Pickering et al. (2010) found an increase in the proportion of Australian skiers who would alter their ski participation behaviour (from 75% in 1996 to 90% in 2007), including 69% who would ski less often, 16% who would ski at an overseas location, and 5% who would stop skiing altogether. Behringer, Buerki, and Fuhrer (2000) similarly asked skiers in Switzerland how they would alter their behaviour if they knew that 'the next five winters would be snow deficient'. Of the responses, 49% would ski at a different/more

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