Chapter 8
Adaptation in the Tourism and Recreation Sector

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Abstract The tourism-recreation sector is increasingly recognized as a climate-sensitive economic sector, with both supply- (tourism operators, destination communities) and demand-side stakeholders (tourists) directly affected by climate and its indirect influence on a wide range of environmental resources that are critical to tourism. Knowledge of the affects of climate on tourism and the effectiveness of climate adaptations in this sector remains inadequate and behind that of other economic sectors that have a longer tradition of scholarly development and government involvement. This is problematic considering the continued rapid growth in tourism world-wide and its prominence in many national economies. This chapter provides an overview of the range of climate adaptations utilized in the tourism-recreation sector, comments on the state of knowledge about climate change adaptation in the sector, and discusses some important directions for future inquiry.

8.1 Introduction

Tourism is one of the largest and fastest growing global industries and is a vital contributor to national and local economies around the world. The World Travel and Tourism Council (2006) estimated that in 2005 the global travel and tourism industry, encompassing transport, accommodation, catering, recreation and services for visitors, contributed 3.6% of global GDP and 2.8% of world-wide employment. The 808 million international tourist arrivals in 2005 (United Nations World

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Tourism Organization [UNWTO] 2006) are projected to increase to 1.6 billion by 2020 (UNWTO 1998).

The tourism-recreation sector is highly influenced by climate (Wall 1992; de Freitas 1990, 2003; Gomez-Martin 2005; Scott 2006a, b, c). At the local scale, climate defines the length quality of multi-billion dollar outdoor recreation seasons (e.g., skiing, snowmobiling, golf, boating, beach use), while at the global scale climate is a principal resource responsible for some of the largest international tourism flows (e.g., from Northern Europe to the Mediterranean and northern North America to the Gulf of Mexico and Caribbean). Climate also affects a wide range of environmental resources that are critical to the tourism-recreation sector (e.g., glaciers, wildlife productivity and migrations, biodiversity, water levels) and affects various facets of tourism-recreation operations (e.g., snowmaking or irrigation needs, water supply).

Despite the growing global economic importance of the tourism-recreation sector and the multiple interactions between climate and the tourism-recreation sector, our understanding of how climate variability and extremes affect tourists, tourism businesses and destination communities remains highly limited. Consequently, knowledge of the potentially profound consequences of global climate change for the tourism-recreation sector remains equally limited (Intergovernmental Panel on Climate Change 2001; UNWTO 2003; Scott et al. 2005a; Gossling and Hall 2006). The title of section two of this book therefore very accurately describes the status of climate and tourism research as a 'research frontier.'

The inadequate state of biometeorological knowledge on the tourism-recreation sector may be partially explained by a combination of factors. First, robust evidence of the economic importance of the tourism-recreation sector at national and international scales has only been made available through methodological advancements over approximately the last 10–15 years. Most outside of the tourism community are still unaware of the sector's economic importance and continued growth trends. Second, with mass tourism being largely a post-World War Two phenomenon, the tourism research community is not as mature as that of other important economic sectors, such as agriculture and fisheries. In most nations, there is very limited tourism research capacity within government and what exists is largely applied, almost exclusively focusing on product/market development, marketing, and monitoring (visitation and visitor spending). Other fundamental research relating to, for example, the non-economic consequences of tourism (social, environmental), falls largely to the academic community, where the size of tourism and recreation research community remains very small relative to the economic importance of the sector. The relatively recent development of research on the tourism-recreation sector is also reflected in the history of the International Society of Biometeorology (ISB), with the Commission on Climate, Tourism and Recreation (CCTR) only being founded at the 14th Congress held at Ljubljana, Slovenia in 1996. Third, until very recently climate change had not garnered substantive attention from the tourism industry or the tourism and recreation research communities (Wall and Badke 1994; Scott et al. 2005a; Gossling and Hall 2006). Butler and Jones (2001:300), in their concluding summary of the *International Tourism and Hospitality in the 21st Century* conference, forthrightly stated, "(Climate change) could have greater

effect on tomorrow's 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)*." Kelly (2001:33) writing about the tourism-recreation sector from the perspective of the insurance industry, similarly concluded that, "Although a number of organizations are seeking to raise awareness, there is little evidence to suggest that the leisure industry and/or its providers is formulating a strategy or has turned its attention to the planning or close examination of the issues involved (with climate change)." Only in the last 5 years has there been recognition within the tourism industry that tourism is an important contributor to processes of global environmental change (Gössling and Hall 2006) and that climate change in particular would have important implications for the tourism industry (UNWTO 2003).

Scott et al. (2006) have compiled a comprehensive bibliography of the international climate and tourism literature, containing over 300 English, French, German and Spanish language publications (as of December 2004). Surprisingly, even though the large majority of climate change-related publications in the bibliography deal with impacts, more publications explicitly focus on climate change mitigation than adaptation. A number of publications that examine climate change impacts, particularly post-2000, implicitly mention adaptation using words like 'respond', 'cope', or 'adjust,' but without providing a thorough discussion of the full range of adaptations available to specific tourism market segments or destinations under examination or how the implementation of certain adaptations could alter the projected impacts (even qualitatively). Scott (2006b) argued that adaptation continues to be a critical research gap in the growing literature on climate change and the tourism-recreation sector. Unlike in other economic sectors, to date there has been no systematic attempt to document the range of climate adaptations currently employed in the tourism-recreation sector.

With the above in mind, this chapter represents the first effort to compile a portfolio of climate adaptations employed by tourism-recreation stakeholders (individual tourists, tourism operators, tourism destinations – communities, financial sector, and government). It remains beyond the scope of this chapter to examine the very wide range of adaptations in detail (i.e., the extent, historical evolution, and barriers to each adaptation) or attempt to evaluate the effectiveness of each adaptation. These remain important directions for future inquiry.

8.2 Climate Adaptation Portfolio for the Tourism-Recreation Sector

Climate adaptation in the tourism-recreation sector is comprised of complex mix of adaptations undertaken by diverse stakeholders at a range of spatial and temporal scales (Fig. 8.1). The climate adaptation portfolio presented in this section is not intended to be comprehensive, as this would require detailed adaptation portfolios, like that developed by Scott (2006b) for the ski industry, to be developed for several

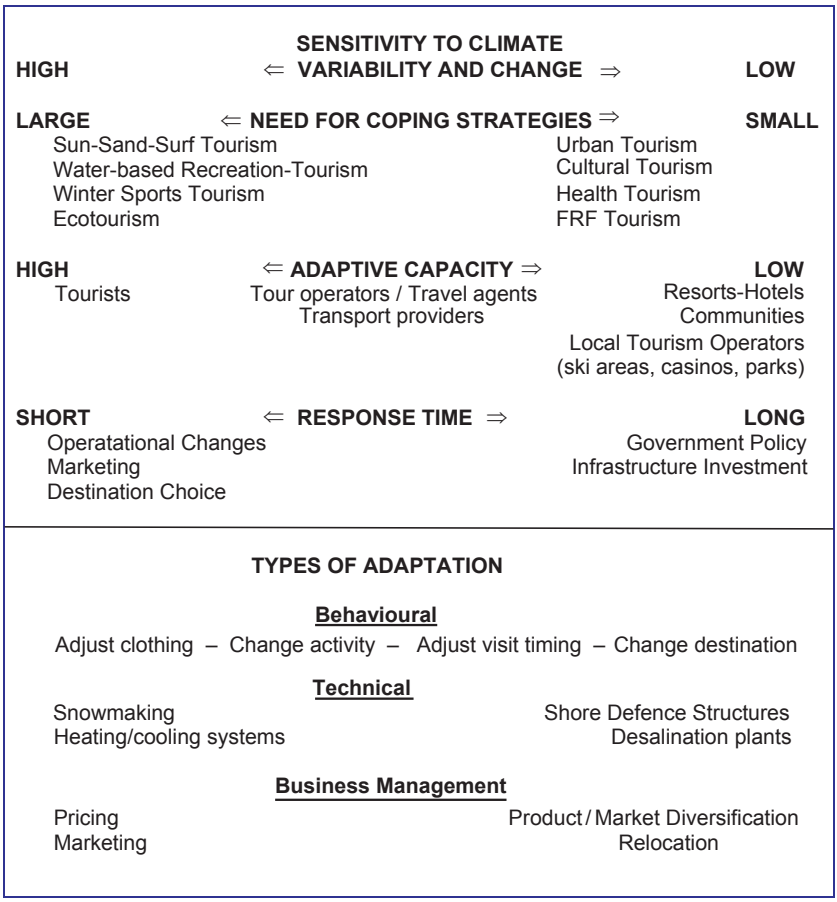

Fig. 8.1 Conceptual framework for considering adaptation to changes in tourism climate

major tourism segments in climatic zones around the world; rather it is meant to be illustrative of the diversity of climate adaptation available to this highly dynamic sector. The climate adaptation portfolio is organized by type of stakeholder (tourists, tourism operators/businesses, tourism industry associations, governments/communities, financial sector) and major types of adaptations (e.g., technical/structural, behavioural, business management, policy, research and education) utilized by each stakeholder. While climate adaptations are described individually in this chapter, rarely are adaptation options undertaken in isolation. More commonly, climate adaptation by stakeholders in the tourism-recreation sector involves multiple adaptation options (Fig. 8.1). Individual adaptation options are sometimes also undertaken by several different stakeholders in the sector (e.g., marketing by tourism businesses, communities and countries), sometimes in isolation and sometimes collaboratively.

To date, all of the studies that have specifically examined climate adaptation in some aspect of the tourism-recreation sector (Elsasser and Bürki 2002;

Scott et al. 2002, 2005b; Raksakulthai 2003; Becken 2004; Sievanen et al. 2005; Scott and Jones 2005; Scott 2006b) have concluded that there is little evidence of adaptation in anticipation of climate change. Thus, almost all of the climate adaptations identified in this portfolio represent adaptation as currently practiced. The few climate change specific adaptations in this sector are clearly identified throughout this section.

8.2.1 Tourists-Recreationists

8.2.1.1 Behavioural

Recreation and leisure tourism are by definition activities undertaken by choice during 'free time.' As such, tourists-recreationists have a great degree of freedom to choose the activities they wish engage in, as well as where and when they will do so. Spatial, temporal and activity substitution provide tourists-recreationists with tremendous adaptive capacity.

Tourists are easily able to adapt to climatic conditions or climate-related impacts at any given destination by simply going elsewhere. Giles and Perry (1998) found that the exceptionally warm and sunny summer of 1995 in the UK resulted in a drop in outbound tourism as travellers opted for domestic holidays. Extreme events regularly influence traveller decisions in regions such as the Gulf of Mexico. The four hurricanes that struck the State of Florida in 2004 caused thousands of cancellations as travellers went elsewhere and a marketing survey found that 25% were also less likely to visit Florida during hurricane season in the future (Pack 2004).

Tourists-recreationists are able to select when climatic conditions are suitable to engage in chosen activities or visit a destination. Tourists can adapt the timing of travel according to climate variability, such as unusually early or late hurricane or monsoon season, and eventually to climate change. Indeed, several climate change impact studies assume that tourists will adapt to new climatic regimes by altering the timing of visitation, particularly new opportunities during shoulder seasons (Maddison 2001; Lise and Tol 2002; Hamilton et al. 2005; Jones and Scott 2006a, b; Berrittella et al. 2006). Tourists-recreationists can also adapt the frequency of their visits in response to climate variability. Scott (2006b) found evidence of such among skiers in the US. Examining ski area 'utilization' data, which is the ratio of actual skier visits to the physical capacity of skier visits at a ski area over the ski season; it was found that utilization decreases during longer ski seasons. Greater utilization during shorter ski seasons, suggests that skiers are participating more frequently than they would in a normal year (i.e., go skiing every weekend, instead of every 2 weeks). This type of behavioural adaptation is particularly possible when the ski season starts later than usual, because skiers know they likely will have fewer opportunities that season.

Activity substitution can take place over a range of time-scales. Tourists-recreationists can also modify their activities to cope with unfavourable weather conditions. Fig. 8.2 illustrates how some tourists visiting a beach resort in Cuba

Fig. 8.2 Small scale–short term behavioural adaptation to weather conditions (Photo credit: Daniel Scott)

have adapted to strong winds and cool temperatures in ways that still allow them to engage in beach related activities (i.e., additional clothing and erecting wind screens with beach chairs). Tourists-recreationists can change from one activity to another or change the frequency of activities in response to climate variability. A 1°C warmer than average summer season has been found to increase domestic tourism expenditures in Canada by 4% (Wilton and Wirjanto 1998). Individuals can also substitute activities on a permanent basis in response to climatic changes. Scott et al. (2002) found some snowmobilers had begun to switch to All-Terrain-Vehicles (ATVs) in response to changes in snow conditions.

A limited number of studies have begun to explore the potential behavioural adaptations of tourists-recreationists to future climate change (König 1998; Braun et al. 1999; Bürki 2000; Richardson and Loomis 2004; Scott and Jones 2006a; Uyarra et al. 2005). In each study, a combination of spatial, temporal and activity substitution were found. König (1998) and Bürki (2000) utilized surveys to examine how skiers in Australia and Switzerland might respond to marginal ski conditions presented in a hypothetical climate change scenario. In Australia, 25% of respondents indicated they would continue to ski with the same frequency, nearly one-third (31%) would ski less often, but still in Australia, and the greatest portion (38%) would substitute destinations and ski overseas (mainly in New Zealand and Canada). A further 6% would not continue to ski under such conditions. In Switzerland, the majority (58%) indicated they would ski with the same frequency (30% at the same resort and 28% at a more snow reliable resort – generally at higher elevation). Almost one-third (32%) of respondents indicated they would ski less often and 4% stated they would stop skiing altogether.

In eastern North America, a climate change analogue approach has been used to understand the potential response of the ski tourism marketplace to future climate change. The winter of 2001–2002 was the record warm winter throughout much

of the region and approximated the normal temperatures expected in mid-century under a mid-range warming scenario (approximately + 4.5°C). Skier visits during this record warm winter were consistently lower than in the previous climatically normal winter of 2000–2001: – 11% in the Northeast ski region of the US, – 7% in Ontario, and – 10% in Quebec (Scott 2006c). Although this finding is not surprising considering the ski season was approximately 20 days shorter in the record warm winter, what is somewhat surprising is how small the reduction in skier visits was during this climate change analogue season. It was observed that utilization levels at ski areas increased, as many skiers in the region adapted by skiing more frequently than in a normal year (i.e., skiing every weekend, instead of every 2 weeks).

Comparable studies have also been conducted on how tourists might respond to climate-induced environmental change in national parks in the Rocky Mountain region of North America. Richardson and Loomis (2004) found that between 9% and 16% of surveyed visitors to Rocky Mountain National Park (USA) would change the frequency of visitation to the park under the hypothetical environmental change scenarios (representing the 2020s). The environmental change scenarios constructed for the early and mid-decades of the twenty-first century were also found to have minimal influence on intention to visit Glacier-Waterton International Peace Park or Banff National Park, with almost all visitors still intending to visit the parks and 10% indicated they would visit more often, presumably due to improved climatic conditions (Scott et al. 2007; Jones and Scott 2006a). There is also the potential that media coverage of melting glaciers might motivate more people to visit these parks over the next 20–30 years to personally see or show children the glaciers before they disappear and in order to witness the impacts of climate change on the landscape. This ‘last chance’ tourism market trend is already being observed in some areas of Alaska, including Kenai Fjords National Park, where the chief ranger has described climate change as one of the new major themes for the park (Egan 2005). If such an increase is visitation is realized, it would require adaptation to accommodate larger numbers of visitors and provide new public education about the changes in natural heritage that are occurring.

In the studies that attempted to look at the potential impacts of greater environmental change (Scott et al. 2007; Jones and Scott 2006a, b), an important threshold was reached for many visitors to Glacier-Waterton International Peace Park and Banff National Park in scenarios that might occur by the end of the twenty-first century. A substantial number of tourists (19% in Glacier-Waterton and 31% in Banff) indicated they would not intend to visit the parks if the specified environmental changes occurred. The projected loss of glaciers in the region was noted as a significant heritage loss and the most important reason cited for not intending to visit the park in the future. Another 36–38% of tourists indicated they would plan to visit less often. Visitors most likely to be negatively affected by climate-induced environmental change were long-haul tourists and ecotourists, motivated by the opportunity to view pristine mountain landscapes and wildlife. As such, the impact of environmental change was more pronounced in Banff National Park, which has a much greater number of international tourists. If realized, such impacts would require these destinations to adapt to very different impacts of climate change.

Recent coral bleaching events and the imperilled future for many coral reefs under climate change are a cause for concern for diving and other related tourism. Unfortunately, there is limited information about how tourists responded to the severe coral bleaching that occurred in many reef systems around the world in 1998. A case study from El Nido, Phillippines does provide some insight into the response of different tourist market segments to coral bleaching and degraded reef environments (Cesar 2000). In El Nido and nearby islands, severe coral bleaching in 1998 led to 30–50% coral mortality and a typhoon that same year (also linked to El Niño) caused further damage to local reefs. Whether divers or not, most tourists (95%) coming to El Nido have at least some interest in the local marine environment. However, general awareness of coral bleaching among tourists was found to be low (44%). The bleaching event did not impact budget tourist arrivals, but fewer budget tourists went diving during their stay. The impact at resorts, some of which cater to the high-end dive market, was much worse. In other coastal locations, the impact of climate change was also projected to adversely affect tourist preferences for these destinations. In Bonaire and Barbados, more than 75% of tourists were unwilling to return for the same holiday price in the event that coral bleaching or reduced beach area occurred as a result of climate change (Uyarra et al. 2005). The response of tourists to recent severe bleaching events on the Great Barrier has not been systematically assessed, however a survey of tourists in Cairns (North Queensland, Australia) asked if they would visit the region if they knew that there had been a recent bleaching event – 29% were uncertain and 35% indicated they would not (Prideaux 2006).

8.2.1.2 Technical

The most common technical climate adaptations used by tourists-recreationists is the wide range of specialized equipment that allows them to engage in activities more comfortably and more safely when climate conditions are not ideal or to expand the climatic range in which activities can be undertaken. Some illustrative examples include: wetsuits for diving or windsurfing, hand and foot warmers built into snowmobiles, rain gear (clothing, equipment covers, etc.) for golf and hiking.

8.2.2 Tourism-Recreation Operators

Tourism-recreation operators is a broad category comprised of diverse stakeholders, including businesses involved in the travel planning and transportation phase (e.g., travel agents, event planners, transportation companies, international tour companies) to the wide range of businesses involved in hospitality (i.e., hotels-resorts, restaurants), attractions management (e.g., museums, golf courses, etc.), and other services (e.g., tour guides, equipment rentals, etc.) at specific destinations. While part of the same tourism-recreation sector actor group, there is an important distinction in the adaptive capacity of tourism businesses that operate in single and

multiple-destinations. As examples will illustrate, tourism-recreation businesses with immobile capital assets (e.g., resort complex, marina, or casino) at individual destinations have less adaptive capacity than businesses that provide transportation or travel planning services.

8.2.2.1 Technical

A tremendous array of technical and structural climate adaptations are used in the diverse environments that the tourism-recreation sector operates in. Here the discussion will be limited to adaptations to two widespread climate-related pressures on tourism-recreation operators: snow reliability and water supply.

The ski industry uses three major types of technological adaptations to improve snow reliability: snowmaking systems, slope development and operational practices, and cloud seeding (Scott 2006b). Snowmaking is the most widespread climate adaptation used by the ski industry and has become an integral component of the ski industry in some regions (eastern North America, Australia, Japan). Over the last 30 years, hundreds of millions of dollars have been invested in snowmaking systems in order to expand operating seasons and increase the range of climate variability that ski areas could cope with. Figure 8.3 illustrates the diffusion of snowmaking technology in the in the five ski regions of the US from 1974–1975 to 2001–2002. In the mid-1970s there was much greater use of this adaptation in the Northeast and Midwest ski regions than regions with higher elevations like the Rocky Mountains and the Pacific West. Since then that difference has been gradually diminishing. A similar east-west geographic pattern exists in Canada (Scott 2006b). The implementation of snowmaking is not as extensive in Europe as in North America, but

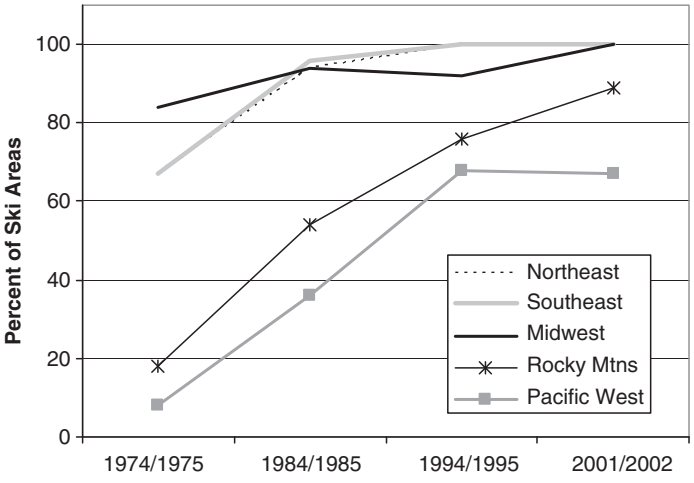

Fig. 8.3 Historical diffusion of snowmaking adaptation throughout the US (National Ski Area Association annual state of the ski industry reports)

there is no comprehensive analysis of how snowmaking differs by country. Barriers to the increased used of snowmaking in Europe include higher energy costs, challenges to securing adequate water supply, and environmental concerns (e.g., chemical additives that allow snowmaking at temperatures near 0°C are banned in Germany).

Slope development adaptations include: slope contouring, landscaping, and, interestingly, the protection of glaciers. With the increased recession of glaciers in the Alps in recent years, notably the record warm summer of 2003, ski areas in Switzerland and Austria, have needed to develop new adaptations. Initially heavy machinery was used in the autumn months to move snow to fill in gaps left by the glacier's retreat over the summer. In response to rapidly increasing fuel costs, some ski areas began to work with glaciologists on a new approach to protect critical areas of glaciers (typically cable car exist areas) from ultraviolet radiation and restrict melting during summer months with large sheets of white polyethylene (Simmons 2005; Jahn 2005). While the results have been 'fantastic' in the words of ski area operators, some environmental groups, such as Switzerland's branch of Friends of the Earth, are opposing plans to expand the use of this adaptation by ski areas (MacInnis 2006).

In addition to the modification of existing ski terrain, the development of new ski terrain in climatically advantaged locations (north facing slopes, higher elevations) is commonly cited as an adaptation to climate change. Expansion of ski areas into higher elevations appears to be the principal climate change adaptation strategy being considered in the European Alps (König and Abegg 1997; Elsasser and Bürki 2002; Breiling and Charamza 1999). High elevation mountain environments are particularly sensitive to disturbance and proposed expansion of ski areas into these environments is often met with opposition from the public and environmental groups. For example, a project to develop a world-class, four-season ski resort on Jumbo Glacier in southern British Columbia has been held up since 1991 by opposition from environmental groups and local residents (Greenwood 2004).

Cloud seeding is a weather modification technology that has been used to produce additional precipitation; although a recent US government report concluded there still is no convincing scientific evidence that this adaptation works (National Research Council 2003). Some ski areas in North America (State of Colorado) and Australia (New South Wales State) have employed this technology in an attempt to generate additional snowfall.

Inadequate water supply is a salient problem in many tourism areas around the world and is often brought about by over development (demand exceeding supply capacity) and climate variability. The following examples illustrate the three most common technical adaptations to increase water supply for tourism operations: water transfers (pipelines or tankers), reservoirs, and desalination plants. During the mid-1990s summer drought conditions on the Spanish island of Majorca threatened the operations of the tourism industry, the islands largest source of income and employment. With local aquifers suffering saline intrusion and failing to meet water supply requirements for tourism and the local population, the Spanish government implemented a yearly 10 million m^3 water transfer from the Spanish mainland via tanker ships (Wheeler 1995). The long-term adaptation strategy was the construction

of two large-capacity desalination plants and additional water transfers (via pipeline) from the mountainous north side of the island (Wheeler 1995).

The Tourism Authority of Thailand (TAT), together with other national agencies, has several adaptation strategies to reduce water shortages in the heavily developed tourism island of Phuket that are often brought about by climate variability (Raksakulthai 2003). Structural elements of the multi-year water supply plan include the construction of new dams, development of abandoned mines as water sources, expanded water transmission and water recycling systems. In addition to these structural adaptations, TAT is also planning non-structural adaptations, such as a revised fee structure for water consumption and water conservation campaigns (Raksakulthai 2003).

Becken's (2004) survey of small and medium size tourism operators in Fiji recorded a number of other small-scale water supply adaptations. Over a third of the survey respondents indicated they had experienced reduced water availability during recent droughts, and as a result structural adaptations to secure on-site water supply was the second most frequent climate adaptation undertaken by respondents. Examples of small-scale structural adaptations included: retrofitting buildings with rainwater collectors, increasing storage tank capacity, converting toilets to saltwater supply, and adding diesel powered desalination capacity. Tourism operators in Fiji also utilized non-structural adaptations, including water conservation education for employees and guests, revised landscaping practices, limited use of pools.

8.2.2.2 Business Management

The business model that tourism-recreation operators chose is an important determinant in the range of climate adaptations utilized. Some tourism operators have adapted to the pronounced seasonality of tourism demand in many destinations by closing during the low season. This adaptation strategy allows operators, particularly small and medium sized family-run enterprises, to make necessary repairs, develop marketing campaigns, attend training sessions, and go on vacation themselves. Other tourism operators substantially reduce capacity and services during low season (Fig. 8.4). Still others, sometimes as part of a broader tourism industry or national tourism strategy, use a range of adaptation strategies to develop low season markets in order to operate year round.

Product and market diversification are common adaptation strategies to increase demand during low seasons. In Thailand, the low season occurs during the southwest monsoon and Raksakulthai (2003) has reported two main adaptation strategies to develop low season. TAT has concentrated on developing tourism attractions that are not climate sensitive, such as health and wellness spas, study tours on Thai culture (e.g., cooking, religion, and language classes), indoors entertainment complexes with Thai cultural performances, and shopping, and also promoted development of the MICE market (meetings, incentives, conventions, exhibitions) among business travellers. In North America, the Economist (1998) referred to the transition of major ski resorts from ski areas to winter theme parks, as the 'Disneyfication' of the winter sports industry. Many ski resorts have

Fig. 8.4 Seasonal resort shut-down as climate adaptation (Greece) (Photo credit: Daniel Scott)

made substantial investments to provide alternate activities for non-skiing visitors (e.g., snowmobiling, skating, dog sled-rides, indoor pools, health and wellness spas, fitness centres, squash and tennis, games rooms, restaurants, retail stores). A number of former 'ski resorts' have further diversified their business operations to become 'four season resorts', offering non-winter activities such as golf, boating and white-water rafting, mountain biking, paragliding, horseback riding and other business lines (spas, conference facilities).

Tourism business models can also influence vulnerability to climate variability and change. For example, an important business model to emerge in the North America ski industry over the past decade is the ski resort conglomerate. Companies like American Skiing Company, Intrawest, Booth Creek Resorts, and Boyne USA Resorts have acquired ski areas in different locations across North America. Although not intended as a climate adaptation, the conglomerate business model may prove to be one of the most effective adaptations to future climate change. The ski conglomerate business model provides greater access to capital and marketing resources, thus enhancing adaptive capacity, but also reduces the vulnerability of the conglomerate to the effects of climate variability and future climatic change, through regional diversification in business operations. The probability of poor snow conditions in one ski region of North America (e.g., New England) is much higher than for several others (e.g., New England, Quebec-Ontario, Midwest, Rocky Mountains, and California). When poor conditions occur, the financial impact can be spread out through the organization and above average economic performance in one or more regions could buffer losses in another. Companies with ski resorts in a single region or independent small-medium size ski enterprises are at greater risk to poor climatic conditions. Without substantive economic reserves or access to capital, a series of economically marginal years may be all that is required to bankrupt the business.

Marketing is another key business strategy that is used to adapt to natural seasonality, climate extremes and most recently climate change. The Caribbean Tourism Organization and individual member states have begun to actively market themselves as four-season destinations in the late 1990s with multi-million dollar advertising campaigns that target the honeymoon market and budget-conscious families (Barnes 2002). In combination with marketing messages that downplay the region's summer heat are upgraded air-conditioning, discounted room rates, and new hurricane interruption policies at many resort companies, including Sandals Resorts, Club Med, SuperClubs, TNT Vacations and Apple Vacations. The hurricane guarantees or waivers differ slightly from company to company, but basically provide a replacement stay of the same duration and equivalent value as the one originally booked (Bly 2006). The strategy has proven successful as summer occupancy rates at beach resorts are approaching or equalling winter season in many destinations (Johnson 2005).

'Last change' marketing for climate change threatened destinations is still relatively rare, but an increasing marketing trend among tourism operators in regions where climate change impacts are clearly observable. Climate change has become one of the major interpretive themes in Kenai Fjords National Park in Alaska and some Alaskan tour guides are inviting travellers who visited 25 years ago to experience how the landscape has changed (Egan 2005). The popular travel magazine *Conde Nast Traveler* (May 2004) featured an article on climate change and international tourism destinations, including at list of 'endangered wonders' that travellers were recommended to visit before they vanish. UNESCO has indicated that world heritage sites such as the Belize Barrier Reef, Waterton-Glacier International Peace Park, Australia's Great Barrier Reef and the snows of Mount Kilomanjaro are threatened by climate change (Black 2006), which will likely inspire future articles in travel magazines and climate change related marketing by opportunistic tour operators.

In contrast to tourism operators with immobile capital assets that must adapt to climate at a specific location, other tourism businesses, that provide travel planning or transportation services, operate in many locations and one of their principal adaptation strategies is to redirect the travellers they represent to alternate destinations as conditions dictate. Travel agents redirect clients away from destinations that have been recently impacted by extreme events. The Government of Mexico estimated that as a result of the late season hurricane Wilma and media coverage of damage and stranded tourists, it would lose US$800 million in tourism revenue between October and December 2004 as travel agents and individual travellers select other destinations (Williams 2005). Large-scale event planners adapt in the same manner. Convention and event businesses increased in Arizona following the four hurricanes in Florida in 2004 and were expected to remain higher during hurricane season for the next 2–5 years as event planners avoid weather risks (USA Today 2005). With the trend toward shorter-term travel planning, especially discounted 'last minute' bookings made in the week (or day) prior to departure, travel agents are increasingly able to redirect clients away from destinations that could be adversely affected by unfavourable weather (using 5–7 day forecasts) or extreme events (areas in the path of developing hurricanes).

8.2.2.3 Policy

Few corporate policies on climate change exist in the tourism-recreation sector. The first known tourism operator in the world to develop a climate change policy is the Aspen Skiing Company. In 2001, they adopted two policy statements: (1) Aspen Skiing Company acknowledges that climate change is of serious concern to the ski industry and to the environment; and (2) Aspen Skiing Company believes that a proactive approach is the most sensible method of addressing climate change. Notably, the Aspen Skiing Company joined the Chicago Climate Exchange and established a climate change action plan, which focuses on mitigation efforts and does not publicly set out the company's adaptation strategy.

8.2.2.4 Public Education

There are a number of examples of tourism-recreation operators participating in pubic education on climate change with the intention of raising awareness and influencing personal behaviours that contribute to climate change mitigation. Many individual ski areas in North America and some celebrity ski athletes participate in the annual 'Keep Winter Cool' public education campaign (described further under Tourism Industry adaptations) (National Ski Areas Association 2006). The Mountain Equipment Co-op Company has been involved with the development and sponsorship of the 'Melting Mountains' public education initiative that focuses on the impacts of climate change on mountain environments and mobilizing stakeholders of these highly important tourism-recreation resources to reduce greenhouse gas emissions at the individual and corporate level (Melting Mountains 2006). A growing number of travel companies are now educating travellers about travel related GHG emissions and promoting carbon offset programs, such as those offered through 'MyClimate' (2006).

8.2.3 Tourism Industry Organizations

Organizations that coordinate and act on behalf of the tourism-recreation industry exist in many forms, from local tourism cooperatives to the United Nation's World Tourism Organization. Climate adaptations by tourism industry organizations are limited and tend to focus on climate change.

8.2.3.1 Policy

One of the few tourism industry organizations that have a climate change policy is the National Ski Areas Association (NSAA) in the US. As Best (2003:57) observed, the development of this policy represented, "a remarkable turnaround for an industry that just five or 6 years ago had largely shrugged off global warming."

In support of its climate change policy, 65 ski areas lobbied government to increase political support the proposed Climate Stewardship Act in the US. Interestingly, although the membership of the NSAA was able to develop a policy on climate change mitigation, no such collaborative initiative for adaptation exists. The North America ski industry is a very competitive business environment, where the tradition of cooperation is largely limited to government lobbying, regional marketing of winter tourism, and environmental standards. As a result, Scott (2006b) argued that it is unlikely that the industry would develop a cooperative adaptation plan, that might include, for example, a national income stabilization program to spread the climate risk exposure of individual ski areas or support vulnerable, low-lying ski areas near major urban markets like Boston and New York, which play an important market development role for the industry as a whole. The more likely scenario is a continuation of the existing competitive business environment and the unplanned, market based contraction of the US ski industry that has been underway for the past 2 decades.

At the international level the United Nations World Tourism Organization has taken a lead in raising awareness about climate change within the tourism industry. UNWTO hosted the first international conference on climate change and tourism in 2003 (Djerba, Tunisia), where delegates from 45 nations developed the *Djerba Declaration on Climate Change and Tourism*, which contained several items of agreement in support of adaptation.

8.2.4 Government (International, National, Local)

8.2.4.1 Technical

Governments at the local to national level are often managers of tourism-recreation lands and other resources (e.g., national parks, reservoirs) and as such, governments utilize many of the technical climate adaptation strategies already discussed in the tourism operators section. A recent example includes government response to changes in the phenology of cherry trees in Japan. Japan's cherry blossom is a national symbol and the basis of a multi-million dollar flower viewing tourism industry. The timing of the peak bloom varies with the seasonal weather and recent warm springs have caused the peak bloom to occur too early for local festival organizers. The local government in Hirosaki have commissioned scientists to 'programme' the cherry bloom at the 'appropriate time' by experimenting with sprays and plant hormone injections as well as piling snow on the base of trees to slow the onset of blossoms (Parry 2005).

8.2.4.2 Business Management

Governments at the local to national level are also involved to varying degrees in tourism product development and marketing and have used climate adaptations that

might be thought of as business strategies. For example, the State of Florida allocated US$30 million to 'hurricane recovery' marketing following the devastating sequence of four hurricanes in 2004. The State also developed a weather insurance program for convention organizers, where it pays the premiums for US$200,000 insurance coverage for rescheduling costs associated with hurricane disruption (Pain 2005).

8.2.4.3 Policy and Planning

The regulatory role of government provides it with many important climate adaptation strategies. Many of these regulatory frameworks are not specific to the tourism-recreation sector and because they are discussed in other chapters of this volume, they are only identified here: coastal management plans and set back requirements, building design standards (e.g., for heating and cooling or hurricane force winds), emergency management (e.g., tourist warning systems, evacuation plans), environmental impact assessments (e.g., influencing adaptations such as snowmaking and desalination plants), wildlife management (e.g., fish and game quotes), water quality standards (e.g., establish swimming bans), and wildfire management (e.g., set open fire bans in parks and campgrounds). Other areas of government policy could have important implications for tourism-recreation sector climate change adaptation in the future, including: establishment of a 12-month school year and post-Kyoto emission reduction targets and mitigation strategies that may affect tourist mobility and demand in some destination regions.

8.2.4.4 Public Education

One of the most successful examples of the use of public education by government to adapt to climatic impacts has been the campaigns on the dangers of UV radiation. Governments around the world and international agencies like the World Health Organization (2002) have developed monitoring tools like the UV Index and combined them with adaptation recommendations for the public that have begun to have documented impacts on public perception of the desirability of a tan and the rates of some skin cancers in some countries. While these public education campaigns represent a public health adaptation and not a tourism-recreation sector specific adaptation, one of the principal target audiences for the UV Index messaging is those engaged in outdoor recreation, whether at the beach or in the backyard.

8.2.4.5 Research

Climate change adaptation research and capacity building in the tourism-recreation sector has been funded by governments at all levels over the past 5 years (e.g., international – NATO, European Science Foundation, European Union, United Nations World Tourism Organization; national governments – Australia, Canada, Finland,

New Zealand, UK; local governments – City of Aspen [USA], Town of Banff [Canada]). Adaptation in the tourism sector remains a key knowledge gap and much more government supported research is needed and expected in the decades ahead, Nowhere is this need more glaring than in developing nations where adaptive capacity is thought to be lowest and where tourism is a major component of the economy (e.g., parts of the Caribbean, Africa, and many Small Island Developing States).

8.2.4.6 Integrated Adaptation

Like tourism operators, climate adaptation by governments typically involves multiple adaptations, which are sometimes integrated as part of a broad adaptation strategy. This integration of adaptations typically occurs at the agency level. Illustrative examples of integrated adaptation can be found in very diverse climatic environments. The range of climate adaptations already in use by the National Capital Commission in Canada for recreation land management and recreation-tourism programming (Table 8.1) provides an example in a temperate nation (Scott et al. 2005b). Here unreliable snow fall, variable spring thaw and growing degree days, and summer temperature extremes each pose challenges for tourism programming.

Table 8.1 Climate adaptations used in tourism programming by the National Capital Commission of Canada (Adapted from Scott et al. 2005b)

Winterlude
• Moved attractions/programming from ice to land locations
• Used refrigerated trucks for the ice sculpture carving contest
• Was converted from a 10-day event to a 3-weekend event to increase the probability of suitable weather during the celebration
• Implemented snowmaking at Snowflake Kingdom to ensure adequate snow supply
• Removed weeds from the canal that could weaken the ice structure (e.g., strength)
• Developed collaborations with local museums to offer package deals that promote non-climate-dependent activities
Tulip festival
• Planted bulbs in shady locations
• Heavily mulched flower beds
• Erected snow fences to increase snow cover on flower beds to delay bulb maturation
• Planted bulbs with different rates of maturation
• Irrigated flower beds during warm/early springs to delay bulb maturation
Canada day
• Educated the public about heat stress
• Provided shade tents and cooling stations
• Position medical staff on stand-by at major events
Gatineau park
• Implemented snowmaking on alpine ski areas
• Developed a cross-country ski track setter for low-snow conditions
• Developed cross-country ski trails in shaded and smoothed-terrain areas that required less snow
• Implemented water quality advisory system in swimming areas

The Great Barrier Reef has experienced several mass coral bleaching events in the past decade (1998, 2002, and 2006). During the 1998 global mass bleaching event about 50% of Great Barrier reefs suffered bleaching; 87% of inshore reefs and 28% of mid-shelf and offshore reefs. Overall about 5% of reefs were severely damaged by this bleaching event (Great Barrier Reef Marine Park Authority 2007a). The Great Barrier Reef suffered the largest mass bleaching event on record in 2002, when 60% of reefs were bleached (Great Barrier Reef Marine Park Authority 2007a). The increasing threat of coral bleaching under projected climate change scenarios inspired the Great Barrier Reef Marine Park Authority to prepare a 'Coral Bleaching Response Plan' (Great Barrier Reef Marine Park Authority 2007b), with the objectives to:

- Improve ability to predict bleaching risk
- Provide early warnings of major coral bleaching events
- Measure the spatial extent of bleaching
- Assess the ecological impacts of bleaching
- Involve the community in monitoring the health of the Reef
- Communicate and raise awareness about bleaching
- Evaluate the implications of bleaching events for management policy and strategies

The Great Barrier Reef Marine Park Authority and the Australian Ministry of Tourism have also considered other technical adaptations, including spraying cooler water from deeper areas onto ocean surface at peak heat times to cool surface waters and protect the corals from being damaged or using awnings or ambrella-like structures on bouys to shade corals in high visitation tourism areas (Sulaiman 2006; Badenschier and Schmitt 2006).

8.2.5 Financial Sector

Climate adaptation by the financial sector, in particular the insurance industry, has already impacted the tourism-recreation sector and increasingly being considered in the context of adapting to future climate change.

8.2.5.1 Business Management

There is growing general consideration of climate change risk in the business community (Reuters 2004; The Wall Street Journal 2005). For example, Hypovereinsbank and Credit Suisse consider climate change in credit risk and project finance assessments (Innovest Strategic Value Advisors 2003). The investment community has also begun to adapt its lending practices to the ski industry. Swiss banks now provide very restrictive loans to ski areas at altitudes below 1,500 m above sea level (Elsasser and Bürki 2002) and banks in Canada have also

discussed the issue of climate change in financial negotiations with ski operators (Scott 2006b).

Climate adaptations by the insurance industry that have affected the availability and affordability of insurance have already affected segments of the tourism-recreation sector. Insurance companies have dropped coverage of certain tourism-recreation properties in US states on the Gulf of Mexico. Following Hurricane Andrew in 1992, US insurance companies realized they had underestimated their exposure in south Florida and would not renew insurance policies for many coastal recreational properties in the region. The State of Florida then created the Florida Windstorm Underwriting Association as an insurer of last resort (Kelly 2001). A number of insurers have also indicated they would no longer insure floating casinos in the Gulf Region. Unless the State of Mississippi changes its law requiring casinos to be water-based, the multi-billion dollar gambling tourism industry that existed prior to Hurricane Katrina is unlikely to be rebuilt.

In recent years, the insurance industry has begun to provide a wider range of insurance and weather derivative products suitable for the tourism-recreation sector. The introduction of weather insurance was a potentially positive development for the ski industry. During the 1999–2000 ski season Vail Resorts in Colorado purchased snow insurance that paid the resort US$13.9 million when low snowfall affected skier visits (Bloomberg News 2004). However, insurance premiums have increased substantially in the last 5 years and large ski corporations like Intrawest and Vail Resorts no longer carry weather insurance because of the high premiums. Snow insurance costs are even more burdensome on smaller business and therefore are unlikely to be used to a great extent by the ski industry in their current form.

8.3 Conclusion

This chapter represents the first attempt to outline the scope of climate adaptation in the tourism-recreation sector and as such is offered as a starting point for future dialogue and research on adaptation in this increasingly important sector of the global economy. Nonetheless, based on this review of the available literature and the authors collective experience a number of conclusions about climate adaptation in the tourism-recreation sector can be drawn.

Climate adaptations by each of the major actor groups in the tourism-recreation sector are not undertaken in isolation as a single discrete action. As noted previously, climate adaptation in the tourism-recreation sector more commonly involves multiple adaptation options that are driven by climate and non-climate factors, sometimes over a span of several years. This is consistent with the findings of Smit et al. (2000) and Adger et al. (2005) in other economic sectors.

The tourism-recreation sector is thought to posses high adaptive capacity overall, although adaptive capacity varies substantially both between actor groups in the tourism-recreation sector (e.g., between tourists and tourism business operators) and within actor groups (e.g., between individual ski area operators). A number

of authors (Wall 1992; Maddison 2001; Elsasser and Burki 2002; Scott 2006a; Gossling and Hall 2006) have theorized that a spectrum of adaptive capacity exists within the tourism-recreation sector and consistently rated the relative adaptive capacity of major actor groups, as we have illustrated conceptually in Fig. 8.1.

Adaptive capacity can also vary substantially among individuals within actor groups. For example, Scott's (2006b) analysis of climate adaptation in the ski industry indicated that ski areas with greater adaptive capacity are characterized by higher elevation terrain or advantageous micro-climates relative to local/regional competition; efficient and extensive snowmaking systems; adequate water supply (with the potential to expand); are located in a region of lower average energy costs; have well diversified resort operations (multiple winter activities and four-season operation); are part of a larger company or regionally diversified ski conglomerate that can provide financial support during poor business conditions; are located in jurisdictions with less land use restrictions (e.g., outside of national parks or in states/provinces where skiing makes a large contribution to the economy); are closer to large urban markets; and have positive relationships with host communities (which may reduce constraints to adaptation).

Within the tourism-recreation sector, adaptations undertaken by one actor group will affect other actors. In some cases, what is adaptation to one tourism-recreation sector stakeholder could be considered maladaptation by other stakeholders. The ability of tourism operators and governments in the Caribbean to use a range of climate adaptations (marketing, pricing, air conditioning, hurricane guarantees, etc.) to substantially increase summer tourism in the region represents successful adaptation by these stakeholders. However, tourist testimonials in Barnes (2002) indicate that at least some tourists believe the marketing campaigns are inaccurate and thus represent a adverse adaptation by the tourism industry.

The available studies that have examined the climate change risk appraisal of tourism operators (Scott et al. 2002; Raksakulthai 2003; Becken 2004; Scott and Jones 2005; Scott et al. 2005b; Sievanen et al. 2005) have consistently found low awareness of climate change and little evidence of long-term strategic planning in anticipation of future changes in climate. Consequently, climate change adaptation by private and public sector tourism-recreation operators is likely to remain reactive and consist mainly of incremental adjustments of existing climate adaptations. There is also some evidence that suggests tourism operators are overestimating their capacity to adapt to future climate change, especially if high emission scenarios are realized (Wolfsegger et al. 2008).

Climate adaptation research in the tourism-recreation sector is 5–7 years behind that of sectors that have been actively engaged in adaptation research (i.e., agriculture – Smit and Skinner 2002, water resources – de Loe et al. 2001, construction – Lowe 2003). In our opinion, the inadequate consideration of adaptation in climate change vulnerability studies within the tourism-recreation sector has had two important consequences. As this chapter illustrates, there exists sizable potential to adapt to climate change in the tourism-recreation sector and as a result some of the existing literature will have overestimated future damages. Future climate change vulnerability assessments in this sector need to minimally identify the range of adaptation options available and discuss how adaptation could alter projected impacts.

The limited discussion of climate change adaptation options has also posed a barrier to engagement and collaboration with the tourism-recreation community. As Grothmann and Pratt (2005:209) suggest, "If only the risks are communicated without communicating adaptation options, people will probably react by avoidant maladaptive responses like denial of risk." The tourism industry is very image sensitive and is therefore very cautious about even acknowledging concerns about climate change risks for fear of adversely affecting their reputation as a destination or sustainable business. If our understanding of the implications of climate change for the tourism-recreation sector is to advance, researchers will need to work hard to better engage the tourism-recreation community in a new generation of multi-disciplinary studies. It is the intent of the International Society for Biometeorology Commission on Climate, Tourism and Recreation to be an important facilitator in this regard.

References

Adger, W.N., Arnell, N. and Tompkins, E. (2005) Adapting to climate change: perspectives across scales, *Global Environmental Change* 15, 75–76.

Badenschier, F. and Schmitt, S. (2006) A Sun Ambrella for the Great Barrier Reef. Speigel Online, 7 November 2006. www.spieget.de/international/0,1518,drunk-446382,00.html

Barnes, B. (2002) The heat wave vacation. The *Wall Street Journal* 2 August, W1

Becken, S. (2004) Climate Change and Tourism in Fiji. Vulnerability, Adaptation and Mitigation. Final Report. Suva, Fiji, University of the South Pacific.

Berrittella, M., Bigano, A., Roson, R. and Tol, R. (2006). A general equilibrium analysis of climate change impacts on tourism. *Tourism Management* 27, 913–924.

Best, A. (2003) Is it getting hot in here? *Ski Area Management*, May, 57–76.

Black, R. (2006) Tower of London on climate list. www.news.bbc.co.uk/go/pr/fr/-/2/hi/science/nature/4810826.stm (accessed 17 March 2006).

Bloomberg News (2004) Operator betting on nature instead of snow insurance, *Financial Post* 12 January, FP5.

Bly, L. (2006) More travel firms offer hurricane 'guarantees'. USA Today, 2 June 2006. 9D.

Braun, O, Lohmann, M, Maksimovic, O, Meyer, M, Merkovic, A, Riedel, A and Turner, M. (1999) Potential impact of climate change effects on preferences for tourism destinations. A psychological pilot study. *Climate Research* 11, 247–254.

Breiling, M. and Charamza, P. (1999) The impact of global warming on winter tourism and skiing: a regionalized model for Austrian snow conditions, *Regional Environmental Change* 1(1), 4–14.

Bürki, R. (2000) Klimaaenderung und Tourismus im Alpenraum – Anpassungsprozesse von Thouristen und Tourismusverantwortlichen in der Region Ob- und Nidwalden, Ph.D. dissertation, Department of Geography, Zurich, University of Zurich.

Butler, R. and Jones, P. (2001) Conclusions – problems, challenges and solutions. In: A Lockwood and S. Medlik (Eds.). *Tourism and Hospitality in the 21st Century*. Oxford, Butterworth-Heinemann, pp. 296–309.

Cesar, H. (2000). *Impacts of the 1998 Coral Bleaching Event on Tourism in El Nido, Phillippines*. Prepared for Coastal Resources Center Coral Bleaching Initiative. Narragansett, RI, USA: University of Rhode Island.

de Freitas, C. (1990) Recreation climate assessment. *International Journal of Climatology* 10, 89–103.

de Freitas, C. (2003) Tourism climatology: evaluating environmental information for decision making and business planning in the recreation and tourism sector, *International Journal of Biometeorology* 4, 45–54.

de Loe, R., Kreutzwiser, R. and Moraru, L. (2001) Adaptation options for the near term: climate change and the Canadian water sector. *Global Environmental Change* 11, 231–245.

Egan, T. (2005) The race to Alaska before it melts. *The New York Times*, 26 June.

Elsasser, H. and Bürki, R. (2002) Climate change as a threat to tourism in the Alps, *Climate Research* 20, 253–257.

Giles, A. and Perry, A. (1998) The use of a temporal analogue to investigate the possible impact of projected global warming on the UK tourist industry. *Tourism Management* 19(1), 75–80.

Gomez-Martin, M.B. (2005) Weather, climate and tourism – a geographical perspective, *Annals of Tourism Research* 32(3), 571–591.

Gössling, S. and Hall, C.M. (2006) An introduction to tourism and global environmental change. In: S. Gössling and C.M. Hall (Eds.). *Tourism and Global Environmental Change*. London, Routledge, pp. 1–34.

Great Barrier Reef Marine Park Authority (2007a) Coral Bleaching on the Great Barrier Reef.
http://www.gbrmpa.gov.au/corp_site/info_services/science/climate_change/climate_change_and_the_great_barrier_reef/coral_bleaching_on_the_great_barrier_reef

Great Barrier Reef Marine Park Authority (2007b) Great Barrier Reef Coral Bleaching Response Plan 2006–2007. http://www.gbrmpa.gov.au/__data/assets/pdf_file/ 0020/13169/Coral_Bleaching_Response_Plan_2006–07_Final.pdf.

Greenwood, J. (2004) Investors wait since 1991 on ski resort plan: regulatory faceoff, *Financial Post*, 12 January, FP1 and 5.

Grothmann, T. and Pratt, A. (2005) Adaptive capacity and human cognition: the process of individual adaptation to climate change. *Global Environmental Change* 15, 199–213.

Hamilton, J., Maddison, D. and Tol, R. (2005) Effects of climate change on international tourism. *Climate Research* 29, 245–254.

Innovest Strategic Value Advisors (2003) *Carbon Finance and the Global Equity Markets*. Carbon Disclosure Project, London.

Intergovernmental Panel on Climate Change (2001) Climate Change 2001: Impacts, Adaptation and Vulnerability, Third Assessment Report. Geneva, Switzerland, United Nations Intergovernmental Panel on Climate Change.

Jahn, G. (2005) Glacial Cover-Up Won't Stop Global Warming, 17 July Associated Press. http://abcnews.go.com/International/wireStory?id = 947283&CMP = OTC-RSSFeeds0312 (accessed 26 January 2006).

Johnson, A. (2005) Early start to hurricane season forces travelers, resorts to adjust. *The Wall Street Journal*, 21 July, D5.

Jones, B. and Scott, D. (2006a) Climate Change, Seasonality and Visitation to Canada's National Parks. *Journal of Parks and Recreation Administration* 24(2), 42–62.

Jones, B. and Scott, D. (2006b) Implications of Climate Change for Visitation to Ontario's Provincial Parks. *Leisure* 30(1), 233–261.

Kelly, N. (2001) Recreation and Tourism. In: *Climate Change and Insurance*. The Chartered Insurance Institute, London, pp. 27–34.

König, U. (1998) Tourism in a Warmer World: Implications of Climate Change due to Enhanced Greenhouse Effect for the Ski Industry in the Australian Alps, Wirtschaftsgeographie und Raumplanung, vol. 28, Zurich, University of Zurich.

König, U., Abegg, B. (1997) Impacts of climate change on tourism in the Swiss Alps, *Journal of Sustainable Tourism* 5(1), 46–58

Lise, W. and Tol, R. (2002) Impact of climate on tourist demand. *Climatic Change* 55, 429–449.

Lowe, R. (2003) Preparing the built environment for climate change, *Building Research and Information* 31(3–4), 195–199.

Maddison D. (2001) In search of warmer climates? The impact of climate change on flows of British tourists. *Climatic Change* 49, 193–208.

MacInnis, L (2006) Swiss ski resort tries to cover up climate change. PlanetArk World News. www.planetark.org/avantgo/dailynewsstory.cfm?newsid = 35717 (accessed 20 March 2006).

Melting Mountains (2006) http://meltingmountains.org/ (accessed 29 March 2006)

MyClimate (2006) http://www.myclimate.org/index.php?&lang = en (accessed 29 March 2006).

National Research Council (2003) Critical Issues in Weather Modification Research. Committee on the Status and Future Directions in US Weather Modification Research and Operations. Washington, DC, National Research Council.

National Ski Areas Association (2006) Available http://www.nsaa.org/nsaa/press/2005/04–05-sa-number-history.pdf (accessed 11 January 2006).

Pack, T. (2004) Florida tourism problem. Hotel Online – News for the Hospitality Executive. www.hotel-online.com/News/PR2004_4th/Oct04_FloridaNextYear.htm (accessed 28 July 2005).

Pain, J. (2005) Florida tourism flying high despite'04 hurricanes. USA Today. www.usatoday.com/weather/hurricane/2005–06–14-florida-tourism_x.htm (accessed 25 July 2005).

Parry, R. (2005) Cherry Trees Programmed to Blossom for Tourists. The Times Online. 9 June 2005. www.timesonline.co.uk/

Prideaux, B. (2006) The use of scenarios to project the imapct of global warming on future visitation to the Great Barrier Reef. ATLAS Asia Pacific 2006 Conference – Tourism After Oil. 2–5 December. Dunedin, New Zealand.

Raksakulthai, V. (2003) Climate Change Impacts and Adaptation for Tourism in Phuket, Thailand. Pathumthai, Thailand: Asian Disaster Preparedness Centre.

Reuters (2004) Climate Change Seen Climbing Agendas-Investor Group, 18 May 2004.

Richardson, R., Loomis, J. (2004) Adaptive recreation planning and climate change: a contingent visitation approach. *Ecological Economics* 50, 83–99.

Scott, D. (2006a). Climate change and sustainable tourism in the 21st century, in Cukier, J. (Ed.). *Tourism Research: Policy, Planning, and Prospects – 2003*. Department of Geography Publication Series, University of Waterloo, Waterloo, Canada.

Scott, D. (2006b) Ski Industry Adaptation to Climate Change: Hard, Soft and Policy Strategies. In: S. Gossling and M. Hall (Eds.). *Tourism and Global Environmental Change*, London, Routledge, pp. 262–285.

Scott, D. (2006c). Global environmental change and mountain tourism. In: S. Gossling and C.M. Hall (Eds.). *Tourism and Global Environmental Change*. London, Routledge, pp. 54–75.

Scott, D. and Jones, B. (2005) Climate Change and Banff: Implications for Tourism and Recreation – Executive Summary, Town of Banff, Banff, Alberta, Canada.

Scott, D. and Jones, B. (2006a) Climate Change and Nature-Based Tourism: Implications for Parks Visitation in Canada. Technical Report to the Government of Canada Climate Change Action Fund – Impacts and Adaptation Program. University of Waterloo, Faculty of Environmental Studies, Waterloo, Canada.

Scott, D. and Jones, B. (2006b) Climate Change and Outdoor Recreation in Canada. Technical Report to the Government of Canada Climate Change Action Fund – Impacts and Adaptation Program. Waterloo, Canada: University of Waterloo, Faculty of Environmental Studies.

Scott, D., Jones, B., Lemieux, C., McBoyle, G., Mills, B., Svenson, S. and Wall, G. (2002) *The Vulnerability of Winter Recreation to Climate Change in Ontario's Lakelands Tourism Region*. Waterloo, Canada, University of Waterloo, Department of Geography Publication Series, Occasional Paper 18.

Scott, D., Wall, G. and McBoyle, G.(2005a) The evolution of the climate change issue in the tourism sector. In: C.M. Hall and J. Higham (Eds.). *Tourism, Recreation and Climate Change*. Channelview Press, London, pp. 44–60.

Scott, D., Jones, B., Abi Khaled, H. (2005b) Climate Change: A Long-Term Strategic Issue for the NCC. Implications for Recreation-Tourism Business Lines. Report prepared for the National Capital Commission. University of Waterloo, Department of Geography, Waterloo, Ontario.

Scott, D., Jones, B., Konopek, J. (2007) Implications of climate and environmental change for nature-based tourism in the Canadian Rocky Mountains: A case study of Waterton Lakes National Park. *Tourism Management*, 28(2), 570–579.

Scott, D., Jones, B., McBoyle, G. (2006) Climate, Tourism and Recreation: A Bibliography 1936 to 2005. University of Waterloo, Department of Geography, Waterloo, Ontario. Available at: http://www.fes.uwaterloo.ca/geography/faculty/dscott.html

Simmons, P. (2005) Swiss plan to wrap up their glaciers, The Times, 30 March, p. 66.

Smit, B. and Skinner, M. (2002) Adaptation options in agriculture to climate change: a typology, *Mitigation and Adaptation Strategies for Global Change* 7, 85–114.
Smit, B. Burton, I., Klein, R., Wandel, J. (2000) An anatomy of adaptation to climate change and variability, *Climatic Change* 45(1): 233–51.
Sievanen, T., Tervo, K., Neuvonen, M., Pouta, E., Saarinen, J., Peltonen, A. (2005) Nature-based tourism, outdoor recreation and adaptation to climate change. FINADAPT Working Paper 11. Helsinki: Finnish Environment Institute.
Sulaiman, Y. (2006) Australia considers hosing the Great Barrier Reef. eTN Pacific, 7 November 2006.
The Economist (1998) Winter wonderlands, *The Economist*, 31 January.
The Wall Street Journal (2005) 'Investors Request Data on Company Emissions, 2 February 2005.
USA Today (2005) Florida's hurricanes boost Arizona tourism. www.usatoday.com/travel/news/2004–10–11-az-hurrican_x.htm (accessed 29 July 2005).
Uyarra M., Cote I., Gill, J., Tinch, R., Viner, D., Watkinson, A. (2005) Island-specific preferences of tourists for environmental features: Implications of climate change for tourism-dependent states. *Environmental Conservation* 32(1), 11–19.
Wall G. (1992) Tourism alternatives in an era of global climate change. In: V. Smith and W. Eadington (Eds). *Tourism Alternatives*. University of Pennsylvania, Philadelphia, pp. 194–236
Wall, G. and Badke, C. (1994) Tourism and climate change: an international perspective, *Journal of Sustainable Tourism* 2(4), 193–203.
Wheeler, D. (1995) Majorca's water shortages arouse Spanish passions. *Geography* 80, 283–286.
Williams, D. (2005) Wilma deals $800 million blow to Mexico travel industry. www.cnn.com/2005/travel/10/26/wilma.mexico.travel/index.html (accessed 27 October 2005).
Wilton D. and Wirjanto T. (1998) An analysis of the seasonal variation in the national tourism indicators. Canadian Tourism Commission, Ottawa, Canada.
Wolfsegger, C., Gossling, S., and Scott, D. (2008). Climate change risk appraisal in the Austrian ski industry. *Tourism Review International* (in press).
World Health Organization (2002) *Global Solar UV Index: A Practical Guide*. World Health Organization, Geneva, Switzerland.
World Travel and Tourism Council (2006) *Executive Summary: Travel and Tourism Climbing to New Heights*. World Travel and Tourism Council, London.
World Tourism Organization (2003) Climate Change and Tourism. Proceedings of the First International Conference on Climate Change and Tourism, Djerba, 9–11 April, Madrid, World Tourism Organization.
World Tourism Organization (2006) *UNWTO World Tourism Barometer* 4 (1).
World Tourist Organization (1998) *Tourism 2020 Vision*. WTO Publications Unit, World Tourism Organization, Madrid, Spain.