Climate Change and Tourism in the Mountain Regions of North America

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Dr. Daniel Scott
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Introduction

Weather and climate have a strong influence on the tourism and recreation sector, including the environmental resources that are the foundation for tourism (e.g., species habitat for ecotourism, snow cover for skiing, water supply, etc.) and the length and quality of tourism seasons. Despite the growing significance of the tourism industry to the global economy and the obvious inter-relationship with climate, a number of researchers have lamented that the vulnerability of individual tourism industries and tourism destinations to climate variability has not been adequately assessed.

Similarly, a number of leading researchers have expressed concern that our understanding of the potentially profound impacts of global climate change on the tourism sector remains equally limited. In their concluding summary of the International Tourism and Hospitality in the 21st Century conference, Butler and Jones (2001:300) indicated that, '(Climate change) could have greater effect on tomorrows world and tourism and hospitality in particular than anything else we've discussed … The most worrying aspect is that … to all intents and purposes the tourism and hospitality industries … seem intent on ignoring what could be *the* major problem of the century *(original emphasis)*.' By bringing together climate change scientists and a wide range of tourism stakeholders, the first international conference on climate change and tourism, convened and organized by the World Tourism Organization is an important step forward in identifying the nature and magnitude of the challenges climate change will pose for the global tourism industry and developing an action agenda to address these challenges.

The countries of North America are an important component of the global tourism industry, with each ranked among the top ten international tourism destinations in terms of tourist arrivals (World Tourism Organization 2002) and possessing strong domestic tourism markets. A broad range of potential climate change impacts on the tourism sector were identified in the North American chapter of the Intergovernmental Panel on Climate Change's Third Assessment Report (Impacts, Adaptation and Vulnerability, section 15.2.6 – IPCC 2001). This paper will examine some of the potential impacts of climate change in the mountainous regions of North America using specific examples of anticipated impacts on nature-based and winter tourism.

Climate Change Implications for Nature-based Tourism in Mountain Regions

The natural environment is very important in determining the attractiveness of a region for tourism. This is especially true of nature-based tourism, which is one of the fastest growing tourism market segments globally. A study of the nature-based tourism market (HLA and ARA, 1995) found that the natural setting was the most critical factor in the determination of a quality tourism product. Consequently, if climate change adversely affects the natural setting of

mountain destinations (the loss of glaciers, special flora or fauna, fire and disease impacted forest landscapes) the quality of the tourism product would be diminished with implications for visitation and local economies.

Nature-based tourism is an important component of North American tourism. Eagles et al. (2000) estimated visitation to park and protected areas in Canada and the United States alone was over 2.6 billion visitor days in 1996. Many of the most popular parks in Canada and the United States are located in mountainous regions. Tourism in the mountain parks of North America is highest during the summer months. Using a 'Tourism Climate Index' (TCI) Scott and McBoyle (2001) found that the length and quality of the summer tourism season in Canada's western mountain parks would improve markedly under climate change. For example, the TCI rating of Calgary (Alberta, Canada) (near Banff National Park) improved every month under the climate change scenarios and by the 2050s it was equal to or better than Denver's (Colorado, USA) (~1500km to the south) current TCI rating in the peak spring and summer tourism period. A detailed assessment of the implications of climate change altered seasonality for park visitation in Rocky Mountain National Park (Colorado, USA) projected that increased visitation (193,000 to 333,540 visitors) would result in a 6-10% increase in local economic output and 7-13% increase in local jobs (US EPA, 2003). Similar opportunities for increased visitation are anticipated in most mountain parks in western Canada and the United States.

Changes in visitor numbers and seasonal visitation patterns are important for park revenues and the economies of nearby communities, but also have ecological implications. Visitor numbers and related tourism infrastructure were identified by Parks Canada (1998) as a significant ecological stressor in 24 of Canada's 38 National Parks and increased visitation has the potential to heighten visitor related pressures in certain parks.

Perhaps more important than changes in tourism season length will be the impact of climate change on the natural mountain environments on which tourism depends. A number of studies have examined the potential biophysical impacts of climate change on mountain environments in North America and provide insight into the implications for tourism. Scott and Suffling (2000) identified a wide range of potential climate change impacts on ecosystems in Canada's national parks. Mountain parks of Canada's Western Cordillera were expected to experience both latitudinal and elevational ecotone changes, with the potential for species reorganizations and implications for biodiversity. The alpine treeline is one of the most distinctive ecological transitions and as the treeline shifts upward in response to climatic warming, alpine habitat will diminish and become increasing fragmented. The upslope migration of the treeline has already been documented in Jasper National Park (Alberta, Canada). Similar impacts are expected in Yellowstone National Park (Wyoming, USA), where vegetation modeling results projected the range of high-elevation species would decrease, some tree species would be regionally extirpated, and new vegetation communities with no current analogue would emerge through the combination of existing species and non-native species (Bartlein et al. 1997). Vegetation modeling in Glacier National Park (Montana, USA) projected a 20m per decade upslope advance of forest through 2050, with considerable spatial variation determined by soil conditions and aspect (Hall and Farge 2003). A study of mammal populations in the isolated mountain tops of the Great Basin in the western United States, projected that regional average warming of 3^0C

would cause a loss of 9% to 62% of species inhabiting each mountain range and the extinction of 3 to 14 mammal species in the region (McDonald and Brown 1992).

Increased snow pack and warmer temperatures would have implications for wildlife as well as a potentially increasing in the magnitude and frequency of avalanches. The large majority of avalanche fatalities in Canada are people involved in recreation (skiing, snowmobiling, mountaineering) and thus climate change may pose a greater avalanche risk to tourists visiting Canada's mountain backcountry areas.

Like glaciers around the world, those in western North America have been retreating over the past century. Glacier National Park (Montana, USA), which early visitors referred to as the 'little Switzerland of America,' has lost 115 of its 150 glaciers over the past century and scientists estimate the remaining 35 glaciers will disappear over the next 30 years (Hall and Farge 2003). Similar projections have been made for glaciers in Canada's Rocky Mountain parks. Climate records show that the Rocky Mountains of Canada have experienced a 1.5^0C increase in average temperatures over the past century, almost three-times the global average of 0.6^0C. All of the glaciers in this region have shown a strong decline over the same period and glaciers less than 100 m thick are expected to disappear over the next 30 to 40 years (Brugman et al. 1997). The loss of glaciers has a direct impact on tourism operations such as Snowcoach Tours in Jasper National Park (Alberta, Canada), which currently provides glacier tours to over 600,000 visitors annually. Scott and Suffling (2000) suggested that the indirect impact of the loss of natural beauty associated with glacial landscapes for tourism also remains an important uncertainty. The loss of Glacier National Park's namesake would be a significant heritage loss, but could serve an important educational role to inform visitors how the landscape the park was established to protect has changed in only 100 years.

Climate change impacts on the vegetation and hydrology of the mountains of New England (USA) also have important implications for tourism in the region. Tourism associated with fall foliage (leaf colours) sightseeing draws visitors from across North America and around the world and could be negatively affected by the decline of maple trees (which provide the bright red colour essential to spectacular fall landscapes) and a greater abundance of less colourful tree species. Vegetation modeling has projected the maple-beech-birch forest type that currently dominates the region would be replaced by the oak-hickory forest type under climate change conditions (Iverson and Prasad 1998). How tourists will respond to changes in forest landscapes remains an important uncertainty in determining the vulnerability of fall tourism in this region.

Warmer stream temperatures in the New England region will adversely affect key coldwater sport fish populations. Several salmonoid species are at the southern limits of their range in New England and are projected to be partially or completely displaced under climate change. Tourists that are attracted to this region for these cold-water species (an estimated 24 million fishing days generated over US $1.3 billion in the region in 1991 – Sinclair 2001) may to travel to other regions (Quebec and New Brunswick in Canada for example) where these preferred species are still available. A study of the impact of climate change on the recreational trout fishery in the Southern Appalachian Mountains of North Carolina (USA) found that the decrease in thermal habitat for trout (82% of streams would no longer support brook trout) would result in an annual economic loss of US$61-584 million (1995 dollars) (Ahn et al. 2000). Similar research on the

thermal habitat for salmonid species in the Rocky Mountain region of the United States found that the projected 4^0C summer warming in the region would reduce habitat area by an estimated 62% (Keleher and Rahel 1996).

The drought in the state of Colorado during the spring and summer of 2002 may provide an important analogue of the potential impacts of climate change in that region and other mountainous regions of western North America. The statewide drought created dangerous wildfire conditions and the park closures and media coverage of major fires in some parts of the state had a significant impact on summer tourism. Visitor numbers declined by 40% in some areas of the state and reservations at state campgrounds dropped 30%. Wildfires in the summer of 2002 also destroyed housing for park staff and the sewage treatment plant in Mesa Verde National Park in Colorado and a large fire in the Six River national forest in Northern California threatened the famed ancient redwood trees of Redwood National Park. A number of studies have projected increases in wildfire severity and frequency in large areas of Canada and the United States (Logan et al. 2001). The fire season in several highly visited Rocky Mountain parks is projected to increase 30 to 50 days.

The Colorado drought also affected fishing and river-rafting tourism in the state. Anglers were restricted from fishing in many state rivers because fish populations were highly stressed by low water levels and warmer water temperatures. Low water levels also shortened the river-rafting season substantially. Some outfitter companies lost 40% of their normal business and statewide economic losses exceeded US$50 million.

One of the most important features of parks for visitors is the perception of a healthy environment that is being protected in perpetuity. The impact of climate change on the landscape (forests affected by fire, insects and disease disturbance; loss of popular species; loss of glaciers and mountain meadows; etc.) may have a negative impact on this social value and, subsequently, visitor numbers. To date, there has been no research to examine how changes in mountain landscapes may affect tourism, however a new study of this issue has just begun in a sample of Canadian parks.

Climate Change Implications for Winter Tourism

Winter tourism has been repeatedly identified as potentially vulnerable to global climate change and has received greater research attention than any other tourism sector. The ski industry has been the particular focus of climate change impact assessments in a number of nations (Australia – Galloway 1988, König 1998; Austria – Breiling et al. 1997; Canada – McBoyle and Wall 1992, Lamothe and Periard 1988; Scotland – Harrison et al. 1999; Switzerland – König and Abegg 1997, Elsasser and Bürki 2002; United States - Bloomfield and Hamburg 1997). All of these studies projected negative consequences for the industry.

In North America, winter tourism research has been limited to the Great Lakes and New England regions. Although snow cover modeling in the mountains of northwestern United States projected a 75 to 125 cm reduction in average winter snow depth under two climate change scenarios and an estimated upward shift in the snowline from 900 masl to 1250 masl (US

National Assessment Team 2000), the implications for major ski areas in the region have not been examined.

An important limitation of previous studies on climate change and skiing has been the omission of snowmaking as a climate adaptation strategy. Scott et al. (2002) was the first study to examine snowmaking as an adaptation strategy. Using a range of SRES-based climate change scenario, Scott et al. (2003) found that with current snowmaking capabilities, doubled-atmospheric CO_2 equivalent scenarios (~2050s) projected a 7% to 32% reduction in average ski season in the central-Ontario study area. With improved snowmaking capabilities modelled season losses were further moderated to 1% to 21%. The findings clearly demonstrate the importance of snowmaking, as the vulnerability of the ski industry was reduced relative to previous studies that projected a 40% to 100% loss of the ski season in the same study area under doubled-CO_2 conditions (McBoyle and Wall 1992). A similar reassessment of widely cited earlier studies on the Quebec ski industry and other areas of North America are required. Importantly, snowmaking requirements to minimize ski season losses in the study area were projected to increase 191% to 380% by the 2080s (Scott et al. 2003). The additional snowmaking requirements and greater energy requirements to make snow in warmer average temperatures would represent an important cost increase that could affect the profitability of some ski areas.

Large corporate ski entities like Intrawest, Vail Resorts and American Skiing Company may be less vulnerable to the impacts of climate change than smaller single ski operations because they generally have more diversified business operations (real estate, warm-weather tourism resorts and four season activities at ski resorts), are regionally diversified (which reduces their exposure to poor snow conditions in one region), and are better capitalized (so that they can make substantial investments in snowmaking systems). The development of a winter tourism weather derivatives market is one mechanize that smaller ski operations could use to equalize this business advantage somewhat.

Recognition of the climate change issue by the North American skiing industry has been increasing. The National Ski Areas Association in the United States recently launched the 'Keep Winter Cool' campaign to educate ski resort visitors about climate change and member ski areas have begun to invest in a range of energy efficiency and alternative energy projects to reduce their greenhouse gas emissions.

Other important components of winter tourism in North America have received much less research attention. The International Snowmobile Association (2003) has estimated the annual economic value of the North American snowmobile industry at over US$10 billion and in some regions it rivals the economic importance of the alpine skiing industry. The climate change impact assessment research community has overlooked the potential vulnerability of this industry to climate change. Notably, climate change was not considered in Canada's recent National Snowmobile Tourism Study (Pannell Kerr Forster 2001) despite potentially important implications for the sustainability of snowmobile-based tourism.

The only study that has examined the implications of climate change for snowmobiling (Scott et al. (2002) found that snowmobiling was more vulnerable to climate change than alpine skiing

because of its greater reliance on natural snowfall. Snowmaking has very limited application in snowmobiling and nordic skiing because of the technical and economic barriers associated with producing snow over tens or hundreds of kilometers of trail. When the climate change impact scenarios for seven snowmobiling areas in southern Ontario (Canada) were compared, the average projected reduction in season length was substantial (29% to 49%) as early as the 2020s. The average snowmobiling season was projected to decline by approximately 50% at most locations by the 2050s, with further average season reductions of between 70% and 79% by the 2080s. Similar assessments are required in other regions of Canada and the United States where snowmobiling is a key component of winter tourism.

Winter festivals in different parts of North America have experienced problems over the past few winters due to lack of snow and warmer than normal temperatures. The famed Winterlude canal skating in Ottawa (Canada's national capital) was limited to only seven days during the winter of 2001-02. The Canadian Ice Fishing Championship was canceled in 2002 because of the lack of lake ice. In January 2003, some winter festivals in the states of Minnesota and Wisconsin (USA) had to cancel events due to dangerous ice conditions and a lack of snow. Snow and ice cover scenarios in this region (US National Assessment Team 2000, Fang and Stefan 1998) indicate that both will decline and become more variable under climate change, putting community winter festivals at greater risk in the future.

Cold climate dependent ecotourism in the Canadian and Alaskan arctic is also at risk to climate change. For example, the polar bear population near the town of Churchill (Manitoba) is an important tourism resource. Sea ice projections for Hudson Bay (Vinnikov et al. 1999) indicate that by the 2030-40s the polar bear population would be extirpated from the region, bringing the estimated CDN$300 million bear tourism market to an end. Conversely, the theorized emergence of a commercially navigable Northwest Passage through the arctic could create new tourism opportunities for cruise ships through this relatively unseen wilderness.

To assess the impact of climate change on winter tourism in any region of North America requires an understanding of the impacts on neighbouring winter recreation destinations. The varied impact of climate change on regional skiing and snowmobile areas could alter competitive business relationships between resorts and communities. This is equally true of competitive relationships between larger winter tourism regions. If the magnitude of climate change impacts in the Northeastern United States is such that more skiers and snowmobiliers chose to travel north to Quebec and Ontario, the Canadian winter tourism market share may increase even though the average ski and snowmobile seasons may be shorter. Conducting systematic regional impact assessments of winter tourism (see Scott et al. 2002 as one example) is therefore an important research need in North America.

Conclusion

Climate change represents an important long-term challenge to the tourism industry of North America. It will create new risks and opportunities for different segments of the tourism marketplace and alter the competitive relationship between tourism destinations. The magnitude of the impact of climate change will depend upon the importance of the tourism industry in the regional economy, the characteristics of climate change and its affect on the natural environment,

the adaptive response of tourists, and the capacity of the tourism industry itself to adapt to climate change as well as its interaction with other long-term influencing variables in the tourism sector (globalization and economic fluctuations, fuel prices, aging populations in industrialized countries, increasing travel safety and health concerns, increased environmental and cultural awareness, advances in information and transportation technology, environmental limitations – water supply and pollution).

The development of a strategic research agenda to assess the implications of climate change for sustainable tourism and target the key informational needs of tourism decision makers (both in government and business) is required. Increased collaboration between climate change scientists, government tourism officials and the tourism industry is paramount to developing such a research program. It is hoped that this conference will represent a watershed in this regard.

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