Managing Leisure 11, 151–163 (July 2006)

Routledge
Taylor & Francis Group

Climate change, tourism and outdoor recreation in Europe

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Climate change is now firmly recognized by the majority of the world's scientists and governments as an issue of extreme concern for the global population. Outdoor recreation and tourism are likely to be impacted directly and indirectly by such change, as both the climate, and the natural environment associated with it, continue to alter. At the same time, however, tourism activity is itself a contributor to the problem of climate change due to its dependency on fossil fuel consumption. The purpose of this paper is to introduce the reader to the relationships between climate change, and outdoor recreation and tourism, in Europe through a review of the relatively limited empirical evidence on this subject to date. Topics discussed include the potential impacts of projected climate change on human health and comfort, possible shifts in preferred destinations, and potential alterations in current patterns of seasonality. Various avenues of future research are also proposed.

INTRODUCTION

As the phenomenon of climate change is increasingly recognized as scientific certainty, and assessed in terms of likely rate and magnitude rather than merely a potential occurrence, the exploration of its possible impacts on the human and natural environment becomes ever more pressing. As noted by the European Environment Agency (2005, p. 16), 'Climate change and its impacts are becoming more visible in Europe and are projected to become more pronounced in the future'. Individual comments regarding the issue have been more dramatic; David King, chief scientific adviser to the UK government, has described climate change as 'the most severe problem that we are facing today' (2004, p. 176).

Tourism, one of the largest industries in the global economy, and outdoor recreation, representing the activities in which virtually all residents and tourists engage on a relatively regular basis, will not remain immune to the effects of climate change. Rather, considering the acute dependence of many forms of tourism and outdoor recreation on favourable atmospheric conditions, the relative dearth of discussion of this issue, in both research and policy settings, is unexpected. According to Higham and Hall (2005, p. 307), editors of the first ever edited volume addressing the interrelationships between tourism, recreation and climate change, 'Understanding and responding to climate change represents one of the more important, complex and challenging issues facing the contemporary tourism and recreation industries'.

The purpose of this paper is to introduce the reader to the potential implications of climate change for outdoor recreation and tourism in Europe. In the next section, the importance of tourism and outdoor recreation

Managing Leisure ISSN 1360-6719 print/ISSN 1466-450X online © 2006 Taylor & Francis
http://www.tandf.co.uk/journals
DOI: 10.1080/13606710600715226

throughout the continent is established. Current and projected future climatic conditions are then described. Following this, potential implications of projected climate change for European tourism and outdoor recreation are summarized via a review of the empirical evidence on this topic to date. The contributions of tourism and outdoor recreation activity to the problem of climate change are then described. Finally, avenues of future research are suggested.

TOURISM AND OUTDOOR RECREATION IN EUROPE

Europe remains the world's most popular tourism destination region, receiving an estimated 416.4 million international tourists in 2004, representing 54.5% of global arrivals. Of the world's top ten destination countries (by international arrivals), six were European in 2004. Similarly, Europe dominates in terms of tourism receipts; 52.5% of tourism earnings, worth US$326.7 billion (euro 262.6 billion), accrued to the region in 2004, and seven of the top ten tourism earners were located on this continent. While France, Spain and Italy remain the three most visited countries in Europe, the popularity of other southern, and several central and eastern, nations continues to grow steadily (World Tourism Organization, 2005).

European dominance of the global tourism market is predicted to continue into the 2020s, despite higher-than-average growth in the Asian inbound markets. According to the World Tourism Organization's *Tourism 2020 Vision* (cited in World Tourism Organization, 2005), international arrivals are expected to exceed 1.56 billion by the year 2020. Of this number, 717 million arrivals (46%) are forecasted for Europe.

Statistics regarding levels of participation in outdoor recreation in Europe tend to be collected at the national level and are not always easy to locate. Suffice it to say that, 'People's recreational use of leisure time will almost inevitably at some stage include outdoor recreation. This is currently true for 90% of those who live in Western countries, and, for many of these participants, it is ... this form of recreation, which represents a very important part of their lives' (Devlin, 1992, p. 5, in Pigram and Jenkins, 1999, p. 11).

CLIMATE AND CLIMATE CHANGE IN EUROPE

In this section, historical, current and projected future climatic conditions throughout the continent of Europe are described.

Historical and current climate conditions

European climate varies naturally with latitude (from Arctic in the North to Mediterranean in the South), longitude (from maritime in the West to continental in the East), and topography. The summary provided is, therefore, European-wide rather than country-specific.

The climate in the countries of Western Europe (e.g., the British Isles) can be described as cool temperate, with winter temperatures in the range of 0°C to 10°C and little snow other than on high ground. These mild temperatures are often accompanied by clouds, drizzle, fog and strong winds. Summers in the cool temperate zone tend to be cool (with a maximum temperature less than 25°C) and cloudy. In Eastern Europe, a continental climate predominates, with cold, snowy winters (below 0°C for 1–5 months), hot summers with moderate rainfall, and pronounced seasonal differentiation. The warm Mediterranean climate of southern Europe is currently one of the world's most ideal for summer beach tourism. The Mediterranean countries experience cool winters with moderate

rainfall, and warm to hot, dry summers with abundant sunshine, though the lack of rainfall can be problematic in terms of water supply and fire hazard (Boniface and Cooper, 2005).

Climate conditions in Europe have not remained static in the recent past, however. The temperature across the continent has risen by an average of 0.95°C over the past century. Further, the 1990s were the warmest decade ever recorded, and three of the hottest years on record—1998, 2002 and 2003—have occurred in the last 6 years (European Environment Agency, 2005).

Projected future climate conditions

According to the Intergovernmental Panel on Climate Change's (IPCC, 2001) summary of the climate change scenarios generated for the European region, a number of broad projections may be made regarding Europe's future climatic conditions (relative to a baseline of present-day conditions represented by historical conditions for the years 1961 to 1990). All the simulations reviewed indicated future warming across the entire continent and in every season, with an average rate of between 0.1 and 0.4°C per decade suggested. Warming is not expected to be uniform across the region, however; rather, it is likely to be most intense over southern (Spain, Italy, Greece) and northeast (Finland, western Russia) Europe and weakest along the Atlantic coastline. Winter warming is predicted to be strongest in the continental interior of eastern Europe and western Russia (at a rate of 0.15–0.6°C per decade), while summer warming is likely to be most noticeable in southern Europe (at a rate of between 0.2 and 0.6°C per decade, compared to northern Europe's rate of between 0.08 and 0.3°C every 10 years). Across the continent as a whole, cold winters are expected to become significantly more rare as soon as the 2020s, and virtually disappear by the 2080s. In contrast, hot summers will likely become much more common. By the 2080s, projections suggest that almost every summer will be hotter than what is currently defined as the one-in-ten hot summer (IPCC, 2001).

In terms of precipitation, while northern Europe is expected to experience increases of between +1 and +2% per decade, southern Europe is projected to experience small decreases (of a maximum of −1% per decade). In central Europe (France, Germany, Hungary, and Belarus), evidence remains somewhat ambiguous. Patterns of projected precipitation change vary substantially by season. The majority of European countries are expected to get wetter in winter (at a rate of between +1 and +4% per decade), though the Balkans and Turkey are likely to experience drier winters. While northern Europe is projected to experience increases in precipitation of as much as +2% per decade in the summer season, southern Europe might dry by as much as −5% of precipitation every decade (IPCC, 2001).

A key likelihood associated with global climate change is an increase in the occurrence of extreme weather events. In the case of Europe, these are most likely to manifest themselves as more frequent and intense summer heat waves, more frequent and intense winter precipitation events, and more frequent gales. Summer drought risk is likely to increase across the central and southern regions of the continent. Of final note are projections concerning global mean sea level; this level is likely to rise by between 13 and 68 cm by the 2050s (IPCC, 2001).

IMPLICATIONS OF CLIMATE CHANGE FOR TOURISM AND OUTDOOR RECREATION IN EUROPE: A REVIEW OF EMPIRICAL EVIDENCE

The projected changes in Europe's climate as identified above have both direct and

indirect implications for tourism and outdoor recreation activity. The direct, or primary, impacts of climate change on tourism include those caused by changes in temperature, precipitation and/or other climatic variables, e.g., wind speed, humidity, or snow depth, that have a direct effect on the activities and experiences of tourists or outdoor activity participants. These changes in climatic conditions, and the changes in the enjoyment of outdoor activities that may result from them, can cause participants to alter the frequency, duration, timing, and/or location of future activity, or to shift to a different activity altogether. In addition, climate change may alter the distributions and compositions of natural resources such as flora and fauna at a location. Such shifts in wildlife and vegetation may be the cause of indirect, or secondary, impacts on tourism and outdoor recreation, as participants alter their activities to account for changes in the natural environment, themselves a result of changes in climatic conditions.

Since the tourism resources of the European region are so many and varied, it is impractical to attempt to assess the implications of projected changes in climate on all types of destination. Rather, as have most analyses of these implications to date, this review concentrates primarily on two major categories of tourism attraction: the Mediterranean, and mountainous regions. In addition, however, potential impacts in urban areas will also be considered; together, these three broad types of venue—the coast, mountains, and cities—account for a good proportion of outdoor recreation and tourism destinations in the region and their consideration provides ample illustration of the likely impacts of climate change. In each of the three categories, potential adaptation strategies are also identified and, where, relevant, their feasibility discussed.

Tourism in the Mediterranean

The annual movement of northern Europeans to the countries of the Mediterranean coast in search of the traditional summer 'sun and sand' vacation is the single largest flow of tourists across the globe, accounting for one-sixth of all tourist trips in 2000 (Todd, 2003). According to Perry (1993), 70–80% of holiday-makers from the United Kingdom cite better climate abroad as the primary reason for their trip. Maddison (2001) found that British tourists prefer destinations in which the average daytime maximum deviates little from 30.7°C, though Lise and Tol (2002) suggested that 21°C (with a standard deviation of 3.4°C) is the ideal average temperature for the majority of international (from the countries of the Organization for Economic Cooperation and Development) tourists. However, regardless of these variations, the evidence suggests that the long-standing tradition of a summer holiday on the Med may be severely impacted by projected changes in climate. This statement is supported by the work of Morgan *et al.* (2000), who found that, based on a beach climate index incorporating measures of thermal sensation (skin temperature), precipitation, sunshine and wind speed, many southern and eastern Mediterranean beach destinations already become unpleasantly hot for beach use by northern Europeans during July and August.

Todd (2003) has documented the potential impacts of climate change on travel to and within Europe based on the regional predictions of climate change developed by the Climatic Research Unit at the University of East Anglia, UK. His assessment suggests that the combination of warmer, drier and more reliable summers in the countries of northern Europe, and substantially warmer, drier summers in the Mediterranean countries (especially those in the east), may significantly alter the flow of tourists

to and within the continent. An increase in the heat index, coupled with a rise in the number of days exceeding 40°C, is likely to leave many of the countries of southern Europe simply too hot for human comfort in the summer months. These areas are also likely to experience: more frequent and more severe droughts and flash floods; an increase in the risk of fire and water shortages; sea level rise, which may lead to coastal erosion, beach degradation, the salinization of aquifers and habitat loss; and increased vulnerability to tropical diseases such as malaria. As a result, it is likely that the countries of northern Europe are likely to benefit during the traditional summer season, as recipients of increased visits by both domestic and international tourists, at the expense of the currently popular destinations of southern Europe.

Giles and Perry (1998) used the unusually hot summer of 1995 as a temporal analogue to investigate the potential impacts of projected climate change on the tourism industry in the UK. Data for that year suggested that, while many overseas package holidays remained unsold, domestic tourism, notably to the many traditional UK seaside resorts, burgeoned. A survey of the 14 British regional tourist boards (of which ten responded) revealed that nine of these regions experienced considerable increases in value and volume in the year in question. However, when asked whether the UK would become a more attractive tourism destination in the future as a result of global warming, five of the tourist boards responded negatively, four indicated that they did not know, and only one thought there was any potential for gain in the market. As noted by Giles and Perry, these findings suggest the need for higher levels of awareness and understanding of climate change as a potential influence on tourism activity among UK tourism organizations and operators. Nevertheless, this study does support the notion of a declining summer season in the Mediterranean region should climate change continue unabated. Similarly, Agnew (1997) documented the likely impacts of an increase in the frequency of warmer, drier summers for the UK tourism industry. She also noted the potential shift in the balance of domestic versus international summer travel, as well as a similar shift from indoor to outdoor attractions, both of which have substantial implications for future investment in tourism infrastructure and related tourism goods and services, as well as for the management of the UK transport system. Of relevance to these UK findings, Lise and Tol (2002) found that, during summers just 1°C warmer than the average, the number of domestic holidays taken by Dutch tourists increases by 4.7%.

While the Mediterranean region is likely to experience substantial declines in visitation during the current high season, these declines are likely to be offset at least partially by increasing numbers of visitors in the current shoulder (spring and autumn) months. Such shifts in visitation patterns would have a series of significant managerial implications, on hiring practices, supply chains, cash flow, and the development of effective and appropriate marketing campaigns. The range of environmental impacts identified above also have serious implications for the future planning and development of tourism attractions in the Mediterranean region, including the potential need for the construction of new and improved sea defences, and new regulations and/or incentives regarding coastal setbacks and the use of traditional building designs and materials in order to minimize rising energy costs. The supply of water is also likely to become an increasingly contentious issue, particularly between local residents and the providers of tourism attractions such as golf courses and swimming pools, and many providers will likely face a rise in the cost of insurance due to the increasing

frequency and severity of extreme weather events (Todd, 2003; Perry, 2005). Perry (2005) has highlighted the health and safety threats to campers and caravanners in the face of extreme heat, drought and fire, as demonstrated with tragic consequences during the summer of 2003.

Mountain tourism

The majority of the work addressing the impacts of climate change on European mountain regions has focused on the Alps and the Scottish Highlands. According to the IPCC (2001), the Alps are in future likely to experience winters that are slightly milder, with increased precipitation, and summers that are warmer and drier. Such changes in temperature and precipitation could have both direct and indirect impacts on tourism and outdoor recreation activity, the former due to the rising snowline (which rises by about 150 metres with every 1°C rise in temperature) and the latter due primarily to the sensitive nature of mountain ecosystems in which many species exhibit limited tolerance for either temperature or altitudinal change.

A series of papers (Koenig and Abegg, 1997; Elsasser and Messerli, 2001; Elsasser and Bürki, 2002) has investigated the potential impacts of climate change on mountain tourism in the Alps in Switzerland. Koenig and Abegg (1997) assessed the impacts of three consecutive snow-deficient winters (1987/88 to 1989/90), as potential precursors to future conditions under climate change, on winter tourism in this region. Their analyses suggested that, while ski resorts at lower altitudes suffered extremely negative consequences as a result of the warmth and lack of snow, those at higher elevations enjoyed longer and more profitable seasons.

In the second part of their paper, the authors examined the snow-reliability of Swiss ski resorts under current and future climate conditions. Based on earlier studies of the criteria necessary to operate a ski area at a profit, which suggested the need for at least 100 days of sufficient snow cover (30 cm or more) per season, the line of snow reliability was defined at 1,200 m under present climate conditions and at 1,500 m under a 2°C temperature rise. The analyses suggested that 85% of existing Swiss ski areas and 40% of existing single ski-lifts were snow-reliable under the 1,200 m minimum requirement, but that these percentages would drop to 63% and 9%, respectively, under a scenario of a 2°C temperature rise. There were considerable variations in snow-reliability by region, however, with ski areas in the regions of Valais and Grisons demonstrating the highest level of resilience to warmer conditions. The authors identified at least two significant implications of these findings: the loss of ski tourism as an economic base in many of the lower altitude areas with the poorest levels of snow reliability, and the potential for increased environmental pressures at higher altitudes as the industry concentrates in these more reliable regions and the numbers of resorts, runs and skiers rise. These problems would be exacerbated further should the snow line rise to 1,800 m. As reported by Elsasser and Messerli (2001), the percentage of existing Swiss ski areas able to operate at a profit under such conditions would drop to 44%.

Breiling and Charamza (1999) provide similar evidence regarding the potential impacts of climate change on winter tourism in an Austrian context. Assuming a 2°C increase in temperature but no change in precipitation, the authors found that in Austria, as in Switzerland, the vulnerability of snow depth and cover to climate change decrease with altitude, and that the negative impacts of warming on the winter tourism industry will occur to a disproportionate degree at lower altitudes. A United Nations report has estimated that the decimation of

the Austrian ski industry would reduce the country's gross national product by 5%, while Switzerland's losses are likely to approach GB£1 billion per annum (Bürki *et al.*, 2003).

While the ski industry in the Scottish Highlands may be considerably smaller than that in the Alps, the degree of dependence of many local communities on winter tourists is equally substantial. Harrison *et al.* (1999) have suggested that climate change in this region, characterized by a shift to a more westerly maritime climate, could result in an increase in the frequency of snow-free months in lowland areas (below 100 m) and a large decline in the duration of snow cover in the 500–1000 m range, but substantially slighter declines in areas above 1000 m. Harrison *et al.*'s (2005) survey of winter tourism stakeholders including snow-sports organizations, ski clubs, mountain guides and climbing instructors indicated a general consensus among winter tourism providers that snow cover in this region has already become unreliable other than in the very highest regions. In 2004, two of Scotland's five ski resorts were put up for sale as a result of large financial losses directly linked to inadequate snow conditions (Seenan, 2004, in Hall and Higham, 2005).

The projections of declining snow depth and increasingly unreliable snow cover summarized above present a range of management implications for the winter tourism industry across Europe. While exact predictions of the magnitude and timing of the changes suggested cannot be given, it is evident that this sector must begin planning now for a substantially warmer future. Elsasser and Bürki (2002) have suggested a range of potential adaptation strategies in the context of ski tourism, as illustrated in Table 1.

The maintenance of profitable ski tourism areas under warmer climatic conditions will require one or more adaptation measures, each with their own implications for winter tourism providers. One key technological adaptation to snow deficiency is the adoption of artificial snow-making capabilities, a strategy that has been shown to offer considerable promise in a Canadian context (Scott *et al.*, 2003). Though the potential contributions of snow-making technology to the viability of European winter tourism operations have yet to be modelled by researchers, it is important to note the considerable costs associated with this measure. As described by Elsasser and Bürki (2002) and Scott *et al.* (2003), snowmaking facilities are expensive to construct and maintain, and require considerable quantities of water and energy to operate. It is, therefore, likely that many of the small-to-medium size ski

Table 1 Climate change adaptation strategies for the ski tourism industry

Strategy	Specific Measures
Maintenance of ski tourism industry at its current level	(Increased) Adoption of artificial snow-making technologies (Increased) Development at higher elevations
Provision of subsidies to ski tourism providers	Annual subsidies One-time subsidies
Development of alternatives to ski tourism	Other winter (non-snow dependent) activities Summer activities/year-round tourism
Fatalism	Business-as-usual Abandon ski tourism

Source: Elsasser and Bürki, 2002.

areas would be unable to afford the adoption of such technology. In addition, artificial snowmaking requires certain climatic conditions, including minimum temperatures, to be met; thus, this technique may in some situations be precluded by the rises in temperature associated with global warming.

The development of new ski areas at higher elevations is another adaptation measure that tends to favour large ski corporations over smaller, family-owned businesses. Such development would also present a host of environmental and safety issues which the industry would need to successfully confront in order to maintain the industry in a viable manner. These include increased pressure (from new construction, increased waste generation, etc.) on the pristine upper Alpine environment, and the dangers associated with accessing and safely navigating the highest, steepest slopes (where wind speeds and wind chill are frequently extremely high and where the risk of avalanches is likely to be increased due to the warmer temperatures), especially for inexperienced skiers (Koenig and Abegg, 1997; Harrison *et al.*, 1999). As recently described in *The Observer* (Anonymous, 2004), plans to develop high altitude resorts in several of the Alpine countries have already caused considerable controversy between development companies and environmental organizations, as well as intense political dilemmas for local and regional governing bodies.

For ski areas that are unable to relocate to higher elevations or implement snowmaking technologies, a range of other adaptation strategies do exist. These include the development of alternatives to ski-based tourism, the acceptance of government subsidies (on a one-time-only or annual basis), or the adoption of what Elsasser and Bürki (2002) label a fatalistic approach. Development of alternatives to the current dependence on ski tourism as the sole source of revenue can occur at two levels, non-snow-based activities that can be offered during the winter season in addition to, or instead of, skiing, and activities such as hill walking, mountain biking, and golf that can be offered in the off-season, i.e., in the spring, summer and autumn months. The construction of conference facilities in combination with the offering of a wide range of outdoor recreational activities throughout the seasons can provide resorts with a steady, year-round source of income that is less reliant on climatic conditions. Again, the development of such alternatives requires an initial outlay of capital which may exceed the abilities of smaller ski businesses, thus, such enterprises are the most likely to be forced to rely on subsidies (where they are available) or close down their facilities completely.

As suggested above, the potential adaptation strategies available to the mountain tourism industry should not be considered in isolation from the perceptions and likely reactions of tourists. The adaptation strategies likely to be adopted by tourists are extremely under-researched, and only two studies appear to have addressed this issue with respect to skiing. König (1998, in Scott *et al.*, 2003) found that the response to projected climate change varied with skill level. Specifically, while one-half of experienced skiers reported that they would be willing to travel to other countries in order to find quality snow conditions, only 18% of inexperienced skiers indicated that they would be willing to engage in that activity. A further 16% of inexperienced skiers reported that they would discontinue skiing should the changes in climate suggested to them by the researcher actually occur. Bürki (2000, in Bürki *et al.*, 2005) also found that almost one-half of skiers (of an unspecified skill level) would search for new resorts with more reliable snow conditions in the face of climate change, while 32% would ski less frequently and only 4% would give up the activity altogether.

Urban tourism

A vast array of historical and cultural attractions are located throughout Europe's cities, and a large number of both domestic and international tourists flock to these urban areas each year to appreciate this rich heritage. According to Paskaleva-Shapira (2003), city tourism is the fastest growing economic sector in Europe. While there appear to have been no studies that have focused specifically on the potential implications of climate change for urban tourism, it is possible to make broad generalizations regarding the impacts of warmer conditions on city tourists' comfort and health.

Rising temperatures are likely to cause an increase in heat stress and decrease in air quality in urban areas, especially those in central and southern Europe which already experience hot summers. This is a result of the urban heat island effect, whereby urban areas experience sometimes substantially higher maximum temperatures due to the differences in absorption and radiation of heat by buildings compared to rural areas where evaporative cooling from vegetation is much more pronounced (McEvoy, 2005). Such changes have implications for both inbound tourism from other areas (which may decrease at especially uncomfortable times of the year) and outbound tourism by urban dwellers (which may see a concomitant increase). Such changes may cause particular problems for the organization of outdoor events in urban areas, e.g., festivals, concerts and sports competitions, as well as for urban dwellers' daily enjoyment of outdoor amenities such as public parks and outdoor cafes; Nikolopoulou (2001) has demonstrated that microclimatic conditions do indeed influence the use of urban open space. At a minimum, increased temperatures and reduced air quality may result in higher incidences of respiratory problems; at worst, previous heat waves in European cities, e.g., in London in 1976 and 1995, in Athens in 1987, and Paris in 2003, have been associated with substantial increases in mortality, especially amongst the elderly (as detailed in IPCC, 2001, and Hall and Higham, 2005). However, for cities in northern Europe, warmer conditions may prove to be a substantial boon, enabling the traditional, outdoor culture of southern European cities to be transferred to their streets and other public spaces and, potentially, improving their attractiveness as tourism destinations (McEvoy, 2005).

Again, a variety of adaptation strategies are available. Among providers, these might include the increased adoption of air conditioning technologies, alterations to the timing of events (whether to a cooler month, or a cooler time of day), and the movement of events and attractions into indoor settings. On the part of visitors, changes in the timing (of day or season), setting (indoor or outdoor), and location (domestic or international; urban, rural or coastal) of activity are all means of adaptation, as is the switch to an entirely different activity or city.

CONTRIBUTIONS OF OUTDOOR RECREATION AND TOURISM TO CLIMATE CHANGE

Thus far, this paper has concentrated on the potential impacts of climate change on tourism and outdoor recreation in Europe. The relationship between climate change, and recreation and tourism, is of a two-way nature, however, and tourism in particular is a major contributor to global warming due to the greenhouse gas emissions associated with tourism activity. According to Gössling (2002), approximately 3.2% of global energy use is accounted for by leisure-related activities (including transportation to and at the destination, accommodations, and in-destination activities), while

5.3% of all carbon dioxide emissions can be attributed to leisure. Of these figures, Gössling estimated that almost 94% of leisure's contribution to global warming may be accounted for by transportation, primarily by planes and cars. As noted by Beatrice Schell of the European Federation for Transport and Environment in November 2001, 'One person flying in an airplane for one hour is responsible for the same greenhouse gas emissions as a typical Bangladeshi in a whole year'.

Dubois and Ceron (2005) have addressed the implications of the high levels of dependence on air and auto travel for tourism in France in light of the Kyoto Protocol, which commits ratifying nations to the reduction of greenhouse gas emissions (by 5.2% compared to the year 1990 globally and by 8% in the European Union). Their analyses suggested that approximately 7–8% of French greenhouse gas emissions can be attributed to tourism transport in the country; the rising mobility of the French population, and their continued dependence on auto and air travel is, therefore, highly incompatible with the reductions in greenhouse gas emissions outlined by the Kyoto Protocol (Dubois and Ceron, 2005). Rising levels of mobility are not confined to the French population, of course, and the rising popularity of the short break, combined with the recent proliferation of low-cost airlines, suggests that airline travel to and within Europe is likely to maintain its popularity long into the future.

In light of its substantial contributions to the climate change problem, attention is now increasingly being given to ways in which the tourism industry can help mitigate its negative impacts, through the reduction of energy use and greenhouse gas emissions, and the adoption of cleaner, more efficient technologies. Several organizations now offer the opportunity for tourists to compensate their carbon dioxide emissions through the purchase of carbon offsets. The proceeds of such schemes are then used to fund projects that attempt either to reduce emissions at source, whether through investment in renewable sources of energy or improvement in the efficiency of current sources, or to increase rates of carbon dioxide sequestration, through e.g., reforestation programs (e.g., Climate Care, http://www.climatecare.org/).

CONCLUSION

Though the exact rate and magnitude of future climate change in the European region remains undetermined, this phenomenon is increasingly recognized as a scientific certainty. As such, it behoves the tourism industry, as well as tourism researchers and policy makers, to pay increased attention to climate trends and their likely impacts. As described above, these impacts are likely to be environmental, economic, and behavioural in nature, and may have far-reaching implications for various regions and types of destination. While in some cases these impacts may have negative consequences, for winter tourism in the Alps, for example, in others climatic conditions may be considerably improved. Climate change is, thus, likely to create both winners and losers at the destination and activity level, and it is important that the outdoor recreation and tourism industries begin planning for such outcomes sooner rather than later if they are to successfully adapt to this climatic, and the associated environmental, change.

Given the economic and social values of outdoor recreation and tourism throughout the continent, the relatively low levels of attention previously given to the potential impacts of climate change on these sectors is worrying. Fortunately, the level of concern does appear to be increasing. The World Tourism Organization convened the First International Conference on Climate Change and Tourism in April 2003 (WTO,

2003), though a date for the second meeting remains undecided. Similarly, the European Science Foundation, North Atlantic Treaty Organization, and the International Society of Biometeorology's Commission on Climate, Tourism and Recreation have all recently sponsored meetings to address this issue, all of which were held in Europe. The éCLAT research network, which is dedicated to understanding the interactions between tourism and climate change, will host a conference on the topic of tourism and climate change mitigation in the Netherlands in 2006 (http://www.cru.uea.ac.uk/tourism/mitigation/Flyer.pdf).

Given the relatively limited amount of research to date focused on the interrelationships between tourism, recreation, and climate change, the avenues of future investigation are many and varied. In addition to the analysis of the direct and indirect effects of projected climate change on specific tourism destinations and activities, further consideration of the public's current levels of awareness and understanding of, as well as their likely behavioural reactions towards, climate change, is highly warranted. While destinations and individual attractions tend to be static entities, tourists and outdoor recreationalists are extremely mobile. They possess the ability to alter not only the location of their trips, but their timing, duration, frequency, and the activity(ies) engaged in. The potential for such changes have considerable implications for the outdoor recreation and tourism industries, from the international to the local and site-specific level. The role of the media in influencing public perception of issues, places and activities, whether accurately or otherwise, is a related issue worthy of increased investigation, as noted by Hall and Higham (2005).

To maximize its effectiveness, future recreation, tourism and climate change research must be carried out using an inter-disciplinary approach and by a broader range of scientists than have previously participated. The majority of research on this topic to date has been completed by natural scientists and published in physical science journals such as *Climatic Change* and *Climate Research*. Few studies have appeared in the recreation, tourism and leisure publications, and levels of communication between climate (change) experts and leisure specialists remain low. As emphasized above, one area in which social scientists may make considerable contributions is in the perceptual and behavioural spheres.

In addition, it falls upon all researchers to maximize the relevance and utility of climate change analyses to the tourism industry, policymakers, and the public. Of particular note is the need for balance in the timeframe typically considered by different groups; while tourists and recreation/tourism providers tend to operate on a short-term basis, planning by the day, week, month or season, climate change analyses are conducted for periods up to one century in advance. Byers and Slack (2001) have studied the decision-making process in the context of small businesses (which the majority of recreation and tourism enterprises are) in the UK tourism industry. Their analyses suggested that such firms operate in an adaptive or reactive manner, making decisions in response to environmental contingencies such as consumer demand or the weather, rather than with any long-term, proactive or strategic agenda. As such, it is often difficult for those involved in the tourism industry to appreciate the consequences of climate scientists' findings. A more participatory approach, in which recreation and tourism planners, providers and participants are actively included in research projects, and findings are disseminated in practitioner as well as traditional research settings, may help alleviate this problem.

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