SAVITRI SACHDEV

TOURISM AND CLIMATE CHANGE

IMPACTS, ADAPTATION AND MITIGATION (VOLUME 2)

Tourism and Climate Change: Impacts, Adaptation and Mitigation (Volume 2)

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Savitri Sachdev
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Part II
Global Challenges

Infectious Diseases and Tourism

C. Michael Hall

For many people the connection with health and tourism is often made with respect to a visit to a spa, a relaxing sea cruise or, given the present rate of obesity in the populations of the developed world, a trip to the 'fat farm'. However, the reality is that tourism is a major contributor to introduction of new diseases to populations as well as contributing to an increased rate of spread of existing disease.

Travel and trade have long been a major transmission vehicle for infectious diseases. Humans are significant vectors for disease, as well as being carriers of pests which may also host disease. Patterns of health and disease are the product of interactions between human biology and mobility and the social and physical environments. However, these patterns are constantly changing. Indeed, the contemporary health situation of the world is somewhat confused because even though death rates in most countries have declined substantially in the past century and people live longer, there is simultaneously the emergence of new disease risks, such as HIV/AIDS, and the re-emergence of diseases that were at one time thought to have almost been eradicated, such as tuberculosis. Increased human mobility, including tourism, has become a major factor in the current and emerging patterns of disease, although it should be recognised as being just one of the most recent expressions of increased contact between human populations that at one time would have existed in isolation from one another. In addition, it must also be recognised that the spread of pests and disease is not limited to human disease, but that humans can also act as vectors of a range of pathogens that can severely impact other species. Issues surrounding disease spread therefore become a significant factor not only in the health of human populations but also in the maintenance of ecosystem health and biodiversity.

As the number of people in the world who have become mobile has increased, so it has meant that the rate of disease spread has grown as has the potential for populations to have contact with pathogens to which they have hitherto not been exposed. McMichael (2001) recognises three historical transitions in the co-evolutionary relationships between humans and disease (see also Gould 2002). The first stage corresponds to the rise of settled agriculture and the concentration of population in the early civilisations of the Middle East, South and East Asia and the Americas. According to McMichael (2001) this created a new web of relationships among animals, humans and microbes, facilitating the migration of microbes from animal to human populations:

> Smallpox arose via a mutant pox virus from cattle. Measles is thought to have come from the virus that causes distemper in dogs, leprosy from water buffalo, the common cold from horses, and so on.
>
> (McMichael 2001: 101)

Most of the infectious 'crowd' diseases appear to have developed during this transition, although it is significant to note that the 'leap' from animal species to humans can still occur today, as evidenced by the recent HIV, SARS and avian bird flu epidemics. Significantly, if a disease is zoonotic – transferred from animal to humans – then it will remain in animal reservoirs, where it may mutate and strike again. Indeed, it is remarkable to note that writing before the 2003 SARS outbreak in southern China, McMichael commented with respect to that region that:

> The intimate pig/duck farming culture creates a particularly efficient environment in which multiple strains of avian viruses infect pigs. The pigs act as 'mixing vessels', yielding new recombinant-DNA strains of virus which may then infect the pig-tending humans.
>
> (2001: 88–9)

It was through such co-evolutionary relationships that each human population acquired its own range of locally evolving infectious diseases.

The second transition corresponds to the period of contact among the Eurasian civilisations from around 500BC to AD1500. McMichael builds on McNeill's (1976) thesis that this contact resulted in the transmission and swapping of microbes, leading to episodic epidemics followed by periods of gradual re-equilibration between the infectious agent and the human host population. One of the best examples of this being the complex pattern of outbreaks of the Black Death in mid-fourteenth-century Europe, which appears to be related to an outbreak of bubonic plague in China during the 1330s, as well as to the development of quite intensive trading networks (Flinn 1979; McEvedy 1988; Cohn 2003). As McMichael (2001: 108) notes: 'After many turbulent centuries, this transcontinental pooling resulted in an uneasy Eurasian equilibration of at least some of the major infectious diseases'.

The third great historical transition refers to Europe's exploration and conquest of distant lands, and the export of 'its lethal, empire-winning, germs to the Americas and later to the south Pacific, Australia and Africa' (McMichael 2001: 89) (see also Crosby 1972, 1986; White 1980; Joralemon 1982; Dobyns 1983; Henige 1986; Snow and Lanphear 1988; Snow and Starna 1989; Diamond 1997; Cook 1998, 2004; Potter 2001; Koplow 2003; Kelton 2004). Importantly, in his examination of the ecological imperialism of Europeans in the rest of the world, Crosby (1986) highlighted that, in addition to disease, Europeans also exported a range of other pests that would affect humans, indigenous animal and plant species and the composition of entire ecosystems. The impact of virgin soil epidemics during this period was enormous (Crosby 1976; Wolfe 1982; Cook 1998; see also Jones 2003). The large Aztec and Inca populations had limited numbers of wild animals they could domesticate and remained relatively free of 'crowd' infectious diseases

until they were decimated by smallpox, measles and influenza introduced by Europeans (Crosby 1972; McMichael 2001; Fenn 2002; Koplow 2003; Cook 2004). Between 1519 and 1620, it is estimated that Mexico's population declined from 28 million to 1.6 million due to waves of measles, smallpox, typhus and influenza (S. Hunter 2003). *Falciparum malaria* and yellow fever were brought to the Americas in the seventeenth century by the trans-Atlantic slave trade (Curtin 1968; Milner 1980). In a series of outbreaks in the mid-eighteenth century, New Orleans and Memphis lost half their populations to yellow fever. As yellow fever and malaria wiped out the Amerindian population, the areas were subsequently settled by African populations who were adapted to both diseases (McNeill 1976; Kipple and Higgins 1992; S. Hunter 2003).

Similar impacts to those in the Americas were experienced by the indigenous peoples of the Pacific. The Aborigines of Australia suffered severe epidemics following the arrival of Europeans on that continent (Crosby 1986), and within 80 years of Captain Cook's first visit to Hawaii in 1778 the native population declined from around 300,000 to less than 40,000 (McMichael 2001). A smallpox epidemic in Hawaii in 1853 killed thousands of people, an estimated 8 per cent of the population, despite quarantining and vaccinating (Greer 1965; Schmitt 1970). In the case of Siberia, smallpox appeared for the first time in 1630 as Russians travelled there – the death rate among indigenes in a single epidemic could be over 50 per cent, When smallpox first arrived in Kamchatka Peninsula in 1768–69, it is estimated that it killed between 66 per cent and 75 per cent of the indigenous population (Crosby 1986). McMichael (2001) observed that the third transition was more a 'dissemination' of microbes that had co-evolved with the Eurasian population to other parts of the world than an 'exchange' (Crosby 1972). Nevertheless, the third transition represented another major process re-equilibrating the balance between microbes and humans, this time across transoceanic populations and on a global scale.

Are we experiencing a fourth major historical transition today? Around 1970 many experts thought that tuberculosis, cholera and malaria would soon become extinct. The United States Surgeon-General declared that it was time 'to close the book on infectious diseases' (in McMichael 2001: 88). But now these diseases are increasing again, and a host of other diseases or their pathogens have been newly identified – they include Lyme disease, hepatitis C and E, human herpes viruses 6 and 8, hanta virus, cryptosporidiosis, toxic shock syndrome, Ebola virus, Legionnaires' disease as well as various food-borne disease outbreaks. As McMichael (2001: 115) observes, something 'unusual' seems to be happening to patterns of infectious diseases whether they be human or animal (see also Dorolle 1969; Wilson 1994; Garrett 1996). Fidler (1999: 17) describes a 'new pathology of public health in the era of emerging and re-emerging infectious diseases'. Such emerging and resurgent diseases and viruses occur where pathogens have either 'newly appeared in the population or are rapidly expanding their range, with a corresponding increase in cases of disease' (Morse 1993a: 10).

Of great significance to this new historical transition is the role of international trade and travel as a channel for the spread of infectious disease through both human mobility as well as the mobility of vectors, what Morse (1993b) describes as 'viral

traffic'. Since 1950 passenger kilometres travelled by planes have increased by a factor of over 50. Air travel increased total mobility per capita 10 per cent in Europe and 30 per cent in the United States between 1950 and 2000 (Ausubel *et al*. 1998). Spatial diffusion via increasingly mobile human vectors (people and their transport) is obviously a significant factor in the appearance of new pathogens in human populations. However, the globalisation of international trade and travel is not singularly responsible for new public health threats. Factors such as cross-species transfer; pathogenic evolution, or changes in the structure and immunogenicity of earlier pathogens (genetic drift and shift); recognition of a pre-existing pathogen; and changes in the environment and, hence, disease ecology are all significant in explaining the emergence of new diseases in human populations. Numerous commentators (e.g. Lederberg *et al*. 1992; McMichael 1993, 2001; Mayer 1996; Fidler 1999) point to the role of contemporary human-induced social-environmental changes which provide new opportunities for pathogens including: urbanisation, intravenous drug use, sexual practices, medical practices – for example, blood transfusion, organ transplants – intensive food production, poverty and inequality, and other changes to the physical environment such as irrigation, deforestation, and eutrophication of rivers. Indeed, McMichael argues that humanity is currently 'depleting or disrupting many of the ecological and geophysical systems that provide lifesupport' (2001: 283). In addition to these factors, Fidler (1999) also notes the roles of deterioating or non-existent national public health capabilities, failure of the internationalisation of public health and a weakening of state control in light of contemporary globalisation (see also Mayer 1996).

Although, in health terms, tourism only constitutes a relatively small fraction of total human movement (Bradley 1989; Wilson 1995; MacPherson 2001; Hall 2005), it is highly significant in terms of its potential to contribute to the spread of pathogens because it is a cross-border phenomena and, unlike migration, it implies a return to the location of origin (Table 9.1). With advances in transport technology and a loosening of economic, temporal, cultural, political and gendered constraints with respect to travel, international tourism has shown steady increase in the post-WWII period, with international tourism trips growing faster than the rate of population increase (Hall 2003a, 2005) (Figure 9.1, Table 9.2). The extent of time-space convergence because

Table 9.1 What is carried by humans when they travel

- Pathogens in or on body, clothes and/or luggage
- Microbiologic fauna and flora in or on body, clothes and/or luggage
- Vectors on body, clothes and/or luggage
- Immunologic sequelae of past infections
- Relative vulnerability to infections
- Genetic composition
- Cultural preferences, customs, behavioural patterns, technology
- Luggage may also contain food, soil, fauna, flora and organic material

Source: Wilson 1995; Hall 2004

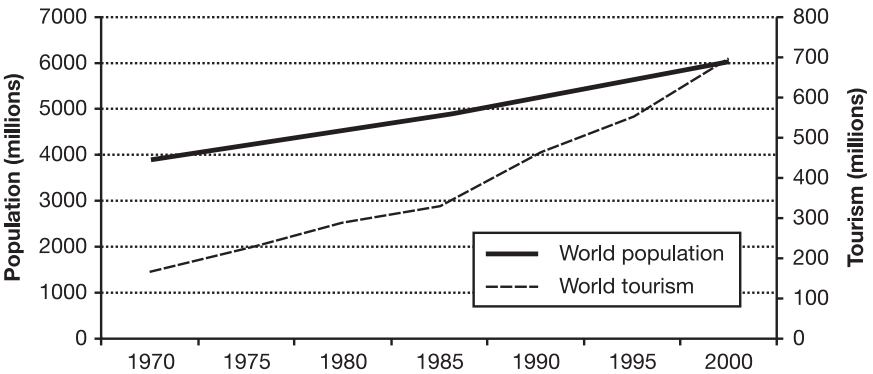

Figure 9.1 Growth in world population versus world tourism

Source: Hall 2004

Table 9.2 World population growth compared to growth in international tourism arrivals

Date	*World population (million)*	*International tourism arrivals (million)*	*International tourism arrivals as a % of world population*
1950	2,520.0	25.3	1.00
1960	3,020.0	69.3	2.30
1970	3,912.1	165.8	4.24
1975	4,205.1	222.3	5.29
1980	4,520.1	287.5	6.36
1985	4,858.8	327.9	6.75
1990	5,222.7	457.3	8.76
1995	5,614.0	552.3	9.84
2000	6,034.5	696.7	11.55
2001	6,122.4	692.7	11.31

Source: United Nations various; WTO various; in Hall 2003a

of changes in transport technology is well illustrated by the observations of Grübler and Nakicenovic (1991) who estimated and plotted the average kilometres travelled daily by the French population over a 200-year period (1800–2000) and found that spatial mobility has increased more than 1000-fold. Similarly, Cliff and Haggett (1995) noted that between the early 1950s and the early 1990s, the size of Australia's resident population doubled while the number of persons moving into and out of Australia increased nearly 100-fold (see also Cliff and Haggett 2004). Such mobility transformations are also significant for international trade. Over 70 per cent of fruit and vegetables consumed in the USA come from less developed countries, while more than 45 per cent of fish and fish products on the international market also come from developing countries, with consequent implications for the migration of pathogenic microbes and food-borne parasites (Fidler 1999).

Epidemics only occur when there is a sufficiently large pool of uninfected people to contract and transmit the disease, that is to say there must be a large enough reservoir of potential victims – or 'susceptibles' – for the disease to spread (Bell and Lewis 2005). For example, S. Hunter (2003) suggests that a minimum population of 250,000 is required to support a measles epidemic. As the disease spreads, it uses up the available pool of 'susceptibles' through either killing them or by conferring immunity on them. At some point, the epidemic will burn itself out but the disease will survive at low levels and re-emerge later as a new epidemic, either in an original or mutant form. For an outbreak to develop into a pandemic (global epidemic), the number of carriers must be large. Urbanisation assists in efficient transmission because of the number of people in close proximity, while geographic mobility enlarges the stock of 'susceptibles', as was the case with influenza in 1918–19 and SARS in 2003 (Bell and Lewis 2005). May's (1958) concept that, for an infectious disease to occur, there must be coincidence in time and space of agent and host is therefore significant for understanding the impact of tourism mobility on disease and environmental health, because an increase in tourist traffic in a given area increases the likelihood of contact occurring with a pool of uninfected people.

The increase in air travel has also increased the potential for disease spread for two reasons: first, the increased speed of travel means that people can travel and pass through airports before disease symptoms become evident; and second, the size of modern aircraft is increasing (Westwood 1980). In the latter case, Bradley (1989) postulated a hypothetical situation in which the chance of one person in the travelling population having a given communicable disease in the infectious stage was 1 in 10,000. With a 200-seat aircraft, the probability of having an infected passenger aboard (x) is 0.02 and the number of potential contacts (y) is 199. If homogeneous mixing is assumed, this means a combined risk factor (xy) of 3.98. If the aircraft size is doubled to 400 passengers, then the corresponding figures are: $x = 0.04$, $y = 399$, and $xy = 15.96$. On the new double-decker Airbus A380 scheduled to come into service in 2006, the passenger configuration ranges from 550 to almost 800 passengers in an all economy-class configuration (Hall 2005). If we assume a 600 seat aircraft then the corresponding figures are: $x = 0.06$, $y = 599$, and $xy = 35.94$. In other words tripling the number of seats available increases the risk factor nine-fold. Therefore, as Cliff and Haggett (1995) observed, new generation jet aircraft are significant for disease spread not only because of their speed but because of their size. Moreover, the larger the aircraft the more likely it will be that it is travelling between transport hubs in large urban areas. The implications of increased rates of mobility with respect to the globalisation of health and disease is discussed below, with the first example being that of an 'old' or 're-emerging' disease – malaria – followed by examples of emerging disease.

Malaria

Malaria affects at least 200–300 million people every year and causes between 1–2 million deaths, mostly children under five and pregnant women in sub-Saharan

Africa (Roll Back Malaria 2004). The economic burden is also extremely high, accounting for a reduction of 1.3 per cent in the annual economic growth rate of countries where malaria is endemic (Sachs and Malaney 2002). It is estimated that malaria costs Africa more than US$12 billion every year in lost GDP, even though it could be controlled for a fraction of that sum (Roll Back Malaria 2004). However, malaria is not limited to Africa – 40 per cent of the world's population is regarded as being at risk of acquiring the disease (Murphy and Oldfield 1996). In addition, each year approximately 30 million people from non-tropical countries visit areas where malaria is endemic (Kain and Keystone 1998), with between 10,000 and 30,000 visitors contracting malaria (Lobel and Kozarsky 1997). Significantly in terms of disease control and assessing the impacts of mobility, around 90 per cent of infected travellers do not become ill until they return home. This 'imported malaria' is easily treated, but only if it is diagnosed promptly (Croft 2000; Kain *et al*. 2001).

Increased tourism mobility to tropical and sub-tropical destinations where malaria is endemic, particularly for nature-based tourism activities, can have substantial consequences for infection rates in the tourist-generating region (Rudkin and Hall 1996; Dos Santos *et al*. 1999; Musa *et al*. 2004). In Canada, for example, Kain *et al*. (2001) reported that between 1994 and 2001 a record number of cases of imported malaria was witnessed, with a peak of 1,036 cases in Canadian travellers reported for 1997. This figure represents a 141 per cent increase since 1994 and a per capita rate about 10 times that reported in the USA (Humar *et al*. 1997). An additional concern in managing malaria is that there has also been a dramatic increase in the number of cases caused by drug-resistant parasites and an approximately 10-fold increase in the number of cases of severe malaria requiring admission to an intensive care unit (Kain and Keystone 1998). Severe malaria is associated with a case fatality rate that often exceeds 20 per cent, even among young, previously healthy adults, and may be complicated by adult respiratory distress syndrome – when this situation arises, case fatality rates often exceed 80 per cent (Kain *et al*. 2001).

AIDS

HIV/AIDS was estimated to claim 3.1 million lives in 2002 (Lee and McKibbin 2004). AIDS has been described as the first great pandemic of the twenty-first century and as the modern equivalent of the 'great plague' (May 2003). The spread of AIDS is interrelated with human mobility. As Garrett (2000: 551) comments:

> It spread swiftly … in a retrovirus form that used human DNA as vehicle and hideaway. Globalized sex and drug trades ensured HIV's ubiquity. And HIV, in turn, facilitated the circumnavigation of new, mutant forms of tuberculosis, the one taking advantage of the weakened human state caused by the other.

Globally, there is a tendency for socially disadvantaged groups to be at greater risk of HIV/AIDS. In the West in the 1980s this included gay men, minorities and injection drug users. The nature of these groups has often meant that AIDS has

been portrayed as a disease of morality. However, in Africa the situation is quite different, with long-distance truck drivers and sex workers known as the earliest groups infected (Williams *et al*. 2002). Instead, AIDS has manifested as a primarily heterosexual disease, accounting for 93 per cent of adult infections in sub-Saharan Africa (Webb 1997: 5).

Transmission patterns, distribution, spread and impacts of the virus vary widely among populations, partly as a result of behavioural difference (Lindenbaum 1997). Webb (1997: 11) identified two main modes – Pattern I spread (primarily men having sex with men and injection drug users), that is primarily found in the USA, Western Europe and Australia; and Pattern II spread (heterosexual, with male to female ratio 1:1 and, increasingly, pediatric AIDS through vertical transmission), that primarily affects sub-Saharan Africa, Latin America, parts of South America and India. However, Webb (1997: xii) warns: 'The complexity of HIV spread is not to be underestimated,' noting:

> Many of the reasons for the failure of prevention programmes to date lie in this oversimplification, in reducing the epidemic to medical or health terms, to talk of HIV/AIDS as if socioeconomic processes were merely incidental … generalizations negate the reality of the great diversity and variety in the way people react to this unprecedented situation .
>
> (Webb 1997: xii–xiii)

Large-scale movements, including tourism, have increased high-risk sexual behaviour and sexually transmitted disease (STD) infection rates (De Schryver and Meheus 1989; Gössling 2002). This has meant considerable emphasis being placed on controlling the health dimensions of sex tourism as well as understanding and influencing the sexual behaviours of tourists (Ford and Koetsawang 1991). In Southern Africa, migration plays a major role in the spread of STDs and HIV because of the long history of economic migration from Lesotho, Botswana, Zambia, Swaziland, Mozambique, Malawi, Zambia and Zimbabwe to the gold and diamond mines of South Africa. However, it is not migration alone that is responsible for HIV/AIDS spread, rather attention needs to be given to the role of labour return, whether on a permanent basis or, more significantly, trips home to visit family (Williams *et al*. 2002).

The significance of the relationship between mobility – which is often substantially gendered – sexual behaviour and HIV infection is indicated in Lydie *et al*.'s (2004) study of an urban population of Cameroon. A representative sample of 896 men and 1,017 women were interviewed and tested for HIV infection and other sexually transmitted infections in Yaounde in 1997. Mobile and non-mobile people were compared with respect to sociodemographic attributes, risk exposure, condom use and prevalence of HIV infection. In terms of mobility, 73 per cent of men and 68 per cent of women reported at least one trip outside of Yaounde in the preceding 12 months. Among men, the prevalence of HIV infection increased with time away from town. Men who declared no absence were five times less likely to be infected than were those away for more than 31 days. Mobile men also reported

more risky sexual behaviours – i.e. more partners and more one-off contacts. However, for women, the pattern was less clear with differences in the prevalence of HIV infection being less marked between non-mobile and mobile women – 6.9 per cent versus 9.8 per cent, respectively ($P > 0.1$).

In the case of HIV/AIDS, its global significance lies not just in its immediate health implications but in its longer-term impacts and ripple effects (Bloom 1999; Bloom and Canning 2003). For example, 'wherever the percentage of HIV-positive adults exceeded ten percent of a given society waves of opportunistic secondary epidemics followed, notably of tuberculosis' (Garrett 2000: 553). In the case of TB it is estimated that about one third of AIDS patients are co-infected with TB, and that TB accounts for approximately one third of AIDS deaths worldwide (May 2003: 7).

According to UNAIDS (the Joint United Nations Programme on HIV/AIDS), at present 42 million people globally live with HIV/AIDS (in Lee and McKibbin 2004). In the southern African regions, the total HIV-related health service costs, based on assumed coverage rate of 10 per cent, is estimated to range from 0.3 to 4.3 per cent of GDP, thus placing enormous strain on longer-term development prospects. As S. Hunter (2003) notes, in economic terms the effect of AIDS on per capita income will make itself felt both through its destruction of existing human capital, a good part of which takes the form of experienced workers, and its weakening of the mechanisms through which new human capital is accumulated.

Arndt and Lewis (2000) estimated that between 1997 and 2010, the AIDS epidemic in South Africa will reduce that country's GDP by 17 per cent and its per capita income by about 8 per cent (or about 0.6 per cent annually). Similarly, MacFarlan and Sgherri (2001) modelled the likely macroeconomic impacts of AIDS in Botswana and conclude that the growth rate of GDP in the non-mining sector will slow by a third or more between 2000 and 2010 due to expected reductions in labour productivity and capital accumulation, stemming in part from a decline in the experience and skills of formal sector workers. In addition, a heavy fiscal impact from higher health spending is also expected (S. Hunter 2003).

SARS

Respiratory infections are the leading cause of human mortality (Raptopoulou-Gigi 2003: 81). In late 2002 the first reports came through in the Western media of an outbreak of a new respiratory disease in southern China which came to be known as SARS (Severe Acute Respiratory Syndrome). The first cases of SARS emerged in mid-November 2002 in Guangdong, China, and the first official report of 305 cases from the area were reported by the World Health Organization on 11 February 2003 – 30 per cent of those affected were health workers. In the six months after the first outbreak in Guangdong province, the SARS disease spread to at least 30 countries/regions including Australia, Brazil, Canada, South Africa, Spain and the USA. By the apparent end of the outbreak on 14 July 2003, the number of probable cases reached 8,437 worldwide – the most affected countries in terms of numbers of cases and deaths were China, Hong Kong, Taiwan, Canada

and Russia. The disease killed approximately 10 per cent of those infected, with the global death toll reaching 813 including 348 in China and 298 in Hong Kong (Lee and McKibbin 2004). The disease was noticeable for its rapid global spread which had substantial repercussions for economies and mobility as well as for health. As Raptopoulou-Gigi commented (2003: 81):

> The rapid worldwide spread of the coronavirus that causes SARS and the fact that by May 25th 2003, 28 countries reported cases of this infectious disease, suggested that as for other infectious diseases, evolution and spread is facilitated by the mobility of the society either through air travel or the densely populated urban areas especially in Asia.

SARS is regarded as a serious health threat for several reasons (see Chan-Yeung *et al*. 2003; Donnelly *et al*. 2003; Lipsitch *et al*. 2003; Leung *et al*. 2004; Li *et al*. 2004):

- The disease has no vaccine and no treatment.
- The virus comes from a family that is recognised for its frequent mutations making it difficult to produce effective vaccines.
- The available diagnostic tests have substantial limitations.
- The epidemiology and pathogenesis for the disease are poorly understood.
- The potential impacts on hospital staff presents a major health human resource problem.
- A significant proportion of patients require intensive care.
- The incubation period of 10 days allows spread via air travel between any two cities in the world.

The spread of SARS was checked by a rigorous system of 'old-fashioned public health measures' (Bell and Lewis 2005: 2) on mobility at international borders and health isolation and quarantine procedures. However, preventing the spread of the disease also came at substantial economic cost due to changes in trade and tourism flows as well as associated capital investment. SARS travel bans were put in place for the major affected areas in April 2003, initially China – especially Hong Kong and Guangdong Province – but other cities in Asia and Canada (Toronto) followed. It was estimated that almost half the planned flights to South East Asia were cancelled during the month of April and total visitor arrivals declined by about two thirds over the course of the crisis, with corresponding effects on related parts of the economy, including hotels, restaurants, retail and even shipping (Bell and Lewis 2005). In Hong Kong, tourism declined by 10–50 per cent over the period, with ripple affects throughout the region's economy, including a 50 per cent drop in retail sales.

However, tourism was affected across the entire region, in part because of travel and business connectivities, but also because of inaccurate perceptions in tourism-generating regions of which places were dangerous to travel to. At the height of the epidemic, visitors and tourism declined 80 per cent in Taiwan and almost as much in Singapore (Bell and Lewis 2005: 20). Nevertheless, as Lee and McKibbin

(2004) have stressed in their analysis of the economic impacts of SARS, just calculating the number of cancelled tourist trips and declines in retail trade is not sufficient to get a full picture of the impact of SARS because there are domestic and international trade and capital linkages across sectors and across economies. Bell and Lewis (2005) estimated that SARS cost the region nearly US$15 billion, or 0.5 per cent of GDP, while a 'less readily measurable, but arguably more serious, impact was caused by faltering business confidence' (2005: 21). Nevertheless, Bell and Lewis' estimate is still only relatively short term. Because of patterns of contemporary trade, the economic costs from a disease such as SARS go beyond the direct impacts on the affected sectors in the disease-inflicted countries. As the world becomes more integrated, the global cost of a communicable disease like SARS is expected to rise, and should also include forgone income as a result of disease-related morbidity and mortality (Lee and McKibbin 2004).

Humans as vectors for plant and animal disease

Humans not only act as vectors for pathogens that attack humans but also for a range of plant and animal diseases, for example, foot-and-mouth disease and phylloxera. The February 2002 outbreak of foot-and-mouth disease in the United Kingdom was the first outbreak of the disease in Britain since 1967. However, its effect on the British countryside was devastating. Over 6 per cent of the national livestock herd was slaughtered, with dramatic effects on those farms that lost their stock. Just as seriously, biosecurity measures limited not only the movement of livestock but also the movement of people in the countryside, including tourists. Once a case was confirmed, under EU regulations, a protection zone based on a minimum radius of 3km and a surveillance zone based on a minimum radius of 10km should be established. In addition, a number of controls were imposed to minimise the risk of the public, including visitors to the countryside, spreading the disease. Not only were the majority of footpaths and other rights of way – i.e. other routes over which the public has a legal right to pass, such as bridleways – closed across the country, but also many rural tourist attractions were closed and land owned by the Forestry Commission and the National Trust, along with some national parks and forest areas, even some parks in London, were closed to the public (Sharpley and Craven 2001).

For both agriculture and tourism, the outbreak will have long-term impacts, in agriculture because of restocking costs and customer confidence, for tourism because of consumer perception of rurality and the safety of the countryside (Hall 2005). According to Sharpley and Craven (2001) the overall potential loss to the tourism industry in England alone in 2001 was estimated at £5 billion, while the lost overseas tourism expenditure in Britain was estimated at between £1 billion and £3.5 billion – realistically the final figures will never be known.

Although biosecurity measures are put in place at many national and, in some cases, domestic borders (for example Australia, USA), little attention is paid to biosecurity issues in the tourism industry (Hall 2005). Hall (2003b) examined the New Zealand wine industry with respect to biosecurity measures in place for the

growing number of wine tourists in that country and noted that only 17 per cent of wineries which responded to a national survey had any biosecurity measures in place at all. An exploratory assessment of biosecurity risks at wineries looking at how humans act as vectors for grape diseases indicated substantial issues with respect to how tourists perceived wineries and vineyards – particularly with regard to the questions asked about tourist movement in border control procedures, as well as tourist mobility and what they had worn on previous visits to vineyards.

Responding to global health and disease risks

In order to combat the introduction of pests and diseases many countries and regions have introduced biosecurity strategies. Biosecurity refers to the protection of a country, region or location's economic, environmental and/or human health from harmful organisms and involves preventing the introduction of harmful new organisms, and eradicating or controlling those unwanted organisms that are already present (Biosecurity Strategy Development Team 2001). Although biosecurity and tourism are closely entwined, the tourism industry has little overt interest in biosecurity issues, whether on a national or global scale, unless some biosecurity risk, such as foot-and-mouth disease or SARS occurs (Gössling 2002; Hall 2005).

Central to appropriate biosecurity practice by travellers and the tourist industry is an improved understanding of biosecurity and quarantine. Improving awareness of biosecurity may lead to a decrease in the number of prohibited items which cross a border or boundary (Hall 2003b). Biosecurity measures occur on a number of different scales, from the international level – such as agreements on the movement of agricultural produce through border controls – through to biosecurity practices at individual locations, such as farms. Biosecurity strategies can also be categorised in terms of their utility at the pre-border, border and post-border stages (Hall 2005). From a tourism mobility perspective biosecurity strategies occur at different stages of the trip cycle: decision making and anticipation, travel to a tourism destination or attraction, the on-site experience, return travel and recollection of the experience. Each of these five stages will have different implications for how tourism and biosecurity and quarantine organisations establish a relationship with the traveller and assist them in practising good biosecurity (Table 9.3).

However, one of the greatest difficulties faced in managing health and disease risks is that it is not just the passenger that potentially constitutes a risk. Their means of transport may also serve to harbour pathogens or the carriers of pathogens. According to Fidler (1999: 14):

> Even before the advent of air travel, experts recognized that the scope of international travel had rendered national quarantine strategies ineffective. The explosion in global travel facilitated by air technology now threatens national public health strategies in a similar fashion.

Indeed, MacPherson (2001) argues that the inability to detect and contain imported disease threats at national borders requires a shift in immigration, quarantine and

Table 9.3 Pre-border, border and post-border biosecurity strategies

Pre-border
- Identifying threats to ecosystems
- Profiling and modelling the characteristics of damaging or potentially damaging organisms and vectors
- Identifying controls (in the country of origin) for selected organisms that pose a threat to destinations
- Analysing and predicting risk pathways for unwanted organisms
- Identifying and collating databases and expertise on unwanted organisms
- Developing systems for rapid access to appropriate data
- Developing import standards and compliance validation methodologies
- Auditing exporting countries' compliance with destination biosecurity standards
- Identifying and locating biosecurity-related risks to animal, plant and human health
- Analysis of public attitudes and perceptions of biosecurity risks and barriers to biosecurity responses in visitor-generating areas
- Development of educational programmes in exporting regions so as to reduce likelihood of introduction of unwanted organisms in imported goods
- Development of educational programmes for tourists in both generating and destination regions so as to reduce likelihood of introduction of unwanted organisms

Border
- Developing improved systems, including clearance systems and sampling methodologies, and technologies for intercepting unwanted organisms according to import standards
- Developing border containment and eradication methodologies according to import standards
- Developing profiles of non-compliance behaviour to biosecurity requirements

Post-border (includes pest management)
- Developing rapid identification techniques for unwanted organisms
- Designing and developing methodologies for undertaking delimiting surveys for new incursions
- Developing rapid response options for potential incursions of unwanted organisms
- Analysis of public attitudes and perceptions of biosecurity risks and barriers to biosecurity responses in destination areas
- Developing long-term containment, control and eradication strategies

General
- Analysis of economic and political models for the management of biosecurity threats
- Development of rapid-access information systems, collections and environmental databases on unwanted organisms
- Improve export opportunities for 'clean' products
- Development of industry and public biosecurity education programmes

Source: after Hall 2004

public health approaches to health and mobile populations, with a new paradigm being needed to facilitate the development of policies and programmes to address the health consequences of population mobility.

An example of the need for a new way of dealing with global health and disease risk lies in the epidemiological characteristics of AIDS. Unlike cases of SARS or influenza, where infected individuals can be kept from coming in close contact with the healthy population through temporary isolation and quarantine, individuals infected with the HIV virus are currently infectious for life. As Bell and Lewis (2005: 26) note:

> Effective quarantine therefore amounts to lifelong house arrest. This may be a feasible policy at the early stages of the epidemic, but it raises thorny ethical issues. At later stages, the numbers of individuals will be so large as to make it impractical. With this measure ruled out, others assume greater importance.

Therefore, increasing emphasis is being placed on the development of global strategies to deal with global health problems that focus on transfer of health management skills and funds, as well as the availability of pharmaceuticals at affordable prices in the developed world (Fidler 1999). Because of the globalisation of mobility what was once just a health problem in 'another country' now assumes significance as a health risk here.

However, the reality is that the development of systems of international governance of health issues is poorly integrated with governance of other aspects of global environmental change, while the financial contributions from the rich to the poor nations are not sufficient to deal with the health issues that are emerging. Moreover, ongoing urbanisation, changes in land use, land degradation and water pollution all contribute to the potent mix of environmental changes that may serve as the basis for a new wave of epidemics such as the world has not seen for almost a hundred years (McMichael 2001, 2002). Mobility is clearly a major factor in such global environmental change but, to further complicate changes in health and disease risk on a global scale, the potential effects of climate change also need to be considered.

Climate change can have an impact on the overall health of populations so that epidemics may have a greater effect than would have been the case if the population was healthy. An example of this was the plague outbreaks in Western Europe which followed the cooling phase of the climatic cycle that set in at the end of the thirteenth century. The first two decades of the fourteenth century were marked by cold, wet weather and poor harvests. In particular, the famine of 1315–17 left the population of many European centres particularly susceptible to the plague (Genicot 1966). However, contemporary climate change is regarded as having significant implications for disease and health because of its potential to contribute to new distributions of pathogens as a result of a changed environment (Parry 2001; P.R. Hunter 2003; McMichael *et al*. 2003, 2004). For example, with respect to such diseases as dengue fever (Hales *et al*. 2002) and malaria (Rogers and Randolph 2000; Tanser *et al*. 2003; Thomas *et al*. 2004; van Lieshout 2004). Indeed, Epstein (2002: 374) observes that: 'Volatility of infectious diseases may be one of the earliest biological expressions of climate instability'. In addition, human health will be affected because human comfort levels will also be impacted by climate

change, along with issues of ozone depletion and skin cancer and effects on food production and water availability (McMichael 2002; Hall and Higham 2005) (Table 9.4).

McMichael (2001, 2002) argues that new patterns of disease emerging today may reflect the fact that humans are stressing ecological life support systems beyond the limits of their tolerance. As Morse (1993b: 23) observes: 'The lesson of AIDS demonstrates that infectious diseases are not a vestige of our premodern past; instead, like disease in general, they are the price we pay for living in the organic world.' There is arguably more focus now from the general public in the developed world on disease than there has been for many years. However, such attention has tended to be generated by concerns about bioterrorist attack (Glass and Schoch-Spana 2002) or the morality of disease (Webb 1997) rather than a considered view of health and disease. Such considerations are not new (e.g. Fenn 2000; Markel 2000). However, the emergence of infectious disease in parallel with other elements of global environmental change clearly has substantial implications for immediate and long-term personal and global security (Bloom and Mahal 1997; Fidler 1999; Hall *et al*. 2003; Eizenstat *et al*. 2004; Haacker 2004).

> Most generations alive today in developed countries are unprepared for the enormous threat infectious diseases now pose to them and their offspring. Even the calamity of AIDS has not dented the complacent attitudes of millions that we have seen the 'end of history' for infectious diseases.
>
> (Fidler 1999: 6)

We are therefore entering what McMichael (2001, 2002) referred to as a fourth transition, marked by disease emergence on a global scale. Not coincidentally, such health risks are also occurring at a time of greater human mobility and travel

Table 9.4 Possible direct and indirect health effects arising from global climate change

- Hyperthermia due to summertime heat-related mortality
- Changes to rate of infection from various diseases as a result of changes in the geographic ranges of pathogens, vectors and reservoirs
- Changes to allergenic reactions as a result of changed geographic ranges of allergic stimulants and environmental changes
- Increases in the rate of respiratory disease due to air pollutants
- Increases in the rate of skin cancer, melanomas, cataracts and immune suppression linked to increases in ambient ultraviolet light
- Impacts of extreme weather events
- Malnutrition and starvation due to changes in location and type of agricultural production
- Population movement as a result of enforced migration from areas affected by major ecological change, e.g. coastlines

Sources: Cliff and Haggett 1995; Epstein 2002; Hall and Higham 2005

to destinations increasingly remote and distant from the traveller's origin. Tourism is an extremely important contributor to such a transition. Unfortunately, while tourism will be dramatically affected by any pandemic, there is very little to suggest that the tourism industry is concerned or even aware of many such global health and disease issues.

References

Arndt, C. and Lewis, J. (2000) 'The macro implications of HIV/AIDS in South Africa: A preliminary assessment', *The South African Journal of Economics*, 69(5): 856–87.

Ausubel, J.H., Marchetti, C. and Meyer, P. (1998) 'Toward green mobility: the evolution of transport', *European Review*, 6(2): 137–56.

Bell, C. and Lewis, M. (2005) 'The economic implications of epidemics old and new', Centre for Global Development Working Paper No.54.

Biosecurity Strategy Development Team (2001) *A Biosecurity Strategy for New Zealand, Strategy Vision Framework Background Paper for Stakeholder Working Groups*. Wellington: Biosecurity Strategy Development Team.

Bloom, D. (1999) 'Economic perspectives on the global AIDS epidemic', *AIDS Patient Care and STDs*, 13(4): 229–34.

Bloom, D. and Canning, D. (2003) 'The health and poverty of nations: From theory to practice', *Journal of Human Development*, 4(1): 47–71.

Bloom, D. and Mahal, A. (1997) 'AIDS, flu, and the Black Death: Impacts on economic growth and well-being', in D. Bloom and P. Godwin (eds) *The Economics of HIV and AIDS: The Case of South and South East Asia*. New Delhi: Oxford University Press, pp.22–52.

Bradley, D.J. (1989) 'The scope of travel medicine: An introduction to the conference on international travel medicine', in R. Steffen, H.O. Lobel and J. Bradley (eds) *Travel Medicine: Proceedings of the First Conference on International Travel Medicine, Zurich, Switzerland, April 1988*. Berlin: Springer-Verlag, pp.1–9.

Chan-Yeung, M., Ooi, G.C., Hui, D.S., Ho, P.L. and Tsang, K.W. (2003) 'Severe acute respiratory syndrome', *International Journal of Tuberculosis and Lung Disease*, 7(12): 1117–30.

Cliff, A. and Haggett, P. (1995) 'Disease implications of global change', in R.J. Johnston, P.J. Taylor and M.J. Watts (eds) *Geographies of Global Change: Remapping the World in the Late Twentieth Century*. Oxford: Blackwell, pp.206–23.

Cliff, A. and Haggett, P. (2004) 'Time, travel and infection', *British Medical Bulletin*, 69: 87–99.

Cohn, S.K. (2003) *The Black Death Transformed: Disease and Culture in Early Renaissance Europe*. New York: Oxford University Press.

Cook, N.D. (1998) *Born to Die: Disease and New World Conquest, 1492–1650*. Cambridge: Cambridge University Press.

Cook, N.D. (2004) *Demographic Collapse: Indian Peru, 1520–1620*. Cambridge: Cambridge University Press.

Croft, A. (2000) 'Malaria: prevention in travellers', *British Medical Journal*, 321: 154–60.

Crosby, A.W. (1972) *The Columbian Exchange: Biological and Cultural Consequences of 1792*. Westport, CT: Greenwood Press.

Crosby, A.W. (1976) 'Virgin soil epidemics as a factor in the aboriginal depopulation in America', *William and Mary Quarterly*, 3rd Series 33: 289–99.

Crosby, A.W. (1986) *Ecological Imperialism: The Biological Expansion of Europe, 900–1900*. Cambridge: Cambridge University Press.

Curtin, P.D. (1968) 'Epidemiology and the slave trade', *Political Science Quarterly*, 83: 190–216.

De Schryver, A. and Meheus, A. (1989) 'International travel and sexually transmitted diseases', *World Health Statistics Quarterly*, 42: 90–9.

Diamond, J. (1997) *Guns, Germs and Steel: The Fates of Human Societies*. New York: Norton.

Dobyns, H.F. (1983) *Their Number Became Thinned: Native American Population Dynamics in Eastern North America*. Knoxville, TN: University of Tennessee Press.

Donnelly, C.A., Ghani, A.C., Leung, G.M., Hedley, A.J., Fraser, C., Riley, S., Abu-Raddad, L.J., Ho, L.M., Thach, T.Q., Chau, P., Chan, K.P., Lam, T.H., Tse, L.Y., Tsang, T., Liu, S.H., Kong, J.H., Lau, E.M., Ferguson, N.M. and Anderson, R.M. (2003) 'Epidemiological determinants of spread of causal agent of severe acute respiratory syndrome in Hong Kong', *Lancet*, 361(9371): 1761–6.

Dorolle, P. (1969) 'Old plagues in the jet age: International aspects of present and future control of communicable diseases', *WHO Chronicle*, 23: 104–7.

Dos Santos, C.C., Anvar, A., Keystone, J.S. and Kain, K.C. (1999) 'Survey of use of malaria prevention measures by Canadians visiting India', *Canadian Medical Association Journal*, 160(2): 195–200.

Eizenstat, S., Porter, J.E. and Weinstein, J. (2004) *On the Brink: Weak States and US National Security*. Report of the Commission on Weak States and U.S. National Security, Washington, DC: Center for Global Development.

Epstein, P.R. (2002) 'Climate change and infectious disease: stormy weather ahead', *Epidemiology*, 13(4): 373–5.

Fenn, E.A. (2000) 'Biological warfare in eighteenth-century North America: Beyond Jeffery Amherst', *Journal of American History*, 86: 1552–80.

Fenn, E.A. (2002) *Pox Americana: The Great Smallpox Epidemic*. New York: Hill and Wang.

Fidler, D.P. (1999) *International Law and Infectious Diseases*. Oxford: Oxford University Press.

Flinn, M.W. (1979) 'Plague in Europe and the Mediterranean countries', *Journal of European Economic History*, 8: 131–48.

Ford, N. and Koetsawang, S. (1991) 'The socio-cultural context of the transmission of HIV in Thailand', *Social Science of Medicine*, 33(4): 405–14.

Garrett, L. (1996) 'The return of infectious diseases', *Foreign Affairs*, 75: 66–79.

Garrett, L. (2000) *Betrayal of Trust: The Collapse of Global Public Health*. New York: Hyperion.

Genicot, L. (1966) 'Crisis: From the Middle Ages to modern times', in M.M. Postan (ed.) *The Agrarian Life of the Middle Ages, The Cambridge Economic History of Europe*, Vol.1. London: Cambridge University Press, pp.660–742.

Glass, T.A. and Schoch-Spana, M. (2002) 'Bioterrorism and the people: How to vaccinate a city against panic', *Clinical Infectious Diseases*, 34: 217–23.

Gössling, S. (2002) 'Global environmental consequences of tourism', *Global Environmental Change*, 12(4), 283–302.

Gould, S.J. (2002) *The Structure of Evolutionary Theory*. Cambridge, MA: Belknap.

Greer, R.A. (1965) 'Oahu's ordeal – the smallpox epidemic of 1853', *Hawaii Historical Review*, 1: 221–42.

Grübler A. and Nakicenovic, N. (1991) *Evolution of Transport Systems, RR–91–8*. Laxenburg, Vienna: International Institute for Applied Systems Analysis.

Haacker, M. (ed.) (2004) *The Macroeconomics of HIV/AIDS*. Washington, DC: International Monetary Fund.

Hales, S., deWet, N., Maindonald, J. and Woodward A. (2002) 'Potential effect of population and climate changes on global distribution of dengue fever: an empirical model', *Lancet*, 360: 830–4.

Hall, C.M. (2003) 'Tourism and Temporary Mobility: Circulation, Diaspora, Migration, Nomadism, Sojourning, Travel, Transport and Home', International Academy for the Study of Tourism (IAST) Conference, 30 June–5 July 2003, Savonlinna, Finland.

Hall, C.M. (2003) 'Biosecurity and wine tourism: Is a vineyard a farm?' *Journal of Wine Research*, 14(2–3): 121–6.

Hall, C.M. (2004) 'Tourism and biosecurity', in C. Cooper, C. Arcodia, D. Soinet and M. Whitford (eds) *Creating Tourism Knowledge, 14th International Research Conference of the Council for Australian University Tourism and Hospitality Education, 10–13 February*, School of Tourism and Leisure Management, University of Queensland.

Hall, C.M. (2005) *Tourism: Rethinking the Social Science of Mobility*. Harlow: Prentice-Hall.

Hall, C.M. and Higham, J. (eds) (2005) *Tourism, Recreation and Climate Change*. Clevedon: Channelview Press.

Hall, C.M., Timothy, D. and Duval, D. (2003) 'Security and tourism: towards a new understanding?' *Journal of Travel and Tourism Marketing*, 15(2–3): 1–18.

Henige D. (1986) 'Primary source by primary source? On the role of epidemics in New World depopulation', *Ethnohistory*, 33: 293–313.

Humar, A., Sharma, S., Zoutman, D. and Kain, K.C. (1997) 'Fatal *falciparum malaria* in Canadian travellers', *Canadian Medical Association Journal*, 156: 1165–7.

Hunter, P.R. (2003) 'Climate change and waterborne and vector-borne disease', *Journal of Applied Microbiology*, 94: 37S–46S.

Hunter, S. (2003) *Black Death: AIDS in Africa*. New York: Palgrave Macmillan.

Joralemon, D. (1982) 'New World depopulation and the case of disease', *Journal of Anthropological Research*, 38(1): 108–27.

Jones, D.S. (2003) 'Virgin soils revisited,' *William and Mary Quarterly*, 3d ser., 60: 703–42.

Kain, K.C. and Keystone, J.S. (1998) 'Malaria in travelers: Epidemiology, disease and prevention', *Infectious Disease Clinics of North America*, 12: 267–84.

Kain, K.C., MacPherson, D.W., Kelton, T., Keystone, J.S., Mendelson, J. and Maclain, J. (2001) 'Malaria deaths in visitors to Canada and in Canadian travellers: A case series', *Canadian Medical Association Journal*, 164(5) (March 6), online. Available at: www.cmaj.ca/cgi/content/full/164/5/654 (accessed 25 January 2005).

Kelton, P. (2004) 'Avoiding the smallpox spirits: Colonial epidemics and southeastern Indian survival', *Ethnohistory*, 51: 45–71.

Kipple, K.F. and Higgins, B.T. (1992) 'Yellow fever and the Africanization of the Caribbean,' in J.W. Verano and D.H. Ubelaker (eds) *Disease and Demography in the Americas*. Washington, DC: Smithsonian Institution.

Koplow, D.A. (2003) *Smallpox: The Fight to Eradicate a Global Scourge*. Berkeley, CA: University of California Press.

Lederberg, J., Shope, R.E. and Oaks Jr., S.C. (1992) *Emerging Infections: Microbial Threats to Health in the United States*. Washington, DC: National Academy of Sciences.

Lee, J.-W. and McKibbin, W.J. (2004) 'Globalization and Disease: The Case of SARS', Brookings Discussion Papers in International Economics No.156.

Leung, G.M., Hedley, A.J., Ho, L., Chau, P., Wong, I.O.L., Thach, T.Q., Ghani, A.C., Donnelly, C.A., Fraser, C., Riley, S., Ferguson, N.M., Anderson, R.M., Tsang, T., Leung, P., Wong, V., Chan, J.C.K., Tsui, E., Lo, S. and Lamm, T. (2004) 'The

epidemiology of severe acute respiratory syndrome in the 2003 Hong Kong epidemic: an analysis of all 1755 patients', *Annals of Internal Medicine*, 141(9): 662–73.

Li, Y., Yu, I.T., Xu P., Lee, J.H., Wong, T.W., Ooi, P.L. and Sleigh, A.C. (2004) 'Predicting super spreading events during the 2003 severe acute respiratory syndrome epidemics in Hong Kong and Singapore', *American Journal of Epidemiology*, 160(8): 719–28.

van Lieshout, M., Kovats, R.S., Livermore, M.T. and Martens, P. (2004) 'Climate change and malaria: analysis of the SRES climate and socio-economic scenarios', *Global Environmental Change*, 14: 87–99.

Lindenbaum, S. (1997) 'AIDS: Body, mind, and history', in G.C. Bond, J. Kreniske, I. Susser and J. Vincent (eds) *AIDS in Africa and the Caribbean*. Boulder, CA: Westview Press, pp.191–4.

Lipsitch, M., Cohen, T., Cooper, B., Robins, J.M., Ma, S., James, L., Gopalakrishna, G., Chew, S.K., Tan, C.C., Samore, M.H., Fisman, D. and Murray, M. (2003) 'Transmission dynamics and control of severe acute respiratory syndrome', *Science*, 300(5627) (June 20):1966–70.

Lobel, H.O. and Kozarsky, P.E. (1997) 'Update on prevention of malaria for travelers', *Journal of the American Medical Association*, 278: 1767–71.

Lydie, N., Robinson, N.J., Ferry, B., Akam, E., De Loenzien, M. and Abega, S. (2004) 'Mobility, sexual behavior, and HIV infection in an urban population in Cameroon', *JAIDS Journal of Acquired Immune Deficiency Syndromes*, 35(1):67–74.

McEvedy, C. (1988) 'The bubonic plague', *Scientific American*, 258(February): 118–23.

MacFarlan, M. and Sgherri. S. (2001) 'The Macroeconomic Impact of HIV/AIDS in Botswana', IMF Working Paper WP/01/80, International Monetary Fund.

McMichael, A.J. (1993) *Planetary Overload: Global Environmental Change and the Health of the Human Species*. Cambridge: Cambridge University Press.

McMichael, A.J. (2001) *Human Frontiers, Environments and Disease: Past Patterns, Uncertain Futures*. Cambridge: Cambridge University Press.

McMichael, A.J. (2002) 'Population, environment, disease, and survival: past patterns, uncertain futures', *Lancet*, 359: 1145–8.

McMichael, A.J., Woodruff, R.E., Whetton, P., Hennessy, K., Nicholls, N., Hales, S., Woodward, A. and Kjellstrom, T. (2003) *Human Health and Climate Change in Oceania: Risk Assessment 2002*. Canberra: Commonwealth of Australia, Department of Health and Ageing.

McMichael, A.J., Campbell-Lendrum, D., Kovats, R.S., Edwards, S., Wilkinson, P., Edmonds, N., Nicholls, N., Hales, S., Tanser, F.C., Le Sueur, D., Schlesinger, M. and Andronova, N. (2004) 'Climate change', in M. Ezzati, A.D. Lopez, A. Rogers, and C.J. Murray (eds) *Comparative Quantification of Health Risks: Global and Regional Burden of Disease Due to Selected Major Risk Factors*, Vol.2. Geneva: World Health Organization.

McNeill, W.H. (1976) *Plagues and People*. London: Penguin

MacPherson, D.W. (2001) 'Human mobility and population health: New approaches in a globalizing world', *Perspectives in Biology and Medicine*, 44(3): 390–401.

Markel, H. (2000) '"The eyes have it": Trachoma, the perception of disease, the United States Public Health Service, and the American Jewish immigration experience, 1897–1924', *Bulletin of the History of Medicine*, 74: 525–60.

May, A. (2003) *Social and Economic Impacts of HIV/AIDS in Sub-Saharan Africa, with Specific Reference to Aging*, Institute of Behavioral Science, Population Aging Center, Working Paper PAC2003–0005. Boulder, CO: University of Colorado.

May, J.M. (1958) *The Ecology of Human Disease*. New York: M.D. Publications.

Mayer, J.D. (1996) 'The political ecology of diseases as one new focus for medical geography', *Progress in Human Geography*, 20: 445–56.
Milner, G.R. (1980) 'Epidemic disease in the postcontact southeast: a reappraisal', *Mid-Continent Journal of Archeology*, 5(1): 39–56.
Morse, S.S. (1993a) 'Examining the origins of emerging viruses', in S.S. Morse (ed.) *Emerging Viruses*. New York: Oxford University Press, pp.10–28.
Morse, S.S. (1993b) 'AIDS and beyond: Defining the rules for viral traffic', in E. Fee and D.M. Fox (eds) *AIDS: The Making of a Chronic Disease*. Berkeley, CA: University of California Press, pp.23–48.
Murphy, G.S. and Oldfield, E.C. (1996) 'Falciparum malaria', *Infectious Disease Clinics of North America*, 10: 747–55.
Musa, G., Hall, C.M. and Higham, J. (2004) 'Tourism sustainability and health impact in high altitude ACE destinations: a case study of Nepal's Sagarmatha National Park', *Journal of Sustainable Tourism*, 12(4): 306–31.
Parry, M., Arnell, N., McMichael, T., Nicholls, R., Martens, P., Kovats, S., Livermore, M., Rosenzweig, C., Iglesias, A. and Fischer, G. (2001) 'Millions at risk: defining critical climate change threats and targets', *Global Environmental Change*, 11: 181–3.
Potter, C.W. (2001) 'A history of influenza', *Journal of Microbiology*, 91: 572–9.
Raptopoulou-Gigi, M. (2003) 'Severe acute respiratory syndrome (SARS): A new emerging disease in the 21st century', *Hippokratia*, 7(2): 81–3.
Rogers, D.J. and Randolph, S.E. (2000) 'The global spread of malaria in a future, warmer world', *Science*, 289: 1763–5.
Roll Back Malaria (2004) Malaria in Africa, online. Available at: www.rbm.who.int/cmc_upload/0/000/015/370/RBMInfosheet_3.htm. (accessed 25 January 2005).
Rudkin, B. and Hall, C.M. (1996) 'Off the beaten track: the health implications of the development of special-interest tourism services in South-East Asia and the South Pacific', in S. Clift and S. Page (eds) *Health and the International Tourist*. London: Routledge, pp.89–107.
Sachs, J. and Malaney, P. (2002) 'The economic and social burden of malaria', *Nature*, 415: 680–5.
Schmitt, R.C. (1970) 'The Okuu – Hawaii's epidemic', *Hawaii Medical Journal*, 29: 359–64.
Sharpley, R. and Craven, B. (2001) 'The 2001 foot and mouth crisis – rural economy and tourism policy implications: a comment', *Current Issues in Tourism*, 4(6): 527–37.
Snow, D.R. and Lanphear, K.M. (1988) 'European contact and Indian depopulation in the Northeast: The timing of the first epidemics,' *Ethnohistory*, 35: 15–33.
Snow, D.R. and Starna, W.A. (1989) 'Sixteenth-century depopulation: A view from the Mohawk Valley', *American Anthropologist*, 91: 142–9.
Tanser, F.C., Sharp, B. and Le Sueur, D. (2003) 'Potential effect of climate change on malaria transmission in Africa', *Lancet*, 362: 1792–8.
Thomas, C.J., Davies, G. and Dunn, C.E. (2004) 'Mixed picture for changes in stable malaria distribution with future climate in Africa', *Trends in Parasitology*, 20: 216–20.
Webb, D. (1997) *HIV and AIDS in Africa*. Chicago, IL: Pluto Press.
Westwood, J.C.N. (1980) *The Hazard From Dangerous Exotic Diseases*. London: Macmillan.
White, R. (1980) *Land Use, Environment and Social Change: The Shaping of Island County, Washington*. Seattle, WA: University of Washington Press.
Williams, B., Gouws, E., Lurie, M. and Crush, J. (2002) *Spaces of Vulnerability: Migration and HIV/AIDS in South Africa*. Cape Town: Southern African Migration Project.

Wilson, M.E. (1994) 'Disease in evolution: introduction,' in M.E. Wilson, R. Levins and A. Spielman (eds) *Disease in Evolution: Global Changes and Emergence of Infectious Diseases*. New York: New York Academy of Sciences, pp.1–12.

Wilson, M.E. (1995) 'Travel and the emergence of infectious diseases', *Emerging Infectious Diseases*, 1(2): 39–46.

Wolfe, R.J. (1982) 'Alaska's Great sickness, 1900: An epidemic of measles and influenza in a virgin soil population', *Proceedings of the American Philosophy Society*, 126: 92–121.

10

Water Resources and Tourism

Stefan Gössling

Introduction

Fresh water is one of the most essential resources to humanity, and it is becoming increasingly scarce. In 1995, an estimated 450 million people lived under severe water stress and an additional 1.3 billion people under a high degree of water stress (Vörösmarty *et al*. 2000). In the future, fresh water will become even scarcer, making the use and management of water an important political issue (see Clarke and King 2004). Tourism is highly dependent on the availability of fresh water resources (e.g. Orams 1998, Garrod and Wilson 2003). Recreational activities such as swimming, sailing, kayaking, canoeing, diving, fishing, and so on, are often related to lakes and rivers, which also form important elements of the landscapes visited by tourists (see also Chapter 4, this volume). Fresh water is also needed for the maintenance of tourist infrastructure such as swimming pools, irrigated gardens, bathrooms, laundry, etc. (see Gössling 2001). Tourism can exacerbate fresh water problems, because it is often concentrated in regions with limited water resources, such as islands and coastal zones where there are few fossil water resources, low aquifer renewal rates, and few surface water sources. Besides causing a shift in global water consumption from regions of relative water abundance to those that are water scarce, tourism also increases total water demand because people use larger quantities of this resource when they are on vacation (Gössling 2002, 2005). Related to these aspects, water quality may often decrease through tourism, as a result of the discharge of untreated sewage, nutrient loads and toxic substances into adjacent water bodies (UN 1995; WWF 2004). In the light of these findings, this chapter seeks to discuss the interdependence of tourism and water resources, the consequences of global shifts in water demand, and the effects of changing water availability in important destinations for the tourist industry.

Global water use and distribution

Fresh water availability is highly unevenly distributed between countries and within countries. For example, within Europe, renewable per capita water resources range from less than 40m^3 per year in Malta to more than 600,000m^3 in Iceland (FAO

2003). Within countries, water availability is dependent on watersheds, which can divide water scarce and water abundant regions (see e.g. Gössling 2001 for Zanzibar, Tanzania). While many countries have vast water resources, desalination has become of major importance in some large industrialised countries such as the USA, Italy and Spain, as well as a range of small islands and island states. Some countries, particularly islands, have also started to import fresh water in tank ships, including the Bahamas, Antigua and Barbuda, Mallorca, the Greek Islands, South Korea, Japan, Taiwan, Nauru, Fiji and Tonga (Clarke and King 2004).

Fresh water use is divided in agricultural, domestic and industrial consumption. On global average, approximately 70 per cent of water use may be for agriculture, 20 per cent for industrial and 10 per cent for domestic purposes (FAO 2003, own calculations). However, there are large differences between countries. For example, agriculture accounts for 1 per cent of the total water use in Belgium or Austria, as opposed to 98 per cent in Afghanistan or Cambodia. Domestic water use, which includes households but also municipalities, commercial establishments and public services, constitutes only 1 per cent of water consumption in Ethiopia, but 83 per cent in Equatorial Guinea. Similarly, industrial consumption is less than 1 per cent in Somalia or Mali, but 89 per cent in Belize. Similar ranges can be observed in terms of per capita water use. For example, daily domestic water consumption varies between 12 litres per capita in Bhutan and 1,661 litres per capita in Australia (WRI 2003). On global average, domestic water consumption is in the order of 160 litres per capita per day (database 1987–1999, WRI 2003). In industrialised countries, 35 per cent of household consumption – constituting the major share of domestic water use – may be for bathing and showering, 30 per cent for flushing toilets, 20 per cent for laundry, 10 per cent for cooking and drinking, and 5 per cent for cleaning (Clarke and King 2004).

Water consumption patterns in tourism

Tourism-related water consumption is still little investigated, and there are few detailed studies of water use in different geographical settings, for different forms of tourism, or for the many forms of accommodation establishments. From what is known, water use varies widely with a range of 100 to 2,000 litres per tourist per day (Lüthje and Lindstädt 1994; UK-CEED 1994; GFANC 1997; Gössling 2001; WWF 2001, 2004). For example, the World Wide Fund for Nature (WWF 2001) reports that the average tourist in Spain consumes 440 litres per day, a value that increases to 880 litres where swimming pools and golf courses exist. A survey of water consumption in the tropical island of Zanzibar showed that water use was lowest in small, locally-owned guesthouses (100 litres per tourist per day), and highest in luxury resort hotels (up to 2,000 litres per tourist per day). The weighted water consumption was found to be 685 litres per tourist per day (Gössling 2001). The survey also assessed water use patterns. Hotels used most water for continuous irrigation of their gardens – 50 per cent, or a weighted average of 465 litres per day per tourist – a result of the poor storage capacity of the soils, high evaporation and use of plant species not adapted to arid conditions. In guesthouses, watering gardens accounted only for 15 per cent of the

total water use – 37 litres per tourist per day. The major proportion of water in guesthouses is spent for direct uses including taking showers, flushing the toilet, and the use of tap water – 55 per cent, 136 litres per tourist per day – with a corresponding consumption of 20 per cent or 186 litres per tourist per day in hotels. The higher demand of hotel guests is a result of additional showers taken at pools, more luxurious or better functioning bathroom facilities, etc. Swimming pools represent another important factor of water use, accounting for about 15 per cent of the water demand of hotels (140 litres per tourist per day). Indirectly, swimming pools add to laundry, for example, when additional towels are handed out to guests. Guesthouses in the study area did not have swimming pools, which can partially explain lower water use rates. Laundry accounts for about 10 per cent – 25 litres per tourist per day – of the water used in guesthouses and 5 per cent – 47 litres per tourist per day – in hotels. Cleaning adds 5 per cent to the water demand in both guesthouses – 12 litres per tourist per day – and hotels – 47 litres per tourist per day. Finally, restaurants in guesthouses account for 15 per cent of the water used in guesthouses – 37 litres per tourist per day – and for 5 per cent – 47 litres per tourist per day – in hotels. Further studies need to be conducted to confirm the results of this case study.

Global water use by tourism

Any calculation of global tourism-related water consumption needs to take into consideration the statistical distinction between international/domestic tourists and business/leisure tourists. Statistics provided by the World Tourism Organization (WTO 2003a) only account for international tourist arrivals, summarising both leisure and business tourists. Little is known about domestic tourism, even though there is evidence that it outweighs international tourism by far in terms of volume (e.g. Ghimire 2001). For international tourism, there is only scattered information on the average length of stay, an important parameter for the calculation of global water use. Data is available for the average length of stay of international tourists (business and leisure) in 97 countries, accounting for about 330 of the 692 million international tourist arrivals in 2001 (WTO 2003a). Based on this data (1997–2001), Gössling (2002) calculated a global average length of stay of 8.1 days. It should be noted that this calculation excludes a large number of important tourist countries such as the USA, Italy, China, United Kingdom, Russian Federation, Germany, Austria, Hungary, Hong Kong and Greece. Finally, data on water consumption per tourist is needed for the calculation. Available data suggests that, on global average, daily per tourist water consumption is in the order of 222 litres (for calculations, see Gössling 2005). This can be compared to the global average per capita water use (domestic), which is 160 litres per day (WRI 2003).

Given an average water consumption of 222 litres per day and assuming an average length of stay of 8.1 days, the 715 million international tourists in 2000 may have, for a rough estimate, used 1.3 km^3 of water. This figure excludes domestic tourism as well as indirect water consumption, for example, for the construction of tourist infrastructure or the production of food. It also excludes water used for energy generation. For example, the Worldwatch Institute (2004)

reports that it takes 18 litres of water to produce one litre of gasoline, and that air travel entails energy uses of 50–100 litres of fuel per passenger for every 1,000 km of flight distance. Excluding these water uses, international tourism may account for a share of 0.04 per cent of the aggregate global water withdrawal of 3,100 km^3 per year (data for 1985, Vörösmarty *et al*. 2000).

Global shifts in water consumption

The major proportion of tourist flows occurs between six regions, North America, the Caribbean, Northern and Southern Europe, North East Asia and South East Asia (WTO 2003b). Of the 715 million international tourist arrivals in 2002, 58 per cent took place within Europe, 16 per cent in North and South East Asia and 12 per cent in North America. Together they represent 86 per cent of all international tourist arrivals. Within sub-regions, about 87 per cent of all international arrivals in Europe are from Europe itself (some 350 million arrivals), while 71 per cent of international arrivals are regionally in the Americas (92 million), and 77 per cent in the Asia Pacific region (88 million). Six major tourist flows characterise international travel: Northern Europe to the Mediterranean (116 million); North America to Europe (23 million); Europe to North America (15 million); North East Asia to South East Asia (10 million); North East Asia to North America (8 million); and North America to the Caribbean (8 million).

Based on the global average length of stay of 8.1 days, each tourist travelling to another region may statistically increase the water use in this region by 1,800 litres, with a concomitant reduction in water use at home. However, there might be great differences between the regions. For example, tourists to the Caribbean might use far more water as a result of the resort character of many hotels in this region, which usually have irrigated gardens and large swimming pools, the main water consuming factors (see Gössling 2001). Travelling abroad also means that water consumption in the source regions is reduced, which needs to be considered when calculating net water increases/decreases. As consumption patterns vary widely, even within industrialised countries, this is a difficult task. The calculation is further complicated by the fact that domestic water use includes municipalities, commercial establishments and public services. The amount of water used for personal purposes may thus be substantially lower. For example, in the USA, per capita use for personal purposes is in the order of 380 litres per day (Solley *et al*. 1998) as compared to 653 litres for domestic purposes (WRI 2003). People on holiday might also reduce only part of their overall household consumption. For example, irrigation of lawns might continue even when the owner of a house is on vacation.

Global shifts in water use can only be calculated by considering the proportion of leisure versus business tourists, their average length of stay, the composition and character of different accommodation establishments, as well as water use patterns at home and in destination countries (Gössling 2005). Currently, no database is available that would allow for such sophisticated calculations. Figures presented in the following are thus based on a number of simplifying assumptions. Table 10.1 shows tourist flows and their respective water use at home –

hypothetical consumption if tourists had stayed at home – and in the destination. It follows that international tourism leads to shifts of fresh water consumption in the order of 470 million m^3 (aggregated increase/decrease), and to an increase of global water use in the order of an estimated 70 million m^3 per year (Gössling 2005).

As shown in Table 10.1 and Figure 10.1, North America and North East Asia are the regions experiencing a net decrease in water consumption, while Europe, the Caribbean and South East Asia experience a net increase in water consumption. The major shift in water use occurs within Europe, with 116 million tourists travelling to southern Europe, particularly the Mediterranean. These movements account for a net transfer of about 70 million m^3.

It should be noted that there is a tendency for tourism to shift water demand from water-rich to water-poor areas both on large regional or continental scales – shifts from Northern Europe to Southern Europe, shifts from Europe and North America to the Caribbean – and on regional or local scales – for example, shifts to coastal zones. Furthermore, tourists may often arrive during the dry season, when rainfall drops to a minimum and water availability is restricted (see Gössling 2001; WWF 2004). Strong seasonality in combination with arrival peaks during dry season might thus put considerable strain on available water resources, particularly in generally dry regions.

Tourism also decreases the quality of water in many regions through the release of untreated sewage, which might also contain toxic components. For example, in

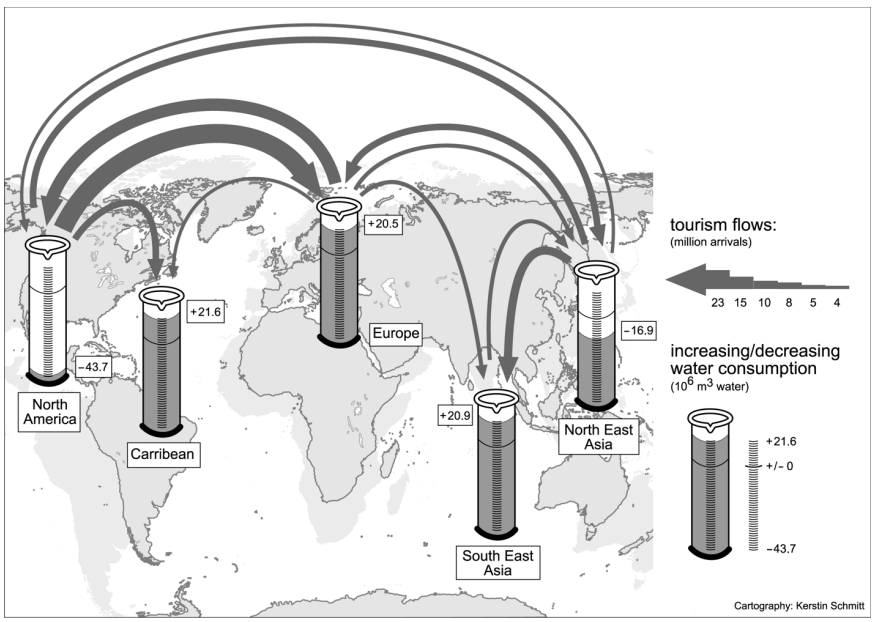

Figure 10.1 Tourism-related shifts in global water use

Source: Gössling 2005

Table 10.1 Global flows of tourists between regions and corresponding water use (2000)

Travel flows between regions	*Internat. tourists (million)*	*Water use home (l/cap/day)*	*Total home (million l)*	*Water use destination (l/cap/day)*	*Total destination (million l)*	*Increase/decrease by region (million l)*	
N. America–Europe	23	300	55,890	222	41,359	N. America	–43,691
N. America–Caribbean	8	300	19,440	222	14,386	Europe	20,510
N. America–N. E. Asia	4	300	9,720	222	7,193	Caribbean	21,579
Europe–N. America	15	150	18,225	222	26,973	N. E. Asia	–16,945
Europe–Caribbean	4	150	4,860	222	7,193	S. E. Asia	20,898
Europe–N. E. Asia	5	150	6,075	222	8,991		
Europe–S. E. Asia	5	150	6,075	222	8,991		
N. E. Asia–N. America	8	200	12,960	222	14,386		
N. E. Asia–Europe	8	200	12,960	222	14,386		
N. E. Asia–S. E. Asia	10	200	16,200	222	17,982		
S. E. Asia–N. E. Asia	5	150	6,075	222	8,991		
Total	95	—	168,480	—	170,831	—	2,351
Europe N. to Europe S.	116	150	140,940	222	208,591	N. Europe	–140,940
						S. Europe	208,591

Source: Gössling 2005

the Mediterranean, it is still a common practice to discharge sewage from hotels directly into the sea (WWF 2004). Similarly, Smith (1997, cited in Kent *et al*. 2002) reported that in the European Mediterranean, only 30 per cent of municipal wastewater from coastal towns received any treatment before discharge. As tourism substantially increases water use in the Mediterranean and other destinations, this sector is also responsible for changes in water quality through the discharge of sewage into adjacent water bodies. However, this problem might be even greater in the tropics, where it is still very common for both municipalities and hotels to release effluents largely untreated into coastal waters with low natural concentrations of nutrients.

Country-specific analysis

In the following, a more detailed database is provided for the world's 50 most important tourism countries (inbound tourism) as well as five small tropical island states for which data on tourism and water use is available. Island states were included because tourism is usually an important pillar of their economies, while they might simultaneously possess limited fresh water resources. The 55 countries contained in the sample account for roughly 584 million (82 per cent) of the 715 million international tourist arrivals in 2002 (Table 10.2).

As Table 10.2 shows, great differences exist between countries in terms of renewable water resources, desalination capacity, use of treated wastewater, and overall water use. For example, in countries such as Bahrain, Barbados, Israel, Malta, Saudi Arabia and the United Arab Emirates, water use greatly exceeds renewable water resources, with up to 15 times the amount of annually available renewable water being consumed (see United Arab Emirates). In these countries, water demand is met by seawater desalination, which can be substantial. Saudi Arabia desalinates some 714 million m^3 per year, which nevertheless represents only a fraction of the total used (17,320 million m^3 per year). Water demand overshooting renewable water resources plus desalinated water capacities thus puts heavy strains on fossil water supplies.

Overall, quite a range of important tourist countries use already a substantial share of their renewable water resources, or even overuse these, as exemplified by Poland (26.3 per cent), Republic of Korea (27 per cent), Ukraine (27 per cent), Mauritius (28 per cent), Germany (31 per cent), South Africa (31 per cent), Cyprus (31 per cent), Spain (32 per cent), India (34 per cent), Morocco (44 per cent), Bulgaria (49 per cent), Tunisia (60 per cent), Barbados (105 per cent), Malta (110 per cent), Israel (122 per cent), Bahrain (258 per cent), Saudi Arabia (722 per cent) and United Arab Emirates (1,538 per cent). Note that these figures represent statistical averages. In many areas water scarcity might already be felt as national water resources are located in remote areas that cannot be tapped. Often, the tourist industry might be able to react flexibly, like, for example, large hotels in tropical islands which are likely to have the financial means to invest in desalination infrastructure to overcome water scarcity. However, small accommodation establishments might not be in the position to adapt to such environmental changes, which raises the question of the

Table 10.2 Country overview statistics

Country	*Total natural renewable water resources (million m3/ year)*	*Desalin-ated water (million m³/year) (note 2)*	*Reused treated waste-water (million m³/year) (note 2)*	*Total water use in 2000 (million m³/year)*	*% of renewable water used*	*Tourist arrivals 2000 ('000)*	*Growth rate tourist arrivals*	*Tourist arrivals 2020 ('000)*	*Average length of stay, 2000*	*Water use per tourist per day³*	*Total tourism-related water use, 2000 (million m³)*	*Tourism-related water use as % of total*	*Tourism-related water use as % of domestic*	*Total tourism-related water use 2020 (million m³)⁴*
Argentina	814,000	0	0	29,072	3.6	2,909	5.1	8,000[1]	9.9	150	4.3	0.01	0.09	11.9
Australia	492,000	—	—	23,932	4.9	4,931	6.4	17,553[1]	26	300	38.5	0.16	1.09	136.9
Austria	77,700	—	—	2,112	2.8	17,982	1.2	23,100[2]	4.6	150	12.4	0.59	1.68	15.9
Bahrain	116	44.1	8.0	299	258.0	2,420	6.6	7,928[1]	2.4	200	1.2	0.39	0.97	3.8
Barbados	80	0	0	84	104.9	545	4.3	1,265[2]	10.1	400	2.2	2.61	7.34	5.1
Brazil	8,233,000	0	0	59,298	0.7	5,313	5.0	14,100[1]	12.1	300	19.3	0.03	0.16	51.2
Bulgaria	21,300	—	—	10,498	49.3	2,785	4.6	10,600[1]	8.4	150	3.5	0.03	1.10	13.4
Canada	2,902,000	—	—	45,974	1.6	19,627	3.6	40,600[1]	5.2	150	15.3	0.03	0.17	31.7
Cape Verde	300	0	0	28	9.3	83	3.6	168[2]	7	300	0.2	0.63	4.36	0.4
Chile	922,000	0	0	125,39	1.4	1,742	4.7	4,800[1]	10.1	200	3.5	0.03	0.25	9.7
China	2,896,569	—	—	6,302,89	21.8	31,229	7.8	130,000[1]	8.1	200	50.6	0.01	0.12	210.6
Cuba	38,120	0	0	8,204	21.5	1,741	9.2	6,700[1]	10.5	300	5.5	0.07	0.35	21.1
Cyprus	780	0	11.0	244	31.3	2,686	2.5	3,893[1]	11	400	11.8	4.84	16.88	17.1
Czech Rep.	13,150	—	—	2,566	19.5	4,666	4.0	44,000[1]	3.5	200	3.3	0.13	0.31	30.8
Denmark	6,000	—	—	1,267	21.1	2,088	3.8	4,402[2]	8.1	200	3.4	0.27	0.83	7.1
Dominican Republic	20,995	0	0	3,386	16.1	2,972	5.0	6,700[1]	10	400	11.9	0.35	1.09	26.8
Egypt	86,800	25.0	200.0	68,653	79.1	5,116	7.4	17,100[1]	6	400	12.3	0.02	0.23	41.0
Finland	110,000	—	—	2,478	2.3	2,714	3.8	5,722[2]	5.9	150	2.4	0.10	0.71	5.1
France	203,700	—	—	39,959	19.6	77,190	2.3	106,100[1]	7.5	400	231.6	0.58	3.69	318.3
Germany	154,000	—	—	47,052	30.6	18,983	1.2	20,000[1]	8.1	200	30.8	0.07	0.53	32.4
Greece	74,250	—	—	7,759	10.5	13,096	2.1	17,111[1]	8.1	400	42.4	0.55	3.34	55.4
Hungary	104,000	—	—	7,641	7.4	2,992	0.7	24,700[1]	8.1	200	4.9	0.06	0.68	40.0
India	1907,760	0	0	645,837	33.9	2,649	5.9	8,900[1]	31.2	150	12.4	<0.01	0.02	41.7

Table 10.2 Country overview statistics (continued)

Country	*Total natural renewable water resources (million m3/ year)*	*Desalinated water (million m^3/year) (note 2)*	*Reused treated wastewater (million m^3/year) (note 2)*	*Total water use in 2000 (million m^3/year)*	*% of renewable water used*	*Tourist arrivals 2000 ('000)*	*Growth rate tourist arrivals*	*Tourist arrivals 2020 ('000)*	*Average length of stay, 2000*	*Water use per tourist per day[3]*	*Total tourism-related water use, 2000 (million m^3)*	*Tourism-related water use as % of total*	*Tourism-related water use as % of domestic*	*Total tourism-related water use 2020 (million m^3)[4]*
Indonesia	2,838,000	0	0	82,773	2.9	5,064	7.7	27,385[1]	12.3	300	18.7	0.02	0.28	101.1
Ireland	52,000	—	—	1,129	2.2	6,737	3.8	14,204[2]	7.4	150	7.5	0.66	2.88	15.8
Israel	1,670	—	—	2,041	122.2	2,417	2.3	3,910[1]	15	300	10.9	0.53	1.73	17.6
Italy	191,300	—	—	44,372	23.2	41,181	2.1	52,451[1]	8.1	400	133.4	0.30	1.65	169.9
Japan	430,000	0	0	88,432	20.6	4,757	4.5	10,055[1]	8	200	7.6	0.01	0.04	16.1
Malaysia	580,000	0	0	9,016	1.6	10,222	5.0	25,046[1]	5.8	200	11.9	0.13	0.78	29.1
Malta	51	31.4	1.6	55	109.6	1,216	2.0	1,831[1]	8.4	400	4.1	7.34	10.21	6.2
Mauritius	2,210	0	0	612	27.7	656	5.3	1,548[1]	10.4	400	2.7	0.45	1.71	6.4
Mexico	457,222	0	0	78,219	17.1	20,641	3.6	48,900[1]	9.9	300	61.3	0.08	0.45	145.2
Morocco	29,000	3.4	0	12,758	44.0	4,113	4.9	8,692[1]	9	200	7.7	0.06	0.72	16.3
Netherlands	91,000	—	—	7,944	8.7	10,003	1.9	14,575[2]	2.7	150	4.1	0.05	0.83	5.9
Norway	382,000	—	—	2,185	0.6	4,348	3.8	9,167[2]	8.1	150	5.3	0.24	1.06	11.1
Philippines	479,000	0	0	28,520	6.0	1,992	7.7	11,293[1]	8.8	300	5.3	0.02	0.11	29.8
Poland	61,600	—	—	16,201	26.3	17,400	4.2	39,619[2]	4.8	150	12.5	0.08	0.60	28.5
Portugal	77,400	—	—	11,263	14.6	12,097	2.1	16,000[1]	6.7	400	32.4	0.29	3.00	42.9
Rep. of Korea	69,700	0	0	18,590	26.7	5,322	4.1	10,272[1]	8.1	200	8.6	0.05	0.13	16.6
Romania	211,930	—	—	23,176	10.9	3,274	2.8	8,500[1]	2.5	150	1.2	0.01	0.06	3.2
Russian Federation	4,507,250	0	0	76,686	1.7	21,169	6.8	48,000[1]	8.1	150	25.7	0.03	0.18	58.3
Saudi Arabia	2,400	714.0	217.0	17,320	721.7	6,296	5.3	12,194[1]	8.1	200	10.2	0.06	0.60	19.8
South Africa	50,000	0	0	15,306	30.6	6,001	8.0	30,523[1]	8.1	300	14.6	0.10	0.57	74.2
Spain	111,500	—	—	35,635	32.0	47,898	2.6	73,867[1]	12.9	400	247.2	0.69	5.16	381.2
Sweden	174,000	—	—	2,965	1.7	2,746	3.8	5,790[2]	8.1	150	3.3	0.11	0.31	7.0

Country	*Total natural renewable water resources (million m3/ year)*	*Desalinated water (million m^3/year) (note 2)*	*Reused treated waste-water (million m^3/year) (note 2)*	*Total water use in 2000 (million m^3/year)*	*% of renewable water used*	*Tourist arrivals 2000 ('000)*	*Growth rate tourist arrivals*	*Tourist arrivals 2020 ('000)*	*Average length of stay, 2000*	*Water use per tourist per day[3]*	*Total tourism-related water use, 2000 (million m^3)*	*Tourism-related water use as % of total*	*Tourism-related water use as % of domestic*	*Total tourism-related water use 2020 (million m^3)[4]*
Switzerland	53,500	—	—	2,571	4.8	11,000	1.7	17,400[1]	8.1	150	13.4	0.52	2.16	21.1
Thailand	409,944	0	0	87,065	21.2	9,579	6.9	36,959[1]	7.8	300	22.4	0.03	1.03	86.5
Trinidad and Tobago	3,840	0	0	305	8.0	399	4.3	926[2]	8.1	400	1.3	0.42	0.62	3.0
Tunisia	4,560	8.3	20.0	2,726	59.8	5,058	3.1	8,916[1]	6.6	400	13.4	0.49	3.11	23.5
Turkey	231,700	0.5	0	37,519	16.2	9,586	5.5	27,017[1]	10	400	38.3	0.10	0.69	108.1
UK	147,000	0	0	9,541	6.5	25,209	3.4	53,800[1]	8.1	200	40.8	0.43	1.97	87.2
Ukraine	139,550	0	0	37,523	26.9	4,406	4.2	10,032[2]	5.3	150	3.5	0.01	0.08	8.0
UAE	150	385.0	108.0	2,306	1537.5	3,907	7.1	15,404[2]	8.1	200	6.3	0.27	1.19	25.0
USA	3,069,400	—	—	479,293	15.6	50,945	3.5	102,400[1]	8.1	300	123.8	0.03	0.20	249.0
Uruguay	139,000	0	0	3,146	2.3	1,968	5.3	5,528[2]	6.9	150	2.0	0.06	2.55	5.7
Totals	34,076,497	—	—	2,886,370	—	584,066	—	1,357,990	—	—	1,487.3	—	—	3,081.3

[1] WTO 2001.

[2] extrapolation based on growth rate.

[3] weighted average, estimate by author. Categories: countries with i) high share of friends and relative-related tourism, high percentage of small accommodation establishments or city hotels, high share of mountain tourism: 150 litres per tourist per day (t/d), ii) Mediterranean and countries with high percentage of resort hotels: 400 litres t/d, iii) other, individual judgement: 200–300 litres t/d.

[4] extrapolation does not consider increases/decreases in per tourist water use estimates; *global average applied in absence of national data, calculation in Gössling 2002.

Sources: WTO 2001, 2003a; WWF 2001, 2004; www.fao.org/aquastat 2003 (accessed 10 August 2004).

interaction between large-scale technical adaptation and small-scale tourist infrastructure. There are also examples where the water demands of hotels have been favoured over the needs of local populations (see Gössling 2001), reminding us that water access and use are also questions of global environmental justice. In the future, global water demand will depend on population growth, modernisation processes, technology and economic restructuring such as moving from water-intensive to less water consuming economic activities. It is projected that global water demand will substantially increase, putting additional constraints on already water scarce countries (Clark and King 2004).

What role does tourism play in these countries as a water consuming factor? As indicated in Table 10.2, tourism-related water demand depends on water use per tourist, number of international tourist arrivals, and average length of stay of tourists. Because country-specific data on these parameters is often not available, some assumptions have to be made for analysis. Water use per tourist per day was estimated for three categories of countries: i) countries with a high share of 'friends and relatives'-tourism, a high percentage of small accommodation establishments or city hotels, a large share of mountain-based tourism (for example, Austria, Romania, Switzerland: 150 litres per tourist per day), ii) Mediterranean and countries with a high percentage of resort hotels (for example, Mauritius, Spain; 400 litres per tourist per day), and iii) those not belonging to categories i) and ii). For the latter, water use was estimated based on individual judgements (for example, Philippines, Mexico, Denmark, with water uses of 200–300 litres per tourist per day). Note that most estimates need to be seen as rather conservative, as for example WWF (2004) calculates an average water consumption of 440 litres per tourist per day for Mediterranean countries.

The results show that tourism generally accounts for less than 1 per cent of the total water consumption in the sample countries. Malta (7.3 per cent), Cyprus (4.8 per cent) and Barbados (2.6 per cent) are exceptions, even though they indicate that temperate and tropical islands with high tourist arrival numbers and limited water resources are more likely to face water conflicts. This becomes even more obvious looking at the importance of tourism-related water uses in comparison to domestic water use. While tourism remains a negligible factor of water use in most countries, it might be responsible for up to 16.9 per cent of domestic water use in countries like Cyprus. Clearly, tourism has an important influence on water consumption patterns. This also becomes obvious looking at tourism's absolute water consumption, which varied between 0.2 million m^3 (Cape Verde) and 247.0 million m^3 (Spain) in 2000.

Extrapolating the results of Table 10.2, global water use by international tourism might be in the order of 1.8 km^3. This estimate is somewhat higher than the top-down assessment of 1.3 km^3 provided above. By 2020, tourism-related water use is likely to increase with international tourist numbers and higher hotel standards (see Gössling 2001). Even though the development of international tourist arrivals has been irregular during the last years, the World Tourism Organization (2004) maintains projections of its *Tourism 2020 Vision* (WTO 2001), which forecasts over 1.56 billion international arrivals by the year 2020. Of these arrivals, 1.2 billion will be intraregional and 0.4 billion will be long-haul travellers. Distribution

by region shows that, by 2020, three regions will receive the majority of tourists: Europe (717 million tourists), East Asia and the Pacific (397 million) and the Americas (282 million), followed by Africa, the Middle East and South Asia. According to the forecast, East Asia and the Pacific, South Asia, the Middle East and Africa will experience growth rates of over 5 per cent per year, compared to the world average of 4.1 per cent per year. Europe and the Americas are anticipated to show lower than average growth rates. Extrapolating projected tourist arrival numbers to water use, and not considering potential changes in water use or average length of stay, international tourism might account for the use of more than 3.8 km^3 of fresh water by 2020.

Vulnerability

In the future, water resources will decrease in many countries; both as a result of the overuse of renewable water supplies and climate change leading to new precipitation patterns. While it is clear that population growth and modernisation processes will lead to increasing water stress, pushing up the number of people living in water scarce countries, it is less obvious how climate change will affect water availability (see Arnell 2004). The results of the models used by Arnell indicate that:

> Climate change increases water resources stresses in some parts of the world where runoff decreases, including around the Mediterranean, in parts of Europe, central and southern America, and southern Africa. In other water-stressed parts of the world – particularly in southern and eastern Asia – climate change increases runoff, but this may not be very beneficial in practice because the increases tend to come during the wet season and the extra water may not be available during the dry season.
>
> (Arnell 2004: 31)

Decreasing water resources will most certainly affect tourism in many areas, particularly in small developing islands and already water scarce areas. However, the consequences for the tourist industry will depend on several factors, including the relative scarcity of fresh water in tourism areas, competition with other economic sectors, the structure of the tourist industry (for example, small guest-houses or large resort hotels), and options to adapt to these changes, for example, through technological change including water saving measures, desalination and wastewater reuse. Technological adaptation might be costly, however, if for example desalination technology is involved. As pointed out earlier, it might also be a solution feasible only for larger accommodation establishments. Water desalination for tourism also contributes to global environmental change, because it entails high energy use. Reverse osmosis, the technical standard for hotels, involves 6 kWh of electricity per m^3 of water – corresponding to emissions of approximately 1.9 kg CO_2 – for pumps forcing water through a membrane to separate fresh water from brine. Distillation, this is heating water to create steam, which distils as

fresh water, leads to an even greater energy use of 25–200 kWh per m^3 (Clarke and King 2004).

Clarke and King (2004) identify a range of countries that will be chronically short of water by 2050, including the Netherlands, Germany, Tunisia, Malta, Morocco, South Africa, Cyprus, Maldives, Singapore, Antigua and Barbuda, St. Kitts and Nevis, Dominica and Barbados. For these countries, it will be increasingly difficult to provide fresh water for tourism, even though this might certainly prove to be a bigger challenge for the Maldives than for the Netherlands and Germany. Many other small islands not included in the list above are also in jeopardy of overusing their water capacity. In particular, small tropical islands might face comparatively higher costs in adapting to water scarcity, because they compete more directly with other sectors of the national economy for generally scarcer water resources.

It seems difficult to predict in which areas of the world water scarcity will have serious or even severe consequences for tourism, even though it might generally be possible to identify coastlines, small – often coralline – islands, and arid/semi-arid zones as those in greatest danger of water stress. Even though some of these areas have been identified, such as the Mediterranean (WWF 2004), Mallorca (Essex *et al*. 2004) or Zanzibar (Gössling 2001), further country-specific studies are needed in order to better understand the vulnerability of the tourist industry in various locations.

Conclusion

This chapter has outlined the linkages between tourism, water and global environmental change. Tourism is highly dependent on water resources, both in terms of providing the physical framework for tourism (oceans, lakes and rivers), and to maintain the tourism production system (fresh water used for swimming pools, bathrooms, food preparation, etc.). In some areas, tourism is already jeopardised because of increasing water stress, while over-consumption and global environmental change are likely to be felt in many regions in the short-term future.

International tourism seems to play a minor role in global water use, with between 1.3 and 1.8 km^3 of fresh water being used annually by international tourists (calculation for 2002), corresponding to 0.04–0.06 per cent of global fresh water consumption. Note that this excludes the water use of domestic tourists as well as indirect water uses, which can be assumed to add significantly to the total. It should also be considered that tourism's water use is highly concentrated in time and space, often occurring in dry and water scarce regions, and usually during the dry season when the recharge of aquifers is limited. In such regions, tourism might often be the most important factor contributing to water consumption. Overall, tourism can thus be said to be highly dependent on fresh water availability, while simultaneously contributing to the depletion of renewable water resources, particularly in already water scarce areas.

Water scarcity can be addressed in various ways. Reducing water use seems the most feasible option in many areas, as this involves lower costs and can often be

done with simple measures. For example, irrigation of gardens is usually the most water-consuming factor, accounting for up to 50 per cent of total water use. The use of recycled water can substantially reduce the total amount of water used, as can the use of less water-dependent vegetation. Because swimming-pools seem to be the second most important water-consuming factor, it is clear that the design of hotels should take into consideration fresh-water related issues, moving away from 'pool-landscapes' of large, interconnected swimming pools. A technical option for fresh water production is desalination. However, desalination is costly, and contributes to substantial emissions of greenhouse gases because desalination plants consume considerable amounts of energy. Desalination might also be an option only for larger accommodation establishments.

This chapter has also rendered prominent the complexity of the interaction between tourism and other aspects of global environmental change. Climate change, to which tourism contributes, leads to changing rainfall patterns and might thus put additional stress on water resources in many tourist destinations. Tourism and climate change can thus be seen as self-reinforcing processes, with water scarcity being a case in point: in areas where fresh water resources have been overused, desalination might be the preferred technological option to maintain the tourism infrastructure. However, desalination increases the energy-intensity of tourism, and thus contributes to climate change. Environmental change related to water over-consumption might also affect biodiversity. For example, global freshwater wetlands have diminished in area by about half over the past century, resulting in the loss of important habitats (Clarke and King 2004). Furthermore, some 10,000 freshwater fish species are reported to be at risk of extinction (Worldwatch Institute 2004). Sewage release by hotels also decreases water quality, which in turn can affect human beings and biodiversity. Obviously, the availability of water is also linked to political and social issues, because tourism might use water resources at the expense of local populations. Such cases of environmental injustice have, for example, been reported in Zanzibar, Tanzania (Gössling 2001), where inequalities in water use have been backed by political and economic elites financially involved in the tourist industry.

References

Arnell, N.W. (2004) 'Climate change and global water resources: SRES emissions and socio-economic scenarios', *Global Environmental Change*, 14: 31–52.

Clarke, R. and King, J. (2004) *The Atlas of Water. Mapping the World's Most Critical Resource*. London: Earthscan.

Essex, S., Kent, M. and Newnham, R. (2004) 'Tourism development in Mallorca. Is water supply a constraint?' *Journal of Sustainable Tourism*, 12(1): 4–28.

FAO (Food and Agriculture Organization) 2003. Review of water resource statistics by country. Available at: www.fao.org/ag/agl/aglw/aquastat/water_res/index.stm (accessed 9 August 2004).

Garrod, B. and Wilson, J.C. (2003) *Marine Ecotourism: Issues and Experiences*. Clevedon: Multilingual Matters Limited.

GFANC (German Federal Agency for Nature Conservation) (1997) *Biodiversity and Tourism. Conflicts on the World's Seacoasts and Strategies for Their Solution*. Berlin: Springer.

Ghimire, K.B. (2001) *The Native Tourist: Mass Tourism Within Developing Countries*. London: Earthscan Publications.

Gössling, S. (2001) 'The consequences of tourism for sustainable water use on a tropical island: Zanzibar, Tanzania', *Journal of Environmental Management*, 61(2): 179–91.

Gössling, S. (2002) 'Global environmental consequences of tourism', *Global Environmental Change*, 12(4): 283–302.

Gössling, S. (2005) 'Tourism's contribution to global environmental change: space, energy, disease, and water', in C.M. Hall and J. Higham (eds) *Tourism, Recreation and Climate Change: International Perspectives*. Clevedon: Channel View Publications.

Kent, M., Newnham, R. and Essex, S. (2002) 'Tourism and sustainable water supply in Mallorca: a geographical analysis', *Applied Geography*, 22: 351–74.

Lüthje, K. and Lindstädt, B. (1994) *Freizeit- und Ferienzentren. Umfang und regionale Verteilung. Materialien zur Raumentwicklung*, Heft 66. Bonn: Bundesforschungsanstalt für Landeskunde und Raumordnung.

Orams, M. (1998) *Marine Tourism. Development, Impacts and Management*. London: Routledge.

Smith, B. (1997) 'Water: a critical resource', in R. King, L. Proudfood and B. Smith (eds) *The Mediterranean: Environment and Society*. London: Edward Arnold, pp.227–51.

Solley, W.B., Pierce, R.R. and Perlman, H.A. (1998) *Estimated Use of Water in the United States in 1995*. U.S. Geological Survey Circular 1200, Denver, CO: US Government Printing Office.

UK CEED (UK Centre for Economic and Environmental Development) (1994) *A Life-Cycle Analysis of a Holiday Destination: Seychelles*. British Airways Environment Report No.41/94. Cambridge: UK CEED.

UN (United Nations) (1995). *Guidebook to Water Resources, Use and Management in Asia and the Pacific. Volume One: Water Resources and Water Use*. Water Resources Series No. 74, New York: UN.

Vörösmarty, C.J., Green, P., Salisbury, J. and Lammers, R.B. (2000) 'Global water resources: Vulnerability from climate change and population growth', *Science*, 289: 284–8.

Worldwatch Institute 2004. Rising Impacts of Water Use. Available at: www.worldwatch.org/topics/consumption/sow/trendsfacts/2004/03/03 (accessed 4 March 2004).

WRI (World Resources Institute) (2003) *World Resources 2002–2004, Data Tables*. Available at: www.wri.org (accessed 4 September 2003).

WTO (World Tourism Organization) (2001). *Tourism 2020 Vision*. Madrid: WTO.

WTO (2003a) *Compendium of Tourism Statistics*. Madrid: WTO.

WTO (2003b) *Climate Change and Tourism*. Proceedings of the 1st International Conference on Climate Change and Tourism. Djerba, Tunisia, 9–11 April.

WTO (2004). Available at: www.world-tourism.org/market_research/facts/menu.html (accessed 10 August 2004).

WWF (World Wide Fund for Nature) (2001) *Tourism Threats in the Mediterranean*. WWF Background information. Switzerland: WWF.

WWF (2004) *Freshwater and Tourism in the Mediterranean* Available at: www.panda.org/downloads/europe/medpotourismreportfinal_ofnc.pdf (accessed 12 November 2004).

11

Climate Extremes and Tourism

Chris R. de Freitas

Introduction

Weather and climate and play a significant role in influencing tourism and recreation behaviour. Many tourist destinations, especially those in the tropics and subtropics, rely heavily on environmental assets such as sun, sea and sand and a generally agreeable climate to attract visitors. Climate change, including changed variability, whether natural or anthropogenic, could modify these assets and how they are perceived by potential visitors. Any change in local weather patterns affecting average and extreme conditions has well-known direct effects on visitors, but may also have indirect effects, such as the influence of storms on the structure of beaches. Both of these categories of impact hold implications for patterns of tourist distribution, including the numbers and types of visitors, and the places they visit.

Given the prospect of changing climate, the past may no longer be an adequate guide for the future, and this needs to be taken into account in tourism planning and investment decisions. Yet the topic of future climate is plagued with uncertainty. At the same time it appears that decision makers who deal with this uncertainty are preoccupied by the prospect of damaging or undesirable changes in climate. It is argued here that this point of view is no more helpful in tourism planning than that which treats climate as being a constant or simply a permanent feature of the physical setting. This chapter puts these views into context. It aims to briefly address the state of scientific knowledge on future climate variability, the sorts of changes that could arise and shifts in risk that might occur.

Evidence, expectations and perceptions of change

One major determinant of risk is the perceived trends in climate extremes. Given that, first, weather hazards are the most significant natural hazards in most places (Downing *et al*. 1996; Dlugolecki *et al*. 1996; Kattenburg *et al*. 1996; Coates 1998; McCarthy *et al*. 2001) and that, second, in the latter part of the twentieth century insured losses have been unprecedented (Dlugolecki *et al*. 1996; Kattenburg *et al*. 1996), the possibility of worsening trends has,

understandably, attracted the attention of the insurance industry. There are a number of possible reasons for increasing losses:

- a greater concentration of people and high value property in vulnerable areas, mainly coastal;
- business processes have become more susceptible to damage; or
- that changes have occurred in the frequency and severity of extreme climatic events.

The last of these is in line with expectations of climate change resulting from an enhanced greenhouse effect and this too has attracted the attention of the insurance industry. Dlugolecki *et al*. (1996: 541) comment: 'It is a common perception in the insurance industry that there is trend toward an increasing frequency and severity of extreme climate events.' The important question arises as to the extent to which these expectations are justifiable.

The ongoing debate on climate change and global warming highlights the possibility of changed magnitude and frequency of extreme weather events globally. But it is a widespread misconception that science generally predicts more severe weather events will accompany greenhouse gas-enhanced climate change. The research so far has produced conflicting results. It is notable that the general circulation models of global climate (GCMs) or scenarios referred to in the reports of the United Nations Intergovernmental Panel of Climate Change (IPCC) do not explicitly quantify changes in daily weather extremes (Houghton *et al*. 2001a). Moreover, reflecting on current trends, the IPCC stated: 'Overall, there is no evidence that extreme weather events, or climate variability, has increased, in a global sense, through the twentieth century' (Houghton *et al*. 1996: 173). This contrasts with the very real upward trend in damage due to weather extremes, particularly hurricanes, in recent decades. But the increasing dollar cost of storm and other weather related events is accounted for by a rise in the value of development and number of properties, especially in tropical cyclone prone areas, rather than by an increased frequency of events (Changnon *et al*. 1997; Pielke and Landsea 1998; Kunkel *et al*. 1999). In fact, there is a great deal of research which, taken together, suggests that extreme climate events may become both less frequent and less severe if the planet warms. Some of the elements of this debate are discussed here.

Table 11.1 summarises a number of categories of weather and climate relevant to tourism that might be expected to change in response to increasing concentrations of greenhouse gases in the atmosphere. It outlines the nature of the extreme events, parent climate variables used to identify them, how they may be quantified and the nature of their impact on the tourism sector. The information in Table 11.1 indicates that tourism is, for the most part, sensitive to extremes in air temperatures and windstorms, predominantly the latter. Storms have the greatest impact on coastal areas and, because of this, Perry (1997) points out the tourist industry is particularly vulnerable to these types of extreme events, as 70 per cent of holidays are coast oriented. Tourists also tend to be more vulnerable than

Table 11.1 Definitions and measures of climate and weather extremes, and impact classes

Climate extreme	*Parent variable*	*Measure of extreme (including probability of occurrence)*	*Impact category*
Hurricane/tropical storm	Storm track Storm strength Rainfall Storm surge	Number of events with wind speeds greater than a given threshold	Property damage Loss of life Added insurance cost
Windstorm	Wind speed (maximum gust)	Number of events with wind gusts greater than a given threshold	Property damage Loss of life Added insurance cost
Thunderstorm	Rainfall	Number of events with rainfall greater than a given threshold	Property damage Loss of life Added insurance cost
Heat wave	Air temperature and humidity	Number of days above a given threshold	Thermal discomfort Heat stress Energy use
Cold wave	Air temperature	Number of days below a given threshold	Thermal discomfort Cold stress Energy use
High temperature	Air temperature	Number of degree days above a given threshold	Reduced ski season (re. snowmaking)

locals because they are unfamiliar with the place they are visiting. Aspects of the weather themes outlined in Table 11.1, their relative significance and apparent trends, are discussed below.

Hurricanes

Hurricanes, also known as typhoons and tropical cyclones, are the most intense form of extreme weather and pose the greatest threat to tourists and tourism infrastructure, especially in tropical areas. It is widely held that global warming may increase the odds in favour of more intense and more frequent hurricanes. Hurricanes require warm water to form and global warming means more warm water. But even without global warming, there is ample warm water in tropical oceans. Some of the highest sea surface temperatures in the world are found in the tropical mid-Atlantic and Caribbean, yet in most years there are less 15 hurricanes and frequently less than five per year (Figure 11.1). Given the great expanse of warm water globally in any given year, the important question is why do hurricanes only form some of the time, and why are there so few? At the same time, it is too early to

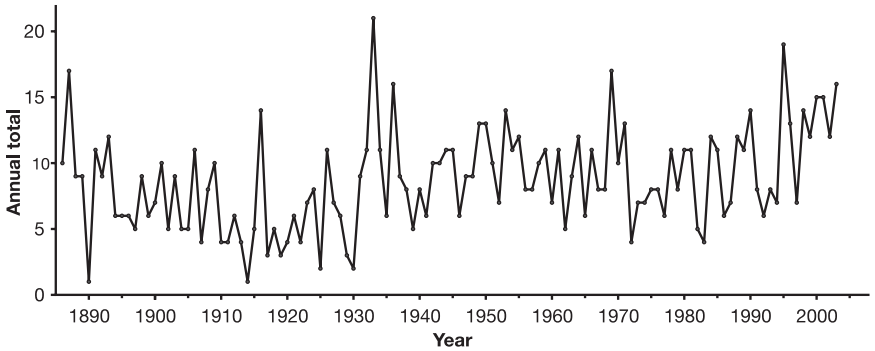

Figure 11.1 The number of hurricanes and tropical storms in the tropical North Atlantic Basin per year, 1886–2003

Source: United States, National Climate Data Center

dismiss the role of changes in sea surface temperature. For example, Goldenberg *et al*. (2001) showed that hurricanes occur in distinct multi-decadal cycles and are linked to sea surface temperature anomalies in the Atlantic Ocean's main hurricane development region. Warm anomalies are associated with increased major hurricane activity; cold anomalies with suppressed activity. But overall, no significant upward trends have been identified.

Hurricanes need exactly the right conditions to form, and warm water and resulting high water vapour levels are just two of the ingredients. So many factors influence the formation of hurricanes that it is difficult to predict how global warming will influence their frequency and intensity. In the tropical mid-Atlantic and Caribbean, for example, the number and strength of easterly pressure waves coming across the Atlantic and the change in wind with height through the atmosphere (wind shear) are as important as warm sea surface temperatures to hurricane formation. It is not known how global warming will affect these processes.

It could be argued that changing ocean and atmospheric conditions due to global warming might make historical weather patterns less useful for long-range climate forecasts, but recent and past statistics of events are revealing. In the tropical North Atlantic Basin the number of intense hurricanes declined during the 1970s and 1980s, and the period 1991–1994 experienced the smallest number of hurricanes of any four years over the past half century (Idso *et al*. 1990; Murphy and Mitchell 1995; Bengtsson *et al*. 1996; Landsea *et al*. 1996; Zhang and Wang 1997).

Easterling *et al*. (2000) showed that, overall, occurrences of Atlantic hurricanes do not reveal a statistically significant long-term trend over the twentieth century; but Landsea *et al*. (1999) found a statistically significant decrease in the high intensity Atlantic hurricanes that are most destructive. Gray *et al*. (1997) showed that there have been large interdecadal variations of hurricane activity over this period. From 1944 to the mid-1990s, the number of intense and Atlantic hurricanes that made landfall declined (Figure 11.2). As for the future, several researchers have suggested reductions in hurricane frequencies in response to global warming (Wilson 1999; Elsner *et*

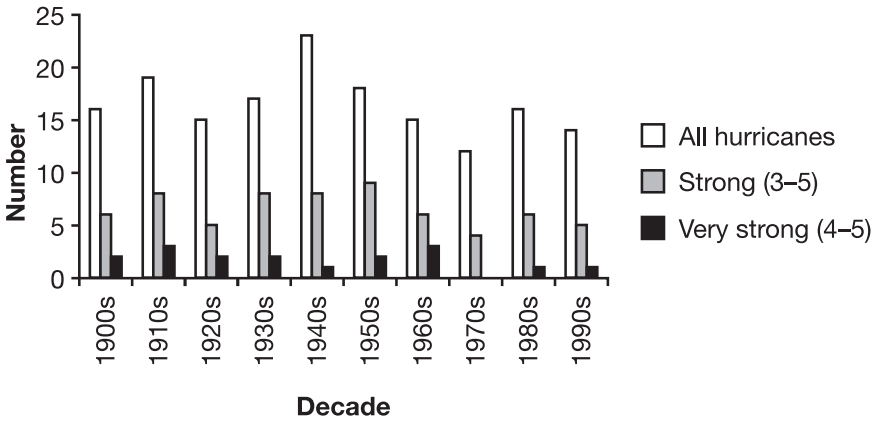

Figure 11.2 USA hurricane strikes by decade, 1900–1999

Source: United States, National Climate Data Center

al. 2000; Liu and Fearn 2000; Parisi and Lund 2000; Singh *et al*. 2000, 2001; Boose *et al*. 2001; Elsner and Bossak 2001; Muller and Stone 2001).

Trends are different in the Pacific. Chu and Clark (1999) analysed the frequency and intensity of intense tropical storms that occurred in the region of the central North Pacific (0–70°N, 140–180°W) over the 32-year period 1966–1997. They found that storm activity has risen, which amounts to an increase of about 3.2 storms over the 1966–1997 period. Accompanying the increase in intense tropical storms is a similar increase in maximum hurricane intensity. In contrast, the results of experiments by Sugi *et al*. (2002) using a GCM indicated that the number of intense tropical storms may be significantly reduced due to the global warming. As for the maximum intensity of intense tropical storms, they state that 'no significant change has been noted'. Nguyen and Walsh (2001) simulated the occurrence of hurricanes in the Australia region using a GCM that assumes a tripling of the atmospheric concentration of CO_2. The results showed that the numbers of hurricanes declined and that the decline is statistically significant.

As a first approximation of hurricane activity over the next two or three decades, one can simply extrapolate past variations in occurrences, assuming there is not some periodicity in the data. Landsea (2000) examined the data for the Australian, the Northwest Pacific and the Atlantic basins in enough detail to allow some suggestions to be made as to what the first decade of the twenty-first century may bring. As regards hurricane frequency, he reported that the Australian basin showed a decline since the late 1960s, the Northwest Pacific showed an increase after experiencing a decrease in frequency from the late 1950s through 1980, while the Atlantic was fairly constant since the mid–1940s. For mean intensity, he reported that there was little or no trend in the Australian basin, the Northwest Pacific showed a downward trend during the 1960s and 1970s and an upward trend in intensity of events since (Landsea 2000). Looking to the future, Landsea concluded that there is no convincing

evidence for systematic changes to occur in the frequency, mean intensity, maximum intensity and area of occurrence of hurricanes.

Extratropical storms

Climate change scenarios do not explicitly quantify changes in daily weather extremes. Despite this, it is often implied that an increase in greenhouse gas concentration could create conditions that favoured severe storms over mid-latitude continental areas. This view, however, is not widely supported in the scientific literature. For example, Balling and Cerveny (2003) reviewed the scientific literature on United States weather records on thunderstorms, hail events, intense precipitation, tornadoes, hurricanes and winter storm activity during the modern era of greenhouse gas build-up in the atmosphere and found that, although there has been an increase in heavy precipitation, trends in other severe storm categories are downward.

The most important energy source for extratropical storms is the temperature difference between the tropics and the poles. Most GCMs suggest that the greatest warming would occur over the high latitudes in winter with relatively little warming in the tropics and around equatorial latitudes. This implies reduced temperature variation, since such variations result from air moving from one latitude to another. Thus, according to these predictions, the future contrast between the polar and equatorial latitudes will lessen, producing a weaker gradient and fewer and less intense storms. Consistent with this, the IPCC 2001 *Summary for Policymakers* (Houghton *et al*. 2001c) notes that no significant upward trends have been identified in tropical or extratropical storm intensity and frequency.

There is evidence from Europe that suggests there has been a decline in the number of mid-latitude storms. For the period 1896–1995, Bielec (2001) analysed thunderstorm data obtained at Cracow, Poland, which he states is one of the few continuous records in Europe with an intact, single place of observation and duration of over 100 years. From 1930 onward the trend is negative, revealing a linear decrease of 1.1 storms per year from 1930 to 1996. Bielec also reported that there has been a decrease in the annual number of thunderstorms with hail over the period of record, and there has been a decrease in the frequency of storms producing precipitation greater than 20mm.

Pirazzoli (2000) analysed storm surges, atmospheric pressure and wind change and flooding probability on the Atlantic coast of France over the period 1951–1997. He found that climate variability is decreasing. Specifically, his work showed that the number of atmospheric depressions and strong winds that cause storm surges in this region are becoming less frequent resulting in reduced frequency and severity of coastal flooding.

Air temperature extremes

How air temperatures might change in a greenhouse enhanced world is contentious and research results are conflicting. For example, Frich *et al*. (2002) presented

Table 11.2 Day-to-day air temperature variability for the USA, People's Republic of China and the former Soviet Union, shown as mean linear trend (°C per decade) in daily temperature variability values

Air temperature	*USA*	*China*	*USSR*
Maximum			
January	–0.19	–1.13	0.07
July	–0.13	0.06	–0.02
Minimum			
January	–0.26	–1.32	–0.37
July	–0.19	0.06	–0.08

Source: Michaels *et al*. 1998

results that suggest that trends in the second half of the twentieth century show that the world has become warmer and wetter, heavy rainfalls more frequent, but that cold temperature extremes have become less frequent over the same period. There has been speculation too that global warming will increase climate variability and thus the frequency of heat waves, but Michaels *et al*. (1998) have shown there is no universal support for this, nor for the popular perception that temperatures have become more variable. Michaels *et al*. examined daily maximum and minimum temperatures from the USA, China and the former Soviet Union for day-to-day variability in January and July and most of the trends indicated declining variability (Table 11.2). Other works produce similar results. Overall, however, it is fair to say that relatively little work has been done on changes in high frequency extreme temperature events such as heat waves, cold waves, and number of days exceeding various temperature thresholds (Easterling *et al*. 2000).

Karl *et al*. (1995) point out that an increase in the atmospheric concentration of CO_2 should decrease temperature variability. Balling (1998) examined changes in the spatial variability of mean monthly and daily temperatures that have occurred during the historical climate record. His research showed that, overall, the spatial variability in temperature anomalies has declined, and that the interannual variability in temperature anomalies is negatively correlated to mean hemispheric temperatures. The work of both Balling *et al*. (1998) and Michaels *et al*. (1998) show that as the atmosphere warms, the month-to-month variability also declines (Figure 11.3). The entire June 2003 issue of the scientific journal, *Natural Hazards*, was devoted to assessing whether global warming causes extreme weather. The editors of the special issue concluded that most studies found no such connection.

Shifting risks

The 'normal' characteristics of weather and climate need to be considered as a backdrop to the elements of climatic extremes outlined in Table 11.1. Extreme weather events are a permanent feature of 'normal' climate and constitute an important factor in both financial terms for tourism operators and the personal

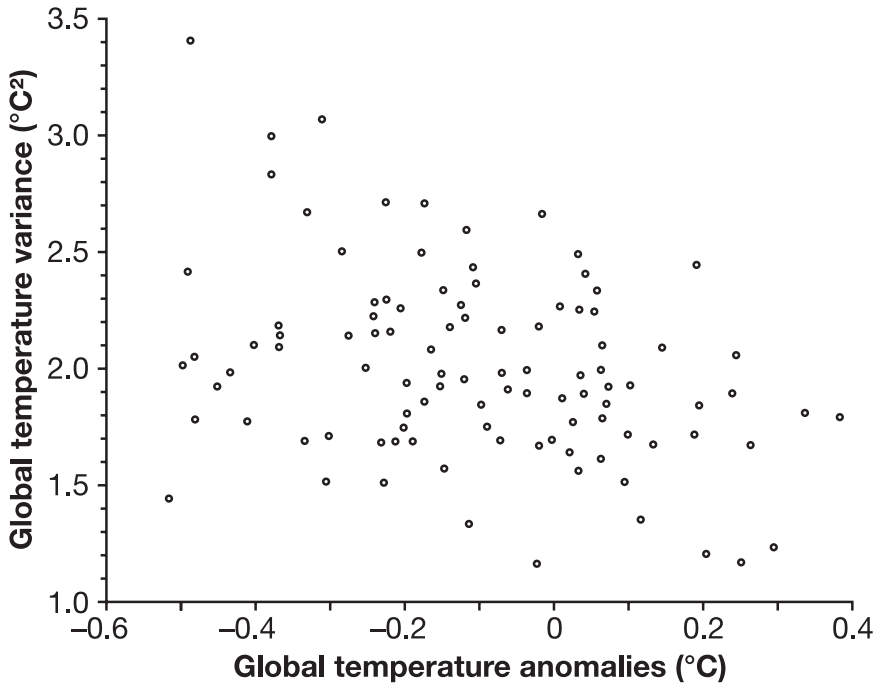

Figure 11.3 Inter-annual surface temperature variability versus global temperature anomalies for the 1897–1997 time series showing the warmer the surface temperature, the less variable climate becomes

Source: Michaels *et al*. 1998

experiences of tourists. Many holiday destinations have 'tourism appeal' that is a function of the destination's climate. Tourism administrators promote places based on this appeal and potential tourists make decisions on whether to visit them based on their perception or expectation of climate conditions. For holiday trip decisions in which climate of the destination is not a motive for travel, extreme weather and climate set limits. Financial losses can result from weather and climate variations and for many tourist activities there are limits or limiting conditions beyond which there is increasing risk of one sort or another (Figure 11.4).

It is possible that climate change due to global warming will shift 'normal' risk thresholds. It is also recognised that changes in the severity and frequency of extreme events are likely to be more important than changes in the average climate. Clearly, tourists respond to events or real conditions rather than to averages – their response to extremes, such as heat waves and storms, is different from their response to a change in the mean climate. In the case of weather extremes, the response time is shorter and the response itself is likely to be greater. By and large, it is reasonable to expect that the impacts of climate change are likely to be more severe due to changes in the occurrence of extreme events than due to a change in the mean climate.

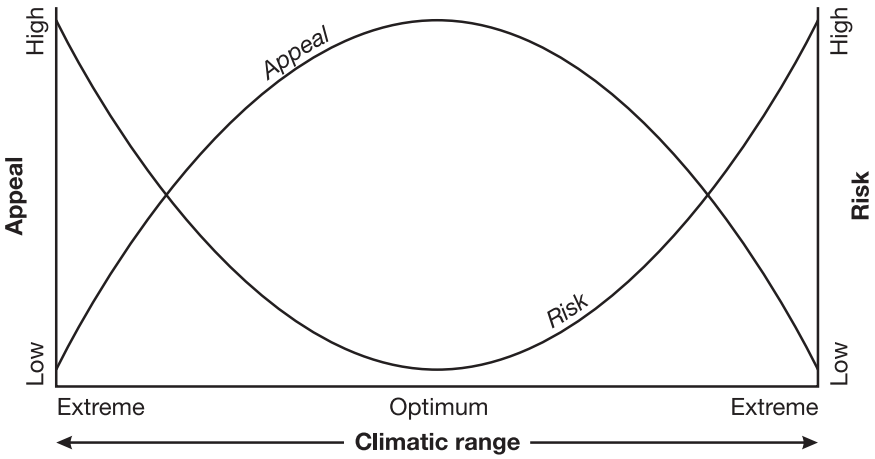

Figure 11.4 A schematic representation of relationships between climatic range and tourism potential. The climate potential of a particular location is a function of its climate and of the risks (e.g. to safety, profit making) weather may impose

Source: Adapted from Perry 1997

In this context, the impact of weather extremes is as much a product of the social, political and economic environment as it is of the natural environment. It follows, therefore, that the risk of these impacts is in part a social construct perceived differently by all of us and must be defined with this in mind (de Freitas 2002). For example, risk is defined by Emergency Management Australia (1995) as the perceived likelihood of given levels of harm. Thus, one major determinant of risk is the perceived trends in weather extremes. In a seminal paper by Hoyt (1981), the theory of extremes as applied to weather records is reviewed and then compared to the actual frequency of record weather events in the USA. He concluded that fewer extremes of temperature are being set in recent years contrary to the popular view. He cautions against using extreme weather events that set new records as evidence of climate change. Hoyt (1981: 248) explains thus:

> Because the probability of establishing a new weather record never drops to zero, then every year some region will establish a new precipitation or temperature record. Even in the warmest years on a global scale there will be some locations where a new monthly mean low temperature record will be set. Even in the coolest years some locations will have periods of record warmth. Individual temperature and precipitation records by themselves tell us nothing about climatic change.

The statistics of climate variability and assumptions used in assessing them are all important in detecting and planning for global climate change. But just as extreme weather cannot be used as evidence of climate change, neither can trends in mean conditions be used as a predictor of trends in extreme

occurrences – unless there is no change variability of the predictor variable in question, which is unlikely. Robeson (2002) addresses this issue by questioning the use of near surface air temperature trends in the USA to determine the impacts on extremes. Robeson (2002: 205) points out that, even though extremes are important:

> It is impossible to determine the impacts of changes in mean air temperatures on extremes, however, without simultaneously analysing changes in the variance of air temperature probability distributions … In addition to its importance for extreme events, the detection of changes in air-temperature variance plays a fundamental role in helping us to understand how the climate system may be changing.

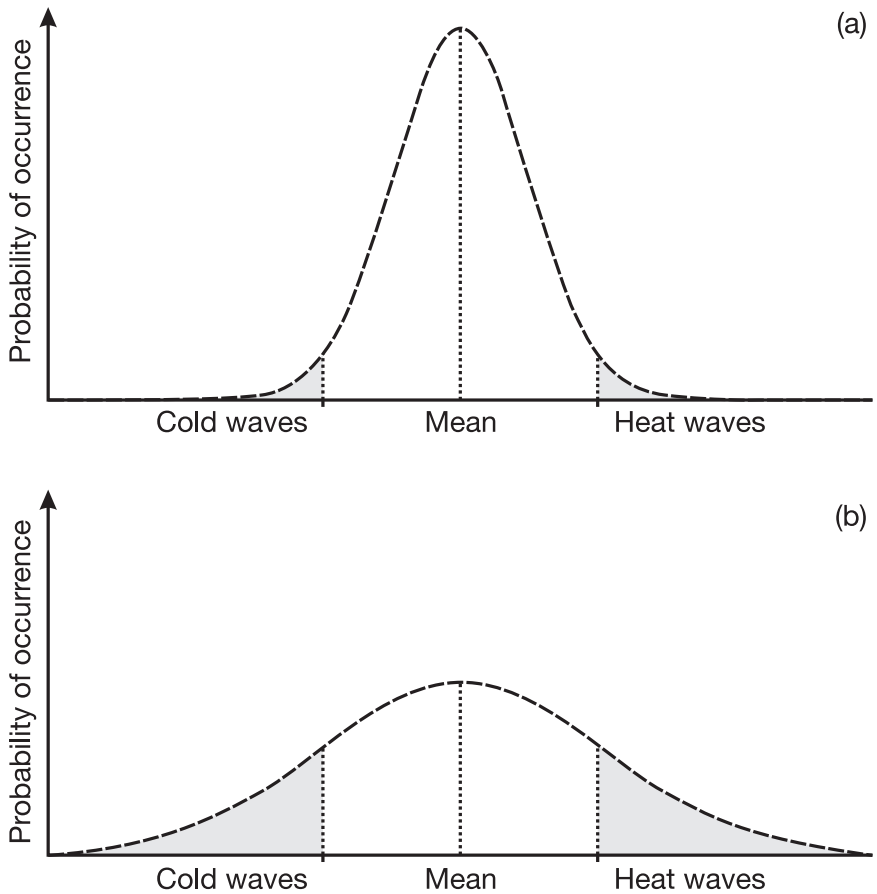

Figure 11.5 These two distributions have the same mean, but the variance is larger for (b). There are more occurrences of extremely high and low temperatures in (b) than in (a).

Aspects of the above are summarised in Figure 11.5 which schematically portrays the statistics of extremes. The distribution of daily temperatures for a given location typically takes the shape of a 'normal' bell-shaped distribution in which temperature on the majority of the days is close to the mean. The number of days with temperatures above or below the mean decreases with movement away from the mean. The normal distribution is characterised by both its mean value and the 'variance', which is a statistic that indicates how close most of the observations are to the mean. A small variance means that most temperatures are quite close to the mean, while a large variance means that a large number of observations are different from the mean. Both Figure 11.5a and Figure 11.5b distributions have the same mean, but the variance is larger in Figure 11.5b, where there are more occurrences of heat waves and cold waves.

If global climate changes, it may do so in a number of ways. The first of these is illustrated in Figure 11.6. Karl *et al*. (1997) point out that GCMs predict temperatures will be confined to a tighter range, which was confirmed by Easterling *et al*. (1997) who found that most of the increase in global temperatures has been occurring during the winter and at night. Summer maximum air temperatures in the northern hemisphere showed no statistically significant trend. If these forecasts are correct, variability in the data will shrink more than the predicted mean warming and give a distribution shown schematically in Figure 11.6.

Figure 11.7 builds on the above by showing different global warming scenarios in which the impact of a rise in mean air temperature is dependent on accompanying changes in the variance, since the probability of extreme temperature occurrence (heat waves and cold waves) can vary greatly depending on the exact nature of the

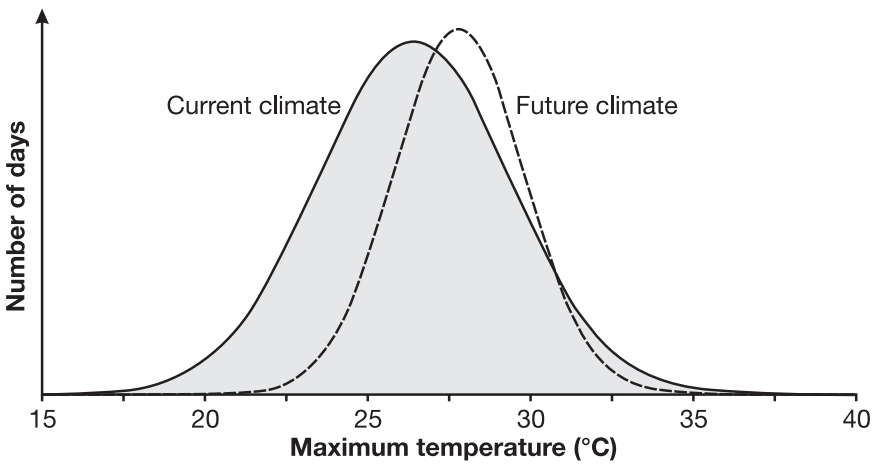

Figure 11.6 A forecast of future maximum air temperature distribution. If interpretations by Easterling *et al*. (1997) and Karl *et al*. (1997) are correct, variability in the data will shrink more than the predicted mean warming and give the distribution shown schematically here

Source: After Michaels and Balling 2000

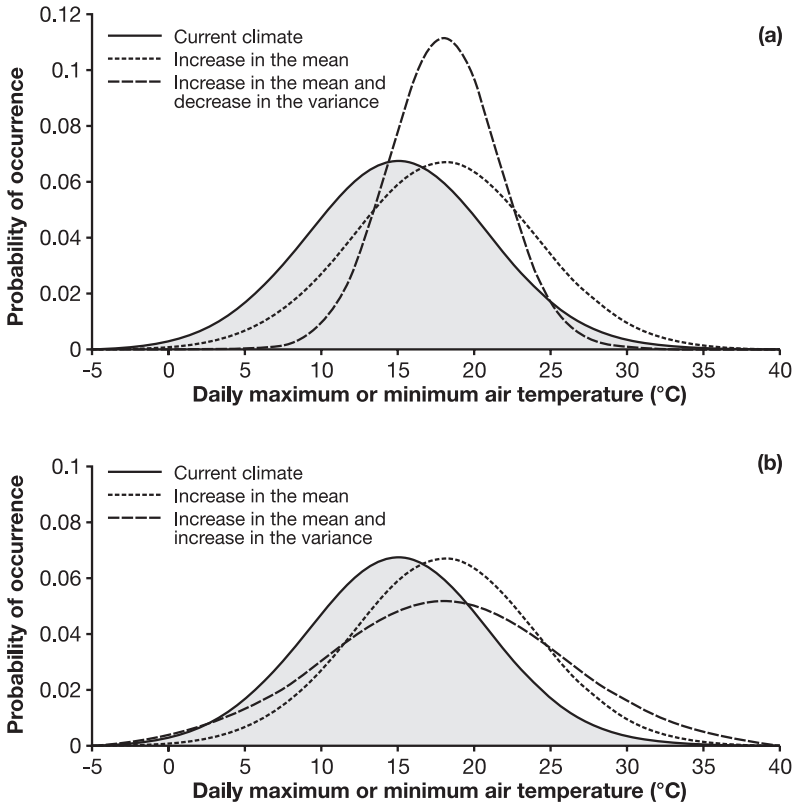

Figure 11.7 Response of probability distributions to changes in mean and variance of daily air temperature. The original climate is warmed by an increase in the mean of 3°C. In the case of (a), a rise in air temperature accompanied by a decrease in variance would lead to a reduction in the number of extreme temperatures. In (b) a rise in temperature accompanied by an increase in variance would lead to a far greater number of extremely hot days. These probability distributions are substantially different from those that include changes in mean temperatures only.

Source: Adapted from Robeson 2002

changes in the distribution. Figure 11.7 shows that a change in the mean can have a disproportionate and non-linear effect on the fraction of extremes beyond critical thresholds. In addition, there may be a non-linear relationship between a change in the mean of a distribution at the extremes because the other aspects of the distribution (variance, kurtosis) have also changed. A rise in mean temperature accompanied by an increase in the variance leads to a big rise in the probability of heat waves. Conversely, a rise in the mean temperature that is accompanied by a decrease in the variance has the opposite effect. While changes in the probability distributions shown here assume a normal distribution, changes in the tails of the curves may not be symmetrical, in which case other parameters such as skewness may need to be

evaluated. Robeson (2002) points out that given an increasing mean temperature – 'global warming' – and decreasing variability, it is likely that the lower tail of the curve would be increasing faster than the upper tail (Figure 11.7). Depending on the magnitude of the warming and accompanying change in the variance, upper-tail temperatures that are considered to be extreme in present-day climate conditions may become more probable as temperature variability is reduced.

Clearly, a key to assessing future impacts of climate change is understanding the relationship between mean temperature and daily temperature variance. In the case of the USA, Robeson (2002) concludes his results by suggesting that in most places a warming climate should produce either reduced air temperature variability or no change in air temperature variability. If, however, a negative variance response accompanies global warming, lower-tail temperatures would rise even more than they would be expected to under no change in variance. If this is the case, some areas of the USA could experience reductions in snow cover that could impact negatively on the skiing tourism industry.

Conclusion

Worldwide, intense storms are the most severe form of extreme weather and pose the greatest threat to tourists and tourism infrastructure, especially in tropical areas where hurricanes occur, which are the deadliest and most costly extreme weather events. Because so much coastal tourism is concentrated in tropical regions, hurricanes are the greatest threat to tourism should climate change lead to an increase in their frequency. Although some climate modelling indicates this is a possibility, model performance has not been verified, so the results are speculative. Moreover, current trends are not toward increasing frequency of extreme storm events. The IPCC (Houghton *et al*. 2001b) stated:

> Based on limited data, the observed variations in the intensity and frequency of tropical and extra-tropical cyclones and severe local storms show no clear trends in the last half of the twentieth century, although multi-decadal fluctuations are sometimes apparent.

Commenting on future trends, the same IPPC reports states:

> There is little consistent evidence that shows changes in the projected frequency of tropical cyclones and areas of formation. However, some measures of intensities show projected increases, and some theoretical and modelling studies suggest that the upper limit of these intensities could increase.

There is still much work to be done in determining whether there will be more or fewer extreme weather events in the future and, if so, what the significance of this will be for tourism. What we do know is that climate is naturally variable and always changing. The notion of constant climate is misleading. We can be confident that future climate will be different from the present. What is unknown is the extent to

which significant change may take place over the short to medium term. According to Easterling *et al*. (2000: 2071), the lack of established definitions for what constitutes an extreme is one of the biggest problems in analysing extreme weather events and determining whether changes in these are consistent with what should be expected in the future. They say another big problem is the absence of high-quality, long-term climate data for many parts of the world, with the time resolution appropriate for analysing extreme events. This means it will be difficult to determine if extremes have changed, and how they may change in the future.

References

Balling Jr., R.C. (1998) 'Analysis of daily and monthly spatial variance components in historical temperature records', *Physical Geography*, 18: 544–52.

Balling Jr., R.C. and Cerveny, R.S. (2003) 'Compilation and discussion of trends in severe storms in the United States: Popular perception vs. climate reality', *Natural Hazards*, 29: 103–12.

Balling Jr., R.C., Michaels, P.J. and Knappenberger, P.C. (1998) 'Analysis of winter and summer warming rates in gridded temperature time series', *Climate Research*, 9: 175–81.

Bengtsson, L., Botzet, M. and Esch, M., (1996) 'Will greenhouse gas induced warming over the next 50 years lead to a higher frequency and greater intensity of hurricanes?' *Tellus*, 48A: 57–73.

Bielec, Z. (2001) 'Long-term variability of thunderstorms and thunderstorm precipitation occurrence in Cracow, Poland, in the period 1896–1995', *Atmospheric Research*, 56: 161–70.

Boose, E.R., Chamberlin, K.E. and Foster, D.R. (2001) 'Landscape and regional impacts of hurricanes in New England', *Ecological Monographs*, 71: 27–48.

Changnon, S.A., Changnon, D., Fosse, E.R., Hoganson, D.C., Roth, R.J. and Totsch, J.M. (1997) 'Effects of recent weather extremes on the insurance industry: Major implications for the atmospheric sciences', *Bulletin of the American Meteorological Society*, 78: 425.

Chu, P.-S. and Clark, J.D. (1999) 'Decadal variations of tropical cyclone activity over the central North Pacific', *Bulletin of the American Meteorological Society*, 80: 1875–81.

Coates, L. (1998) 'Deaths and ENSO: Fate, Chance or Change?' *Natural Hazards Quarterly*, 4(4): 2–3.

Dlugolecki, A.F., Clark, K.M., Knecht, F., McCauley, D., Palutikof, J.P. and Yambi, W. (1996) 'Financial Services', in R.T. Watson, M.C. Zinyowera and R.H. Moss (eds) *Climate Change 1995 – Impacts, Adaptations and Mitigation of Climate Change*. Contribution of Working Group II to the Second Assessment Report of the Intergovernmental Panel of Climate Change. New York: Cambridge University Press, pp.539–60.

Downing, T.E., Olsthoorn, A.A. and Tol, R.S.L. (eds) (1996) *Climate Change and Extreme Events*. ECU Research Report Number 12. Amsterdam: Vrije Universiteit.

Easterling, D.R., Horton, B., Jones, P.D., Peterson, T.C., Karl, T.R., Parker, D.E., Salinger, M.J., Razuvayev, V., Plummer, N., Jamason, P. and Folland, C.K. (1997) 'Maximum and minimum temperature trends for the globe', *Science*, 277: 364–67.

Easterling, D.R., Evans, J.L., Groisman, P.Ya., Karl, T.R., Kunkel, K.E. and Ambenje, P. (2000) 'Observed variability and trends in extreme climate events: A brief review', *Bulletin of the American Meteorological Society*, 81: 417–25.

Elsner, J.B. and Bossak, B.H. (2001) 'Secular changes to the ENSO-U.S. hurricane relationship', *Geophysical Research Letters*, 28: 4123–6.

Elsner, J.B., Liu, K.-b. and Kocher, B. (2000) 'Spatial variations in major U.S. hurricane activity: Statistics and a physical mechanism', *Journal of Climate*, 13: 2293–305.

Emergency Management Australia (1995) *National Emergency Management Competency Standards*. Canberra: EMA.

Freitas, C.R. de (2002) 'Perceived change in risk of natural disasters caused by global warming', *Australian Journal of Emergency Management*, 17(3): 34–8.

Frich, P., Alexander, L.V., Della-Marta, P., Gleason, B., Haylock, M., Klien Tank, A.M.G. and Peterson, T. (2002) 'Observed changes in climatic extremes during the second half of the twentieth century', *Climate Research*, 19: 193–212.

Goldenberg, S., Landsea, C.W., Mestas-Nuñez, A.M. and Gray, W.M. (2001) 'The recent increase in Atlantic hurricane activity: Causes and implications', *Science*, 293: 474–9.

Gray, W.M., Scheaffer, J.D. and Landsea, C.W. (1997) 'Hurricanes', in H.F. Diaz and R.S. Pulwarty (eds) *Climate and Socioeconomic Impacts*. Berlin: Springer Verlag.

Houghton, J.T., Meira Filho, L.G., Callander, B.A., Harris, N., Katenberg, A. and Maskell, K. (eds) (1996) *Climate Change 1995: the Science of Climate Change*. Contribution to Working Group 1 to the Second Assessment Report of the Intergovernmental Panel on Climate Change. New York: Cambridge University Press.

Houghton, J.T., Ding, Y., Griggs, D.J., Noguer, M., van der Linden, P.J. and Xiaosu, D. (eds) (2001a) *Climate Change 2001: The Scientific Basis*. Contribution to Working Group 1 to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). New York: Cambridge University Press.

Houghton, J. T., Ding, Y., Griggs, D. J., Noguer, M., van der Linden, P. J. and Xiaosu, D. (eds) (2001b) *Technical Summary, Third Assessment Report. Climate Change 2001: The Scientific Basis*. New York: Cambridge University Press.

Houghton, J. T., Ding, Y., Griggs, D. J., Noguer, M., van der Linden, P. J. and Xiaosu, D. (eds) (2001c) *Summary for Policymakers, Third Assessment Report. Climate Change 2001: The Scientific Basis*. New York: Cambridge University Press.

Hoyt, D.V. (1981) 'Weather "records" and climate change', *Climate Change*, 3: 243–9.

Idso, S.B., Balling, R.C. and Cerveny, R.S. (1990) 'Carbon dioxide and hurricanes: Implications of Northern Hemispheric warming for Atlantic/Caribbean Storms', *Meteorology and Atmospheric Physics*, 42: 259–63.

Karl, T.R., Knight, R.W. and Plummer, N. (1995) 'Trends in high frequency climate variability in the twentieth century', *Nature*, 377: 217–320.

Karl, T.R., Nicholls, N. and Gregory, J. (1997) 'The coming climate', *Scientific American*, 276: 79–83.

Kattenburg, A., Giorgi, F., Grassl, H., Meehl, G.A., Mitchell, J.F.B., Stouffer, R.J., Tokioka, T., Weaver, A.J., Wigley, T.M.L. (1996) 'Climate models – Projections of future climate', in J.T. Houghton, *et al*. (eds) (1996) *Climate Change 1995: the Science of Climate Change*. Contribution to Working Group 1 to the Second Assessment Report of the Intergovernmental Panel on Climate Change. New York: Cambridge University Press, pp.285–357.

Kunkel, K. E., Pielke, R.A. and Changnon, S.A. (1999) 'Temporal fluctuations in weather and climate extremes that cause economic and human health impacts: A review', *Bulletin of the American Meteorological Society*, 80: 1077.

Landsea, C.W., Nicholls, N., Gray, W.M. and Avila, L.A. (1996) 'Downward trends in the frequency of intense Atlantic Hurricanes during the past five decades', *Geophysical Research Letters*, 23: 1697–700.

Landsea, C.W., Pielke Jr., R.A., Mestas-Nuñez, A.M. and Knaff, J.A. (1999) 'Atlantic basin hurricanes: indices of climatic changes', *Climatic Change*, 42: 89–129.

Landsea, C.W. (2000) 'Climate variability of tropical cyclones: past, present and future', in Pielke, R.A. Sr and Pielke, R.A. Jr, (eds) *Storms*. New York: Routledge, pp.220–41.

Liu, K.-b. and Fearn, M.L. (2000) 'Reconstruction of prehistoric landfall frequencies of catastrophic hurricanes in northwestern Florida from lake sediment records', *Quaternary Research*, 54: 238–45.

McCarthy, J.J., Canziani, O.F., Leary, N.A., Dokken, D.J. and White, K.S. (eds) (2001) *Climate Change 2001: Impacts, Adaptation, and Vulnerability*. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. New York: Cambridge University Press.

Michaels, P.J and Balling, R.C. Jr. (2000) *The Satanic Gases*. Washington, DC: Cato Institute.

Michaels, P.J., Balling, R.C. Jr., Vose, R.S. and Knappenburger, P.C. (1998) 'Analysis of trends in the variability of daily and monthly historical temperature measurements', *Climate Research*, 10: 27–33.

Muller, R.A. and Stone, G.W. (2001) 'A climatology of tropical storm and hurricane strikes to enhance vulnerability prediction for the southeast U.S. Coast', *Journal of Coastal Research*, 17: 949–56.

Murphy, J.M. and Mitchell, J.F.B. (1995) 'Transient response of the Hadley Centre coupled ocean-atmosphere model to increasing Carbon Dioxide. Part II: Spatial and temporal structure of response', *Journal of Climate*, 8: 57–80.

Nguyen, K.C., and Walsh, K.J.E. (2001) 'Interannual, decadal, and transient greenhouse simulation of tropical cyclone–like vortices in a regional climate model of the South Pacific', *Journal of Climate*, 14: 3043–54.

Parisi, F. and Lund, R. (2000) 'Seasonality and return periods of landfalling Atlantic basin hurricanes', *Australian & New Zealand Journal of Statistics*, 42: 271–82.

Perry, A.H. (1997) 'Recreation and tourism', in R.D. Thompson and A. Perry (eds) *Applied Climatology: Principles and Practice*. London: Routledge, pp.240–8.

Pielke, R.A. and Landsea, C.W. (1998) 'Normalized hurricane damages in the United States 1925–1995', *Weather Forecasting*, 13: 621–31.

Pirazzoli, P.A. (2000) 'Surges, atmospheric pressure and wind change and flooding probability on the Atlantic coast of France', *Oceanologica Acta*, 23: 643–61.

Robeson, S.M. (2002) 'Relationships between mean and standard deviation of air temperature: implications for global warming', *Climate Research*, 22: 205–13.

Singh, O.P., Ali Khan, T.M. and Rahman, S. (2000) 'Changes in the frequency of tropical cyclones over the North Indian Ocean', *Meteorology and Atmospheric Physics*, 75: 11–20.

Singh, O.P., Ali Kahn, T.M. and Rahman, S. (2001) 'Has the frequency of intense tropical cyclones increased in the North Indian Ocean?' *Current Science*, 80: 575–80.

Sugi, M., Noda, A. and Sato, N. (2002) 'Influence of the global warming on tropical cyclone climatology: an experiment with the JMA global model', *Journal of the Meteorological Society of Japan*, 80: 249–72.

Wilson, R.M. (1999) 'Statistical aspects of major (intense) hurricanes in the Atlantic basin during the past 49 hurricane seasons (1950–1998): Implications for the current season', *Geophysical Research Letters*, 26: 2957–60.

Zhang Y. and Wang, W.C. (1997) 'Model simulated Northern winter cyclone and anticyclone activity under a Greenhouse warming scenario', *Journal of Climate*, 10: 1616–34.

12

Environmental Change, Biological Diversity and Tourism

C. Michael Hall

Biodiversity (biological diversity) refers to the total sum of biotic variation, ranging from the genetic level, through the species level and on to the ecosystem level. The concept therefore indicates diversity within and between species as well as the diversity of ecosystems. The extent or quantity of diversity can be expressed in terms of the size of a population, the abundance of different species, as well as the size of an ecosystem (area) and the number of ecosystems in a given area. The integrity or quality of biodiversity can be expressed in terms of the extent of diversity at the genetic level, and the resilience at the species and ecosystem level (Martens *et al*. 2003).

Biodiversity loss is a major policy issue and, as with climate change with which it intersects in both environmental and regime terms, is the subject of an international convention (McNeely 1990; Rosendal 2001; Kim 2004). The extinction of species is a natural process (Lande 1993, 1998). However, species and ecosystem loss has accelerated as a result of human activity. The United Nations Environment Programme (UNEP) estimate that almost 4,000 mammal, bird, reptile, amphibia and fish species are threatened with extinction, while about 600 species of animals are on a critically endangered species list (UNEP 2002; Nielsen 2005). Pitman and Jørgensen (2002) estimate that between 24 and 48 per cent of the world's plant species are presently faced with extinction. Wilson (1992) estimated that one species was being lost every 20 minutes, with approximately 27,000 species being lost per year. In contrast, Pimm *et al*. (1995) estimated that human-induced extinction of species was as high as 140,000 per year. At that rate, half of the existing species will be extinct in 70 years.

Although the exact rate of biodiversity loss is disputed (Purvis and Hector 2000) there is no doubt that human domination of the natural environment has led to a decline in biodiversity at all levels, with an acceleration in the rate of species extinction in recent years. According to Martens *et al*. (2003):

> The current speed of extinction of species through human intervention is approximately 100–1,000 times faster than the natural speed of extinction. In many groups of organisms 5–20% of all species are already extinct.

Also critical is recognition of endemic biodiversity versus the total amount of biodiversity for a given region. Endemic biodiversity refers to the biodiversity that

is indigenous (native) or endemic for a given region as opposed to introduced or alien biodiversity, which is that biodiversity which is present in a specific environment because of human interference in natural systems and human mobility. The focus on biodiversity conservation is nearly always on the maintenance of endemic biodiversity, with the exception being when an introduced species or variety is endangered or extinct in its naturally occurring range. There are essentially six main tenets to be found in the desire for conserving biodiversity (see Soulé 1985; Callicot 1990; Wilson 1992):

1 The diversity of organisms and habitats on different scales (for example, genetic, species, ecosystem) is positive.
2 The untimely extinction of organisms and habitats on different scales is negative.
3 Ecological complexity is good.
4 Allowing evolutionary processes to occur is positive.
5 Biodiversity has extrinsic or anthropocentric value in terms of the goods and services it provides humankind.
6 Biodiversity has intrinsic or biocentric value.

There are three main mechanisms by which biodiversity is being lost:

- reduction in the size and fragmentation of natural areas
- changes in ecosystem conditions
- deliberate extinction of species.

Conversion to agriculture, forest clearance and urbanisation are the main causes of the loss of natural areas on the global scale. For example, in 2004 the United Nations Environment Programme (UNEP) warned the governments of the Congo, Rwanda and Uganda that, according to satellite studies, the Virunga National Park was being colonised by farmers at the rate of 2km^2 a day. The park is home to half of the world's population of mountain gorillas of which there are only an estimated 700 left (Radford 2004) The most important causes of changes to ecosystem conditions are fragmentation, disruption and isolation of natural areas, eutrophication, pollution, climate change, erosion and the introduction of diseases and species (Martens *et al*. 2003). Species are also being deliberately extinguished. Not only through poaching of high profile species such as tigers, rhinoceros and elephant, but also though the use of herbicides and biocides and hunting, fishing and farming practices. As Andrew Purvis, a conservation biologist, commented:

> Other species generally have their numbers limited by competitors, predators, parasites and pathogens … Any competitors, we get rid of those pretty quickly, even if they are just competing with things like crop plants, or our livestock, or our golf courses. We are also doing things to eliminate parasites and pathogens.
>
> (quoted in Radford 2004)

Historic and current loss of biodiversity is related to growth in human population and consumption. Pressure on natural resources is occurring not only because of existing consumption in developed countries but also because of increased consumption levels in the less developed countries.

> Each human needs roughly two hectares of land to provide food, water, shelter, fibre, currency, fuel, medicine and a rubbish tip to sustain a lifespan. So the more land humans take, the less that is available for all other mammals, birds, reptiles and amphibians. … humans and their livestock now consume 40 per cent of the planet's primary production, while the planet's other 7 million species must scramble for the rest. No other single species on the planet – except possibly some termites and the Antarctic krill – can match human numbers. People are having such an impact: we are sharply reducing the numbers of other things and very quickly you can go from large numbers to nothing.
>
> (Radford 2004)

Tourism represents a significant part of the consumption practices that impact biodiversity (e.g. German Federal Agency for Nature Conservation 1997; Gössling 2002; Christ *et al*. 2003). However, the impact of tourism development, for example, through tourism urbanisation, and habitat and species disturbance is not all negative. In many locations, tourism provides an economic justification to establish conservation areas, such as national parks and private reserves, as an alternative to other land uses such as logging, clearance for agriculture, mining or urbanisation. Often such tourism is described as ecotourism, safari, wildlife or nature-based tourism or even sustainable tourism (e.g. Cater and Lowman 1994; Hall and Lew 1998; Fennell 1999; Newsome *et al*. 2002; Hall and Boyd 2005). Regardless of the name that is used, it is apparent that charismatic mega-fauna, for example, such animals as dolphins, elephants, giraffes, gorillas, lions, orang-utan, rhinoceros, tigers and whales, do serve as a significant basis for tourism in a number of parts of the world, while national parks and reserves can also be significant tourist attractions in their own right. Indeed, tourism is seen as a mechanism to directly benefit biodiversity and the maintenance of natural capital through several means (Brandon 1996; Christ *et al*. 2003; Hall and Boyd 2005), including:

- an economic justification for biodiversity conservation practices, including the establishment of national parks and reserves (public and private)
- a source of financial support for biodiversity maintenance and conservation
- an economic alternative to other forms of development that may negatively impact biodiversity and to inappropriate exploitation or harvesting of wildlife, such as poaching
- a mechanism for educating people about the benefits of biodiversity conservation
- potentially involving local people in the maintenance of biodiversity and incorporating local ecological knowledge in biodiversity management practices.

In 2003 Conservation International, in collaboration with the United Nations Environment Programme (UNEP), produced a report on the relationships between tourism and biodiversity that focused on the potential role of tourism in biodiversity 'hotspots' – 'priority areas for urgent conservation on a global scale' (Christ *et al*. 2003: vi). Hotspots are areas that both support a high diversity of endemic species and have been significantly impacted by human activities. Plant diversity is the biological basis for designation as a biodiversity hotspot, according to Christ *et al*. (2003: 3): 'a hotspot must have lost 70 percent or more of its original habitat. Overall, the hotspots have lost nearly 90 percent of their original natural vegetation'. The biodiversity hotspots identified by Conservation International 'contain 44 percent of all known endemic plant species and 35 percent of all known endemic species of birds, mammals, reptiles, and amphibians in only 1.4 percent of the planet's land area' (Christ *et al*. 2003: 3). The report highlighted several key issues:

- Although most biodiversity is concentrated in less developed countries, five tourism destination regions in the developed world were also identified as biodiversity hotspots – the Mediterranean Basin, the California floristic province, the Florida Keys, south-west Australia and New Zealand.
- An increasing number of biodiversity hotspot countries in the less developed world are experiencing rapid tourism growth: 23 of them record over 100 per cent growth in the last 10 years, and more than 50 per cent of these receive over one million international tourists per year; 13 per cent of biodiversity hotspot countries receive over five million international tourists per year.
- Although receiving fewer tourists overall than the developed countries, many biodiversity-rich countries in the less developed world receive substantial numbers of international tourists. Thirteen of them – Argentina, Brazil, Cyprus, the Dominican Republic, India, Indonesia, Macao, Malaysia, Mexico, Morocco, South Africa, Thailand and Vietnam – receive over two million foreign visitors per year, while domestic tourism is also of growing significance in some of these countries.
- More than half of the world's poorest 15 countries fall within the biodiversity hotspots and, in all of these, tourism has some economic significance or is forecast to increase according to the World Tourism Organization and the World Travel and Tourism Council.
- In several biodiversity hotspots in less developed countries – for example, Madagascar, Costa Rica, Belize, Rwanda, South Africa – biodiversity or elements of biodiversity, such as specific wildlife, is the major international tourism attraction.
- Forecast increases in international and domestic tourism suggest that pressures from tourism development will become increasingly important in other biodiversity hotspot countries, for example, in South and South East Asia.

The Conservation International report highlighted some of the key relationships between tourism and biodiversity and stated that:

> Biodiversity is essential for the continued development of the tourism industry, yet this study indicates an apparent lack of awareness of the links – positive and negative – between tourism development and biodiversity conservation.
>
> (Christ *et al*. 2003: 41)

Indeed, it went on to note that while many ecosystems serve to attract tourists, for example, coral reefs, rainforest and alpine areas, many of the factors linked to the loss of biodiversity, such as land clearance, pollution and climate change, are also linked to tourism development. Unfortunately, the report failed to adequately emphasise what some of the strategies by which tourism could both contribute to diversity and economic development might be or to state the broader ramifications of those strategies. For example, while the concept of scarcity rent that underlay much of earlier thinking with respect to the value of ecotourism – reduce access to desirable wildlife in the face of high demand and charge more for the experience while reducing the stress on animals and the environment – sounds sensible, it has often foundered on cultural and political values that have historically favoured access. Indeed, for most of their history, national parks agencies have often sought to encourage visitation so as to meet the recreational component of their mandate and to create a political environment supportive of national parks. Unfortunately, in the face of growing populations and increasing personal mobility the access issue is becoming increasingly problematic for many conservation authorities who seek to conserve biodiversity (Budowski 1976; Runte 1987; Hall 1992; Cater and Lowman 1994; Butler and Boyd 2000; Hall and Boyd 2005).

Despite the growth of research and publications on tourism in natural areas, our understanding of the role and effects of tourism in natural areas is also surprisingly limited. Arguably, the majority of studies have examined the impacts of tourism and recreation on a particular environment or component of the environment rather than over a range of environments (Holden 2000; Weaver 2001; Hall and Boyd 2005). There is substantial research undertaken on tourism with respect to rainforest, reefs and dolphins and whales, for example, but very limited research undertaken on what are arguably less attractive environments, such as wetlands, or animal species that are not the charismatic mega-fauna that are a key component of wildlife viewing tourism but which are just as important a part of the ecosystem (Newsome *et al*. 2002; Hall and Boyd 2005). Moreover, the scale on which interactions between tourism and biodiversity are examined is also critical. The Conservation International report on tourism and biodiversity (Christ *et al*. 2003) can only serve to highlight relationships at the macroscopic level of biological provinces, it does not serve as a useful management tool at the level of ecosystems, let alone individual species. Such a comment is not to denigrate the report because it serves an extremely useful function in terms of policy debate, but the harsh reality is that knowledge of the structure and dynamics of the geographic range of species in terms of abundance, size and limits is extremely limited even before the implications of human impact, including tourism, on range and abundance is considered (Gaston 2003).

As noted above, species extinction is a natural process. It has long been recognised that extinction and colonisation of habitats is an ongoing process. But just as importantly it has also been recognised that without human interference such processes lead to equilibrium between extinction and immigration (e.g. see MacArthur and Wilson 1967; Whitehead and Jones 1969). Human impact is changing this natural balance with respect to both extinction and immigration of new species at a rate that is making it extremely difficult, if not impossible, for new equilibria to be established. Tourism's contribution to the present human-induced mass extinction of species (May *et al*. 1995; Pimm *et al*. 1995; Hilton-Taylor 2000) is several-fold and will be examined in the following sections. Although tourism rarely directly kills off species, tourism-related developments and land use contributes to species range contraction and extinctions through habitat loss and fragmentation. Tourism and other forms of human mobility also introduce alien organisms into areas beyond the natural limits of their geographical range, thereby creating new competition among species. Tourism also affects biodiversity through its contribution to climate change. Finally, we can raise issues over the extent to which national parks and other protected areas can be used to conserve biodiversity.

Habitat loss and fragmentation

Tourism directly affects habitat through processes of tourism urbanisation. As Chapter 8 notes, such processes are spatially and geographically distinct and are often related to high natural amenity areas such as the coast, where coastal ecosystems are subject to urbanisation, land clearance and the draining and clearance of wetlands. Tourism also contributes to habitat loss and fragmentation via its ecological footprint in terms of resource requirements and pollution and waste.

The loss of endemic biodiversity through species extinction can be expressed in relation to changes in the size of the geographic range of a species and its total population size as the total number of individuals in a species declines. Four different idealised forms of these relationships can be presented (Wilcove and Terborgh 1984; Schonewald-Cox and Buechner 1991; Lawton 1993; Gaston 1994, 2003: 168–74), although, as Gaston notes:

> Declines in extinction are often likely to walk much more varied paths through abundance-range space than these simple models might imply, given the complexities of the abundance structure of species' geographic ranges and of the processes causing reductions in overall population size.
>
> (2003: 174)

- The geographic range size remains approximately constant as the number of individuals declines and overall density declines with time. Activities such as hunting, pollution or climatic change can all lead to declines in the number of individuals of a species without affecting the overall geographic range in which they are found.

- The number of individuals and range size decline simultaneously so that the density remains constant. Two circumstances can be identified in which such a situation may occur. First, reduction of losses of individual members of a species may be balanced by losses of lower density areas. Gaston (2003: 168), for example, notes: 'declines in the local abundances of persistent populations accompanied by the loss of small, and often peripheral, populations appear to be a widespread phenomena'. Second, the total habitat area may be eroded without loss in the quality of the remaining habitat. One of the best examples of this situation that is often related to coastal tourism development is the loss of individual wetlands which are drained, leaving other wetlands as yet undeveloped.
- The number of individuals of a species and the size of their range decline simultaneously such that the density of individuals declines with time. Gaston (2003) recognises three cases in which such a situation might exist. First, with respect to broad-scale environmental change, including the effects of an increase in the proportion of 'edge' as a habitat area is fragmented therefore leading to micro-climatic changes as well as other changes to patterns of predation and species invasion (Laurance 2000; Laurance *et al*. 1997, 2000). Such a situation is consistent with the development of edge effects when recreational access is unmanaged in habitat fragments and people do not keep to trails, thereby creating further edges as new walking paths are created. Second, in areas that undergo differential exploitation through, for example, timber extraction. Third, if there is a causal link between abundance of a species and occupancy of a given habitat (see also Gates and Donald 2000; Lawton 1993, 2000).
- The number of individuals of a species and range size decline simultaneously such that the density of individuals increases with time. Such a pattern is most likely to occur when habitat is lost with no compensating increase in density of individuals in other available habitat. This particular model of extinction has substantial implications for conserving biodiversity 'hot spots' which tends to assume (see Christ *et al*. 2003) that protecting such areas in the face of the loss of other areas where the species are present should increase the density of individuals of the species. Yet such density increases may be only short-term if populations in the 'hot spots' were dependent on their relationship with other populations of the species that have been made extinct. As Gaston highlights: 'This emphasizes the need for a regional rather than a site-by-site approach to conservation planning and action, albeit this is at odds with the methodology embodied in some international agreements … for example Ramsar Convention on Wetlands of International Importance … and espoused by some conservation agencies' (2003: 174).

Introduction of foreign organisms

It is estimated that approximately 400,000 species have been accidentally or deliberately introduced to locations that lie beyond the natural limits of their geographic

range (Pimentel 2001). The introduction of alien species into an environment is a major influence on biodiversity that is associated with tourism because of the capacity of tourists and the infrastructure of tourism to act as carriers of exotic species. Many introductions have no apparent adverse effects (Williamson 1996), although some introductions, such as deer, rabbits and possum in New Zealand, and cane toads and rabbits in Australia, have caused massive ecological damage and harm to native species (Fox and Adamson 1979).

In the nineteenth and early twentieth centuries many species were deliberately introduced from one part of the world to another by the European colonial powers as a means of economic development and the Europeanisation of the natural environment (Crosby 1986). Although agricultural development and the creation of an ideal environment were the primary motives for such introductions, leisure and tourism were also significant. For example, in New Zealand a number of Australian and European animal species were introduced for hunting purposes but it was not until the 1920s that substantial opposition emerged to the introduction of new species, including widespread indignation and opposition to Lady Liverpool's efforts to introduce grouse into Tongariro Park, New Zealand's oldest national park. Prof. H.B. Kirk, one of New Zealand's leading natural historians, sent an angry letter to the *Evening Post*, which had earlier applauded Lady Liverpool's efforts as likely to 'give added attractions to sportsmen coming to New Zealand from the Old Country': 'No other country would do so ludicrous a thing as to convert the most distinctive of its national parks into a game preserve … this thing is an insult to the Maori donors and to all lovers of New Zealand as New Zealand'. Kirk's letter appeared to find a supportive response among a wide range of individuals and authorities. By the end of 1924 the New Zealand Legislative Council had 'pushed through a resolution condemning all introduction and proclaiming that the park should be held inviolate' (in Harris 1974: 109–110).

International trade has also served to introduce alien species through accidental carriage in shipping containers and on ships and aircraft (Drake and Mooney 1988; Carlton and Geller 1993). Nevertheless, travellers remain a major source of accidental and intentional species introductions to the point where they are a focus of biosecurity concerns at both international and regional levels (Timmins and Williams 1991; Hodgkinson and Thompson 1997; Hall 2003; Jay *et al*. 2003).

Much of the concern over the introduction of alien species lies in their potential economic damage. Pimentel *et al*. (2000) estimated that the approximately 50,000 exotic species in the USA have an economic impact of US$137 billion per annum in terms of their economic damage and costs of control. For example, since 1998 the State of California has provided US$65.2 million for a statewide management programme and research to combat the glassy-winged sharpshooter and the deadly Pierce's disease (a bacterium, *Xylella fastidiosa*) that it carries. Accidentally introduced in 1989, 15 counties in California have been identified as being infested (Wine Institute of California 2002).

For many grape diseases, humans are a significant vector (Pearson and Goheen 1998), the most notable of which is grape phylloxera, an aphid *Daktulosphaira*

vitifoliae, which wreaked havoc on the world's vineyards in the late nineteenth century (Ordish 1987). The economic impact of a phylloxera outbreak on the modern wine industry would be substantial. In Western Australia, it is estimated that phylloxera could cost affected growers A$20,000/ha in the first five years in lost production and replanting costs (Agriculture Western Australia 2000). Increased personal mobility, particularly through wine and food tourism, is a potential threat to the wine industry because of the potential for the relocation and introduction of pests. Yet, despite recognition of the potential role of humans in conveying grape pests, there is only limited awareness of the biosecurity risks of wine tourism (Hall 2003). However, it is likely that in the future concerns over the risks associated with the introduction of exotic species for endemic biodiversity can only increase as rates of international travel continue to grow and the climate change leads to the creation of environmental conditions conducive to the establishment of alien species.

Climate change

Climate change sets particular challenges for conservation. One of the most significant long-term issues for the global network of protected areas that serve to help maintain biodiversity is how can they 'be established and developed in such a way that it can accommodate the changes in species distributions that will follow from climate change' (Gaston 2003: 181). Substantial research has been undertaken on the implications of climate change for species' geographic ranges which has typically sought to model the relationships between climate and distribution in relation to such issues as habitat fragmentation (e.g. Nakano *et al*. 1996) and loss (e.g. Keleher and Rahel 1996; Travis 2003), species distribution (e.g. Jeffree and Jeffree 1994, 1996), pests (e.g. Baker *et al*. 1996) and disease (e.g. Rogers and Randolf 2000; Lieshout *et al*. 2004). Undoubtedly, the distribution of species is affected by temperature. However, studies of the relationship between species distribution and future climate change scenarios tend to make a number of critical assumptions (Gaston 2003):

- Correlations between climate and species occurrence reflect causal relationships.
- Any influence of other factors on observed relationships between climate and the occurrence of a species, such as competitors, diseases, predators, parasites and resources will remain constant.
- Temporally generalised climatic conditions – for example, seasonal means, annual means, medians – are more important influences on the distribution of species than rates of climatic change and extreme events.
- Spatially generalised climatic conditions derived or interpolated from the nearest climate stations sufficiently characterise the conditions that individuals of a species actually experience.
- Climate change will be relatively simple, in that its influence on species distributions can be summarised in terms of the projected changes in one or a few variables.

- There is no physiological capacity to withstand environmental conditions which are not components of those existing conditions in areas in which a species is presently distributed.
- Range shifts, expansions, or contractions are not accompanied by physiological changes, other than local non-genetic acclimatisation.
- Dispersal limit is unimportant in the determination of the present distribution of species and in their ability to respond to changes in climate.

As Gaston (2003: 185) points out, the reality is that a number of these assumptions will be, and already have been, 'severely violated' (see Lawton 1995, 2000; Spicer and Gaston 1999; Bradshaw and Holzapfel 2001). For example:

> Human activities impose a marked influence on the distribution of species, and how these alter with changes in climate is alone likely to be extremely complicated, and dependent on social pressures and technological developments.
>
> (Gaston 2003: 183)

The above observations are not to deny that climate change will affect the geographic range of species, it clearly will in the future just has it has in the past (e.g. Boer and de Groot 1990; Hengeveld 1990; Huntley 1991, 1994; Huntley and Birks 1983; Huntley *et al*. 1989, 1995). However, the use of relatively simple models based on climate matching approaches is likely to prove misleading in terms of planning conservation regimes that can accommodate future climate change.

Conserving biodiversity

At the start of the twenty-first century the world's biodiversity is threatened as never before – as noted above many species become extinct each year and the number is growing. This section looks at the role of national parks and reserves as present and future refugia. Tourism, and ecotourism in particular, has become a major economic rationale for the establishment of national parks and reserves that serve to conserve and present charismatic mega-fauna and habitats.

The global conservation estate has grown enormously since the first UN List of Protected Areas was published in 1962 with just over 1,000 protected areas. In 1997 there were over 12,754 sites listed. The 2003 edition listed 102,102 sites covering 18.8 million km^2. 'This figure is equivalent to 12.65 per cent of the Earth's land surface, or an area greater than the combined land area of China, South Asia and South East Asia' (Chape *et al*. 2003: 21). Of the total area protected, it is estimated that 17.1 million km^2 constitute terrestrial protected areas, or 11.5 per cent of the global land surface, although some biomes, including Lake Systems and Temperate Grasslands, remain poorly represented. Marine areas are significantly under-represented in the global protected area system. Approximately 1.64 million km^2 comprise marine protected areas – an estimated 0.5 per cent of the world's oceans and less than one tenth of the overall extent of protected areas worldwide (Chape *et al*. 2003).

The size of the global conservation estate raises the question of just how large the global network of protected areas needs to be (Rodrigues and Gaston 2001). The present size of global conservation estate exceeds the IUCN's earlier target of at least 10 per cent of the total land area being set aside for conservation purposes, although there is clearly substantial variation between both countries and biomes in terms of the actual area set aside (Chape *et al*. 2003). Yet commentators such as Soulé and Sanjayan (1998) have noted that the IUCN's target has been dictated more by political considerations than biological science. Rodrigues and Gaston (2001, 2002) observed that the minimum area needed to represent all species within a region increases with the number of targeted species, the level of endemism and the size of the selection units. They concluded that:

- No global target for the size of a network is appropriate because those regions with higher levels of endemism and/or higher diversity will correspondingly require larger areas to protect such characteristics.
- A minimum size conservation network sufficient for capturing the diversity of vertebrates will not be sufficient for biodiversity in general, because other groups are known to have higher levels of endemism (Gaston 2003).
- The 10 per cent target is likely to be grossly inadequate to meet biodiversity conservation needs. Instead, Rodrigues and Gaston (2001) estimated that for a selection unit of $1^{o} \times 1^{o}$ (approximately12,000 km^2) 74.3 per cent of the global land area and 92.7 per cent of the global rain forest would be required to represent every plant species and 7.7 per cent and 17.8 per cent respectively to represent the higher vertebrates. However, Gaston (2003) also notes that even reserves of 12,000 km^2 may not be large enough for maintaining populations of many species, citing examples from the national parks of Africa (Newmark 1996; Nicholls *et al*. 1996) and the USA (Newmark 1984; Mattson and Reid 1991). Indeed, it must be noted that while there has been a well-considered literature on the size and shape of conservation reserves since the 1970s (e.g. Main and Yadav 1971; Diamond 1975; Slatyer 1975; MacMahon 1976) there has been inadequate utilisation of such knowledge with respect to park and reserve establishment and design and their dual role conservation and tourism roles.

A further concern in terms of biodiversity conservation is the capacity of a national park and reserve system to cope with the impact of global environmental change (GEC) including climate change (Dockerty et al. 2003), surrounding land-use change and anthropogenic pressure (Cardillo *et al*. 2004). Given the migration of species as a result of climate change, present reserves may not be suitable for conservation of target species and ecosystems (Huntley 1994, 1999). Given the potential scale of GEC it is therefore important that sites are identified that can act as refugia from future change. A refuge is a region in which certain species are able to persist during a period in which most of the original geographic range becomes uninhabitable because of environmental change. Historically, such changes have been climatic although in terms of contemporary biodiversity conservation anthropogenic environmental change is just as significant. Although some present

national parks and reserves are likely to fill this role, it is also important that sites that are available which have attributes that may potentially fulfil the role of refugia for endangered species in the future also be identified, conserved and managed so as to reduce the impacts of GEC on populations. Such 'future refugia' may then become locations from which future species migration can occur should climate become stabilised.

Conclusion

The loss of biodiversity is one of the most significant aspects of GEC given the extent to which it underpins the global economy and human welfare (Martens *et al*. 2003). Biodiversity, or at least the existence of certain charismatic species (usually mega-fauna) and ecosystems is also significant as an attraction for 'ecotourism' and 'nature-based tourism'. Nevertheless, the interrelationships between tourism and biodiversity are poorly understood in terms of empirical data, although the potential impacts of the loss of some charismatic species such as the polar bear (The Age 2005), or African wildlife, or even entire ecosystems, such as the Great Barrier Reef (Fyfe 2005), on tourism would be dramatic.

The extent to which tourism contributes towards biodiversity loss through tourism urbanisation, habitat loss and fragmentation and contribution to climate change is also dramatic and, arguably, makes a lie out of attempts to paint a picture of tourism as a benign industry. Undoubtedly, tourism can make a contribution to the conservation and maintenance of biodiversity. However, in reality the success stories are few and far between and are generally isolated to individual species and relatively small areas of habitat (e.g. see Newsome *et al*. 2002) rather than a comprehensive contribution to conservation. Such a comment is not to belittle the efforts that have been made with respect to developing a positive contribution from tourism toward biological conservation. Instead, it is to highlight the fact that while tourism has led to biodiversity maintenance at a local level in some instances, the global picture is one in which tourism, like many other industries that have a large ecological footprint and lead to clearance of natural areas, is not a net contributor to biodiversity.

References

Agriculture Western Australia (2000) *Grape Phylloxera: Exotic Threat to Western Australia, Factsheet no.0002–2000*. Perth: Department of Agriculture.

Baker, R.H.A., Cannon, R.J.C. and Walters, K.F.A. (1996) 'An assessment of the risks posed by selected non-indigenous pests to UK crops under climate change', *Aspects of Applied Biology*, 45: 323–30.

Boer, M.M. and de Groot, R.S. (eds) (1990) *Landscape-Ecological Impact of Climate Changes*. Amsterdam: IOS Press.

Bradshaw, W.E. and Holzapfel, C.M. (2001) 'Genetic shift in photoperiodic response correlated with global warming', *Proceedings of the National Academy of Sciences of the USA*, 98: 14509–11.

Brandon, K. (1996) *Ecotourism and Conservation: A Review of Key Issues*. Environment Department Paper no.33. Washington, DC: World Bank.

Budowski, G. (1976) 'Tourism and conservation: conflict, coexistence or symbiosis', *Environmental Conservation*, 3(1): 27–31.
Butler, R. and Boyd, S. (eds) (2000) *Tourism and National Parks*. Chichester: John Wiley.
Callicott, J.B. (1990) 'Whither conservation ethics?' *Conservation Biology*, 4: 15–20.
Cardillo, M., Purvis, A., Sechrest, W., Gittleman, J.L., Bielby, J. and Mace, G.M. (2004) 'Human population density and extinction risk in the world's carnivores', *PloS Biology*, 2(7): 0909–0914
Carlton, J.T. and Geller, J.B. (1993) 'Ecological roulette: the global transport of non-indigenous marine organisms', *Science*, 261: 78–82.
Cater, E. and Lowman, G. (eds) (1994) *Ecotourism: A Sustainable Option*? Chichester: John Wiley.
Chape, S., Blyth, S., Fish, L., Fox, P. and Spalding, M. (compilers) (2003) *2003 United Nations List of Protected Areas*. IUCN, Gland and Cambridge: IUCN and UNEP-WCMC.
Christ, C., Hilel, O., Matus, S. and Sweeting, J. (2003) *Tourism and Biodiversity: Mapping Tourism's Global Footprint*. Washington, DC: Conservation International.
Crosby, A.W. (1986) *Ecological Imperialism: The Biological Expansion of Europe, 900–1900*. Cambridge: Cambridge University Press.
Diamond, J.M. (1975) 'The island dilemma: lessons of modern biogeographic studies for the design of natural reserves', *Biological Conservation*, 7: 129–46.
Dockerty, T., Lovett, A. and Watkinson, A. (2003) 'Climate change and nature reserves: examining the potential impacts, with examples from Great Britain', *Global Environmental Change*, 13: 125–35.
Drake, J.A. and Mooney, H.A. (eds) (1988) *Biological Invasions: A Global Perspective*. New York: John Wiley.
Fennell, D. (1999) *Ecotourism: An Introduction*. London: Routledge.
Fox, M.D. and Adamson, D. (1979) 'The ecology of invasions', in H. Recher, D. Lunney and I. Dunn (eds) *A Natural Legacy: Ecology in Australia*. Rushcutter's Bay: Pergamon Press.
Fyfe, M. (2005) 'Too late to save the reef', *The Age*, February 12.
Gaston, K.J. (1994) 'Geographic range sizes and trajectories to extinction', *Biodiversity Letters*, 2: 163–70.
Gaston, K.J. (2003) *The Structure and Dynamics of Geographic Ranges*. Oxford: Oxford University Press.
Gates, S. and Donald, P.F. (2000) 'Local extinction of British farmland birds and the prediction of further loss', *Journal of Applied Ecology*, 37: 806–20.
German Federal Agency for Nature Conservation (1997) *Biodiversity and Tourism: Conflicts on the World's Seacoasts and Strategies for Their Solution*. Berlin: Springer Verlag.
Gössling, S. (2002) 'Global environmental consequences of tourism', *Global Environmental Change*, 12: 283–302.
Hall, C.M. (1992) *Wasteland to World Heritage: Preserving Australia's Wilderness*. Carlton: Melbourne University Press.
Hall, C.M. (2003) 'Biosecurity and wine tourism: Is a vineyard a farm?' *Journal of Wine Research*, 14(2–3): 121–6.
Hall, C.M. and Boyd, S. (2005) 'Nature-based tourism and regional development in peripheral areas: Introduction', in C.M. Hall and S. Boyd (eds) *Tourism and Nature-based Tourism in Peripheral Areas: Development or Disaster*, Clevedon: Channelview Publications, pp.3–17.
Hall, C.M. and Lew, A. (1998) 'The geography of sustainable tourism development: an introduction', In C.M. Hall and A. Lew (eds) *Sustainable Tourism: A Geographical Perspective*. London: Addison-Wesley Longman, pp.1–12.

Harris, W.W. (1974) 'Three parks: An analysis of the origins and evolution of the national parks movement', unpublished MA Thesis, Christchurch: Department of Geography, University of Canterbury.

Hengeveld, R. (1990) *Dynamic Biogeography*. Cambridge: Cambridge University Press.

Hilton-Taylor, C. (2000) *The 2000 IUCN Red List of Threatened Species*. Gland: IUCN.

Hodgkinson, D.J. and Thompson, K. (1997) 'Plant dispersal; the role of man', *Journal of Applied Ecology*, 34: 1484–96.

Holden, A. (2000) *Environment and Tourism*. London: Routledge.

Huntley, B. (1991) 'How plants respond to climate change: migration rates, individualism and the consequences for plant communities', *Annals of Botany*, 67 (Supplement 1): 15–22.

Huntley, B. (1994) 'Plant species' responses to climate change: implications for the conservation of European birds', *Ibis*, 137: S127-S138.

Huntley, B. (1999) 'Species distribution and environmental change: considerations from the site to the landscape scale', in E. Maltby, M. Holdgate, M. Acreman and A. Weir (eds) *Ecosystem Management: Questions for Science and Society*. Virginia Water: Royal Holloway Institute for Environmental Research. pp.115–29.

Huntley, B. and Birks, H.J.B. (1983) *An Atlas of Past and Present Pollen Maps for Europe: 0–13,000 Years Ago*, Cambridge: Cambridge University Press.

Huntley, B., Bartlein, P.J. and Prentice, I.C. (1989) 'Climatic control of the distribution and abundance of beech (*Fagus L.*) in Europe and North America', *Journal of Biogeography*, 16: 551–60.

Huntley, B., Berry, P.M., Cramer, W. and McDonald, A.P. (1995) 'Modelling present and potential future ranges of some European higher plants using climate response surfaces', *Journal of Biogeography*, 16: 551–60.

Jay, M., Morad, M. and Bell, A. (2003) 'Biosecurity – A policy dilemma for New Zealand', *Land Use Policy*, 20(2): 121–29.

Jeffree, C.E. and Jeffree, E.P. (1996) 'Redistribution of the potential geographical ranges of Mistletoe and Colorado Beetle in Europe in response to the temperature component of climate change', *Functional Ecology*, 10: 562–77.

Jeffree, E.P. and Jeffree, C.E. (1994) 'Temperature and the biogeographical distributions of species', *Functional Ecology*, 8: 640–50.

Keleher, C.J. and Rahel, F.J. (1996) 'Thermal limits to salmonoid distributions in the Rocky Mountain Region and potential habitat loss due to global warming: a geographic information system (GIS) approach', *Transactions of the American Fisheries Society*, 125: 1–13.

Kim, J.A. (2004) 'Regime interplay: the case of biodiversity and climate change', *Global Environmental Change*, 14: 314–24.

Lande, R. (1993) 'Risks of population extinction from demographic and environmental stochasticity and random catastrophes', *American Naturalist*, 142: 911–27.

Lande, R. (1998) 'Anthropogenic, ecological and genetic factors in extinction', in G.M. Mace, A. Balmford and J.R. Ginsberg (eds) *Conservation in a Changing World*. Cambridge: Cambridge University Press, pp.29–51.

Laurance, W.F. (2000) 'Do edge effects occur over large spatial scales', *Trends in Ecology and Evolution*, 15: 134–5.

Laurance, W.F., Laurance, S.G., Ferreira, L.V., Rankin-de Merona, J.M., Gascon, C. and Lovejoy, T.E. (1997) 'Biomass collapse in Amazonian forest fragments', *Science*, 278: 1117–8.

Laurance, W.F., Delamonica, P., Laurance, S.G., Vasconcelos, H.L. and Lovejoy, T.E. (2000) 'Rainforest fragmentation kills big trees', *Nature*, 404: 836.

Lawton, J.H. (1993) 'Range, population abundance and conservation', *Trends in Ecology and Evolution*, 8: 409–13.

Lawton, J.H. (1995) 'The response of insects to environmental change', in R. Harrington and N.E. Stork (eds) *Insects in a Changing Environment*. London: Academic Press, pp.3–26.

Lawton, J.H. (2000) *Community Ecology in a Changing World*. Oldendorf: Ecology Institute.

Lieshout, M. van, Kovats, R.S., Livermore, M.T.J. and Martens, P. (2004) 'Climate change and malaria: Analysis of the SRES climate and socio-economic scenarios', *Global Environmental Change*, 14: 87–99.

MacArthur, R.H. and Wilson, E.O. (1967) *The Theory of Island Biogeography*. Princeton, NJ: Princeton University Press.

MacMahon, J.A. (1976) 'Thoughts on the optimum size of natural reserves based on ecological principles', in J. Franklin and S. Krugman (eds) *Selection, Management and Utilization of Biosphere Reserves*. Proceedings of the USA-USSR Symposium on Biosphere Reserves, Moscow, May 1976, Corvallis: Pacific Northwest Forest and Range Experiment Station, United States Department of Agriculture, Forest Service, pp.128–34.

McNeely, J.A., (1990) 'Climate change and biological diversity: policy implications', in M. Boer and R.S. de Groot (eds) *Landscape-Ecological Impact of Climate Change*. Amsterdam: IOS Press, pp.406–29.

Main, A.R. and Yadav, M. (1971) 'Conservation of macropods in reserves in Western Australia', *Biological Conservation*, 3: 123–33.

Martens, P., Rotmans, J. and Groot, D. de (2003) 'Biodiversity: luxury or necessity?', *Global Environmental Change*, 13: 75–81.

Mattson, D.J. and Reid, M.M. (1991) 'Conservation of the Yellowstone grizzly bear', *Conservation Biology*, 5: 364–72.

May, R.M., Lawton, J.H. and Stork, N.E. (1995) 'Assessing extinction rates', in J.H. Lawton and R.M. May (eds) *Extinction Rates*. Oxford: Oxford University Press, pp.1–24.

Nakano, S., Kitano, F. and Maekawa, K. (1996) 'Potential fragmentation and loss of thermal habitats for charrs in the Japanese archipelago due to climatic warming', *Freshwater Biology*, 36: 711–22.

Newmark, W.D. (1987) 'A land-bridge perspective on mammalian extinctions in western North American parks', *Nature*, 325: 430–2.

Newmark, W.D. (1996) 'Insularization of Tanzanian national parks and the local extinction of large mammals', *Conservation Biology*, 10; 1549–56.

Newsome, D., Moore, S.A. and Dowling, R.K. (2002) *Natural Area Tourism: Ecology, Impacts and Management*. Clevedon: Channelview Publications.

Nicholls, A.O., Viljoen, P.C., Knight, M.H. and van Jaarsveld, A.S. (1996) 'Evaluating population persistence of censused and unmanaged herbivore populations from the Kruger National Park, South Africa', *Biological Conservation*, 76: 57–67.

Nielsen, R. (2005) *The Little Green Handbook: A Guide to Critical Global Trends*. Carlton North: Scribe Publications.

Ordish, G. (1987) *The Great Wine Blight*, 2nd ed. London: Sedgwick and Jackson.

Pearson, R.C. and Goheen, A.C. (eds) (1998) *Compendium of Grape Diseases*. Saint Paul: The American Phytopathological Society.

Pimentel, D. (2001) 'Agricultural invasions', in S.A. Levin (ed.) *Encyclopedia of Biodiversity*. San Diego: Academic Press, pp.71–85.

Pimentel, D., Lach, L., Zuniga, R. and Morrison, D. (2000) 'Environmental and economic cost of nonindigenous species in the United States', *BioScience*, 50: 53–65.
Pimm, S.L., Russell, G.J., Gittleman, J.L. and Brooks, T.M. (1995) 'The future of biodiversity', *Science*, 269: 347–50.
Pitman, N.A. and Jørgensen, P.M. (2002), 'Estimating the size of the world's threatened flora', *Science*, 298: 989.
Purvis, A. and Hector, A. (2000) 'Getting the measure of biodiversity', *Nature*, 405: 212–19.
Radford, T. (2004) 'Life on the brink', *The Age*, 11 August.
Rodrigues, A.S.L. and Gaston, K.J. (2001) 'How large do reserve networks need to be?' *Ecological Letters*, 4: 602–9.
Rodrigues, A.S.L. and Gaston, K.J. (2002) 'Rarity and conservation planning across geopolitical units', *Conservation Biology*, 16: 674–82.
Rogers, D.J. and Randolf, S.E. (2000) 'The global spread of malaria in a future, warmer world', *Science*, 289: 1763–6.
Rosendal, G.K., (2001) 'Overlapping international regimes: the case of the inter-governmental forum on forests (IFF) between climate change and biodiversity'. *International Environmental Agreements: Politics, Law and Economics*, 1(4): 447–68.
Runte, A., (1987) *National Parks: The American Experience*, 2nd ed. Lincoln, NE: University of Nebraska Press.
Schonewald-Cox, C. and Buechner, M. (1991) 'Housing viable populations in protected habitats: the value of a coarse-grained geographic analysis of density patterns and available habitat', in A. Seitz and Loeschke (eds) *Species Conservation: A Population-Biological Approach*. Basel: Birkhauser Verlag, pp.213–26.
Slatyer, R.O. (1975) 'Ecological reserves: size, structure and management', in F. Fenner (ed.) *A National System of Ecological Reserves in Australia*. Canberra, Australian Academy of Science, pp.22–38.
Soulé, M. (1985) 'What is conservation biology?' *Bioscience*, 35: 727–34.
Soulé, M. and Sanjayan, M.A. (1988) 'Ecology-conservation targets: do they help?', *Science*, 279: 2060–1.
Spicer, J.J. and Gaston, K.J. (1999) *Physiological Diversity and its Ecological Implications*. Oxford: Blackwell Science.
The Age (2005) 'Polar bears' days may be numbered', February 3.
Timmins, S.M. and Williams, P.A. (1991) 'Factors affecting weed numbers in New Zealand's forest and scrub reserves', *New Zealand Journal of Ecology*, 15: 153–62.
Travis, J. (2003) 'Climate change and habitat destruction: A deadly anthropogenic cocktail', *Proceedings of the British Royal Society B*, 270: 467–73.
United Nations Environment Programme (UNEP) (2002) *Global Environmental Outlook 3: Past, Present and Future Perspectives*. Nairobi: UNEP.
Weaver, D. (2001) *The Encyclopedia of Ecotourism*. Oxford: CABI Publishing.
Whitehead, D.R. and Jones, C.E. (1969) 'Small islands and the equilibrium theory of insular biogeography', *Evolution*, 23: 171–9.
Wilcove, D.S. and Terborgh, J.W. (1984) 'Patterns of population decline in birds', *American Birds*, 38: 10–13.
Williamson, M. (1996) *Biological Invasions*. London: Chapman and Hall.
Wilson, E.O. (1992) *The Diversity of Life*. New York: Norton.
Wine Institute of California (2002) *Pierce's Disease Update*. San Francisco: Wine Institute of California.

Part III
Role of Stakeholders

13

Deciding Tourism Destination and Impact of Climate Information

Jacqueline M. Hamilton and Maren A. Lau

Introduction

The impact of climate change on tourism has been examined quantitatively in several different ways. There are economic theory-based studies that involve estimating the demand for destinations using, among other things, climate variables (see Maddison 2001; Lise and Tol 2002; Hamilton, 2003). Related to these studies are global models of tourism flows that include temperature as a determinant of the flows of tourists between countries (Berritella *et al*. 2004; Hamilton *et al*. 2003). There are also studies that use tourism climate indices to predict the effect of a changed climate on tourism demand (Scott and McBoyle 2001; Amelung and Viner, in press). The latter group of studies combine climate variables in a more complex way to reflect the thermal, physical and aesthetic properties of climate. The former two groups take a more simplistic approach: they include temperature, and up to two other variables. How far does the reduction of climate to one or two variables limit these studies? Moreover, de Freitas (2003) argues that climate data expressed as an average, which is used in the economic studies mentioned above, have no psychological meaning. Nevertheless, the economic theory-based studies and the global models base their analysis on the actual behaviour of tourists, in other words, actual destination choices.

A tourist's choice of destination will be based on what they expect from the chosen destination. What they expect will be driven by the image that they have of the destination. Of course, weather is not experienced as a set of separable and independent attributes but as a complex impression. In terms of climate, this leads us to ask: do tourists have an image of the climate and, if so, how was this image formed? It is unclear whether tourists form a complex picture of climate or if information on a few key attributes tells them enough about climate to construct an image. Lohmann and Kaim (1999) note that there is a lack of empirical evidence on the importance of climate on destination choice decision making. In contrast to the German travel surveys reported by Lohmann and Kaim, we have focused this study on climate image and climate information. As far as the authors of this chapter know, this is the first study of its kind and there is a considerable gap to be filled.

After considering the issues mentioned above, we formulated the following research questions:

A How decisive is climate as a factor in decision making?
B At what point in the holiday decision-making process do tourists gather information about climate and weather?
C What sources of climate information are most frequently used?
D What are the most frequently used types of climate information?

In order to gather data to answer these questions, a survey of tourists departing from Hamburg and its vicinity was carried out during July and August 2004. The survey produced 394 completed self-administered questionnaires. The questionnaire provided details on the current holiday, destination image, information sources, type and presentation of information and demographic details of the respondents.

Literature review and hypothesis formulation

Morley (1992) criticises tourism demand studies, which typically focus purely on economic factors, because they do not consider utility in the decision-making process (see Witt and Witt 1995; Lim 1995). He suggests an alternative way to estimate demand based on the expected utility derived from the characteristics of the product – in this case the destination country is the product. Lancaster (1966 in Um and Crompton 1990) originally developed the concept that the characteristics of a good are more important to the consumer than the actual good itself. How these characteristics are perceived will determine the expected utility. In the case of tourism, the product is the holiday at a certain destination and at a certain time and this product will have certain characteristics. Knowledge of destination characteristics will be limited for a first time tourist. As climate can be temporally as well as spatially defined, even repeat visitors will not necessarily have experienced all seasons at the destination. Limits to knowledge lead Um and Crompton (1990: 433) to argue that:

> The image and attitude dimensions of a place as a travel destination are likely to be critical elements in the destination choice process, irrespective of whether or not they are true representations of what the place has to offer.

The final choice of destination is the result of a decision-making process that involves the use of information, whether from personal experience or through an active search, to generate an image of the destination. This section develops the hypotheses related to destination image, decision making and information search as well as climate information for tourists.

Destination image

There are many different definitions of what destination image actually is (Gallarza *et al*. 2002). There is, however, a consensus that destination image plays an important role in destination choice. What role does climate play in destination image? Not

all studies of destination image include climate as an image defining attribute, as can be seen in the extensive review of destination image studies by Gallarza *et al*. (2002). Of the 25 destination image studies reviewed, climate was included as an attribute in 12 studies. Nevertheless, from their list of 20 attributes, climate is the seventh most frequently used attribute. Studies of destination image that include climate/weather as an attribute find that it is one of the most important attributes. There are, however, differences in the preferences shown by different types of tourists and for tourists from different places (Hu and Ritchie 1993; Shoemaker 1994; Kozak 2002; Beerli and Martin 2004).

Only one of the 142 destination image papers reviewed by Pike (2002) specifically deals with weather. This was a study by Lohmann and Kaim (1999), who assess the importance of certain destination characteristics using a representative survey of German citizens. Landscape was found to be the most important aspect, even before price considerations. Weather and bioclimate were ranked third and eighth respectively for all destinations. They found that, although weather is an important factor, destinations are also chosen in spite of the likely bad weather. In a study by Gössling *et al*. (2005) of tourists surveyed in Zanzibar, tourists were asked to rate climate's importance in their decision to travel to Zanzibar. More than half rated climate important but a small share of the respondents (17 per cent) stated that climate was not important at all. Based on the existing literature, it seems that climate is an important factor for tourists when choosing their holiday destination. We have, therefore, formulated the following hypothesis: *Hypothesis A1: Destination climate is an important consideration for the choice of destination*.

Decision making and information search

Fridgen (1984) expanded the five-phase model of recreation behaviour of Clawson and Knetsch (1966). The five phases are anticipation, travel to the site, on site behaviour, return travel and recollection of the trip. The anticipation phase includes decision making and preparation for the holiday. According to Fridgen (1984), tourism decision making involves environmental preferences and the cognitive image of what they expect from the destination. Other models of decision making in the tourism literature contain a number of stages. Among these stages may be the motivation to go on holiday, information gathering and evaluation of the holiday, which may include feedback loops into the next holiday decision (e.g. see Van Raaij 1986; Ahmed 1991; Mansfeld 1992). The temporal aspect of the holiday decision, in other words when to go on holiday, is absent from these models of decision making. Sirakaya and Woodside (in press) distinguish between behavioural and choice set approaches to decision making. According to them, behavioural approaches seek to identify the different stages in the decision-making process and the factors that influence the process. Choice set approaches involve identifying the various destinations that are in the awareness set and, following an active information search, an evoked set develops (e.g. see Um and Crompton 1990). From the latter set, the final destination will be chosen. In both of these models the tourist assesses the destination options available, using information

acquired from their search and gradually eliminates the options that do not meet their needs. In both cases and in the studies discussed above, information is gathered in order to make the decision. Hence, we formulate our hypothesis as: *Hypothesis B1: Tourists gather climate information before they make their concrete holiday decision*.

Information on the current weather at the destination or predictions for the weather in the coming week can only be used to make decisions about destination choice at the very last minute. Therefore, we assume that the tourist gathers weather information in order to prepare for their holiday and make any necessary adjustments to the clothing or equipment that they will take with them. They may also do so to adjust their image according to the current situation and so modify their expectations. This leads to the following hypothesis: *Hypothesis B2: Tourists gather weather information in preparation for their holiday*.

Closely related to the time of information gathering is the question of which information sources are used. The destination image studies that take climate and weather into account do not consider this factor, whereas another group of studies focus on information search strategies but do not specifically look at climate information. Three distinct information search strategies are classified by Fodness and Murray (1998, 1999). First, there is a spatial element – the information search can occur internally, that is information from the individual's own memory, or it can occur externally, through the acquisition of information from sources such as travel agents or friends and family. Second, there is a temporal element to the information search. Tourists may continually be gathering information for their holiday or they may do so only when they are planning to go on holiday. The third aspect of the search is operational, which reflects the type and number of sources used. In a survey of American tourists who travelled to Florida, 68 per cent of the tourists used more than one source in their information search (Fodness and Murray 1998, 1999). The sources most likely to be used on their own were: personal experience, travel agencies, and friends and relatives. For a repeat visit, which involves less complex problem solving than a first time visit, Fodness and Murray (1999) argue that personal experience will be favoured. In their results, however, an external source of information – friends and relatives – was the main source. For those with a longer decision period, possibly reflecting a first time visit, friends and relatives are also the main source followed by auto club and travel agent. This study uses the length of planning period but the actual type of decision, that is whether it was a first time visit or a repeat visit, is not made explicit.

Van Raaij (1986) argues that novel destination possibilities and expensive holidays will necessitate an extensive information search. As the following analysis concerns itself with international tourism trips, the holidays under consideration are likely to be one of the major purchases by a household. Not only this, a holiday abroad is a significant event. Therefore, we can assume that the majority of the tourists will use several different information sources. Four information source categories were examined by Baloglu and McCleary (1999). These were professional advice, word of mouth, advertisements, books/movies/news. Word of mouth was ranked highest in terms of its importance in forming an image of the destination.

The least important category was advertisements. In addition, they find the mean number of sources used in their sample to be 3.75. In a study on the destination image of India, tourists used several different information sources. Friends and relations were the main source for more than half of the tourists (Chaudhary 2000). From the above, we have formulated the following hypotheses. *Hypothesis C1: Tourists rely on more than one information source*. *Hypothesis C2: 'Friends and family' is the dominant information source category for first time visitors*. *Hypothesis C3:'Own experience' is the dominant category for repeat visitors*.

Climate information

Types of climate information can be examined in terms of content as well as presentation. De Freitas (2003) classifies climate according to its aesthetic, physical and thermal aspects. The thermal aspect is argued to be a composite of temperature, wind, humidity and radiation. Since climate is complex, we assume tourists are striving for a detailed picture in their information search and therefore formulate the hypothesis as: *Hypothesis D1: Tourists gather climate information on several different attribute types*.

The studies that analyse the demand for destinations in terms of characteristics include variables for temperature and in some cases precipitation and the number of wet days in the demand function (see Loomis and Crespi 1999; Mendelsohn and Markowski 1999; Maddison, 2001; Lise and Tol 2002; Hamilton 2003; Berritella *et al*. 2004). Moreover, in the studies that use tourism indices, such as Scott and McBoyle (2001) or Amelung and Viner (in press), temperature plays a greater role than any other climate variable. The tourism climate index, developed with regard to the biometeorological literature on human comfort, consists of five sub-indices. The sub-indices contain seven climate variables, three of which are temperature ones (mean, maximum and minimum temperature). The two sub-indices that contain the various temperature variables account for 50 per cent of the weighting in the tourism climate index. Because temperature is an important factor in both behavioural and biometeorological studies of tourism and climate, we have formulated the following hypothesis: *Hypothesis D2: Temperature is the dominant attribute for climate information.*

We found little guidelines in the literature on the way that climate information is portrayed. De Freitas (2003) argues that a climate index would be the most appropriate way to present climate information to tourists. Nevertheless, the authors are not aware of actual studies where the preferences of tourists for different formats are tested. From a survey of the internet and print sources of climate information, we can conclude that there are many different ways of presenting such information. There was, however, no clear tendency towards a particular presentation form. For this reason we randomly chose one of the possibilities for our hypothesis, which we have formulated as: *Hypothesis D3: Tourists prefer a textual format for the presentation of climate information*.

The nine hypotheses and the related research questions are shown in Figure 13.1. This figure depicts the phases of potential image change indicated by the

various grey shades. The tourist has an image before planning that may change during the actual planning process and even after the decision for a specific destination has been made. Although not examined in this paper, the tourist's image could also change after the experience of the holiday.

Research Design

The fact that this study includes not only the question of information sources and information types but emphasises the time of information gathering led us to

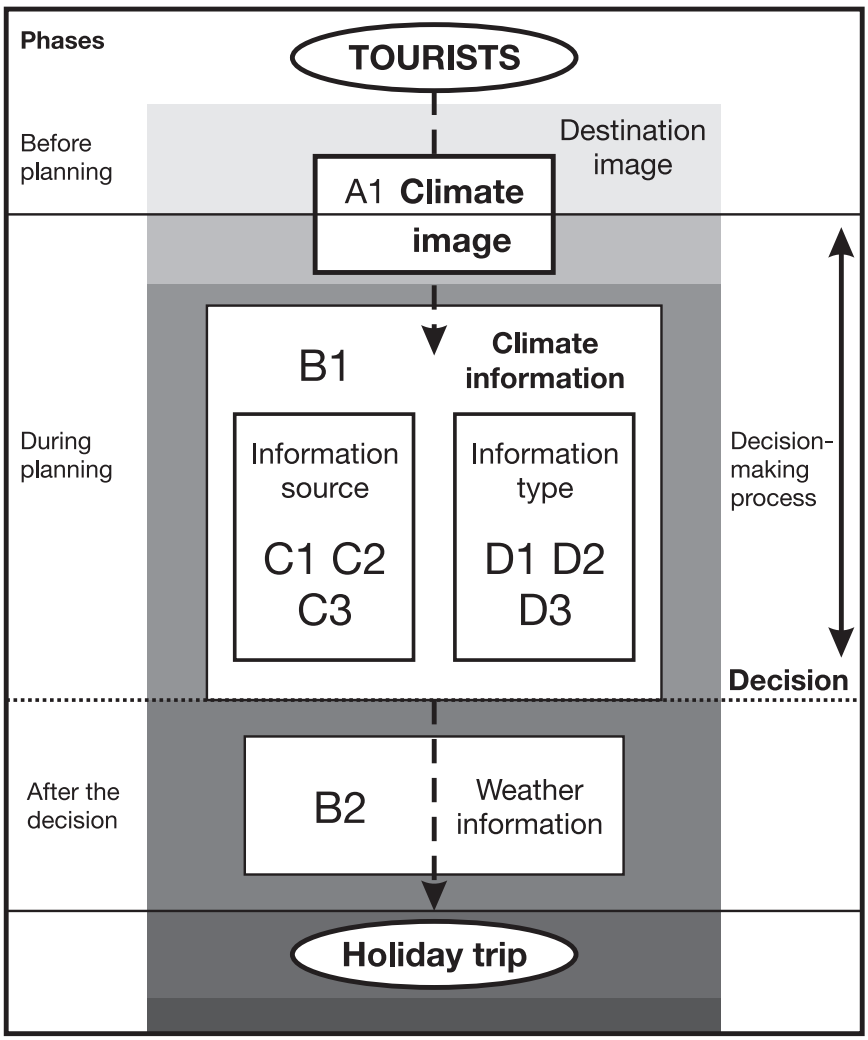

Figure 13.1 Conceptual model with hypotheses of the role of climate information in the tourist decision-making process

choose a specific point in time to survey tourists – shortly before departure. This allowed us to include the phase of preparation for the travel. Our study population was those residents of Germany going on an outbound holiday and departing from Hamburg and its vicinity. Our sampling frame consists of those tourists departing from Hamburg and its vicinity at specific points of departure: the airport, the train station, the international bus terminal and the harbours of Travemünde and Kiel for ferries to Scandinavia. Our convenience sample consists of those tourists travelling on the selected days and on the selected departures. All participants were aged 16 or over and resident in Germany. Additionally, only one member of a travel party was questioned. We purposefully excluded business travellers from the sample.

We paid attention to the following quotas:

1 Destination countries according to the market shares from the Reiseanalyse (FUR 1998, 2004).
2 Transportation mode market shares also from the Reiseanalyse.

The survey was carried out on 20 days spread over the months of July and August 2004. The days and times of the survey were chosen to correspond with departures to the countries with a high quota. The study period covered the main parts of the local school holidays. The schedule and budget of this study did not allow for an inclusion of car travellers according to the market share of about one third of all travellers. The quotas, therefore, corresponded to the relative market shares of the other transport modes.

While creating the questionnaire, we consulted a group of specialists who commented on preliminary versions of the questionnaire. These were tourism experts from academia as well as professionals from the tourism industry and others from the fields of marketing and quantitative research. A two-step pilot study was carried out at the end of June with the target group of tourists leaving from Hamburg Airport and a group of randomly chosen students. This pilot phase yielded valuable insights into intelligibility for the final questionnaire version. The comments of the experts and the results of the pilot phase resulted in the reformulation of individual questions and the questionnaire to improve its intelligibility.

In the following, we give an overview of the relevant questions from the questionnaire that we use in this analysis. The first section of the questionnaire includes general questions on the holiday: the destination country, the length of stay and the organisational form of the trip. We largely oriented this section on the Reiseanalyse (FUR 1998, 2004) in order to guarantee comparability to other studies. As far as possible, these questions are in multiple-choice format. Another section contains two questions that identify the main image attributes and the main information sources. See Table 13.1 for details of the sources used to formulate these questions.

The next section begins with a filter question about whether the tourist had been to the destination country before. Answered positively, the respondents are asked to complete five additional questions. After that another filter question is asked; if the respondent had informed themselves about the climate of their destination. If answered positively, another block of five questions follows. The questionnaire

closes with a section containing demographic questions that provide details on the respondent's place of residence, gender, age, and education level.

Hypothesis A1

This hypothesis will be tested by examining if climate is at least the third most important attribute for the choice of destination. In order to assess this we asked respondents to rank the three most important out of 10 attributes. The 10 attributes were chosen according to an analysis of the attributes that were found to be the most important for tourists in studies on destination image (see Table 13.1). (We took the five highest valued attributes from each study and calculated the frequency that each attribute appeared over all the studies. The 10 most frequent were then taken from this list.) We purposefully put this ranking question on the first page of the questionnaire. Respondents were not told in advance the specific focus of the questionnaire. This way the individual's perception of the importance of climate was assessed before the respondent became aware that climate was the main theme of the questionnaire.

Our assumption that climate information is indeed important within the decision-making process purposefully does not implicate a certain quality of climate, for example as Baloglu and Mangaloglu (2001) do when using the attribute of 'good climate'. Although this could mean either a good climate according to the individual's perception or a good climate for certain activities that the tourist prefers to undertake while on holiday, such a formulation may yield a pre-valuation of the climate factor. We assume that some tourists will search for warmer places to go, others may prefer a cooler climate than they experience in their home region at the same time of the year and some may be completely indifferent. Moreover, the individual's perception of the climate at the destination as being 'good' may be influenced by the home weather at the time of booking. In the region of Hamburg, where the survey has been undertaken, the summer 2004 has been

Table 13.1 Sources of attributes for the questionnaire

Tested attributes	*Source of attributes*
Destination image	Baloglu and Mangaloglu (2001); Baloglu and McCleary (1999); Kozak (2002; Lohmann and Kaim (1999; Gallarza *et al*. (2002); Hu and Ritchie (1993); Yaun and McDonald (1990)
Information sources	Baloglu and McCleary (1999), Chaudhary (2000), Fodness and Murray (1999) and Phelps (1986)
Type and presentation of information	Own research of online weather information providers, online travel guides, information provided online by travel agents, tour operators, foreign offices and tourist boards, and print travel guides
General information on the trip and demographic information	FUR (1998, 2004)

widely perceived as comparatively cold and wet. In order to hold this sort of seasonal deviation at a minimum, we focus on climate and do not value it.

Hypotheses B1 and B2

Motivated by the decision phases formulated in studies of Fridgen (1984), Ahmed (1991) and Mansfeld (1992), we emphasise three distinct phases of information gathering. The first phase is limited to the time before the tourist decides to go on holiday. It is not an active information gathering phase, since an image of the climate of the destination is there already either through previous experience in the country – or comparable climatic regions – or through knowledge gained from a general interest in the area. Phase 2 covers the period after the tourist is motivated to go on holiday but has not made the concrete decision of where and when. In this phase, information will be actively gathered in order to make these decisions. Phase 3 includes information gathering in preparation for the holiday. This is carried out after the decision has been made but before the actual trip.

The hypotheses B1 and B2 are tested using the results of two questions. The first question asks the tourists to state when they informed themselves about climate. There were seven options, which belonged to the following three groups: *before planning, during planning* and *after the decision*, which correspond to the phases 1 to 3 respectively. We gave the tourists the opportunity to choose more than one option. The second question concerns the actual weather at the destination before the trip: we ask the tourists whether they have been following the weather during the week before their holiday.

Pinpointing the time at which information is gathered also contributes to the analysis of the climate as an important factor in decision making (see hypothesis A1). Information gathering *during planning* indicates a decisive character, while *after the decision* indicates, for instance, an adaptation of clothing to the climate and does not play an important role in the decision to go to the destination.

Hypotheses C1, C2 and C3

We included a question on the sources of information about the destination in general. Information sources for general information on a destination may be different from the sources used for climate information. From the review of the studies shown in Table 13.1, we included 12 possible sources of information, including *friends and family* and *own experience*, as well as weather information providers. The latter was included not only because of the purpose of this study but also because such sites contain information about destinations and links to online travel agents, tour operators and airlines.

In order to test the hypotheses, exactly the same sources were included in a question specifically focusing on climate. We asked the tourists to rate, on a five point Likert scale, the actual information sources used according to the importance for the decision. The filter question on previous visits is used to establish the two groups of first time and repeat visitors.

Hypotheses D1, D2 and D3

In these hypotheses, we distinguish between the presentation of the information and the content of the information. An examination of the possible sources of destination information and destination climate information resulted in the inclusion of the following categories: text format, maps, diagrams and numerical data (see Table 13.1). The various information sources provide different types of climate information, which range from several temperature types to precipitation-related information and less frequently mentioned attributes such as humidity or UV-radiation.

Analysis

General results

Not all of the tourists asked to participate in the survey agreed to take part. The response rate differed in two ways, first between the two months and second according to the departure point where the survey was carried out. Generally, July showed a better response rate (of 2:1 and even better) than August. The response rate at the airport was altogether less high than at the bus terminal, train station or ferry terminal. At the airport, the terminals seemed to matter. The survey was easier to carry out in the charter flight terminal, where we had a response rate of 3:1 during August, whereas at the terminal for scheduled flights, on some survey days, we had a response rate of 10:1. In total, we had 413 returned questionnaires. We eliminated 19 questionnaires because core questions were unanswered and so we coded 394 questionnaires in total.

Table 13.2 shows the demographic profile of the tourists surveyed. Compared to the age structure from the Reiseanalyse data from 1998 (FUR 1998), this survey has a more distinctive bi-modal pattern, which can be seen by the larger shares of tourists in the 20–29 and 40–49 age groups and the much smaller percentage in the 30–39 age group. The male/female split corresponds to that of the current population of Germany. Compared to the Reiseanalyse from 1998, this survey has a much larger share of those with a degree or who have a university entrance diploma. A comparison with national statistics is difficult because the statistics cover the age group 25–64.They are also based on completed years of education and include technical qualifications, which are not included in our options.

Questions were also asked about the current holiday, the results of which are presented in Table 13.3. The average length of the holiday is 14.3 days, which corresponds to the average length of holiday (13.7 days) reported for the Reiseanalyse 2004 (FUR 2004). Surprisingly, a large proportion of the holidays were organised independently. The shares for package tours and booking through a travel agent are similar to that of international trips in the Reiseanalyse 2004. As mentioned above, quotas had been used to get a representative spread of holidays to the most popular countries for German tourists. Nevertheless, an important group of tourists, those travelling to their destination by car, could not be included. Countries that are very

Table 13.2 Descriptive profile of respondents (n=394)

	Mean	*Frequency*
Age (n=377)	40.3	
16–19		9.0%
20–29		28.9%
30–39		18.3%
40–49		21.5%
50–59		10.1%
60–69		11.4%
70–79		0.8%
Gender (n=387)		
Male		48.8%
Female		51.2%
Place of residence (n=362)		
Hamburg		34.5%
Northern Germany		51.7%
Other within Germany		13.8%
Education (n=378)		
Completion of compulsory education		40.2%
University entrance diploma		27.5%
Higher education		31.7%
No qualifications		0.5%

popular but which are typically travelled to by car include: Austria, Switzerland, Poland, Denmark and the Netherlands, and are under-represented in the survey. In addition, the share of long-haul trips is smaller than that of the Reiseanalyse (2004). We must take into consideration however that the Reiseanalyse covers a whole year. This study concentrates on the summer and it is logical that there would be less of a tendency to travel far, when Europe is at its most attractive climatically. Finally, the majority of respondents had visited their destination previously.

Research question A: climate as a factor in decision making

The tourists were asked to pick the three attributes from a list of 10 that were most important in their decision to travel to their destination, and rank them. Ninety-four per cent of the respondents provided a useable ranking of the attributes. From Table 13.4, we can see that only two attributes are chosen more often than they are not chosen, namely climate and access to the sea/lakes. Not only was climate the most frequently chosen attribute, it also achieves the highest ranking of all attributes. The t-test for related samples was used to test if the mean rank value of climate is significantly different from that of sea/lakes, culture/history and nature/landscape, the

Table 13.3 Descriptive profile of holidays (n=394)

	Mean	*Frequency*
Duration of stay (n=388) in days	14.3	
Less than one week		14.4%
One week		17.5%
One to two weeks		19.1%
Two weeks		27.1%
Two to three weeks		9.8%
Three weeks		4.9%
Three to four weeks		1.0%
Four weeks and more		6.2%
Holiday organisation (n=393)		
Independent		42.5%
Travel agents (but not a package tour)		20.6%
Package tour		32.3%
Other		4.6%
Destination (n=394)		
Spain		25.4%
Greece		8.9%
France		7.1%
Italy		6.3%
Croatia		5.3%
Hungary		5.3%
Turkey		5.3%
Bulgaria		3.8%
Sweden		3.8%
Tunisia		3.8%
Other European		20.1%
Other non-European		4.8%
Previous visit to the destination (n=391)		
No		36.8%
Yes		58.6%
No response but answered the follow up questions		4.6%

three attributes closest in popularity to climate. Table 13.5 presents the results of this test and we can see that the mean of climate is significantly different from the other three attributes. For that reason, we can accept our hypothesis that climate is at least the third most popular attribute. Moreover, we can say that it is the most popular for the tourists in our survey. Almost two thirds of the respondents said that they had informed themselves about climate before their holiday. A further 10 per cent

Table 13.4 Results of the ranking of destination attributes (n=370)

	1st position value=3	*2nd position value=2*	*3rd position value=1*	*Not chosen value=0*	*Total chosen*	*Mean*
Access to the sea/lakes	53	79	56	182	188	1.01
Accommodation	14	33	22	301	69	0.35
Climate	91	65	40	174	196	1.20
Cuisine	2	12	10	346	24	0.11
Cultural/historical attractions	60	50	33	227	143	0.85
Ease of access	3	22	23	322	48	0.21
Hospitality	17	38	35	280	90	0.44
Nature/landscape	62	58	36	214	156	0.91
Price	17	61	48	244	126	0.60
Sport and leisure activities	8	22	19	321	49	0.24

Table 13.5 Mean differences between destination attribute rank values (n=370)

	Mean	*T-value*	*2-tail sig.*
Climate and nature/landscape	0.28	2.701	0.007
Climate and access to the sea/lakes	0.19	2.228	0.027
Climate and cultural/historical attractions	0.35	3.242	0.001

answered the questions on climate information, even though they said that they did not inform themselves about climate or did not give any answer to the question.

Research question B: Decision-making process and information search

There were seven options, which we converted into three stages: *before planning the holiday*, *during the planning* and *after the decision* has been made to go to the destination. The most common phase for gathering information about climate is during the planning stage (42 per cent). Nevertheless, 'shortly before the holiday' was the most frequently chosen single category (34 per cent) and for those that only chose one category, the split between the three phases *before planning*, *during planning* and *after the decision* is 25 per cent, 35 per cent and 39 per cent respectively. The majority stated only one phase where they gathered climate information. Of the tourists that combined two or more options, 61 per cent combined the phases *during planning* and *after the decision*. We can thus accept our hypothesis B1 that tourists gather climate information before they make their decision but with the caveat that the group of tourists informing themselves after the decision is also considerable.

In addition to the results presented above, we examined whether the respondents had been following the weather at their destination during the week before their departure. The majority of respondents (59 per cent) had been following the weather during the week before their departure. Table 13.6 shows the cross-tabulations of this variable and the groups *before planning*, *during planning* and *after the decision*. The correlations are not significant. It seems that there is no relationship between when the tourists inform themselves about climate and whether they follow the weather. Nevertheless, the relationship between obtaining climate information and following the weather in the week previous to travel is significant. If tourists inform themselves about climate, they also inform themselves about the weather shortly before they travel. We can accept the hypothesis B2 that tourists gather weather information before they travel, because the majority of tourists do this. Nevertheless, we accept this hypothesis with the caveat that a large group of tourists (41 per cent) showed no interest in weather. An examination of different tourists groups and destinations could provide more information on what conditions make weather and climate information important for the tourist.

Research question C: Sources of climate information

The results of the question on information sources are problematic. Tourists were asked to rate 12 different information sources and a thirteenth option of 'other' on

Table 13.6 Cross-tabulations of climate information and the weather in the week before the holiday

		Yes	*No*
		Climate information gathered	
Respondent was aware of the weather at their destination during the week before their holiday	Yes	68%	33%
	No	33%	67%
	N	286	91
		Climate information before planning	
	Yes	71%	68%
	No	29%	33%
	N	68	206
		Climate information during planning	
	Yes	70%	67%
	No	30%	33%
	N	133	141
		Climate information after the decision	
	Yes	68%	68%
	No	32%	32%
	N	132	142

a scale of one to five only for those sources that they used. The question was answered in two different ways: first, that only the actual sources used were given a rank and second, that all sources were given a rank. For the following analysis we have examined these two groups separately. The first group, those that ranked only the sources that were used, we will call group A. The second group, B, are those that ranked more than 10 sources. Table 13.7 shows the number of climate information sources used. The first column contains the number of sources used by group A. The second column contains the number of sources used for group B, when we exclude those that are ranked lowest. In both cases, we can accept the hypothesis C1 that more than one source is used, given that 21 per cent (A) or 7 per cent (B) of the respondents state only one source. For comparison, the number of sources used as information about the destination is shown. Here there is a greater reliance on only one source (45 per cent).

For the first time visitors of group A, friends and family and travel guides are the most frequently chosen sources with 51 per cent each – more than one response was possible. The second most important sources are travel agent and tour operator. For the group of repeat visitors of group A, own experience was chosen by 69 per cent of the respondents, followed by friends and family (53 per cent) and travel guides (40 per cent). An examination like this is difficult for group B because they rank (almost) all of the sources. From this preliminary analysis, it seems that we can accept our hypothesis C2 that for first time visitors family and friends are the most important source and the hypothesis C3 that for repeat visitors own experience is the most important source. Nonetheless, a more detailed analysis is needed. Table 13.8, shows the cross-tabulations of previous visit (yes/no) with the sources family and friends (yes/no) and with own experience (yes/no), for

Table 13.7 Number of information sources used

	Climate-group A	*Climate-group B*	*Destination*
1	21%	7%	45%
2	24%	6%	28%
3	24%	20%	17%
4	17%	19%	8%
5	4%	10%	2%
6	4%	17%	<1%
7	<2%	9%	<1%
8	<2%	14%	
9	<2%	7%	
10	2%	8%	
11		4%	
12		6%	
13		2%	
N	141	138	392

the sources of information about the destination in general – for all tourists – and about the climate for the groups A and B. For destination information and for climate information (group A), there is no statistically significant effect of being a first time visitor on the tourists' likelihood to get information from family and friends. For group B, the effect is significant but counterintuitive. Having visited the destination before has the effect that you are more likely to ask family and friends about the climate. The results are much clearer for own experience. The positive relationship between previous visit and own experience is significant for all groups.

Not only can we examine the most frequently chosen sources, we can also look at the mean of importance value attached to them. There are no statistically significant differences in the means of own experience and family and friends for groups A and B. There are, however, differences in the means if we examine the groups of repeat and first time visitors separately. For group A, there are few first time visitors who used both sources. This makes a comparison of the means difficult, so we will continue with the repeat visitors. For that group, we have a mean difference of

Table 13.8 Cross-tabulations of information sources and the weather and having visited the destination previously

		Previous visit	
		Yes	*No*
Sources of information about the destination			
Family and friends	Yes	38.5%	41%
	No	61.5%	59%
	N	247	145
Own experience	Yes	53%	2%
	No	47%	98%
	N	247	145
Sources of climate information (group A)			
Family and friends	Yes	49%	57%
	No	51%	43%
	N	92	47
Own experience	Yes	65%	6%
	No	35%	94%
	N	91	47
Sources of climate information (group B)			
Family and friends	Yes	71%	51%
	No	29%	49%
	N	83	53
Own experience	Yes	85%	36%
	No	15%	64%
	N	85	50

–0.4828 between friends and family and own experience, which is significant at the 5 per cent level. Not only is own experience relied on by more tourists it also is more important. For the first time visitors of group B, friends and family has a higher mean value than own experience and is statistically significant at the 10 per cent level. Again, for the repeat visitors, we see a significant difference in the means and own experience is ranked the more important of the two sources. Other sources that were given a high rank were newspapers and television, travel guides and weather information providers.

Research question D: Types of climate information

An overwhelming majority of the respondents (91 per cent) chose more than one climate attribute. The mean number of attributes chosen is 3.23. We can therefore accept the hypothesis D1 that tourists choose more than one attribute.

In Table 13.9, we can see that temperature is quite clearly the most frequently chosen attribute. Maximum temperature was chosen by two thirds of the respondents, while 32 per cent and 16 per cent of the respondents chose average and minimum air temperature respectively. Other attributes that were chosen by more than half of the respondents were the number of rainy days, duration of sunshine and water temperature. Because respondents were able to chose more than one attribute, we present the frequencies with which the air temperature attributes were chosen both singularly and in combination. As the lower half of Table 13.9 shows, only 12 per cent of the respondents did not choose one of the air temperature attributes. This gives very clear support for hypothesis D2, that temperature is the dominant attribute.

From the five possibilities offered, textual format was the second least preferred option and, if we discount the option 'other', then it is the least preferred. In this case, we can reject the hypothesis D3 that tourists prefer a textual format. Table 13.10 shows the results for all options in two forms: for all respondents and for those only giving one response. In both cases, numerical data is the most popular option.

Discussion and conclusion

This study adds to the evidence that climate is an important factor in destination choice. In addition, it provides clarity over the role of climate and weather information gathering in the various phases of the decision-making process. Our results highlight the importance of information gathering before making a decision. Furthermore, this study shows that information gathering also occurs after the decision. The number of sources used by the tourists is comparable with other studies (Van Raaij 1986; Fodness and Murray 1998, 1999; Baloglu and McCleary 1999; Chaudhary 2000). Moreover, this study gives support for Fodness and Murray's theory (1999) that personal experience will be the main source of information for repeat visitors. The importance of friends and family as an information source for all of the tourists in our sample reflects the results of Chaudhary (2000). The majority of tourists informed themselves about climate from a variety of

Table 13.9 Preferences for information about climate attributes

	Mean	*Frequency*
Number of attributes chosen	3.23	
Climate attributes chosen		
Maximum temperature		67%
Water temperature		52%
Duration of sunshine		51%
Number of rainy days		50%
Average temperature		32%
Minimum temperature		16%
Amount of precipitation		16%
Humidity		14%
Cloudiness		10%
Wind conditions		7%
UV Radiation		6%
None of these		3%
Air temperature options chosen		
Maximum temperature		27%
Average temperature		19%
Minimum temperature		1%
Maximum and minimum		8%
Maximum and average		25%
Average and minimum		<1%
Maximum, minimum and average		6%
Did not choose any temperature option		12%
N	283	

Table 13.10 Preferences for the presentation of information about climate attributes

	Frequency	
	more than one response	*only one response*
Maps and satellite images	33%	23%
Text	27%	15%
Diagrams	36%	17%
Numerical data	57%	42%
Other	2%	3%
N	283	149

sources. Therefore, the results of this study could also be useful for the providers of tourism information, in that they tailor the information they present to meet the preferences of tourists.

There has been some debate on the effectiveness of using tourism climate indices and demand studies to assess the impact of climate change on tourism. Studies of destination demand have been criticised for simplistically representing climate using single variables, such as temperature and precipitation and not a complex of variables. The results presented in this study support the use of temperature as the main determining variable in destination demand studies. Nevertheless, we cannot claim from these results that temperature alone is enough to represent the considerations of tourists about destination climate. We do not find support for de Freitas' argument (2003) that data presented as averages has no psychological meaning. Travel guides typically present climate data as monthly averages and they were, along with family and friends, the most frequently used source for first time visitors.

The limitations of this study need to be addressed. A major issue is that of the sample used. Time and budget considerations limited the study to easily accessible departure points. Because tourists travelling by car have no common departure point, we had to omit them from our sample. This had the consequence that certain destinations, such as Italy, Denmark, the Netherlands and Austria were underrepresented. Nevertheless, climatically comparable destinations were well represented. It is unclear if different information search strategies are related to particular travel mode choices. In addition, a non-random sampling method was used, which limits the generability of the results. The survey period encompassed the school holidays for the states of northern Germany. This peak holiday period can easily be avoided by other groups of tourists who are not tied to institutional holidays. Therefore, the study may be biased towards tourists travelling with children. From other survey sources, it can be seen that older travellers favour the off-peak months (e.g. Oppermann 1995). Despite two pilot studies, certain questions were not formulated clearly enough, which hindered the analysis – see the results for research question C. An interview methodology may be better to examine such complex issues but this would be expensive and time consuming on this scale. Instead of using a self-administered questionnaire, verbally administering the questionnaire could bring more success.

Although they have quite different definitions, the terms weather and climate are used interchangeably by the general public. This can also be seen in some of the images studies that refer to weather, even though what is actually meant is climate. We tried to be clear and to distinguish between weather and climate in our survey. Nevertheless, in some questions it is possible that the respondents misunderstood and gave responses in terms of weather information. This is particularly the case with climate information sources, where some of the sources listed can give information on past weather, the climate, current weather and predicted weather. For example, the weather information providers, which have information on all four, or family and friends, who may also be able to provide information on all four. Again a verbally administered questionnaire could be more effective.

Global climate change is already having an effect on mean temperature and its further course is very likely to have an impact on the tourism industry as well. As the results of this study showed, climate is a defining factor for the destination choice of tourists. When the climate changes, destinations' attractiveness will change and with it – probably with a considerable time lag – also tourists' images of the destinations. An ancillary effect of global warming is that of sea-level rise. Access to the sea will change considerably and the quality of beaches will mostly deteriorate, with intensified erosion and change of slope occurring. As this study shows that access to sea and lakes is the second most important attribute to tourists when choosing a destination, sea-level rise will have a large effect on the tourism industry – tourists will not necessarily adapt to the new situation by changing their preferences, they may prefer to change destinations.

Having carried out this survey, the first of its kind to focus on climate as a specific attribute of destination image and on its role in the decision-making process, we have produced a valuable database that can be used for further research. For instance, the issue of whether the tourists' images of climate are accurate when compared to the climate of their destination can be assessed (Um and Crompton 1990). Some destination image studies found that there were differences in image for different groups of tourists (Shoemaker 1994; Kozak 2002). It would be an interesting extension of this study to examine whether we find different information preferences for different demographic or holiday groups.

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References

Ahmed, Z.U. (1991) 'The influence of the components of a state's tourist image on product positioning strategy', *Tourism Management*, 12(4): 331–40.

Amelung, B. and D. Viner (in press) 'The vulnerability to climate change of the Mediterranean as a tourist destination', in: B. Amelung, K. Blazejczyk, A. Matzarakis and D. Viner (eds) *Climate Change and Tourism: Assessment and Coping Strategies*. Dordrecht: Kluwer Academic Publishers.

Baloglu, S. and McCleary, K.W. (1999) 'A model of destination image formation', *Annals of Tourism Research*, 28(4): 868–97.

Baloglu, S. and Mangaloglu, M. (2001) 'Tourism destination images of Turkey, Egypt, Greece, and Italy as perceived by US-based tour operators and travel agents', *Tourism Management*, 22: 1–9.

Beerli, A. and Martin, J.D. (2004) 'Tourists' characteristics and the perceived image of tourist destinations: a quantitive analysis – a case study of Lanzarote, Spain', *Tourism Management*, 25(5): 623–6.

Berritella, M., Bigano, A., Roson, R. and Tol, R.S.J. (2004) *A General Equilibrium Analysis of Climate Change Impacts on Tourism*. Research Unit Sustainability and Global Change Working Paper FNU–49. Hamburg: Hamburg University and Centre for Marine and Atmospheric Science.

Chaudhary, M. (2000) 'India's image as a tourist destination – a perspective of foreign tourists', *Tourism Management*, 21: 293–7.

Clawson, M. and Knetsch, J.L. (1966) *Economics of Outdoor Recreation*. Baltimore, MD: Johns Hopkins Press.

Fodness, D. and Murray, B. (1998) 'A typology of tourist information search strategies', *Journal of Travel Research*, 37: 108–19.

Fodness, D. and Murray, B. (1999) 'A model of tourist information search behaviour', *Journal of Travel Research*, 37: 220–30.

FUR (Forschungsgemeinschaft Urlaub und Reisen e.V.) (1998) *Die Reiseanalyse RA 98*. Köln: Zentralarchiv für empirische Sozialforschung.

FUR (2004) *Reiseanalyse Aktuell*. Online. Available at www.fur.de/downloads/Reiseanalyse_2004.pdf (accessed 4 November 2004).

Freitas, C. de (2003) 'Tourism climatology: evaluating environmental information for decision-making and business planning in the recreation and tourism sector', *International Journal of Biometeorology*, 48: 45–54.

Fridgen, J.D. (1984) 'Environmental psychology and tourism', *Annals of Tourism Research*, 11(1): 19–39.

Gallarza, M.G., Saura, I.G. and Garcia, H.C. (2002) 'Destination image: towards a conceptual framework', *Annals of Tourism Research*, 29(1): 56–78.

Gössling, S., Bredberg, M., Randow, A., Svensson, P. and Swedlin, E. (2005) 'Tourist perceptions of climate change: a study of international tourists in Zanzibar', *Current Issues in Tourism*, (in press).

Hamilton, J.M. (2003) *Climate and the Destination Choice of German Tourists*. Research Unit Sustainability and Global Change Working Paper FNU–15 (revised). Hamburg: Centre for Marine and Climate Research, Hamburg University.

Hamilton, J.M., Maddison, D.J. and Tol, R.S.J. (2003) *Climate Change and International Tourism: A Simulation Study*. Research Unit Sustainability and Global Change Working Paper FNU–31. Hamburg: Centre for Marine and Climate Research, Hamburg University.

Hu, Y. and Ritchie, J.R.B. (1993) 'Measuring destination attractiveness: a contextual approach', *Journal of Travel Research*, 32(2): 25–34.

Kozak, M. (2002) 'Comparative analysis of tourist motivations by nationality and destinations', *Tourism Management*, 23: 221–32.

Lim, C. (1995) 'Review of international tourism demand models', *Annals of Tourism Research*, 24(4): 835–49.

Lise, W. and Tol, R.S.J. (2002) 'Impact of climate on tourism demand'. *Climatic Change*, 55(4): 429–49.

Lohmann, M. and Kaim, E. (1999) 'Weather and holiday destination preferences, image attitude and experience', *The Tourist Review*, 2: 54–64.

Loomis, J.B. and Crespi, J. (1999) 'Estimated effects of climate change on selected outdoor recreation activities in the United States', in R. Mendelsohn and J.E. Neumann (eds) *The Impact of Climate Change on the United States Economy*. Cambridge: Cambridge University Press, pp.289–314.

Maddison, D. (2001) 'In search of warmer climates? The impact of climate change on flows of British tourists', in D. Msddison (ed.) *The Amenity Value of the Global Climate*. London: Earthscan, pp.53–76.

Mansfeld, N. (1992) 'From motivation to actual travel', *Annals of Tourism Research*, 19: 399–419.

Mendelsohn, R. and Markowski, M. (1999) 'The impact of climate change on outdoor recreation', in R. Mendelsohn and J.E.Neumann (eds) *The Impact of Climate Change on the United States Economy*. Cambridge: Cambridge University Press, pp.267–88.

Morley, C.L. (1992) 'A microeconomic theory of international tourism demand', *Annals of Tourism Research*, 19: 250–67.

Oppermann, M. (1995) 'Travel life cycle', *Annals of Tourism Research*, 22(3): 535–52.

Phelps, A. (1986) 'Holiday destination image – the problem of assessment: an example developed in Menorca', *Tourism Management*, 7(3): 168–80.

Pike, S. (2002) 'Destination image analysis – a review of 142 papers from 1973 to 2000', *Tourism Management*, 23: 541–9.

Scott, D. and McBoyle, G. (2001) 'Using a "Tourism Climate Index" to examine the implications of climate change for climate as a tourism resource', in A. Matzarakis and C. de Freitas (eds) *International Society of Biometeorology Proceedings of the First International Workshop on Climate, Tourism and Recreation*. Retrieved from www.mif.uni-freiburg.de/isb/ws/report.htm

Shoemaker, S. (1994) 'Segmenting the U.S. travel market according to benefits realized', *Journal of Travel Research*, 32(3): 8–21.

Sirakaya, E. and Woodside, A.G. (in press) 'Building and testing theories of decision making by travellers', *Tourism Management*, corrected proof available online 13 August 2004.

Um, S. and Crompton, J.L. (1990) 'Attitude determinants in tourism destination choice', *Annals of Tourism Research*, 17: 432–48.

Van Raaij, W.F. (1986) 'Consumer research on tourism: mental and behavioral constructs', *Annals of Tourism Research*, 13: 1–9.

Witt, S.F. and Witt, C.A. (1995) 'Forecasting tourism demand: a review of empirical research', *International Journal of Forecasting*, 11: 447–75.

Yuan, S. and MacDonald, C. (1990) 'Motivational determinants of international pleasure time', *Journal of Travel Research*, 29(1): 42–4.

14

Marketing, Climate Change and Adaptive Strategies

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Introduction

Depending on the economic role of tourism in their particular area, regional and national governments are anxious to assess the consequences of climate change scenarios in terms of vulnerability or new market opportunities. Alpine skiing regions and seaside resorts prepare for a declining tourism industry, expecting enduring deficiencies in snow and fresh water supply (Parry 2000; Bürki *et al*. 2003). At the same time, cold-water resorts in higher latitudes hope that warmer temperatures could boost tourism in the form of diversified products and a prolonged season. There are a growing number of policy workshops, conferences, expert panels and think tanks established to advise the industry on future development strategies (see Chapter 1). However, in many cases, these are being projected at single cases – destinations or specific market segments – often making the discussion limited in scope. The focus is typically directed at curing already acute or expected direct symptoms of environmental change in order to maintain present levels of tourism activities.

Practitioners in stagnating or declining mass destinations urge immediate adaptation measures: 'We do not have a lack of knowledge; we have a lack of the implementation'(Wolfgang Pfefferkorn, Director of the Future of the Alps initiative). Future tourism agendas in these areas do not only include mitigation and adaptive measures, but also climate-safe projects, such as 'managed retreat', for example, the construction of new beach resorts farther back from the sea on the island of Jersey; or the building of second-generation ski resorts in the Tyrol above the revised alpine snowline. Arguably, both developments are the result of a difficult trade-off between securing local employment structures and the environmental protection of pristine areas. However, giving artificial breath to the regional economy's cash-cow in this form is a myopic, short-term reaction to inevitable environmental change. 'Rescue' developments of this kind attempt to maintain known forms of mass tourism, which are essentially monocultural, unsustainable and sensitive to shifts in demand. The question is not so much about *how*, but rather *whether* present forms of climate-jeopardised tourism activities should be preserved in a global context.

The illustrations above reflect reactive patterns in the process of restructuring the tourism industry, focusing on isolated local responses to changing visitor

arrivals. Even if these investments can maintain present levels of tourism or generate additional business in the short term, their long-term consequences may not be in balance with marginal economic gains. Adjustments to the destination product portfolio may influence declining or increasing tourist numbers in some areas, but will hardly address the ecological footprint of another long-haul tourist or a new snow canon. Instead of local measures reacting to a narrowly defined problem, practitioners and decision makers should acknowledge the far reaching implications of climate change for the global tourism system and its components – entailing tourist destinations as well as tourist-generating regions.

Clearly, altered physical destination conditions or product alternatives will affect tourism demand, but the nature of demand is also shaped by climate-induced socio-economic changes (see Aall and Høyer 2005). This complex causality is seldom captured in the academic debate on changing travelling patterns and habits in Western societies. For instance, several sources (Giles and Perry 1998; IPCC 2001; Maddison 2001; Viner and Amelung 2003) name global warming-related opportunities for tourist investment in traditionally marginal – and less favourable – areas and predict that dominant, north-to-south tourist flows may be reversed in Europe (Maddison 2001). However, if traditional tourist economies in the south collapse because of drought and sea-level rises, how could these regions generate affluent demand for the new 'Nordic Costas'? Tourist behaviour may not only be influenced by temperature preferences, as Hamilton suggests (2004), but also by recently experienced weather extremes at home. Summer heat waves followed by a cold and wet season the year after may influence outbound travel flows in often unpredicted ways (see Dewar 2005). Furthermore, travelling patterns are also subject to external market factors, such as increased fuel prices or environmental taxes. If the cost of everyday life becomes more expensive because of higher energy prices, this could greatly influence potential tourists' discretionary income. The present pattern of long-haul short breaks (for example, Europeans on Christmas shopping trips to Shanghai), facilitated by inexpensive flight offers, may also change dramatically if policy makers effectuate planned taxation on air transport. Although it is impossible to account for all factors in drawing future scenarios, the debate would benefit from a more holistic approach, identifying complex, induced effects of climate change reverberating through the global economy and society at large.

The real challenge of climate change, as Higham and Hall (2005) claim, is about making tourism sustainable, by providing macro-level insights and moving beyond short-term planning horizons concerning energy and fossil fuel consumption. Arguably, governments and international tourism organisations play an important role in educating and raising awareness, for example, through 'The Djerba Declaration on Tourism and Climate Change' (TRI 2003). Despite the strategic significance of the declaration – in terms of urging adaptive, constraining and educative measures to cut greenhouse gas emissions – only few practical implementations have seen light since then, and there is little operative co-ordination taking place across national, organisational and sector borders in this field. The lack of specific actions may partly be accounted for by the scope and uncertainty associated with this 'wicked problem' (Stewart *et al*. 2004). At present, there exist several

alternative future scenarios, and the expected consequences or prioritised areas are debated by climatologists, politicians and industry experts alike. Furthermore, there is a real challenge associated with the institutionalisation of environmentally responsible practices in a fragmented, neo-liberal tourism industry. Despite their subscription to the Kyoto protocol, several European governments provide generous subsidies or VAT-exemptions to low-cost airlines – like EasyJet, Ryanair and Germanwings – in order to boost regional growth around smaller provincial airports. Furthermore, tourists and tourism suppliers are unlikely to regulate their market behaviour based on the recognition of long-term environmental risks and sustainability principles alone. While there is certainly a growing group of conscious and reflective actors, and numerous policy guidelines and operational monitoring tools exist (for example, Green Globe 21), there is still a long way to go to alter the behaviour of the grand majority from being reactive and economic opportunity driven towards proactive and strategic measures.

If the tourism industry as a whole is to serve as a tool for mass education and a model for global change, it must change its strategic approach. There is first a need to understand the limitations of isolated local rescue projects in a global context and, second, the poor viability of global institutionalised control must be acknowledged. The challenge is to permanently change the attitudes of actors, mobile consumers and stakeholders in the tourism industry, which calls for the application of more subtle methods. This chapter argues for the significance of marketing activities and product development strategies in inducing those attitude changes.

Global responsible marketing

The main objective of any marketing activity – product development, advertising or strategic alliance development – has always been focusing on achieving corporate goals – maximising economic profitability – by inducing changes in market conditions in order to alter consumers' perceptions, motives and eventually behaviour in a favourable way. This implies that marketing activities may play a historical role in changing consumers' environmental consciousness and in catalysing co-ordinating activities among destination actors towards a more sustainable agenda. New marketing perspectives may also energise the creative process of new product development and innovative destination branding, by moving away from traditional representations and commodification practices that dominate the industry today. Tourism marketers should recognise and use their powerful potential in influencing and challenging present constructions of cognitive destination concepts and contemporary practices of tourist activities and geographical flows.

Environmental responsibility is often placed on the individual consumers' shoulders, which in principle corresponds with the consumer trend shift in tourism described by Poon (1993). Poon argues for the rise of a new, diversified generation of tourists, which is essentially autonomous, sophisticated and conscious of its environmental and social impact. Non-price factors, such as quality or fair-trade concepts are central to new tourism and Poon stresses that these consumers are prepared to pay more for good value (for example, ecological products). However,

environmental consciousness or leisure sophistication can also be interpreted as a social differentiator to mark cultural superiority. As Hughes (2004) points out, demonstrative ecological consumerism ('ego-tourism') has its roots in a struggle for personal uniqueness and self-actualisation, rather than a deep-seated concern for the environment. Hughes (2004: 503) notes: 'Environmental rhetoric is used by ego-tourists to claim the moral high ground and to obfuscate their part in the exploitation of the destinations they visit.' This implies that 'eco-friendly' individuals may also engage in alternative, ego-enhancing tourism activities during their trips, which border on deliberate negativism – snow scooter safaris, big game hunting, coral reef diving. Because the inherent motive for leisure travel is hedonistic escape from the rationality of the everyday, it is unclear 'how far tourism will be shaped by environmental reflexivity and how far by self-indulgence' (Hughes 2004: 507).

In principle, each tourist can contribute individually to mitigate global climate change by regulating his or her lifestyle and refraining from excessive consumption. However, environmentally conscious 'new' tourism – whether driven by ideological convictions or consumerist trends – is still a niche; the majority of travellers are unintentionally ignorant of their contributional share to environmental problems. If environmental responsibility must be consumer driven, marketers and regulating bodies must define steps towards widening and altering consumers' perspective on travelling as an everyday commodity and a consumer right. Tourist behaviour can primarily be influenced by institutionalised constraints, such as environmental taxation or emissions-based pricing of tourism commodities. These measures would make tourists consider reducing their use of fossil fuels and would also support the development and use of nonpolluting renewable energies – solar, wind, biological. An alternative awareness-raising measure with a consumption implication could include the development of a new generation of tourism packages, configuring various CO_2-neutral travel, accommodation and attraction brands. While tourists' motivations to consume 'green destinations' today are typically driven by moral and ideological arguments, in the future, these places may become more price-competitive, because CO_2-neutral energy consumption will cost less.

Environmental responsibility may also be extended to the entire supply side of the tourist system – tour operators, transport companies, destination and transit suppliers. The Djerba declaration calls for responsible measures aimed at reducing the industry's own contribution to greenhouse gas emission and thus to future climate changes. Arguably, the declaration is an important and visionary statement, however, individual firms may be more easily convinced by economic arguments. Because of increasing energy prices in the future, operation costs of hospitality and attraction products may rise dramatically. Therefore, it is important to consider investing in energy-saving installations now and to educate small entrepreneurial actors to be conscious about their use of fossil fuel resources. Recently, a few pioneering companies, such as the Aspen Skiing Co. have begun marketing 'low-impact' recreation to tourists, in the form of an eco-friendly ski lodge. This includes the building of new resort facilities from recycled materials, as well as operations exclusively powered by renewable energy sources. Other actors in the accommodation sector have also begun to set corporate policies with

specific goals concerning the reduction of CO_2 emissions within their operational boundaries. Such developments must be integrated into revenue management strategies that motivate environmentally friendly consumption, for instance charging less for CO_2-neutral products and including additional fees in the price of polluting/energy demanding activities.

National marketing agencies must define strategies addressing the challenges of climate change, even if local scenarios do not offer dramatic environmental transformations. This does not only imply the establishment and educational dissemination of sustainability regulations, but also seizing the consequences of present and future development activities on a global scale. Destination marketers in Scandinavia, for instance, seem to worry little about the global sustainability paradox of attracting new, long-haul segments. Nordic countries are opening tourist representations in the Far East and Pacific Region in order to draw more Chinese and Australian tourists to Swan-labelled hotels or Blue Flag beaches. Tour operators and destination marketers must realise that environmentally-oriented consumerism does not only create new business opportunities or an attractive market positioning argument. Sustainability principles, if rightfully implemented, also impose certain codes of conduct on tourism actors – for instance, giving up some market segments or products – that hamper rather than fulfil short-term economic goals.

Challenges arising from climate changes

Global warming scenarios have implications for almost every tourism activity. With a few exceptions, the implications appear mostly negative. Temperature increases of a few degrees are projected to induce wide-ranging environmental changes: sea-level rises, reduced precipitation, glacier melting, beach erosion, inundation, degradation of ecosystems and saline intrusion. Changes in coastal morphology, hydrological balance, fauna and flora will affect the established mix of attractors of a destination, which in turn reshape economic, political and socio-cultural life. It is hard to imagine any region or sector that is not going to be (directly or indirectly) affected by global environmental change. The tourism industry has no choice but to prepare for and adapt to climate-related impacts already in the pipeline, so it is plausible that several countries will follow the Arctic example (ACIA 2004) and integrate adaptation measures into strategic tourism planning.

Arguably, the scope of environmental change in certain areas will reach dimensions at which tourism cannot be regarded as a viable long-term economic option. The implications of rising sea levels, beach erosion and drinking water contamination may be fought by adaptive strategies, but a considerable problem in the immediate future will be responding to the frequency and intensity of extreme weather phenomena. Flooding, storms and hurricanes may boost insurance rates and, in extreme cases, entail uninsurability. Apart from the real costs of insurance and reconstruction, destinations must also calculate the market effects of intense media coverage of tourism disasters (Faulkner 2001), especially significant when an affected area is being described in terms signalling a ‘troubled’ or ‘lost’ Paradise.

Many of the genuine, iconic qualities of destinations worldwide are climate-dependent, and destination brand equity is severely affected by environmental change. Fluctuations in accessibility or in perceived quality of established products result in uncertainty about regional brand product portfolios, undermining the consumers' primary 'reason-to-go' perceptions. Unpredictable climatic characteristics and vulnerable tourist assets cannot be considered appropriate and stable unique selling points over time, thus marketers must define the attractiveness of a place in terms of the relative value-in-use for the individual customer. This calls for a more sophisticated or altered marketing rhetoric in destination representations. For instance, advertisements might focus on addressing so called 'push'-motives, such as escaping densely populated agglomerations and urban living style – without the conventional pathos of climatic opposites or stereotyped clichés (such as 'untamed wilderness', 'lost Eden' or 'Paradise on Earth').

Taking a look at any peripheral tour operator, it is striking that many of their products are still promoted by the glamour of 'the last frontier' or 'beyond the modern world': the virtues of stability, familiarity, the supposed authenticity and a 'return to the roots' (Blomgren and Sørensen 1998; Schellhorn and Perkins 2004). Representations of native culture and traditional lifestyle are stereotyped and stress ecological and cultural unchangedness, a construction that resembles Saïd's (1979) depiction of the orientalist discourse. For example, a 15-day trekking tour in Greenland's Disko Bay area includes dog sledge-running, visits to trapper-villages, traditional hunting tours and regional gastronomic experiences with drum-dance performances. But, as the trapper culture slowly disappears in the wake of climatic and societal changes, such packages will become just as inauthentic and superficial as tribal tourism in tropical destinations. Even if Inuit and Saami people take pride in demonstrating their cultural heritage to visitors and, as according to Johnston and Viken (1997), tourism has a positive impact on Greenlandic culture, there are great problems associated with the museification and commodification of traditions, arts and crafts. Although often presented as such in tourism advertising, peripheral regions in a global economy are neither 'primitive' nor 'remote'. Therefore, romantic, ethnicising representations of 'vanishing worlds' must be complemented with images of the modern society, if tourism marketers are to successfully preempt the image consequences of destination changes borne by extrinsic climate factor changes.

Probably the biggest marketing challenge arising from environmental changes apart from the addressing of altered flows of tourism demand is a radical revision of how nature should be redefined and re-presented in a particular destination iconology. According to the constructionist perspective, tourism is grounded in the ideas that people attach to places far away (Saarinen 2004), hence, a 'destination' is a constantly changing product of our perception. This implies that attached meanings can be reconfigured by inventing new brand assets and spatial practices. The image of many tourist places will be radically altered in the next 20–50 years, losing physical characteristics that prompted associations with the 'romantic' – a wide sandy beach bathed in moonlight – 'spiritual' or 'sublime' – a bird's eye view from a snow-covered mountain top. The task for future destination marketers is

then to design new representations of a region that use a different language of form to express the 'romantic' or the 'spiritual' or, alternatively, to develop concepts – exploration, recreation, contemplation, leisure hunting – that match a modified shoreline or snowless slopes.

Adaptive strategies: new product development

Long-term changes bear the seeds of new opportunities, product concepts and place identities. A proactive measure on climate change may start with reflecting on what other experiences can be offered to tourists and how a diversified product portfolio can best be developed. In other words, destinations must assess and revise their soft infrastructure and marketing activities. Changes in the environmental profile necessitate adjustments in the tourism product, in order to remain competitive during global change. Changes in the composition of market segments require meeting the expectations of new tourist cultures, in terms of developing new services and products catering for their specific needs. Both consolidated resorts and peripheral destinations on the rise must acknowledge and compare various segments' preferences and potential behaviour in order to evaluate current and future visitor impacts.

Tourism consumption is often described through functionalist arguments, such as breaking free from everyday routines and obligations or looking for otherness and difference. Tourists' motives are often classified along a novelty–familiarity continuum (Cohen 1972; Plog 1987), defining various forms of how the out-of-the-ordinary experience is conceptualised by the individual tourist. The construction of particular tourism geographies was rationalised through the modern individual's quest for the authentic (MacCannell 1976) or a centre 'out there' (Cohen 1979), disillusioned by the urbanisation and social alienation. Despite accelerating globalisation processes in the past decade, *nature* and natural resources are still considered and represented in brochures as offering 'real' and 'authentic' experiences on the peripheries of the modern world (Shaw 2001; Saarinen 2004). However, maintaining the illusion of the 'untouched', 'indigenous' or 'unique' Other in twenty-first-century tourism marketing will become contested and bemusing as sophisticated consumers are presented with opposite images and representations in other, non-tourist media. The question is what alternative representations can replace reassuringly the loss of 'Paradise' and the 'Exotic Other'. How can difference and cognitive opposites be constructed if not through historically and ideologically determined images of cultural, or environmental, otherness?

It is unclear whether post-modern tourists are still looking for preconstructed and referential novelty and difference, as the modernist discourse advocates. Leisure consumption in the post-industrial society is no longer understood through its restorative function and as routinised breaks from everyday life, but through demonstrative individualism and lifestyle management. Societal structures and routines are becoming fragmented, illegibile and fuzzy: spatial and temporal segregation of the classic dichotomy between work and leisure disappears. Thus it will be increasingly difficult to frame and define routinised breaks from work

activities. The everyday of the mobile individual in a hypermodern network society is characterised by unstability, uncertainty and unknown variation, which points towards a growing consumer trend towards nostalgia (Goulding 2001), familiarity and a sense of belonging (Prentice 2004). Even if stability, slowness, security and intimate kinships are just as illusory as 'real wild natural areas', these can be marked off and commodified unrelated to the physical environment.

Peripheral areas are becoming metaphors of home and the private domain. The post-modern rural nostalgiascape materialises cosmopolitan yearnings into an idealised fixed point and a refuge in an increasingly fluid and changeable world as well as to the degree of alienation and disorientation in the present (see Allon 2000). The first wave of nostalgic lifestyle products has already hit the market, Slow Food, Cittá Slow, stress-releasing wellness packages witness the reorganisation of commodities and ideologies into a coherent collection of signs for tradition, continuity and Gemeinschaft. None of these offerings are bounded to traditional natural or climatic resources in a strict sense. The consumption of this new generation of tourism products is little dependent on geographical location and weather conditions: their attractiveness is defined through inherent values for contemporary consumers. This implies that there is a strong future market for innovative product developments, which smartly address the malaise of the hypermodern society rather than focusing on ambient or extreme climatic resources, a major attractor in modernity.

The nostalgic turn in contemporary tourism consumption combined with global environmental changes may entail reversive life cycle development at tourist destinations. Major phase shifts may take place as a result of complex covariating external conditions – altered physical environment, travelling habits, reduced discretionary income, higher energy prices, environmental taxes, perceived higher risks associated with long-haul travel – where tourist activity levels may return to earlier – exploration, involvement or development – life cycle stages. There are some indicators that domestic tourism in the UK and Scandinavia is growing again, and previously popular accommodation forms – inns, youth hostels and campsites – are experiencing a renaissance and new boom in visitor numbers. Such 'retro-tourism' is partly a condition of the larger structural changes in society explained above; but it is also fuelled by demographical factors: the first generation of mass tourists, baby-boomers are retiring, looking for easily accessible commodities with emotional bonding – products they can feel nostalgic about. In either way, it is plausible that future consumption trends will be even more characterised by a search for stability, 'back to the roots', bonding with family and friends.

Recommendations for adaptive measures often stress the importance of new, climate-neutral products, achieving a diversification of product portfolios, and thereby spreading the risks related to uncalculated events or deficiencies in natural assets. Monocultural – sea-and-sand or snow – destinations are now following the example of urban destinations, developing year-round, complementary packages of weather independent activities, including hiking, or romantic getaways. In Denmark, provincial destinations urge small-scale thematic developments – like gastronomy, golf and wellness – targeted at corporate and shortbreak markets. Other development scenarios include the all-inclusive indoors visitor attractions,

science or aquaparks. Although these establishments are independent of weather variations and seasons, there are a number of challenges. There are considerable capacity investments and maintenance expenses related to a spa or a theme park and operation costs may be increased dramatically if energy prices rise.

Tourism planners may decide upon focusing on low-tech, ideologically reconfigured retro-products or high-tech indoor experience arenas, according to how local stakeholders relate to future progress and adaptation. The choice of either of the two solutions implies a radical revision of how destination product portfolios are presented in marketing communication. Whichever development strategy actors subscribe to, they also vote for ceasing to rely on classical image and stereotyped products. The quest is not so much about revitalising declining sun-and-sea or ski resorts, but about designing hybrid concepts of destination products that mix both familiar and innovative elements into new thematic packages. Development strategies in temperate areas are mostly focused on special interests, including: gastronomy, golf, wellness, art, shopping and active holidays. Marketing efforts to attract MICE (meetings, incentives, conventions and exhibitions) and cruise visitors have been intensified in the past years. The strategic benefit of targeting these affluent segments is that they are relatively climate-insensitive and the majority of the product offerings are interchangeable and not season-dependent. The challenge is now to expand/renew these concepts so that they can attract an even more diversified and mobile market, including opportunities for local recreational and corporate visitors, in case other segments fail in the short term.

Another task related to thematic product developments is to change established employment structures and competence profiles. Coastal summer destinations and northern ski resorts are both highly dependent on an unskilled seasonal labour force. There might be problems in accessing the usual pool of seasonal employees in the off-season, because they typically have permanent occupations in urban areas (for example, students). Similarly, many small hotel and restaurant owners move their operations elsewhere in the low season. Many attractions are periodically closed and public transport runs on a less frequent basis, which means that tourist choice and access is limited in these periods. The destination must, therefore, be geared to welcome visitors on a different temporal basis (Baum and Hagen 1999). In order to meet the expectations of new market segments, destinations must also adjust their customer care skills. A growing number of international visitors necessitate the development of language skills of front-line employees. Furthermore, there is an urgent need to be conscious about different cultural understandings of service expectations and customer care. What domestic Scandinavian guests see as personal, informal service might be regarded impolite by overseas visitors. Some customer segments will need a higher level of coaching and information than others. Traditional segments, such as outdoor recreational visitors from Germany or Scandinavia are typically self-serviced, bringing their own provisions, maps and guidebooks. New market segments may be far less autonomous and their entire stay in the region must be facilitated by service providers. There is an urgent need for a destination-embracing hospitality training directed at accommodation providers as well as guides, instructors and

outfitters. A formal training in customer care, complaint management as well as emissions management may not only standardise the level of welcome for a destination, but also create opportunities for customer relationship management, including loyalty schemes and regional bonus programmes.

Conclusions

'Global warming is an issue the tourism industry must – and I think will – pay more and more attention to in the near future,' said P. Wall after the release of the IPCC report (in Tidwell 2001). The early signs of irreversible environmental change are already confirmed from various locations, and it has become clear that on a global level, the tourism industry is standing on a 'burning platform', that is, a situation that is untenable even in the short term. This chapter has pointed out the potential future use of marketing agendas as a framework to influence market behaviour towards more energy-conscious forms of consumption. Furthermore, marketing tools may assist nature-based destinations ravaged by environmental change in defining alternative product development scenarios, for instance, by addressing contemporary malaises of post-modern society.

References

Aall, C. and Høyer, K.G. (2005) 'Tourism and climate change adaptation: the Norwegian case', in C.M. Hall and J. Higham (eds) *Tourism, Recreation and Climate Change*. Clevedon: Channel View Publications.

ACIA (2004) *Impacts of a Warming Arctic*. Susan Joy Hassol (ed.). Arctic Climate Impact Assessment. Cambridge: Cambridge University Press.

Allon, F. (2000) 'Nostalgia unbound: illegibility and the synthetic excess of place', *Continuum: Journal of Media & Cultural Studies*, 14(3) 275–87.

Baum, T. and Hagen, L. (1999) 'Responses to seasonality: the experiences of peripheral destinations', *International Journal of Tourism Research*, 1: 299–312.

Blomgren, K. B. and Sørensen, A. (1998) 'Peripherality - factor or feature? Reflections on peripherality in tourism research', *Progress in Tourism and Hospitality Research* 4(4): 319–36.

Bürki R., Elsässer, H. and Abegg, B. (2003) 'Climate change – impacts on the tourism industry in mountain areas', Proceedings, 1st International Conference on Climate Change and Tourism, Djerba, 9–11 April.

Cohen, E. (1972) 'Towards a sociology of international tourism', *Social Research*, 39: 164–82.

Cohen, E. (1979) 'A phenomenology of tourist experiences', *Sociology*, 13: 179–201.

Dewar, K. (2005) 'Everyone talks about the weather…', in C.M. Hall and J. Higham (eds) *Tourism, Recreation and Climate Change*. Clevedon: Channel View Publications.

Faulkner, B. (2001) 'Towards a framework for tourism disaster management', *Tourism Management*, 22(2): 135–47.

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

Goulding, C. (2001) 'Romancing the past: heritage visiting and the nostalgic consumer', *Psychology and Marketing*, 18(6): 565–92.

Hamilton, J.M. (2004) 'Climate and the Destination Choice of German Tourists'. FEEM Working Paper No. 21. (February).

Higham, J. and Hall, C.M. (2005) 'Making tourism sustainable: the real challenge of climate change', in C.M. Hall and J. Higham (eds) *Tourism, Recreation and Climate Change*. Clevedon: Channel View Publications.

Hughes, G. (2004) 'Tourism, sustainability and social theory', in A.A. Lew, C.M. Hall and A.M. Williams (eds) *A Companion to Tourism*. Malden, MA: Blackwell Publishing.

IPCC (2001) *Climate Change 2001: Impacts, Adaptation, and Vulnerability*. Intergovernmental Panel on Climate Change, 3rd Assessment Report. Cambridge: Cambridge University Press.

Johnston, M.E. and Viken, A. (1997) 'Tourism development in Greenland', *Annals of Tourism Research*, 24(4): 978–82.

MacCannell, D. (1976) *The tourist: A new theory of the leisure class*. New York: Schocken.

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

Parry, M.L. (ed.) (2000) 'Assessment of the potential effects and adaptations for climate change in Europe', The Europe ACACIA Project, Jackson Environment Institute, University of East Anglia.

Plog, S. (1987) 'Understanding psychographics in tourism research', in: J. Ritchie and C. Goelder (eds) *Travel Tourism and Hospitality Research*. New York: Wiley, pp.203–14.

Poon, A. (1993) *Tourism, Technology and Competitive Strategies*. Oxford: CAB International.

Prentice, R (2004) 'Tourist familiarity and imagery', *Annals of Tourism Research*, 31(4) 923–45.

Saarinen, J. (2004) 'Tourism and touristic representations of nature', in A.A. Lew, C.M. Hall and A.M. Williams (eds) *A Companion to Tourism*. Malden, MA: Blackwell Publishing.

Saïd, E.W. (1979) *Orientalism*. New York: Vintage Books.

Schellhorn, M. and Perkins, H.C. (2004) 'The stuff of which dreams are made: representations of the south sea in German-language tourist brochures', *Current Issues in Tourism*, 7(2): 95–133.

Shaw, J. (2001) 'Winning territory: Changing place and change place', in: J. May and N. Thrift (eds) *Timespace: Geographies of Temporality*. London: Routledge, pp.120–32.

Stewart, R.E., Walters, L.C. Balint, P.J. and Desai, A. (2004) *Managing Wicked Environmental Problems: A Report to Jack Blackwell, Regional Forester*, USDA Forest Service, Pacific Southwest Region.

Tidwell, M. (2001) 'Glaciers are melting, islands are drowning, wildlife is vanishing', *The Washington Post*, 9 September.

TRI (Travel Research International) (2003) 'The interrelations between tourism and climate change. Report prepared for WTO in association with the CRU at UEA', *Proceedings of the First International Conference on Climate Change and Tourism*, Djerba, Tunisia, 9–11 April.

Viner, D. and Amelung, B. (2003) Climate change, the environment and tourism: the interactions. *Proceedings of the ESF-LESC Workshop in Milan*: *'Climate Change, the Environment and Tourism: the Interactions'*. Norwich: ÉCLAT, Climatic Research Unit.

15

Climate Change and Ski Industry

Daniel Scott

Introduction

The reduction of anthropogenic greenhouse gases (GHG) has been the main climate change policy focus of the international community. However, it is increasingly recognised that, even if current agreements to limit GHG emissions are successfully implemented, atmospheric GHG concentrations will not stabilise and some climate change is inevitable. With this realisation, climate change adaptation has been gaining importance in the international literature and policy making community as a crucial response to reduce the risks and take advantage of any opportunities associated with climate change (Smit *et al*. 2000).

The tourism and outdoor recreation sector is inherently sensitive to climate conditions, yet our understanding of how climate variability affects the sector and how the sector has adapted to climate remains very limited (Wall 1992; Perry 1997; Scott 2005). The US National Academy of Sciences has indicated that the tourism and recreation sector is more vulnerable to climate change than most other sectors of the economy because of its close interlinkages with climate and the natural environment. Nonetheless, relative to other economic sectors (for example, agriculture and forestry), tourism has been largely neglected by the climate change impact research community. Wall (1998) noted that tourism was not mentioned in the IPCC first assessment report, which was completed in 1990, reflecting the paucity of research available. More recently, Agnew and Viner (2001) and Scott *et al*. (2002) have commented that research on climate change and tourism is still in its formative stages. Until very recently climate change also garnered minimal attention from the tourism industry and tourism research community. Surveying 66 national tourism and meteorological organisations around the world in 1989, Wall and Badke (1994) found most respondents (81 per cent) felt climate was important to their country's tourism industry, but few were aware of any specific research or existing publications related to climate change and tourism. A decade later, Butler and Jones (2001: 300) reached a similar conclusion, stating:

> [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).

With research on climate change and tourism still in its formative stages, it is not surprising that adaptation is not a well-developed theme within this field. Discussion of climate change adaptation in the tourism sector is most advanced for the ski industry (see Elsasser and Bürki 2002; Scott *et al*. 2003) and will be the focus of this chapter as well. Although the chapter will mainly concentrate on potential climate change adaptation by the US ski industry, discussion will occasionally be extended to the broader North American ski industry.

Adaptation to climate change in the ski industry is a diverse topic. In order to advance our understanding of climate change adaptation in the ski industry it is necessary to assess what types of adaptations are possible, who are the agents involved and what is their decision-making process, which are the most feasible options that are likely to occur, and what barriers (if any) need to be overcome to facilitate implementation of these adaptation options. This chapter will focus on the first of these questions, with the objective of developing a comprehensive inventory of climate change adaptation options available to the ski industry, including climate adaptations currently in use and other initiatives used in other climate sensitive economic sectors that could be used by the ski industry in the future. This chapter does not attempt to evaluate the relative merit – institutional feasibility, economic efficiency, technical feasibility or environmental sustainability – of the adaptation options in the inventory or assess the likelihood of implementation. Addressing these questions is beyond the scope of this chapter, but they remain important areas for future inquiry.

This chapter will begin with a brief overview of the US ski industry and how it is currently affected by climate variability. The next section will identify the broad range of climate change adaptations available to ski industry and has been organised into hard, soft and policy options.

Climate sensitivity of the US ski industry

In 2001, the North American ski market represented just over 20 per cent of the global ski market with approximately 72 million skier visits (57 million in the USA and 15 million in Canada) (Lazard 2002). Although there is a perception that the North American ski industry has been in a period of stagnation since the late 1980s, the industry has reinvigorated itself and, despite having 100 fewer ski areas in operation in the period of 2000–04 than 1986–90, has averaged approximately four million more ski visits per year (56,527,000 in 2000–04 and 52,753,000 in 1986–90) (National Ski Areas Association 2004).

According to Packer (1998), the US snow sports industry generates approximately US$12 billion in the economy annually. Because the economic impact of the industry is concentrated in the regions where ski areas operate, the industry is a very important part of the economies of some communities. For example, the small state of Vermont accounted for 8 per cent of skier visits in the USA in 2000–01 and the ski industry is estimated to contribute US$1 billion to the state economy each year (Smith 2001).

Ski areas are located in climatically diverse regions of the USA, ranging from Maine in the east and California in the west and from New Mexico in the south to Alaska in the north. Inter-annual climate variability affects the ski industry in each of these regions differently, but the aspects of climate variability that affect the ski industry are mainly fluctuations in snow cover and temperature. Availability of snow is a prerequisite for the ski industry and the unreliability of adequate natural snowfall gave rise to the invention and widespread implementation of snowmaking systems across North America. The adaptation of snowmaking largely overcame the ski industry's sensitivity to a lack of precipitation. However, snowmaking does not overcome two other impacts related to variable snowfall. A lack of snow in urban centres is thought to have a detrimental effect on skier demand. In discussions with ski management professionals, this 'urban snow effect' has been observed in ski regions across Canada and the USA. Conversely, too much snow is a problem for the ski industry because it can disrupt transportation systems, preventing skiers from reaching ski areas, and it can increase the avalanche hazard, putting skiers and ski area infrastructure at risk. The other main climate attribute affecting the ski industry is temperature. Very cold temperatures reduce skier demand, while temperatures above freezing adversely affect snow conditions and prevent efficient snowmaking. In some areas, wind can also affect ski area operations by rendering ski lifts unsafe for operation.

As Figure 3.1 demonstrated (Chapter 3), inter-annual climate variability has a major impact on the length of operating seasons in the US ski industry. Even with widespread use of snowmaking, the difference in the length of the operating season in the winters of 1995–96 and 1996–97 (40 per cent) illustrates how sensitive the ski industry in the mid-west and south-east ski regions remain. Putting this inter-annual variability into a business context, consider if the number of days a retail store was open for business varied by 40 per cent from year to year, with no way to predict the length of the business year. The already difficult challenge of marketing, cash flow and personnel planning would be compounded tremendously. It is within this climate-sensitive business environment that the US ski industry has evolved and developed a range of adaptation strategies to reduce its exposure to the impacts of climate variability.

Climate change adaptation strategies

There are many types of potential climate change adaptations that could be undertaken by the ski industry, including technical, financial, operational management, behavioural and policy options. There are also a wide range of stakeholders that can influence the adaptation options available to the ski industry including: individual ski areas, ski industry associations, governments – at local, state/provincial, and national levels – the financial sector – banks, investors and insurance companies – skiers and tourists more broadly, nearby landowners and communities, and environmentalists. Each of these stakeholders has different, yet often interrelated, roles that will contribute to the collective response of the ski industry to climate change.

Table 15.1 Types of climate change adaptation options available to the ski industry

Hard technological developments
- Snowmaking systems and additives
- Slope development
- Energy and water systems
- Cloud seeding
- Improved climate prediction
- Artificial ski slopes

Soft business practices
- Ski area operations
- Market and revenue diversification
- Marketing and public education
- Industry consolidation and regional diversification
- Private insurance and weather derivatives
- Industry-wide income sharing programme

Government and industry policy
- Government environmental regulatory frameworks
- Government energy policies
- Government subsidies
- Ski industry climate change policy

The inventory of potential adaptation strategies in this chapter has been organised according to the three main categories of adaptations set out in this volume: hard technological developments, soft business practices, and government and industry policy (Table 15.1). These main adaptation categories are not mutually exclusive. For example, a water reservoir constructed to provide water supply for snowmaking is part of the snowmaking system (technological developments), but may also function as water supply for a golf course or boating (diversification of business), and would be governed by changes in environment regulatory frameworks (government policy). Specific examples of adaptation options from each of the three main categories are discussed in the remainder of this section.

Hard technological developments

Snowmaking

Snowmaking is the most widespread climate adaptation currently used by the ski industry in North America. Snowmaking technology was first implemented at the

Grossinger Resort (Fahnestock, New York) in 1952 and over the past 30 years has become an integral component of the ski industry in North America. Figure 15.1 shows the historical diffusion of snowmaking technology from 1974–75 to 2001–02 in five ski regions of the USA. In the mid-1970s there was a very distinctive east–west regional pattern in the use of snowmaking technology. More than 80 per cent of ski areas in the mid-west region had snowmaking systems. Similarly, the majority of ski areas in the north-east and south-east regions had snowmaking in place. The use of snowmaking was much lower in the higher alpine ski regions of western USA, with less than 20 per cent of ski areas in the Rocky Mountain region and less than 10 per cent in the Pacific West region using snowmaking.

A series of winters with poor snow conditions in eastern USA during the late 1970s and early 1980s motivated ski areas in these regions to invest millions of dollars to improve their snowmaking capacity. For example, the president of a major ski area in Vermont stated: 'We learned one thing this winter [1979–80]: how to operate entirely on machine-made snow' (Robbins 1980: 81). A historian of the ski industry, commenting on the early development of snowmaking in the north-east USA, stated: '[the lack of natural snow] got so bad it couldn't be ignored. By 1981–82, it became obvious that if you wanted to stay in business, you had to have top-to-bottom snowmaking'(Hamilton *et al*. 2003: 65). Consequently,

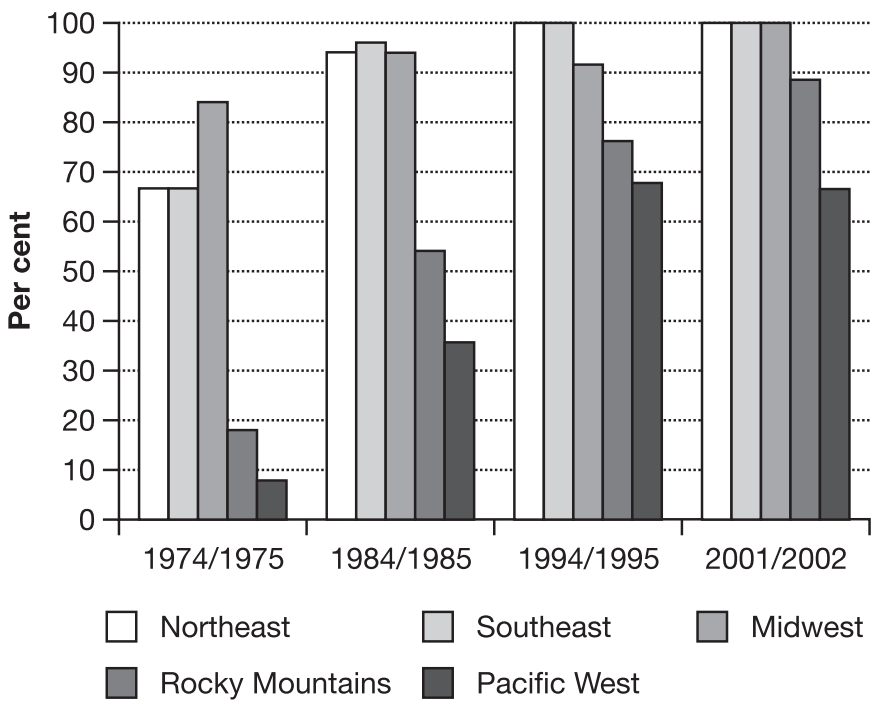

Figure 15.1 US ski areas with snowmaking systems

Sources: National Ski Area Association annual state of the ski industry reports

by the mid-1980s almost every ski area (greater than 93 per cent) in the south-east and north-east regions had snowmaking systems in place.

Over the past 20 years, the difference in the level of snowmaking between ski areas in eastern and western USA has been diminishing. Today, all ski areas in the north-east, south-east and mid-west ski regions use snowmaking, although the amount of skiable terrain covered by snowmaking in 2001–02 varied from 62 per cent in the north-east, to 95 per cent in the south-east, and 98 per cent in the mid-west. While the majority of ski areas in the Rocky Mountains (89 per cent) and Pacific West (66 per cent) regions now employ snowmaking, the proportion of skiable terrain covered by snowmaking remains much lower (13 per cent and 8 per cent respectively).

A similar east–west pattern for snowmaking implementation exists in Canada. In eastern Canada, 100 per cent of the skiable terrain in the Province of Ontario is covered with snowmaking, while in Quebec snowmaking coverage varies in the 50–90 per cent range of skiable terrain. The use of snowmaking is very different in the higher elevation alpine regions of western Canada, where only 50–75 per cent of ski areas have snowmaking systems and the proportion of skiable terrain is typically 25–50 per cent.

The importance of snowmaking as an adaptation to climate variability cannot be understated. In their analysis of six ski areas in eastern North America, Scott *et al*. (2005) found that snowmaking extended the average ski season from 55 to 106 days during the baseline period (1961–90) (Table 15.2). In addition to its current importance to the ski industry, Scott *et al*. (2005) documented the increased importance of snowmaking under projected climate change. Table 15.2 displays the average ski season in the 2020s under two climate change scenarios (low impact = NCARPCM-B2, high impact = CCSRNIES-A1). In almost every case the difference between the natural ski season and the ski season extended by snowmaking is greater than in the baseline period. In both the baseline period and the 2020s a financially viable ski season would not be possible at four of the six locations without snowmaking.

The development of sophisticated snowmaking systems that delivered reliable snow conditions had important synergies with other adaptation strategies. By providing a more predictable ski season length, snowmaking allowed ski areas to begin to diversify their business operations. With a reliable winter tourism product, investment in larger resorts became more feasible, as did the sale of recreational homes. Even as early as the late 1970s the relationship between reliable snow cover and resort development was noted by the president of the Sugarbush ski area (Vermont), who stated: '… the addition of a sports centre at the base of Sugarbush Valley and the construction of over 300 mountain side condominiums last summer were made possible because of the snowmaking' (Robbins 1980: 82). At a number of major ski resorts, the technological adaptation of snowmaking allowed for additional adaptations in business operations to take place, which further reduced the ski area's vulnerability to climate variability.

Scott *et al*. (2005) also found that the amount of snowmaking required to maintain ski seasons in their study areas could increase substantially under warmer

Table 15.2 Natural and snowmaking-enhanced ski seasons in eastern North America

Study area	*Baseline (1961–90) days*			*Climate change (2020s) days*			
	Natural snow	*With snowmaking*	*Difference*	*Scenario*	*Natural snow*	*With snowmaking*	*Difference*
Brighton, Michigan	6	115	+99	Low impact	1	109	+108
				High impact	0	83	+83
Orillia, Ontario	60	150	+90	Low impact	24	146	+122
				High impact	9	122	+113
Quebec City, Quebec	99	160	+61	Low impact	87	158	+71
				High impact	59	139	+80
Rutland, Vermont	13	119	+106	Low impact	4	113	+109
				High impact	1	89	+88
Ste. Agathe-des-Monts, Quebec	108	163	+55	Low impact	89	163	+74
				High impact	53	142	+89
Thunder Bay, Ontario	44	164	+120	Low impact	33	161	+128
				High impact	7	136	+129

Source: based on modelling outputs of Scott *et al*. 2005

climate change scenarios. For example, under the highest impact 2050s scenario (CCSRNIES-A1), snowmaking requirements were projected to more than double at four of the six ski areas.

The potential for large increases in snowmaking requirements raises interesting questions about the sustainability of this adaptation strategy in some locations. There have been concerns in several communities about the environmental impacts of water withdrawals for snowmaking. In most situations, the concern is that water withdrawals from natural water bodies (streams and lakes) can lower water levels at critical times during the winter, impacting fish and other marine species. Responding to this issue, the State of Vermont implemented some of the strictest water withdrawal rules for ski areas in the USA in 1996. The State of Vermont established a 'February Mean Flow' standard, which means that water withdrawals for snowmaking are not permitted when water supply in natural water courses are at or below the average mean flow. Ski areas with water withdrawal permits must comply with FMF standard and show that they will continue to meet this standard if applying to expand snowmaking capabilities. Studies of snowmaking impacts on fish populations by the Vermont Agency of Natural Resources found that if the FMF standard was complied with, no loss of fish populations above or below withdrawal sites occurred (Ski Vermont 2004). If snowmaking requirements by ski areas in Vermont double, as projected under a high impact 2050s scenario (Scott *et al*. 2005), the ability of ski areas to obtain adequate water supply for snowmaking and maintain the FMF standard may be severely tested. Ski areas may increasingly need to construct water reservoirs to address this challenge. For example, the Okemo ski area in Vermont built the largest snowmaking pond in New England (70 million gallons capacity), which enables them to 'stockpile' water from the Black River during the spring and summer, thus having the necessary water available during the winter.

Without adequate access to water resources for snowmaking, the adaptive capacity of ski areas to climate change will be dramatically reduced, forcing some ski areas out of business. Water supply is already a limiting factor for some ski areas. For example, the owner of the Ski Sunrise resort in Wrightwood, California (since 1942) recently tried to sell the resort and has been unable to because the ski area does not have snowmaking capabilities. The cost of installing a snowmaking system is not the principal barrier – it is the inability to obtain the necessary water-use permits that prevents the ski area from increasing its adaptive capacity. Without the adaptive capacity provided by snowmaking, the resort has had marginal business during most of the warmer than normal winters from 1998 to 2002 and the owner has reduced the sale price of the resort by 50 per cent since it first went on the market in 1996 (Ramage 2003).

A second aspect of sustainability raised by potentially large increases in snowmaking requirements is energy use and associated costs. Energy requirements for snowmaking are high and are inversely related to temperature – the warmer the temperature the more energy is required to make snow. Consequently, the impact of climate change on energy use (and costs) for snowmaking is two-fold: a greater volume of snow will need to be made and on average snow will need to be made at warmer temperatures.

The Sunday River ski area in the State of Maine will be used to explore the potential impacts of climate change on snowmaking-related GHG emissions. Sunday River ski area (957 metres above sea level (masl)) has 663 acres of skiable terrain, 92 per cent of which is covered by snowmaking. The ski area uses approximately 26 million kilowatt-hours of electricity in an average year (Hoffman 1998). The US Department of Energy (2002) estimated that for each kilowatt-hour of electricity used from the State of Maine grid, 0.85lbs of CO_2 emissions are produced. Current average levels of snowmaking at Sunday River generate an estimated 10,022 tonnes of CO_2 emissions annually (or about 0.019 tonnes per skier visit). This is the equivalent to the emissions from the electricity use of 3,600 average households in the State of Maine. A doubling in required snowmaking would more than double the related emissions unless the Maine electricity grid developed renewable energy sources or the ski area substantially improved the energy efficiency of its snowmaking system. Ironically, these increased CO_2 emissions would contribute to the process of global climate change for which this adaptation is increasingly required.

Snowmaking technology has been constantly improving since it was first developed and will continue to do so in the decades before the projected climate change scenarios outlined above may be realised. Continued improvements in snowmaking towers, water and air distribution systems, and computer control systems will improve the water, energy and cost efficiency of snowmaking. The development of new snowmaking additives – natural substances that act as nucleators to increase the nucleation temperature at which water droplets begin to form ice particles – will also allow ski areas to make snow more efficiently at warmer temperatures in the future. Although it is not currently possible to incorporate these technological advancements into an assessment of the sustainability of snowmaking as a climate change adaptation, some efficiency improvement is a certainty and the aforementioned changes in water and energy use are likely a worst-case situation.

Slope development

Slope development can be used to adapt to climate variability and change in a number of ways. Landscape planning can be used to preserve snow cover and lengthen the ski season by developing at least some north facing ski slopes and preserving forest cover to partially shade ski slopes. Land contouring or smoothening ski slopes can be used to reduce the amount of snow a ski area requires to operate, thereby extending the ski season and, where applicable, reducing the amount of snowmaking needed. Land contouring could also be used in conjunction with water reservoir development as part of a comprehensive water resource management plan to capture on-site precipitation and snow melt for snowmaking purposes.

Another form of slope development used to adapt to climate is the expansion of ski areas into higher elevations where snow cover is generally more reliable and a longer ski season is available. This appears to be the principal climate change adaptation strategy being considered in Switzerland (König and Abegg 1997; Elsasser and Bürki 2002) and Austria (Breiling and Charamza 1999). Elsasser and Bürki

(2002) noted that while Swiss ski area operators have tended to discount the threat posed by climate change, they have already used climate change as a justification for plans to expand ski areas to higher elevations. For example, 36 ski areas in Austria have applied for permits to expand into higher elevations in 2002–03 (Tommasini 2003 – personal communication). Citizens in both nations do not generally favour development in sensitive high-mountain environments and public opposition may pose a significant political barrier to this adaptation strategy.

There is limited potential to expand existing ski areas in eastern North America into higher elevations, but it is possible that lower elevation ski areas could be abandoned and more new high elevation ski areas constructed. Upslope expansion has more potential as a climate change adaptation in the western ski regions of North America but, as in Europe, may face significant opposition from environmental groups. 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). In 1998, the radical environmental group Earth Liberation Front caused over US$12 million in fire damage at Vail Resort (Colorado) in response to the start of forest clearing for a 1,000 acre expansion of the ski area (Faust 1998).

Cloud seeding

Cloud seeding is a weather modification technology that has been used in an attempt to produce additional precipitation for agricultural regions or to reduce the potential of large hailstone development that could damage crops and property in urban areas. Scientific evidence that this weather modification technology makes a significant difference in precipitation is controversial and although there are strong proponents of the technology it is not widely used. Nonetheless, ski areas in North America and Australia have used this technology in an attempt to increase snowfall. Vail Ski Resorts (Colorado) paid US$170,000 during the 2003–04 ski season to have clouds seeded with silver iodide in order to increase snowfall. In 2004, the New South Wales State government approved a US$15 million, five-year cloud seeding project that will use ground-based generators – instead of the usual airplane based distribution – to scatter silver iodide into passing clouds in the hopes of increasing snowfall by 10 per cent in Australia's Snowy Mountains. Snowfall in the region had been declining by approximately 1 per cent per year over the past 50 years and a New South Wales State government report warned that projected climate change could have a devastating impact on the ski industry in the region (Hennessy *et al*. 2003). The objective of this cloud seeding project is to keep ski areas viable under a changing climate and also to capture the runoff from additional snowfall for hydroelectric generation and crop irrigation in the summer.

Weather and climate prediction

Another type of technological advance that would have important implications for adaptation in the ski industry is improved weather and climate forecasting abilities. Ski

areas use daily and weekly weather predictions for operating decisions such as when to produce snow and levels of staffing. Improved seasonal forecasts could become useful for key business decisions, including when to plan to open the ski hill – based on snowfall predictions at the ski area and centres of skier demand – and whether to purchase weather insurance. Greatly improved models for long-term climate change projections could also reach a level of practical utility by ski area operators and ski corporations. Information on probable long-term changes in temperature and precipitation could be used for risk assessments and strategic business decisions, including which ski area properties to acquire or sell, the level of investment in a ski resort or snowmaking system, and the amount of water rights to acquire.

Artificial ski slopes

Artificial, non-snow ski surfaces were first developed in the 1970s. This technology has improved over the past three decades and today offers surfaces with good gliding and edging properties that will not damage ski equipment. This technology still has very limited application in ski areas of North America and is generally only found in sport or theme parks – both indoor and outdoor.

In the future, if the cost of snowmaking becomes prohibitive or the ability to make snow is no longer feasible early in the ski season, some ski areas may adopt this technology for use in high traffic areas (for example, lift lines and exit areas) or for teaching areas, snowboarding parks and snowtube-toboggan runs. This technology may prove to be particularly attractive to smaller ski areas near large urban markets that would otherwise have difficulties maintaining sufficient snow for an economically viable ski season. It remains to be seen if this technology would be economical in large-scale applications, such as an entire ski run, and whether skiers would respond positively to such applications. Market research would be needed to evaluate skier perceptions of the potential applications of this technology. Would skiers go to a nearby ski area where the snowboarding park was open year round? If given the choice would skiers travel four hours to reach a ski area with snow or one hour to a ski area with an artificial, non-snow surface?

Another technology that could provide much the same adaptive capacity as non-snow ski surfaces for smaller applications would be the underground refrigeration of small slope areas (for example, snowboarding parks and snowtube-toboggan runs) to preserve the snowpack. The technical and economical viability of such an adaptation has yet to be examined, but the capital and operating costs would likely limit it to the niche applications identified above.

Soft business practices

Operational changes

Climate change may alter the ways that ski area managers have traditionally operated ski areas. Changes in the timing of business operations are one possible climate adaptation. For example, as the cost of snowmaking increases and the

opportunities to make snow in the early part of the season diminish in the future, ski areas that today endeavour to open in October or November, may have to be content with opening in early December. Other ski areas, which are traditionally open for the Thanksgiving holiday in the USA (the last week of November), may have to adjust their business operations to open for the Christmas–New Year holiday instead. Ski areas may also have to adapt their operations to function with less snow. For example, very rocky slopes that require greater amounts of snow to operate safely may need to be abandoned or smoothed. Ski areas that traditionally waited until they had a 60cm base before opening may have to adjust their operations to open with a 30cm base or even less.

Ski areas may also attempt to increase the intensity of their operations by either raising their lift capacity or closing some of their skiable terrain – either permanently or seasonally when sufficient natural snow is not available – to reduce operating costs. The number of skier visits each season is critical to the profitability of ski area operations. If the utilisation level of ski areas can be increased so that the same number of skier visits can be accomplished in a shorter period of time, then any adverse impact of a shortened ski season may be negated.

Marketing and public education

The importance of snow conditions for skier satisfaction was emphasised by the research of Carmichael (1996), who found that snow condition was by far the key attribute in tourist image and destination choice for winter sports holidays. Reporting current snow conditions is a crucial marketing strategy for ski areas and has been a source of tension between ski areas and the media. Although the ski industry generally has a better relationship with the media today than 10 or 20 years ago, almost all of the ski industry representatives the author has communicated with have concerns about how the media represents (or misrepresents) snow conditions. This was particularly troublesome when snowmaking technology was being implemented into the ski industry. The media would report on the lack of natural snow or focus on ski areas that did not have snowmaking and were not open, to the detriment of the ski areas that did have snowmaking and were open for business. During the 1980s and 1990s many partnerships were formed between the ski industry and the media to address this situation. In the Province of Ontario, for example, the government ministry responsible for tourism began a programme where ski areas would report their snow conditions and operational status to a central tourism office, which would then provide this 'official ski report' to media outlets across the province and other regional market areas. The development of the internet provided ski areas with a marketing approach to overcome any perceived or real misrepresentation by the media. By placing pictures from live 'snow cams' on a website, ski areas had direct marketing access to skiers and could provide a non-biased report of current snow conditions.

Another marketing strategy used by ski areas to attract skiers when there has been low snowfall has been to issue snow guarantees. In the winter of 1999–2000, the American Ski Company promised visitors to its six New England resorts a 25 per cent reduction on their next vacation if the ski area failed to open 70 per cent

of its ski runs during the Christmas–New Year holiday period. Warm temperatures made snowmaking difficult and the company had to pay out the rebates to customers at three of the six resorts (Keates 2000).

One of the few climate change specific adaptations initiated by the US ski industry thus far is the 'Keep Winter Cool' public education campaign. In partnership with the Natural Resources Defence Council (a leading environmental organization) the National Ski Area Association (NSAA) in the USA has run the campaign in February 2003 and 2004. The objective of the campaign is to combat climate change through public education and GHG emission reductions within the ski industry. The public outreach component of the campaign discussed the potential impacts of global warming on winter recreation and encouraged guests to do their part in reducing GHG emissions. The 'Keep Winter Cool' campaign also showcased the various initiatives ski areas have taken to reduce GHG emissions in their operations.

Business diversification

Business diversification is an important climate adaptation strategy for ski areas, which has been driven by the high seasonality of the tourism sector, inter-annual climate variability and other non-climatic business stimuli. Over the past 20 years, most ski areas in North America have diversified their winter operations and diversified their recreation market beyond traditional skiers. Others have also diversified their operations into other non-skiing related business lines that enable the resort to operate year-round.

The Economist (1998) referred to the transition of major ski resorts in North America from ski areas to winter theme parks as the 'Disneyfication' of the winter sports industry. By broadening their operations into accommodations, skiing and snowboarding lessons and retail sales, ski resorts were able to capture more of the profits generated by skiing activities. Table 15.3 illustrates how typical ski area revenue sources have changed over the past 25 years. In 1974–75, lift tickets represented almost 80 per cent of revenues for the average ski area in the USA. The dependence on lift ticket sales has been reduced almost by half, while other forms of revenue – food and beverages, lessons, accommodations and retail – have each increased substantially. If only larger, more diversified ski areas were considered in this comparison, this tremendous change in revenue sources would be even more pronounced.

Though not included in Table 15.3, real estate development and management has also become an increasingly important source of non-skiing revenue for larger ski resorts. Many larger ski areas have profited from the sale of condominiums and other real estate as well as the management of these properties on behalf of their owners – helping owners rent out the properties when they are not using them. During the sales phase of new real estate developments, real estate has often replaced resort operations as the prime source of revenue at some ski areas.

The past 15 years have also seen a diversification trend in visitors to ski areas and the activities they engage in. One of the most significant new markets to develop for ski areas has been the tremendous growth in the popularity of snowboarding. In the late 1980s and early 1990s, a number of ski areas banned snowboards. According to

Table 15.3 Ski area revenue sources

Revenue sources	*1974–75* %	*2001–2* %
Lift tickets	79.0	47.4
Food and beverages	2.8	14.1
Lessons	2.8	9.8
Accommodations/lodging	1.8	9.4
Other	2.1	6.1
Retail	0	5.5
Rentals	4.5	5.3
Property operations	5.1	1.2

Source: National Ski Area Association annual state of the ski industry reports

the NSAA, only three ski areas in the USA continue this policy. Most ski areas embraced this growing market and the proportion of total skier visits in the USA by snowboarders has increased from 5 per cent in 1990–91 to 29 per cent in 2001–02 (National Ski Area Association 2004).

Ski areas also did not ignore the potential market that non-skiers represented. Williams and Dossa (1990) estimated that 20–30 per cent of visitors to ski resorts in Canada did not ski during their visit. A similar pattern was found for visitors to winter resorts in France (Cockerell 1994) and Switzerland (Wickers 1994). To capture the potential of the non-skier market, many ski resorts made substantive investments to provide alternate activities for non-skiing visitors – including snowmobiling, skating rinks, dog sled-ride, indoor pools, health and wellness spas, gym and fitness centres, squash and tennis courts, games rooms, restaurants and retail operations.

Another very important and common climate adaptation strategy aimed principally at overcoming the business challenges imposed by tourism seasonality has been the transformation of ski resorts into four-season resort operations. This transformation included several ski resorts removing 'ski' from their name and referring to themselves as four-season resorts. Diversification to four-season operation required ski resorts to provide warm-weather season recreational activities like golf, boating and white-water rafting, mountain biking, paragliding, horse riding and other business lines.[1]

Ski conglomerates and regional diversification

Another major trend in the North American ski industry over the past decade has been the consolidation of a substantial proportion of the industry into ski

1 As Scott *et al*. (2001) noted, because many ski areas in North America now operate as four-season resorts, any climate change assessment should also examine the implications of climate change on warm-weather operations.

conglomerates like American Skiing Company, Intrawest and Vail Resorts. Each of these conglomerates owns several ski areas (Table 15.4) and has become geographically diversified in its operations. Although not a planned climate adaptation, this business strategy has reduced the vulnerability of the larger corporation, and therefore each individual ski area, to the regional effects of climate variability. The probability of a winter with poor snow conditions and negative economic impacts in one ski region of North America is much higher than for the multiple ski regions in which these conglomerates now operate. In other words, the economic consequences of a poor ski season at a resort in one ski region (for example, the mid-west) could be buffered by the average or better than average economic performances of ski areas in other regions (for example, Rocky Mountains, Quebec or British Columbia). This regional diversification, together with greater access to capital for technological and business diversification adaptations, has made these multi-resort conglomerates less vulnerable to the impacts of climate change than individual ski areas or ski companies that own multiple ski resorts in only one region (for example, Powdr Corp, Aspen Skiing Company, Alpine Valley Holding Company or Peak Resorts). A future adaptation strategy by individual ski areas or companies with multiple ski resorts in one region would be to join one of the above regionally diversified conglomerates or examine establishing a co-operative business programme that would provide the benefits of regional diversification (for example, a ski industry income stabilisation programme).

Table 15.4 North American ski conglomerates

American Skiing Company		*Intrawest*	
Mount Snow	Vermont	Whistler Blackcomb	British Columbia
Killington/Pico	Vermont	Panorama	British Columbia
Sunday River	Maine	Tremblant	Quebec
Sugarloaf	Maine	Blue Mountain	Ontario
Attitash Bear Peak	New Hampshire	Mammoth Mountain	California
The Canyons	Utah	Snowshoe/Silver Creek	West Virginia
Steamboat	Colorado	Stratton	Vermont
		Copper Mountain	Colorado
		Vernon Mountain Creek	New Jersey
Vail Resorts		*Booth Creek Inc.*	
Beaver Creek	Colorado	Loon Mountain	New Hampshire
Breckenridge	Colorado	Cranmore Mountain	New Hampshire
Keystone	Colorado	Waterville Valley	New Hampshire
Vail	Colorado	Northstar-at-Tahoe	California
Heavenly	California/Nevada	Sierra-at-Tahoe	California
		The Summit	Washington

Ski industry income stabilisation programme

The ski industry is a very competitive business and, although precedents for co-operative initiatives within the industry exist (for example, government lobbying, marketing, environmental standards), there is no tradition of economic co-operation for the common good as there is in some other economic sectors. If future research shows climate change to be a significant risk to the majority of the US ski industry, the potential for economic co-operation within the industry might change. Broad industry participation in an income stabilisation programme would have the potential to spread the climate risk exposure of individual ski areas and reduce their vulnerability to climate change. The ski industry income stabilisation programme would be a voluntary, perhaps government subsidised, savings programme, from which ski areas could draw when their income falls below a threshold value because of adverse climatic conditions. With broad regional participation, an income stabilisation programme would provide individual ski areas with similar benefits to joining a regionally diversified ski conglomerate.

Weather derivatives and insurance

Despite its growth to economic prominence in the past 50 years, the tourism sector does not have the lobby power and tradition of government support of other economic sectors (for example, agriculture, forestry and mining). Consequently, tourism operators do not generally benefit from government subsidised weather insurance – although disaster relief funds are sometimes available. Instead any climate-related insurance for the ski industry would be a private sector initiative. Even private weather insurance for the tourism and recreation sector is a fairly recent development.

Snow insurance and weather derivative products have been made available to the ski industry by companies such as Société Générale SA and Goldman Sachs, and through the Chicago Weather Derivatives Exchange. During the 1999–2000 ski season, Vail Resorts in the State of Colorado bought snow insurance that paid the resort US$13.9 million when low snowfall affected skier visits (Bloomberg News 2004). Insurance premiums have increased substantially in the past five years and major ski corporations like Intrawest and Vail Resorts have decided not to buy insurance because of the high cost. Interestingly, Vail Resort has instead opted to pay US$170,000 in the 2003–04 ski season for unproven cloud seeding technology.

If larger ski companies like Intrawest and Vail Resorts find the current cost of weather insurance prohibitive, the cost is sure to exclude the small to medium size ski enterprises that are at greatest risk from climate change. A co-ordinated initiative by the ski industry to increase participation in weather insurance and thereby reduce premiums for the entire industry is an adaptation strategy that should be further examined. In the future, perhaps the NSAA (or even a larger international ski organisation) may be able to negotiate with a preferred insurance provider and governments where winter tourism is important to the economy to offer affordable weather insurance to ski operators.

Contraction

The alternative to a co-ordinated, co-operative ski industry approach to promote the financial sustainability of its members in an era of climate change would be the continuation of the current competitive business environment that would ensure what some might see as a 'healthy' contraction of the industry. A contraction of the US ski industry, in terms of operational ski areas, has been underway for the past two decades. The total number of ski areas in the USA has declined from 735 in 1983 to 494 in 2003 (Figure 15.2). Regionally, the New England Lost Ski Areas Project (2004) lists over 550 ski areas that have been 'lost' over the last four decades in the New England region and an additional 50 in other regions of the USA. In their analysis of the contraction of the ski industry in the State of New Hampshire (New England Region), Hamilton *et al*. (2003: 68) indicated that the 'extinction of the small [ski areas], and concentration of the industry into a few high-investment, high-elevation northern areas, was driven partly by a changing climate.'

Analysis of the impact of climate change on the New England ski area revealed that some of the most vulnerable ski areas were lower lying, more southerly ski areas near the major urban markets of Boston and New York (Scott 2004). While these ski areas are not major contributors to the ski industry in terms of overall skier visits, they play an important market development role as ski areas where people in major urban markets learn to ski, refine their skills and build the desire to visit the larger, more challenging ski areas in Vermont, New Hampshire, Quebec and Western North America. The ski industry must evaluate more closely the role these 'feeder hills' play in the development of skier demand and carefully assess the potential implications of their potential loss as a result of climate change. Can the ski industry get by without these feeder hills or can it accomplish market development in other ways? If the answer is no, then an unplanned, market-driven contraction may not be the best strategy for the ski industry and the ski industry may need to collectively devise a strategy to ensure that key feeder hills remain operational. The aforementioned income stabilisation programme or other direct economic support of these feeder hills by the ski industry (for example, snowmaking system improvements and training, emergency financial support) are some potential means of accomplishing this co-operative industry response to climate change.

Government and Industry Policy

Government Policy

Unlike other economic sectors (agriculture, forestry) where government policy has a direct role in climate change adaptation (for example, through subsidies, public insurance, marketing boards or research), government policy has a more limited role in the ski industry. The policy responses of government to climate change will not be inconsequential, however, because policy changes will facilitate or place constraints on the adaptation options available to the ski industry.

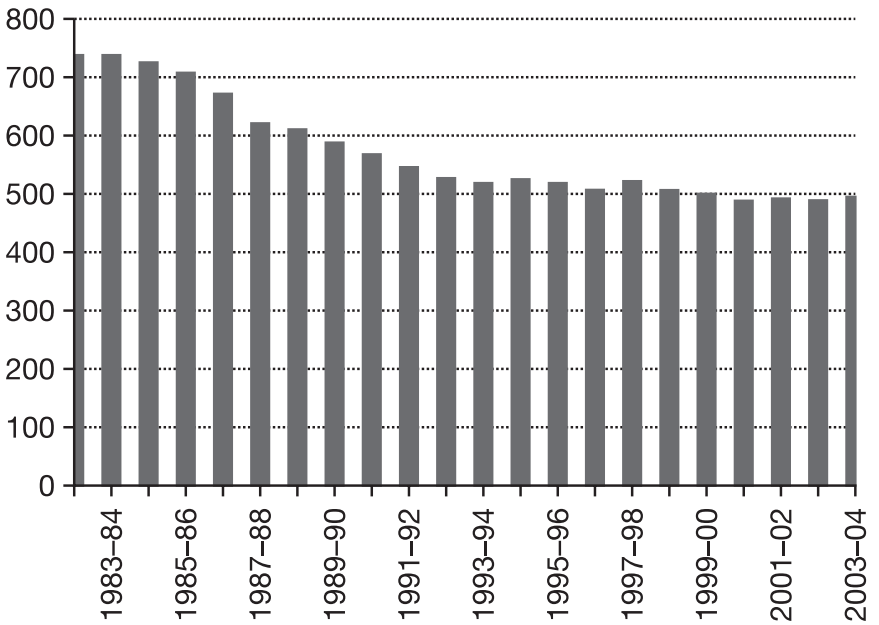

Figure 15.2 Number of ski areas operating in the USA (1983–2003)

Sources: National Ski Area Association annual state of the ski industry reports

Government resource management policies will affect land use, water use and energy prices, with potentially important implications for the ski industry. Land-use policy and environmental assessment processes will determine whether ski areas can expand into higher elevations. Water resource policy and programmes will determine whether ski areas can obtain the water withdrawal permits necessary for snowmaking. Energy policy, including climate change mitigation policies, will influence energy prices strongly, with implications for the operating costs of ski areas and, perhaps more fundamentally, tourism demand. The later point is critical for the tourism industry and has been discussed in more detail elsewhere in this volume. Its implications for the ski industry provide an interesting example of maladaptation to climate change.

Air travel, which is necessary for long-haul tourism, is the most GHG-intensive mode of transportation. Currently, the United Nations Framework Convention on Climate Change does not cover GHG emissions from international aviation. This is unlikely to remain the case given the substantive post-Kyoto Protocol GHG emission reductions required to achieve atmospheric CO_2 stabilisation. Some nations are already beginning to investigate options to reduce aviation-related GHG emissions. The UK Department of Transport (2003) has examined the use of economic instruments to reduce the growth in UK air passengers by 10 per cent before 2030.

The application of post-Kyoto GHG emission reduction strategies on air travel would have a greater impact on international tourists. Some ski areas in North America have concentrated on increasing their international markets – mainly

from Western Europe and Japan – in recent years; the tourism market that is potentially the most vulnerable to post-Kyoto Protocol energy policy changes. Adaptation by ski areas to this energy policy uncertainty would focus market development at the local, regional or national level, where tourists will be less sensitive to increased travel costs.

Other than discounted electricity prices, long-term leases of public lands and infrastructure grants – subsidies that are available to other business sectors – governments in North America have not generally provided direct subsidies to the ski industry. In the future, in order to help sustain this economically important winter tourism sector under climate change conditions, governments may need to consider the use of direct subsidies. In the past, some state and provincial government-owned electricity providers provided electricity to ski areas for off-peak snowmaking at highly discounted prices. Although the level of electricity discount to the ski industry has declined in most North American jurisdictions over the past five to ten years, this policy could be used again by governments to help the ski industry adapt to climate change.

Including the tourism sector in disaster relief programmes is another specific example of a government policy change that would enhance the adaptive capacity of the tourism sector and the ski industry by decreasing the risk of climate-related income loss. When drought occurs in farm regions, there are often relief programmes available to assist the affected communities and businesses. Tourism is becoming increasingly important to the economies of many communities and a snow drought or warm winter temperatures that affect winter tourism can have an equally adverse impact on communities with tourism-based economies. Under projected climate change scenarios there may be some years when winter tourism becomes impossible and it is during such extreme situations that income loss compensation could be made available to tourism areas as it is for other climate sensitive economic sectors and communities.

Ski industry policy and political lobby

Writing in the industry journal *Ski Area Management*, Best (2003) observed that the ski industry has begun to acknowledge its vulnerability to a climate that is shifting in the wrong direction for ski operations and the need to confront climate change. 'This is a remarkable turnaround for an industry that just five or six years ago had largely shrugged off global warming' (Best 2003: 57).

A large proportion of ski areas in the USA adopted an Environmental Charter ('Sustainable Slopes') in 2000 to address environmental issues relevant to the ski industry. The charter identified global climate change as a key environmental issue and the climate change policy developed by the NSAA is outlined in Table 15.5. In support of its climate change policy, 65 ski areas lobbied government to increase political support for the proposed Climate Stewardship Act in the USA.

The only individual ski company and one of the very few tourism operators in the world to adopt a climate change policy is the Aspen Skiing Company. In 2001, the company indicated that it shared the concern of the scientific community about the

Table 15.5 National Ski Areas Association policy on climate change

To collectively address the long-term challenges presented by climate change and continue our commitment to stewardship under the Sustainable Slopes program, we hereby adopt this climate change policy. Through this policy, we aim to raise awareness of the potential impacts of climate change on our weather-dependant business and the winter recreation experience; reduce our own greenhouse gas emissions; and encourage others to take action as well. We are committed to working toward solutions that will keep both the environment and economy healthy and preserve quality of life. To this end, we will take the following actions:

- Educate the public and resort guests about the dependence of winter sports on natural ecosystems and the potential impacts of climate change on the winter recreation experience; educate guests on how they can help reduce GHG emissions
- Raise policy maker awareness of the dependence of winter sports on natural ecosystems and the potential impacts of climate change on the winter recreation experience
- Advocate the national reduction of GHG emissions through legislative, regulatory or voluntary measures
- Support sound, science-based solutions to climate change, including the use of renewable energy technologies
- Partner with appropriate organizations and agencies to assess opportunities to reduce resort emissions and increase energy efficiency; invest in new, more efficient products, practices and technologies; and measure our emission reductions.

linkages between increasing atmospheric CO_2 levels, increasing global temperatures and fossil fuel use. The company 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. More importantly, unlike the NSAA climate change policy, the Aspen Skiing Company established a climate change action plan, committing to the following:

- use of green development principles in new Aspen Skiing Company developments
- energy efficiency in old buildings through economically viable retrofits
- continued support of mass transportation and local employee housing
- annual accounting of GHG emissions
- a 10 per cent reduction in GHG emissions by 2010 based on a 1999 baseline.

The inclusion of annual monitoring of GHGs and an emission reduction target proportionally larger than that required of industrial nations (5 per cent) by the Kyoto Protocol, are particularly noteworthy.

Conclusion

The inventory of climate change adaptation options provided in this chapter is based mainly on the experience of the ski industry in North America. It is therefore considered a starting point only; to which it is hoped future contributions from

Europe, Japan, Australia and other nations will be added to provide a comprehensive overview of climate change options available to the international ski industry. The preceding inventory also provides an overview of historical trends in climate adaptation and offers some insight into how adaptation to climate change might proceed over the next 25 years.

The place- and context-specificity of each ski area means that the most beneficial combination of adaptation options varies for individual ski resorts. There is no single adaptation strategy that is optimal for all ski areas, in all ski regions and in all countries. There are clear geographic patterns in adaptation as the differential use of snowmaking across the major US ski regions illustrated (Figure 15.2). While virtually all skiable terrain in the ski regions in eastern USA and Canada is covered with snowmaking, the proportion of skiable terrain covered by snowmaking remains much lower in western North America (approximately 10–15 per cent) and even lower in Europe (estimated 3.6 per cent in Switzerland – Theus 1995). Research to better understand these regional patterns and their implications for future vulnerability to climate change is needed. The hundreds of millions of dollars invested by the North American ski industry in snowmaking over the past 25 years has paid big economic dividends for the industry and a comparison of recent studies in Europe (König and Abegg 1997; Breiling and Charamza 1999; Elsasser and Bürki 2002) and North America (Scott *et al*. 2003, 2005) appears to suggest that this investment in adaptation has made the ski industry of North America less vulnerable to climate change. Developing methods to assess this question of relative risk will be a significant step forward for researchers, but of course is also of great practical interest to tourism investors.

Taking into consideration the substantial uncertainty of climate change projections, the absence (until very recently) of credible climate change impacts assessments to inform the US ski industry of the potential magnitude of risk posed by climate change, and equally great uncertainty in the range of other non-climatic factors that will affect the business context in which the ski industry will operate in the 2020s or 2050s, it is not surprising that the US ski industry has not engaged in discussions about a co-ordinated climate change adaptation strategy for the industry. Instead, the ski industry has focused its climate change response on the development of public education programmes and GHG mitigation. This is not to exclude the possibility that forward-thinking stakeholders in the ski industry are not discussing climate change adaptation strategies. Currently, the potential for the development of an anticipatory, industry co-ordinated adaptation strategy for climate change appears very limited. Climate change adaptation by the US ski industry in the near-term is likely to be individualistic, reactive and incremental, focusing on 'no regrets' adaptation options – initiatives that enhance economic or environmental sustainability regardless of whether climate change occurs – that are modifications of current climate adaptations.

Without a substantive change in the current climate adaptation strategies employed by the US ski industry, the most likely scenario over the next 25 years, if climate change projections are accurate, is a continuation of the historical contraction in the number of operational ski areas. Twentieth-century climate

change contributed to the loss of over 600 ski areas in the USA. The projected warming trend over the first five decades of the twenty-first century is also likely to have a pronounced impact, with the adaptive capacity of remaining ski areas determining the survivors. Ski areas with low adaptive capacity – low elevation ski areas in climatically marginal regions, that have less diversified revenue sources, and have less access to capital for business diversification and snowmaking technology, and fewer financial reserves to get them through poor business conditions – are likely to be put out of business by a combination of reduced average ski seasons and higher costs associated with snowmaking. Ski areas that have greater adaptive capacity – larger, well diversified resort operations with leading edge snowmaking systems, that are part of a larger company that can provide financial support if needed during poor business conditions – will be able to take advantage of this changing business environment. Under such a scenario it is conceivable that 30 years from now, a smaller US ski industry could be largely dominated by 5–10 large regionally diverse ski conglomerates which have a greater capacity to withstand a series of poor ski seasons in any ski region.

Innovative research is required to advance our understanding of the vulnerability of the global ski industry to climate change. Future inquiry into the adaptation decision-making process of key stakeholders, their perceptions of the relative risk posed by climate change, and the identification of barriers to the implementation of adaptation options would be important contributions to the tourism literature. This future research agenda can only be accomplished by greater collaboration between the climate change research community and ski industry stakeholders. This co-operation is only likely to occur once the ski industry believes that the risk of climate change is real enough to warrant consideration of a long-term adaptation strategy. Alternatively, the time line for this research agenda may be forced upon the ski industry by investors wary of the risk climate change poses. Considering recent trends in the financial sector, where large investors are requesting companies to examine their risk exposure to climate change and banks are incorporating climate change into credit risk assessments (Innovest Strategic Value Advisors 2003), pressure by investors for ski areas to assess the implications of climate change on their business may occur in the next 10 years.

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References

Agnew, M. and Viner, D. (2001) 'Potential impact of climate change on international tourism', *Tourism and Hospitality Research*, 3: 37–60.

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

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

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.

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.

Carmichael, B. (1996) 'Conjoint analysis of downhill skiers used to improve data collection for market segmentation', *Journal of Travel and Tourism Marketing*, 5(3): 187–206.

Cockerell, N. (1994) 'Market segments: the international ski market in Europe', *EIU Travel and Tourism Analyst*, 3: 34–55.

Elsasser, H. and Bürki, R. (2002) 'Climate change as a threat to tourism in the Alps', *Climate Research*, 20: 253–7.

Faust, J. (1998) 'Cloaks of secrecy surround activist group Earth Liberation', online. Available at: http://more.abcnews.go.com/sections/us/DailyNews/elf981022.html (accessed 22 September 2004).

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

Hamilton, L., Rohall, D., Brown, B., Hayward, G. and Keim, B. (2003) 'Warming winters and New Hampshire's lost ski areas: an integrated case study', *International Journal of Sociology and Social Policy*, 23(10): 52–73.

Hennessy, K., Whetton, P., Smith, I., Batholds, J., Hutchinson, M. and Sharples, J. (2003) *The Impact of Climate Change on Snow Conditions in Mainland Australia*. Aspendale, Australia: CSIRO Atmospheric Research.

Hoffman, C. (1998) 'Let it Snow', *Smithsonian*, 29(9): 50–8.

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

Keates, L. (2000) 'Flake out: ski season off to slow start', *The Wall Street Journal*, 7 January: W7.

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

Lazard, A. (2002) 'Ski winter: world flat', *Ski Area Management*, September: 24–7.

National Ski Areas Association (2004) Available at: www.nsaa.org (accessed 1 September 2004).

New England Lost Ski Areas Project (2004) Available at: www.nelsap.org (accessed 11 September 2004).

Packer, J. (1998) 'Everything you wanted to know about ski and snowboard tourists but were afraid to ask', *Journal of Vacation Marketing*, 4(2): 186–92.

Perry, A. (1997) 'Recreation and tourism', in R. Thompson and A. Perry (eds) *Applied Climatology*. London: Routledge, pp.240–8.

Ramage, J. (2003) 'Ski resort for sale: lack of snow is problematic', *Tribune Business News*, 13 February.

Robbins, P. (1980) 'Weather, gas, inflation – so what else is new in skiing?', *Ski Area Management*, January: 79–96.

Scott, D. (2004) 'Tourism plenary', Paper presented at the New England Governor's and Eastern Premiers Conference on Climate Change Impacts and Adaptation, Boston, March. CD-ROM available from New England Governors' Conference Inc. Available at: www.negc.org.

Scott, D. (2005 in press) 'Climate change and sustainable tourism in the 21st century', in J. Cukier (ed.). *Tourism Research: Policy, Planning, and Prospects*. Waterloo, Canada: Department of Geography Publication Series, University of Waterloo.

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., McBoyle, G. and Mills, B. (2003) 'Climate change and the skiing industry in Southern Ontario (Canada): Exploring the importance of snowmaking as a technical adaptation', *Climate Research*, 23: 171–81.

Scott, D., McBoyle G., Mills B. and Minogue, A. (2005 in press) 'Climate change and the sustainability of ski-based tourism in eastern North America: a reassessment', *Journal of Sustainable Tourism*.

Ski Vermont (2004) Available at: www.skivermont.com (accessed 15 September 2004).

Smit, B., Burton, I., Klein, R. and Wandel, J. (2000) 'An anatomy of adaptation to climate change and variability', *Climatic Change*, 45(1): 233–51.

Smith, M. (2001) 'Vermont sees year-over-year skier increase', *DCSki*, June 10.

The Economist (1998) 'Winter wonderlands', 31 January.

Theus, R. (1995) 'Klima und Seilbahnen im Wandel: Struktur und Strategien der Seilbahnunternehmungen', unpublished manuscript of a presentation at the Status Seminar organized by the Swiss National Research Programme, Zurich, November.

Tommasini, D. (2003) Personal communication. NORS- North Atlantic Regional Studies, University of Roskilde, Roskilde, Denmark.

United Kingdom Department of Transport (2003) *Aviation and the Environment: Using Economic Instruments*. London: Department of Transport.

US Department of Energy (2002) *State-level GHG Emissions Factors for Electricity Generation*. Available at: ftp.eia.doe.gov/pub/oiaf/1605/cdrom/pdf/e-supdoc.pdf (accessed 15 Sept 2004).

Wall, G. (1998) 'Climate change, tourism and the IPCC', *Tourism Recreation Review*, 23(2): 65–8.

Wall, G. (1992) 'Tourism alternatives in an era of global climate change', in V. Smith and W. Eadington (eds) *Tourism Alternatives*. Philadelphia, PA: University of Pennsylvania, pp.194–236

Wall, G. and Badke, C. (1994) 'Tourism and climate change: an international perspective', *Journal of Sustainable Tourism*, 2(4): 193–203.

Wickers, D. (1994) 'Snow alternative', *Sunday Times*, 27 November: 9.

Williams, P. and Dossa, K. (1990) *British Columbia Downhill Skier Survey 1989–90*. British Columbia Ministry of Tourism. Vancouver, Canada: Simon Fraser University, The Centre for Tourism Policy and Research.

16

Natural Disasters in Swiss Alps

Christian J. Nöthiger, Rolf Bürki and Hans Elsasser

> Tourism can … be significantly exposed to natural disasters, because of its attachment to high-risk areas with exotic scenery. The lure of snow-capped peaks brings the hazard of avalanches. Tropical beaches attract tourists to the potential paths of hurricanes ...
>
> (Murphy and Bayley 1989: 36)

This quotation clearly illustrates the fact that natural hazards are no deterrent to tourism. On the contrary, the hazards of natural disasters are often particularly high in regions attracting large numbers of tourists. It is therefore surprising that, as Faulkner points out:

> Relatively little systematic research has been carried out on disaster phenomena in tourism, the impacts of such events on the tourism industry and the responses of industry and relevant government agencies to cope with these impacts.
>
> (Faulkner 2001: 136).

This pertinent statement refers not to natural disasters alone, but also includes man-made catastrophes like plane crashes and political crises.

Studies of the impacts of natural disasters on tourism do exist, dating from the 1970s and early 1980s, for example on avalanches and floods in Val d'Isère, France (Hanns 1975), on mudflows and avalanches in the federal state of Salzburg, Austria (Pipan 1977), or on the eruption of Mt Usu in northern Japan (Hirose 1982). However, such studies did not go beyond a description of specific occurrences. Murphy and Bayley's paper (1989) is also based on specific phenomena, namely the eruption of Mt St Helens, USA, in May 1980 and the forest fires in East Kootenay, British Columbia, Canada, in July 1985. In these cases general conclusions and recommendations were made for the tourism industry as to how to cope with natural disasters. In the 1990s, the few papers on this topic referred back to Murphy and Bayley, for example, Milo and Yoder (1991), who considered the role of travel journalists in repositioning tourist destinations after natural disasters, or Burby and Wagner (1996), examining how to protect tourists from tropical hurricanes on the coast of the Gulf of Mexico. The most in-depth investigation in the

1990s was conducted by Drabek (1994) on the correlations between tourism and natural disasters. His research focused mainly on risk awareness and precautionary planning by tourism suppliers (Drabek 1994), as well as on evacuated tourists' behaviour and their assessment of crisis management measures (Drabek 1996).

The earthquake in Assisi in September 1997 served as the basis of the first extensive study expounding how to calculate the financial impacts of natural disasters on the tourist industry (Mazzocchi and Montoni 2001). The principle employed is simple: the decrease of tourist frequency caused by the natural disaster is multiplied by a tourist's average daily expenditure. This yields the deficiency in receipts which can be put down to the disaster.

In Switzerland there is no scientific literature from before 1999 which deals with the topic of 'hazards of nature and tourism'. The avalanche winter 1999 and the storm Lothar altered this situation. The disaster analyses of the avalanche winter (SLF 2000) and the storm Lothar (WSL and BUWAL 2001) discussed various aspects of the impacts of the occurrences. Extended studies dealt with the impact of the avalanche winter on the tourist region of Elm, the consequences of the avalanches for the Swiss mountain and cable railway companies, and the effects of that winter on the tourist industry in Davos. The results of these studies, along with numerous literary references, can be found in Nöthiger (2003).

Basically, every natural disaster which could possibly occur in the Alps can also affect tourism. Preponderant among the natural hazards in alpine mountain regions are gravity-induced mass movements: floods, mudflows and, particularly, avalanches. There are also disasters which are not specifically alpine in nature, but which affect the countryside surrounding the alpine area as strongly as the actual mountain region, for example storms. Phenomena with a very low probability of occurrence, for example, devastating earthquakes, are looked upon as hardly relevant for the alpine tourism industry, because they are not considered in any long-term economic planning either.

Direct and indirect damage

Reports on the impacts of natural disasters often focus on direct damage – damage directly induced by the effect of the damaging process. Losses resulting from conditions altered by a damaging occurrence are described as indirect or consequential damage. The underlying assumption is that direct damage can be assigned a monetary value; direct damage requires an object potentially at risk, which is estimated at a certain value. Thus, direct damage can also be called direct costs. The formulation of direct damage is closely connected with the actual time when the occurrence took place. As regards indirect effects, this is merely the starting point and the period of effectiveness is theoretically indefinite. Furthermore, direct damage is limited to the process area of the natural disaster, whereas indirect effects can, in extreme cases, become globally manifest.

Indirect damage subsumes all resultant costs from a natural disaster which exceed the costs of clearing and repair work of direct damage. The main emphasis is on economic costs resulting from the occurrence. These are the deficiency in

receipts caused by the natural disaster through loss or difficulties of production, loss of market shares and suchlike. Indirect costs can arise not only in the area directly affected by the natural disaster; companies further away can also be dependent on supplies from the destroyed businesses. On the other hand, it is also possible that certain firms receive new orders which can no longer be completed by the destroyed businesses, thus these companies achieve additional revenue because of the disaster.

Natural disasters can also be put to conspicuous touristic use after the event. The classic examples are the Roman cities Pompeii and Herculaneum, which were destroyed by the eruption of Mt Vesuvius. A more current example is the Mt St Helens National Volcanic Monument in the USA, which was erected two years after the devastating eruption on 18 May 1980 (Murphy and Bayley 1989).

The avalanche winter 1999 and the storm Lothar

In Switzerland, the direct costs of the avalanche winter totalled US$313 million. Approximately US$21 million or 7 per cent of that sum can be attached to damage of the tourist infrastructure, cable cars and ski lifts being the most affected. Considering the great importance of the tourist industry for the alpine economy, these costs nevertheless have to be characterised as minor. Agriculture, for example, was affected by direct costs to a far greater extent by comparison.

In February 1999, more than 40 tourist resorts in Switzerland were cut off from the outside world for up to 14 days in a row, resulting in indirect costs caused by the complete absence of day-trippers. Where roads had to remain closed for a particularly long time, overnight guests had to be evacuated by air, leading to even bigger losses. Forty-five per cent of Swiss cable cars and ski lifts could not run for an average of seven days. This meant that some day-trippers stayed away even

Table 16.1 Direct costs of the avalanche winter of 1999 in Switzerland

Category of damage	*Costs (US$ million)*
Buildings	139
Personal property	41
Streets	45
Railway lines	8
Cable cars/ski lifts	12
Protecting structures	6
Power supply system	19
Forests	33
Farm land	10
Total	*313*

Source: SLF 2000

Table 16.2 Loss of earnings for the tourist industry in the Swiss Alps caused by the avalanche winter of 1999

Category of expenses	*Losses (US$ million)*
Lodging	30
Catering	78
Retail	32
Cable cars/ski lifts	59
Other	16
Total	*215*

Source: Nöthinger 2003

when access roads were actually open. Not just cable car companies but also the rest of the tourist industry had to bear the financial consequences of the situation.

The direct damage from the storm Lothar on 26 December 1999 amounted to a total of US$1,216 million, US$6.4 million of which related to cable cars and ski lifts (Nöthiger 2003). It is not known to what extent buildings of the hotel and restaurant industry were affected. The enormous total damage caused by the storm Lothar is due to the fact that the principal damage occurred in the densely populated midland and not in the alpine region. In the case of the cable cars and ski lifts, the storm Lothar caused more damage events than the avalanche winter; the average damage costs per facility and the total damage sum, however, were lower. The indirect costs caused by the storm Lothar – the deficiency in receipts for the tourist industry in the Swiss mountain region – were estimated at US$90 million (Nöthiger 2003). Again the indirect costs were significantly higher than the direct costs for the tourist industry.

Measures

All measures aimed at preventing direct damage by natural disasters are at the same time preventive measures against indirect damage. Therefore, the question of whether an additional measure can be offset by the total of the prevented damage costs should necessarily take the indirect damage costs into account. Assuming low effectiveness may cause a measure to be rejected, even though consideration of the indirect costs would make it profitable. The difficulties which present themselves in calculating indirect damage are often the reason for not taking it into account.

The tourist industry is only of small significance regarding the preparation of preventive measures against direct damage by natural disasters (Wilhelm 1996). Cable car and ski lift companies are an exception, because they need specialist staff to assess the danger of avalanches, to trigger controlled avalanches and to close off ski runs when necessary. The World Tourism Organization (WTO 1996) recommends that tourism businesses inspect the emergency plans of the civil defence as a preventive measure. That would guarantee that the presence of a large number of tourists would be taken into consideration in the plans, if need be.

Besides prevention, the correct measures also play an important role during and after an occurrence in keeping indirect damage costs low. After the avalanche winter 1999 a survey was conducted among the Swiss cable car and ski lift companies. They were asked which special measures should be taken in future, based on their experiences, to lower indirect costs from natural disasters. More active media work (external communication) and better-informed customers (internal communication) were foremost among the responses (Nöthiger 2003). This shows that external and internal communication among businesses and organisations in tourism is of the utmost importance. The following recommendations from the WTO regarding external communication are, however, not only valid for the tourist industry: be quick, be honest and objective, be responsive to the media, be prepared (WTO 1996). Nevertheless, it is internal communication – on-the-spot communication – which should be prioritised, because it is directed at people who are potentially at risk from natural disasters.

The most important measure following the end of the acute phase of a natural disaster is the restoration and recommissioning of the tourist infrastructure. Tourism businesses have the possibility of taking out insurance against the financial consequences of natural disasters. So far as the direct costs are concerned, that means mainly insurance of buildings. Insurance against service interruptions and repercussive damage are recommended for indirect costs. However, insurance companies demand relatively high premiums on natural disasters if the probability of occurrence is not known. That is the reason why insurance against repercussive damage is not at all common in the tourist industry. This, in turn, explains why the indirect costs from natural disasters are predominantly borne by the businesses concerned.

The restoration of the infrastructure after a natural disaster does not completely rectify the situation for the tourist industry, because 'the recovery of destinations usually takes longer than the period required for the restoration of services to normalcy' (Faulkner 2001: 142). It is of the utmost importance that the first visitors return straight after the situation has been dealt with. As Murphy and Bayley (1989: 39) note:

> Such visitors will bear witness to the re-established safety and attractiveness of the area and will bring new revenue to assist in reconstruction. Successful visits can reinforce the fact that tourism has survived and that recovery is under way.

Again, external and internal communication are of great significance in assisting this process. One of the main difficulties of public relations work after a natural disaster is that a successfully mastered situation is of only small interest to the media. But for tourism the message that everything is back to normal and that visitors can return is particularly important. The faster the situation is normalised, the lower the indirect damage costs are, but the return to normalcy must be successfully communicated.

Climate change and avalanches

On the basis of its predictions for climate change, the IPCC (2001) anticipates a general increase of extreme occurrences. Although the economic consequences for tourism are usually locally or regionally confined, the overall threat to the tourist industry of an increase of natural disasters must not be underestimated. So far as the avalanche situation is concerned, for example, assuming warming of median temperatures, an increase of precipitation in winter and a rise in the frequency of extreme weather situations in winter because of global warming, the snow line in the Alps will climb by several hundred metres (OcCC 2003). Taking just the influence of warming into consideration, that would lead to less snow cover and shorter duration of snow cover. However, the result of an increase of precipitation in winter will be greater snow cover at high altitudes. If the precipitiation is not evenly distributed throughout the winter, but falls mainly during an extraordinary weather situation, the potential for extreme avalanche situations is heightened and a rise in the frequency of extreme weather situations also means an increasing probability of an extreme avalanche situation in winter. One of the consequences of climate change is that the winter tourism industry will increasingly open up high-altitude regions (Elsasser and Bürki 2002), and it is precisely those areas which will be even more imperilled by avalanches.

References

Burby, R.J. and Wagner, F. (1996) 'Protecting tourists from death and injury in costal storms', *Disasters*. *The International Journal of Disaster Studies and Practice*, 20(1): 49–60.

Drabek, T.E. (1994) 'Risk perception of tourist business managers', *The Official Journal of the National Association of Environmental Professionals (NAEP)*, 16(4): 327–41.

Drabek, T.E. (1996) 'Disaster evacuation behaviour. Tourists and other transients', Program on environment and behaviour, Monograph No. 58, Institute of behavioural science, natural hazards research and applications information centre, University of Colorado, Boulder.

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

Faulkner, B. (2001) 'Towards a framework for tourism disaster management', *Tourism Management*, 22: 135–47.

Hanns, C. (1975) 'Die Lawinen- und Überschwemmungsschäden in der Wintersportstation Val d'Isère (Hochtarantaise). Folgen einer physiogeographische Gegebenheiten nicht berücksichtigenden Siedlungserweiterung', *Geographische Rundschau*, 9(75): 390–400.

Hirose, H. (1982) 'Volcanic eruption in northern Japan', *Disasters. The International Journal of Disaster Studies and Practice*, 6(2): 89–91.

Mazzocchi, M. and Montoni, A. (2001) 'Earthquake effects on tourism in central Italy', *Annals of Tourism Research*, 28(4): 1031–46.

Milo, K.J. and Yoder, S.L. (1991) 'Recovery from natural disaster. Travel writers and tourist destinations', *Journal of Travel Research*, 30(1): 36–9.

Murphy, P.E. and Bayley, R. (1989) 'Tourism and disaster planning', *Geographical Review*, 79(1): 36–46.

Nöthiger, C.J. (2003) *Naturgefahren und Tourismus in den Alpen. Untersucht am Lawinenwinter 1999 in der Schweiz*, Davos: Eidg, Institut für Schnee- und Lawinenforschung.

OcCC (Organe consultatif sur les Changements Climatiques) (2003) *Extremereignisse und Klimaänderung*, Bern: OcCC.

Pippan, T. (1977) 'Der Einfluss von katastrophalen Wetterereignissen auf den Saison-Fremdenverkehr und die behördlichen Kontrollmassnahmen am Beispiel des Landes Salzburg', *Mannheimer Geographische Arbeiten*, 1, Mannheim.

SLF (Eidg. Institut für Schnee- und Lawinenforschung) (2000) *Der Lawinenwinter 1999*. Ereignisanalyse, Davos: SLF.

Wilhelm, C. (1996) *Wirtschaftlichkeit im Lawinenschutz. Methodik und Erhebungen zur Beurteilung von Schutzmassnahmen mittels quantitativer Risikoanalyse und ökonomischer Bewertung*, Davos: Eidg, Institut für Schnee- und Lawinenforschung.

WSL (Eidg. Forschungsanstalt für Wald, Schnee und Landschaft) und BUWAL (Bundesamt für Umwelt, Wald und Landschaft) (2001) *Lothar. Der Orkan 1999*. Ereignisanalyse, Birmensdorf und Bern: WSL und BUWAL

WTO (World Tourism Organization) (1996) *Tourist Safety and Security. Practical Measures for Destinations*. Madrid: WTO

17

Global Environmental Change: Nature and Notions of Authenticity

Erika Andersson Cederholm and Johan Hultman

Introduction

The aim of this chapter is to discuss global environmental change (GEC) through the social construction of nature and notions of authenticity. We will discuss the social construction of nature in a specific context, namely that of different kinds of nature-based tourism. The argument will revolve around what we perceive as a shift in focus from the image of nature as *thing* to nature as *experience*, also expressed as a shift from nature as *place* to nature as *globalised locality*. We will sketch a development from 'traditional' nature tourism practices and rhetoric to the formation of another cultural economy of nature in order to discuss possible effects of GEC on tourist phenomenologies. By structuring our analysis around three aspects of authenticity, we will argue that different nature tourism operators stress the non-essentialist, experiential image of nature, where the destination *per se* seems to have a secondary role. We further suggest that the non-essentialist and therefore fluid concept of authenticity in tourist experiences might be adaptable to perceptions of change on a global scale. We aim to interpret GEC, although encompassing potentially devastating processes in a great number of ways, as also being able to be incorporated in common discourses of tourist experiences.

Global environmental change and the rearrangement of nature

One important aspect of tourism involves the social construction of nature. Websites, brochures, television programmes, travel magazines and other kinds of promotional material represent local natures and cultures and shape later tourist experiences – these kinds of textual and pictorial materials act as manuals to the interpretation of nature and culture. GEC is also a kind of production of nature in the sense that it is a process producing qualitative, quantitative and geographical rearrangements of nature. This is seldom seen as positive, it is commonly defined as a negative consequence of anthropogenic resource use practices. In order to make these two kinds of nature production practices inhabit the same argument,

we will in the following give environment and nature the same meaning although there are good reasons not to do so. One of these is that environment in this context is a scientific concept, at the same time geographically abstract and measurable down to the molecular level, while nature is a romantic concept harbouring a host of images, feelings and experiences. It is nature that tourists seek, not environment, but GEC affects touristic nature, thus making it necessary to interpret the two concepts equally. In this text, however, GEC could as well have been termed global nature change.

It is interesting to note that while changes or trends in nature driven from outside the tourism industry (for example, GEC) are slow, changes or trends within the industry are comparably fast, unstable and subject to sudden shifts in symbolic meaning (Buckley 2000). At the same time, nature both in tourism and GEC discourses respectively is commonly represented as unstable and non-robust, sensitive and vulnerable (see Bandy 1996). Tourism on the other hand is a stable process, unstoppable, ever growing and robust – a sure and significant cultural force, an important form of consumption. Change in (at least western) culture is not so problematic, it is often expected and even cherished, but change in nature is commonly regarded as wrong, immoral and problematic. This is because nature is natural, and therefore untouchable. Nature shows us our origin, and furthermore a number of ecological imperatives which must be followed if we want to avoid imminent ecological collapse. But since tourism is the construction of nature, nature's 'naturalness' must here be treated as a cultural category and a subject for discourse (Demeritt 1994; Braun 2002; but see Cafaro 2001).

Nature-based tourism, specifically ecotourism, involves environmental management, for example, education and contribution to conservation. At the same time, many business actors and stakeholders strive for growth, and this is also true for government and municipal agencies. For example, tourist agencies see it as one of their primary roles to facilitate and help local business by attracting tourists (Andersson Cederholm *et al*. 2004). So tourism is basically a competition between stakeholders in the commoditisation and commercialisation of local nature and culture (see Luke 1998; McAfee 1999). These categories are then translated and represented in promotional material, which in turn act as carriers of meaning and expectations. In the same way, 'texts' about environmental change act as promotional material, promoting a trend, creating expectations and experiences (Burgess 1990; Catasus 2000; Bickerstaff and Walker 2003; Pedynowski 2003). Such 'texts' become manuals to the creation of meaning as well. There are large discrepancies between these two kinds of meaning constructions, so how might this issue act out from tourists' perspectives and tourists' perceptions of nature?

In a way, all nature-based tourism depends on scarcity – without special nature in short supply, why bother to label anything unique or eco-? The question here is what happens with touristically desirable natures when these are subjected to GEC? Is truly unique nature destroyed and made scarcer – a dystopic scenario whose ultimate consequences are discussed by Tonn (2002)? Or is nature – from the viewpoint of tourists – rather rearranged, redefined, displaced and thus available elsewhere? The tourism industry is after all driven by constant change and is

in this sense discursively – not absolutely – structured. Trends and changes in travel styles, tourist practices and destination popularity follow no natural law.

Our purpose in this chapter is to analyse GEC's impact on tourism by discussing nature with this question in mind. Our wider framework is the concept of cultural economy in relation to nature, that is the contention that: 'the cultural construction of nature is one medium of translation between the biophysical world and economic systems of value and exchange' (Mansfield 2003: 329). Nature is in many ways incorporated into the economy either as a consumer object in itself – common, of course, in the tourism industry – or as an attribute of other consumer objects such as automobile motors, snacks or clothes. Thus, the cultural economy of nature articulates the inseparability of culture and economy if this relationship is analysed in terms of practice (Simonsen 2001). Nature is culturally constructed – that is given meaning – by the actual doings of, for example, nature-based tourism operators, and this meaning is transformed into cash flows through tourist practices. It is this construction of nature by touristic practices we will focus upon here.

This chapter is structured as an examination of a change having occurred in nature-based tourism representations and practices during the past few years. We will tentatively define this change as a shift in focus from nature as thing to nature as experience, and consequently from nature as place to nature as globalised locality. We will deal with this change by an analysis of three aspects of authenticity: the notion of the essentialist Origin, that is the image of nature as a unchangeable and untouchable thing; the notion of the Unique, indicating exclusivity in a commercial sense; and finally the notion of Existential authenticity, indicating the subjective and often spiritual experience of being part of a greater whole. The material we use comes from eco- and nature tour operators. We view such organisations as mediators or constructors of nature in the way they represent nature. We will sketch a development from 'traditional' nature-based touristic practices and rhetoric to what we perceive as a new cultural economy of nature in order to illustrate the change we have identified, eventually arriving at some conclusions with potential relevance for GEC's impact on tourists' perception of nature. The material is internet-based, since web-mediated interaction between operators and tourists is becoming an increasingly important means of pre-travel information gathering (Andersson Cederholm *et al*. 2004). This would then imply that websites are important elements in the formation of discourses about nature, and thus also important for the tourist's interpretation of nature and expectations of authentic experiences.

Tourism and dissociation from nature: nature as thing

Nature-based tourism and ecotourism rhetoric often revolves around the moral obligation of the individual tourist not to degrade nature and local culture. In the standard definition of ecotourism, proper ecotourist behaviour is translated as a sense of responsibility while being in nature: 'responsible travel to natural areas that conserves the environment and improves the well-being of local people' (ecotourism.org). There is an inscription written into this simple definition, hidden

within the phrase 'conserve the environment', which highlights the fundamental paradox contained within ecotourism. On the one hand, ecotourism and much nature-based tourism are all about getting to know nature. This is evident in the rich textual and pictorial material that is used, for example, to construct ecotourism websites, or in quotes such as: 'Ecotourism travel gives visitors the *possibility to acquire knowledge* about issues related to nature, culture, environment and development' (ekoturism.org, our translation, emphasis in original). But at the same time the ecotourist must not bodily engage with nature in any invasive way; nature shall remain untouched, undisturbed. The trace of the tourist must be non-existent.

In order to resolve this paradox in practice, two things must happen. The first is that tourism operators must represent nature as distanced from the tourist. Nature is coded as a thing, an object to be worshipped; the goal is to: 'actively *exhibit* charismatic and rare or sensitive species in a non-invasive way' (ekoturism.org, our translation and emphasis). The other is that the tourist must distance herself from nature. Nature must be viewed, not messed with. Just as in many other kinds of tourisms, the camera lens is a primary filter through which the ecotourist views nature and culture. So the actual role of the ecotourist is often, or has at least been, that of the gazer (Urry 1990), and nature and local people have consequently been constructed as attractions in a way that mirrors mass tourist attractions, for example, buildings, monuments, London punk rockers, etc. Many nature-based and ecotourism websites bear witness to this in the way these virtual encounters with nature are structured around a style of photography that is geared towards capturing the sublime and awe-inspiring aspects of nature. The result is that nature, and local culture, is in several ways represented as fragile, pre-modern and mysterious, that is conceptually and geographically distant from modern society.

Interpreted in this way, tourism in nature is one mode of reproducing the modernist dichotomy between nature and society. Nature is a sphere outside or apart from society. Mass tourism is in effect a toxic leak from society to nature, but ecotourism is a gentle exploratory expedition into the secrets of nature. So while traditional ecotouristic rhetoric stresses that ecotourism is all about coming really close to nature and local culture in a respectful way, on nature's own terms, ecotourism practices have actually served to reproduce the distance between nature and western culture. And there is a strong normative agenda behind separating touristic nature and culture from western society. The explicit reason for ecotourism organisations to exist is that: 'all tourism related to nature or the combination of nature and culture is guided towards fulfilling ecotourist requirements' (ekoturism.org, our translation). This would, in effect, mean that all tourist practices would have to withdraw from close engagement with the natural or cultural Other – in a way this would mean a formalisation of the tourist gaze.

The ecotourist dichotomy of nature and (western) culture is paralleled in much of the sustainability discourse in general (Hultman 2003). For all the anxiety expressed about nature, the different kinds of we-are-a-part-of-nature rhetoric that suffuse this discourse, the result is still that nature has been firmly positioned as a system totally apart from the societal system (as evident and/or discussed in different ways in e.g. Muir 1994; Hornborg 1998; Gullone 2000; Sneddon 2000;

de Paiva Duarte 2001; Barr 2004; see also Hammond 2004; but see Luke (1998) on the fusion logic inherent in the commercialisation of nature). This is an ontological logic carried on by many GEC scenarios: society is active, dominant and ignorant/malevolent, nature is passive, holistic, amoral but still normative and pure in essence (e.g. UNEP/WTO 2001; WTO 2003). In line with this, it has been argued that ecotourism has been governed by an approach informed by science and above all planning – as opposed to the unmanaged character of other kinds of tourism when it comes to environmental issues (Hughes 1995). Nature, and the tourist, must be managed in an organised way in order to remain attractive. Ecotourist travel: 'is conducted with the outmost care, and the least possible wear on the destination's natural and cultural values, *with the purpose of conserving the biodiversity and cultural values* that the visitor has come to experience' (ekoturism.org, our translation and emphasis). Encounters between the tourist on the one hand and nature and local culture on the other must be controlled and directed. On several levels, the scientisation of nature (Urry 1999) in tourist contexts has thus acted to dissociate tourists from nature and local culture, quite contrary to the general rhetoric. Nature has been objectified, a viewable thing.

What it also has done is in a way to situate nature and indigenous culture in the same position (Bandy 1996). Ecotourism allows the traveller to: 'explore rainforests, mountains, deserts, tropical beaches, coral reefs … guided by those who know them best – the people who live there' (tourismconcern.org.uk). Local people are part of nature; they have intimate knowledge of nature and all its secrets. In some ways nature and local culture have been fused together, they have been hybridised, and through this ontological arrangement runs a discourse of conservation because ecotourism is a touristic mode that: 'actively contributes to the protection of nature and safeguards cultural values' (ekoturism.org, our translation). To expand on this in order to understand how GEC will be a factor in nature tourist industries, we turn to the concept of authenticity.

A sense of origin: nature as place and as globalised locality

Authenticity is much debated in studies of the tourist experience. Quite often the notion of authenticity is related to the experience of non-authenticity, and MacCannell's (1973, 1976, 1992) concept of 'staged authenticity' indicates the disillusionment when the tourist scene seems too adapted to the expectation of the tourist gaze (Pearce and Moscardo 1986). Studies on the search for authenticity quite often focused on the image of the cultural Other (Silver 1993; Albers and James 1988). However, the cultural Other is often portrayed, in tourist narratives as well as in marketing, as part of nature or at least close to nature – in a geographical as well as a cultural sense. The fusion of culture and nature thus reflects a primitivistic image of the natural Other, common in tourist mythology (Andersson Cederholm 1999; Elsrud 2004). One aspect of authenticity is thus the notion of the Origin; an essentialist image of cultures and natures preserved – even conserved – and of time standing still. Quite often, the idea of the Origin acts to highlight a perception of time prevalent in late modern societies: the notion of acceleration of

time. 'You have to go there before it is too late', is a quite common notion among tourists seeking the last reservoirs of authenticity in the world (Andersson Cederholm 1999). This argument is also evident in tourist marketing, where the explicit threat of modernisation is used to legitimise travel to authentic milieus (Kilroy Travels, autumn 2004 campaign: 'Go before it's too late'; authenticity here ranges from the African savannah to British industrial heritage). Thus, you have to run faster to be able to stand still, even though it might be just for a few days visiting the remote Other, in a geographical and/or cultural sense.

Peoples of Origin are also expected to have a traditional knowledge of nature and how to cultivate it in a small-scale and sustainable way. The knowledge they have acquired is regarded as inherited and traditional. A local guide is thus expected to convey knowledge about the local culture that even a well-trained non-local guide will never manage. Stressing the presence of a local guide is common in ecotourism marketing. In Nature's Best – a certifying organisation for Swedish ecotourism products – requirements directed to operators applying to use the brand, the connection to the local community is emphasised. Using a local guide not only benefits the local economy, but also gives the arrangement an aura of authenticity. Knowledge of nature and traditional culture are not only regarded as inherited, but mysterious, tacit and essentialist. It is natural and thus should be respected. One of Nature's Best's six main requirements is formulated as: 'Respect the limits of the destination – the least possible impact on nature and culture' and has as a subrequirement: '*Always respect* local rules and recommendations for protected areas' (naturensbasta.com, Document of Requirements 2002–2005, our translation and emphasis).

However, it is not always authenticity in an essentialist, primitivistic meaning that tourists search for. Another aspect of authenticity, prevalent in ecotourism discourse as well as in other forms of tourism, is the notion of *the unique*. It implies the search for the unique experience not as much in relation to a western materialistic society – as in the notion of Originality – but rather in relation to the tourist industry and the existence of other tourists. That is, a destination is regarded as authentic if the local way of life is not 'bought' or dominated by the tourist industry, even though it is obviously commoditised to serve the needs of the customer. However, it is important for the tourist not to be treated as *merely* a customer (Andersson Cederholm 1999), but as a *person*. This notion of *the unique* is echoed in the 'new tourism' (Poon 1993) directed towards the demand for tailor made, non-standardized personal solutions. Exclusivity is a key word in marketing and the concept of 'cutting edge product' is often used by Nature's Best: '[In this way] have several of Laponia's absolute top-notch attractions been transformed into bookable cutting edge products' (ekoturism.org, our translation). The notion of uniqueness implies uniqueness in the business arrangement as a whole, rather than the destination *per se*. Here, perhaps, can we glimpse a first clue as to how GEC could affect tourists' perception of nature: place might not be the most important aspect of nature experiences. Instead, it is the way in which experiences are discursively constructed and packaged that matters most for tourists' appreciation of nature.

Even though the notion of the Origin as well as uniqueness are cultural ideas existing side by side in tourist industry narratives, we argue that there has been a shift in focus from emphasis on the essentialist notion of authenticity, towards the experiential. Or, as Kurt Kutay of ecotourist company Wildland Adventures puts it:

> Some of our more novice clients still think authenticity is synonymous with travel to pristine natural areas and untrodden villages where native peoples retain traditional values. (…) However, what I find equally gratifying and meaningful is simply the truth. (…) Authentic experiences are just as available in popular tourism destinations like Costa Rica and Thailand, as they are in remote Mongolia or the Bolivian highlands. *It all depends on how we conduct our business* and integrate our tour operations from trained guides to informed guests.
>
> (wildland.com, our emphasis)

This director positions himself as being in the frontline of ecotourism business: 'some of our more novice clients *still* think'. Further, authenticity is not about the destinations, it is about conducting business and doing it well. This shift in focus is reflected by a Swedish certified ecotourism operator:

> Nature and the culture of people of nature have always fascinated the traveller: we seek backwards to the Origin and to the vital beauty of nature. This quest often brings us far away, to distant corners of the world, in spite of the fact that the same possibilities for experiences are present close by.
>
> (lapplandssafari.se, our translation)

A sense of uniqueness could be found nearby as well as in remote destinations. The product – described as 'cutting edge product' – is marketed and sold as an *experience*. It is the unique experience of nature that is in focus, not a specific nature – nature as place – or a specific culture. Only by this way of constructing nature can a horse riding holiday through 'the mythology of the deep, Swedish forest' – taking place in the southern part of Sweden and brought to the consumer wrapped in literary references to John Bauer and Astrid Lindgren – include as a specified attraction one night in a Sami tent complete with reindeer skins to sleep on (wildhorseriding.com). This is a non-essentialist type of authenticity at one level, but the notion of Origin is still prevalent as the background to the experiential type of authenticity implied in the concept.

When experiential authenticity is the key concept, the actual nature that is the setting for the experience could be anywhere in the world, as long as it has a local flavour and is represented as being far from modern society – at least in an discursive sense, if not a geographical one. However, it is a globalised, generalised locality. Locally produced food and local attractions with a long history and a place inhabited by people of Origin are important, but the local nature and culture in question could be localised anywhere in the world. It is not the place that is important, but a sense of place. A sense of place that gives you a certain kind of

experience: 'Ecotourism works as well in the Laponia mountains and our archipelagos as it does in Nepal or New Guinea' (naturensbasta.com, Document of Requirements, our translation). It is ecotourism defined as experience-packed practice that is important, and this can take place *anywhere* local.

So even though the notion of Originality is implicit in the documents from Nature's Best and in marketing material from different ecotourism and nature tourism operators, it is a sense of place, a sense of tradition and, quite often, the personal encounter with the locals that are supposed to give you a unique experience, juxtaposed to a standardised or mainstream type of travelling. This would then further imply that tourists' experiences of nature are not so dependent on actual map coordinates since it is *the everywhere unique* tourists seek. Instead, it is how tourists position themselves in relation to each other that gives a sense of authenticity, something GEC would not necessarily have a great impact upon. It would also highlight the relevance of how tourist natures are discursively constructed and likewise valued in relation to each other, something that would be affected by GEC. For example, the geographical distribution of desirable natures could change dramatically, even though the relative scale of value distinguishing between different natures would remain. The reason is that tourism is a form of consumption and consumption is a communicative practice and a primary source in the creation of cultural and social meaning.

Connecting to the greater whole

We will mention a third aspect of authenticity, even more experiential and less dependent on the actual destination of the traveller. It is the notion of *existential authenticity*, indicating a sense of belonging, an intimate relationship between the tourist and the world surrounding her, a non-reflexive attitude and a sense of flow (Csikzsentmihalyi 1991). This emotional state of authenticity could occur at any time and in any place in life, in those spheres of life which are socially institutionalised and framed as daily life as well as more extraordinary events like tourist trips, even though tourists describe these emotional states as being more frequent when they travel than in their daily life (Andersson Cederholm 1999).

The tourist trip is socially defined as extraordinary, but within this institutionalised liminal sphere (Turner 1969) individual islands of liminal experiences of intensity and flow become markers of the trip as a whole. They define the journey as an extraordinary event and make it even more unique in relation to the experiences of other tourists. In ecotourism marketing, nature is used as the medium for reaching the holistic experience of being part of something eternal – the encounter with nature works 'by bringing you in collective harmony with the web of life that surrounds us', something that initiates a process of reclamation: 'Rediscover a sense of belonging to something larger than yourself' (wildland.com). This is often juxtaposed to a society dominated by a stressful busy lifestyle, governed by the clock. As one of the Swedish ecotourist operators describes it: 'Discover the calmness, silence and freedom far beyond mobile phones and "technostress"' (lapplandsafari.se).

It is a way of feeling and being that is stressed, no matter where you are in the world. It is not the tourist gaze that is encouraged, but a sensual holistic experience. The background is often nature or peoples of nature, but it is not as much nature *per se* that is marketed, but nature as an environment that encourages a certain way of feeling and thinking. Even if a Sami village or bear safari is the exotic background that legitimises an expensive trip that is socially framed as extraordinary, the main attraction is a specific kind of authentic experience. The last two aspects of authenticity mentioned – the quest for uniqueness and existential authenticity – are experiential rather than essentialist. The experience of nature and culture is thus both individualised and commoditised. Nature's Best and its certified operators emphasise the experience, not nature *per se*: 'Geunja, Sami mountain lodge in roadless land. A creative and inspiring meeting place for development, group cooperation, leadership and fresh thinking' (lapplandsafari.se).

Nature as the exclusive experiential product

We would argue that what can now be discerned is the formation of new touristic discourses and practices related to nature, where tourism operators are in the process of situating nature in a new global cultural economy. The scientific approach to managing nature has given way to another logic: conservation through exclusivity, which can also be expressed as conservation through commoditisation. The way nature and local culture is commoditised is how these categories are translated as *experiences* instead of (scientific) objects. Nature moves from object to experience. It is clearly exclusive – the targeted consumers are obviously upscale – and the notion of sustainability is strikingly absent in the message. In a 2003 conference presentation of the Nature's Best concept, one of the organisation founders explicitly stated that the goal was to dissociate nature from environmental sustainability. Tourists were not seen as willing to pay anything for sustainability, whereas they were more than willing to pay for the added-value *experience* of nature. So within the context of nature-based tourism, nature is being constructed in new ways. Rhetorically and discursively, nature is developing towards a medium for entertainment and self-fulfilment, and thus away from the scientific object it is within 'traditional' ecotourism.

This meaning given to nature, in combination with how the notion of nature as specific place is exchanged for nature as globalised locality, forms the basis of what we perceive as a new cultural economy of nature. Nature and local culture are perhaps not becoming more democratic – we are after all talking about cutting edge products – but these touristic categories are being incorporated into tourist phenomenologies in new ways. In a sense, the ecotourist is allowed and encouraged to experience nature reflexively instead of objectively. Because nature is represented as a medium for sensual experiences and personal development, rather than an object *per se*, the actual destination might have a secondary role. The search for uniqueness as well as existential authenticity – as two important aspects of authenticity – are connected to the quality of the experience and the exclusivity of the business product, rather than the actual physical place.

The concept of Originality, however, as the first aspect of authenticity mentioned in this chapter, is inherently connected to physical place. As such, it is also more vulnerable to environmental change and the physical as well as the perceptual carrying capacity of a specific destination. However, the disconnection from the physical space significant for experiential notions of authenticity opens up endless variations of the tourist product.

To conclude our argument, GEC will certainly affect the tourism industry as a whole. Tourists' perceptions of nature will also change – although we find it difficult to relate perceptions of global change to discussions about perceptions of local change (see Hillery *et al*. 2001). For example, the discursive construction of nature as fragile might be reinforced as a result of a stronger and more explicit symbiosis between touristic and scientific narratives – in a way a variant of the almost total economisation of nature discussed by Luke (1998). But our discussion here would suggest that GEC impact on tourism might primarily become an issue of geographical rearrangements of natures and thus a spatial redistribution of tourists. Tourist discourses of nature, authenticity and experiences are possibly well able to incorporate GEC without this necessarily having a noticeable effect on tourists' motivation and willingness to travel and experience nature. In this sense tourists' perception of nature might not change very much, although the imperative 'Go before it's too late!' will continue to haunt us and remind us of the late modern condition. As long as nature is constructed as an exclusive experiential product, the consumption of nature will have the same communicative function as before, even if anthropogenic climate changes rearrange nature on a global scale.

References

Albers, P.C. and James, W.R. (1988) 'Travel photography: A methodological approach', *Annals of Tourism Research*, 15: 134–58.

Andersson Cederholm, E. (1999) *Det extraordinäras lockelse: luffarturistens bilder och upplevelser*. Lund: Arkiv Förlag.

Andersson Cederholm, E., Gyimóthy, S. and Hultman, J. (2004): *Kompetenceudvikling i Norra Öresunds turismeerhverv*. Rapport. Department of Service Management, Lund University, Campus Helsingborg.

Bandy, J. (1996) 'Managing the Other of nature: sustainability, spectacle, and global regimes of capital in ecotourism', *Public Culture*, 8: 539–66.

Barr, S. (2004) 'Are we all environmentalists now? Rhetoric and reality in environmental action', *Geoforum*, 35: 231–49.

Bickerstaff, K. and Walker, G. (2003) 'The place(s) of matter: matter out of place – public understanding of air pollution', *Progress in Human Geography*, 27(1): 45–67.

Braun, B. (2002) *The Intemperate Rainforest. Nature, culture, and power on Canada's west coast*. Minneapolis, MN: University of Minnesota Press.

Buckley, R. (2000) 'Neat trends: Current issues in nature, eco- and adventure tourism', *International Journal of Tourism Research*, 2: 437–44.

Burgess, J. (1990) 'The production and consumption of environmental meanings in the mass media: a research agenda for the 1990s', *Transactions of the Association of British Geographers NS*, 15(2): 139–61.

Cafaro, P. (2001) 'For a grounded conception of wilderness and more wilderness on the ground', *Ethics & the Environment*, 6(1): 2–17.
Catasus, B. (2000) 'Silent nature becomes normal', *International Studies of Management & Organisation*, 30(3): 59–83.
Csikszentmihalyi, M. (1991) *Flow. The Psychology of Optimal Experience*. New York: Harper Perennial.
Demeritt, D. (1994) 'The nature of metaphors in cultural geography and environmental history', *Progress in Human Geography*, 18(2): 163–85.
Elsrud, T. (2004). *Taking Time and Making Journeys. Narratives on Self and the Other among Backpackers.* Lund Dissertations in Sociology 56. Lund: Dept. of Sociology, Lund University.
Gullone, E. (2000) 'The biophilia hypothesis and life in the 21st century: increasing mental health or increasing pathology?' *Journal of Happiness Studies*, 1: 293–321.
Hammond, K. (2004) 'Monsters of modernity: Frankenstein and modern environmentalism', *Cultural Geographies*, 11: 181–98.
Hillery, M. *et al*. (2001) 'Tourist perception of environmental impact', *Annals of Tourism Research*, 28(4): 853–67.
Hornborg, A. (1998) 'Towards an ecological theory of unequal exchange: articulating worlds system theory and ecological economics', *Ecological Economics*, 25(1): 127–36.
Hughes, G. (1995) 'The cultural construction of sustainable tourism', *Tourism Management*, 16(1): 49–59.
Hultman, J. (2003) 'Natur och miljö – diskurs och materialitet', in L.J. Lundgren (ed.) *Vägar till kunskap. Några aspekter på humanvetenskaplig och annan miljöforskning*. Stockholm: Symposion.
Luke, T.W. (1998) 'The (un)wise (ab)use of nature: environmentalism as globalized consumerism', *Alternatives*, 23(2): 175–213.
McAfee, K. (1999) 'Selling nature to save it? Biodiversity and green developmentalism', *Environment and Planning D: Society and Space*, 17: 133–54.
MacCannell, D. (1973) 'Staged authenticity: Arrangements of social space in tourist settings', *American Journal of Sociology*, 79(3): 589–603.
MacCannell, D. (1976) *The Tourist: A New Theory of the Leisure Class*. New York: Schocken Books.
MacCannell, D. (1992) *Empty Meeting Grounds. The Tourist Papers*. New York: Routledge.
Mansfield, B. (2003) 'From catfish to organic fish: making distinctions about nature as cultural economic practice', *Geoforum*, 34: 329–42.
Muir, S.A. (1994) 'The web and the spaceship: metaphors of the environment', *Et Cetera*, summer.
Paiva Duarte, F. de (2001) '"Save the earth" or "Manage the earth"? The politics of environmental globality in high modernity', *Current Sociology*, 49(1): 91–111.
Pearce, P.L. and Moscardo, G.M. (1986) 'The concept of authenticity in tourist experiences', *The Australian and New Zealand Journal of Sociology*, 22: p.x.
Pedynowski, D. (2003) 'Science(s) – which, when and whose? Probing the metanarrative of scientific knowledge in the social construction of nature', *Progress in Human Geography*, 27(6): 735–52.
Poon, A. (1993) *Tourism, Technology and Competitive Strategies*. New York: CABI Publishing.
Silver, I. (1993) 'Marketing authenticity in Third World countries', *Annals of Tourism Research*, 20: 302–18.

Simonsen, K. (2001) 'Space, culture and economy – a question of practice', *Geografiska Annaler*, 83B: 41–52.
Sneddon, C.S. (2000) '"Sustainability" in ecological economics, ecology and livelihoods: a review', *Progress in Human Geography*' 24(4): 521–49.
Tonn, B.E. (2002) 'Distant futures and the environment', *Futures*, 34(2): 117–32.
Turner, V. (1969) *The Ritual Process. Structure and Anti-Structure*. London: Routledge and Kegan Paul.
UNEP/WTO (2001) *Climate change 2001: Impacts, adaption and vulnerability*. Report. Intergovernmental Panel of Climate Change. UNEP/WTO (accessed through www.grida.no/).
Urry, J. (1990) *The Tourist Gaze. Leisure and Travel in Contemporary Societies*. London: Sage Publications.
Urry, J. (1999) 'Sensing leisure spaces', in D. Crouch (ed.) *Leisure/tourism geographies*. London: Routledge.
WTO (2003) *Djerba Declaration on Tourism and Climate Change*. Madrid: WTO.

Internet references

www.ecotourism.org
www.ekoturism.org
www.grain.org
www.lapplandsafari.se
www.naturensbasta.com
www.tourismconcern.org.uk
www.wildhorseriding.com
www.wildland.com

18

Global Climate Change and Tourism: Severity and Need for Action

Stefan Gössling and C. Michael Hall

> Wake Up … This is Serious (headline in *The Age*)
>
> (Fyfe 2005)

> If our economies are to flourish, if global poverty is to be banished, and if the wellbeing of the world's people [is to be] enhanced – not just in this generation but in succeeding generations – we must make sure we take care of the natural environment and resources on which our economic activity depends.
>
> (Gordon Brown, UK Chancellor of the Exchequer, 15 March 2005)

As the various chapters in this book have indicated, tourism is implicated in a number of key areas of global environmental change (GEC). Tourism is both a factor in GEC and is, in turn, affected by it. However, arguably one of the most remarkable aspects of tourism's relationship to GEC is the relative lack of attention paid to these issues not only by much of the tourism industry but also by many people who research tourism. Indeed, tourism is often portrayed as a significant contribution to the conservation of natural resources, particularly through the growth of 'ecotourism' and 'sustainable' tourism which serve as clarion calls for academic research as much as they do for government and industry. Indeed, the word 'sustainable' is now seemingly a 'standard' term to throw into tourism planning documents which is then seen to magically transform them into something that will make a better contribution to stakeholders in the tourism development process, whether they are willing stakeholders or not (Mowforth and Munt 1998). This is not to say that the editors are claiming that tourism is necessarily an 'evil' industry. Instead, the evidence of this book suggests that tourism is like any other industry, it does make some positive contributions to society, communities and the environment but it can also be extremely negative. Critically, tourism cannot claim to have any moral high ground. Furthermore, for all the writing about sustainable tourism since the mid-1980s, the global evidence clearly suggests that in terms of damage to the environment things have got worse, not better.

Issues of scale and perspective

Arguably, one of the key problems in understanding tourism's contribution to GEC is the issue of scale as it applies to both conceptualising tourism and undertaking empirical research. For example, conceptually the notion of sustainable

tourism is highly problematic in terms of GEC, as it is highly likely that one can have sustainable tourism without other elements in a specific environment also being sustainable. Instead, the focus needs to be on the potential benefits of tourism within a wider context. But then, what should that context be? Most tourism research occurs at the destination (Hall 2005a). At first glance this would seem obvious – but then first looks can be deceiving. The reality is that it has long been recognised that a tourist trip occurs in various stages, which are usually divided into decision to travel, travel to destination, return travel, and the recollection stage once the traveller has returned 'home'. Why, therefore, should one focus just on the destination stage given that the effects of tourism will be felt at all those stages? This is not just an 'academic' observation but one that goes to the heart of understanding tourism's global contribution to environmental change. In fact, the further one travels the greater will be the environmental impacts of tourism away from the destination. For example, in their study of the ecological footprint of international tourism to the Seychelles, Gössling *et al*. reported that more than 97 per cent of the energy footprint was the result of air travel:

> This implies that current efforts to make destinations more sustainable through the installation of energy-saving devices or the use of renewable energy sources can only contribute to marginal savings in view of the large amounts of energy used for air travel.
>
> (2002: 208)

From a global perspective, transport produces approximately 20 per cent of carbon emissions and smaller shares of the other five greenhouse gasses covered under the Kyoto Protocol. According to International Energy Agency statistics, the transport sector's share of world greenhouse gas (GHG) emissions increased from about 19 per cent in 1971 to 23 per cent in 1997 (IPCC 2001), with CO_2 from combustion of fossil fuels the predominant GHG produced by transport, accounting for over 95 per cent of the annual global warming potential produced by the sector (IPCC 2001). The transport dimension is clearly critical in understanding the impacts of tourism because, although transport is responsible for about one fifth of worldwide energy consumption, approximately two thirds of transport energy demand in OECD countries is from passenger travel. In 1997, 54 per cent of the oil purchased by OECD countries was for transport, with an increase of 62 per cent projected by 2020 (Doering *et al*. 2002). Although nearly all modes of transport are showing growth in energy use air transport is the second largest, and most rapidly growing mode, accounting for about 12 per cent of current transport energy use (IPCC 2001). Thus, a key 'finding' of this book is that it is vital to look at the impacts of tourism over the totality of travel and travel decision making and not just in isolation. This not to deny that ecotourism, for example, can make a positive contribution to biodiversity conservation and community well-being at a specific location, but to point out that it should also be acknowledged that there are negative environmental outcomes arising from the travel to and from destinations that must be accounted for.

The environmental impacts of tourism also need to be understood over the life-span of the individual. Indeed, commentators such as Lanzendorf (2000) and Hall (2005b) have argued that such an approach needs to be undertaken in order to see how people exchange or substitute certain blocks of leisure mobility activity in time and space depending on their lifestyle, accessibility and mobility arrangement (e.g. see Ceron and Dubois (2003) for the implications of this with respect to leisure mobility contribution to climate change). Indeed, within tourism development there has generally been little attention to energy and environmental implications of the lifespan of infrastructure either. For example, Hall (2000) in discussing issues of designing sustainability in tourism identified the role of preservation in retaining inter-generational equity, noting that stadia, festival marketplaces and convention centres are often constructed with the likelihood of relatively short-term periods of use, in the order of 15–30 years, before they are replaced. Indeed, in terms of creating options for future use, one of the tenets of sustainability, Lynch (1972) writes of 'future preservation':

> Our most important responsibility to the future is not to coerce it but to attend to it. Collectively, [such actions] might be called 'future preservation', just as an analogous activity carried out in the present is called historical preservation.
>
> (Lynch 1972: 115)

Similarly, Brand (1997: 90) observed that: 'Preservationists have a philosophy of time and responsibility that includes the future'. In this sense, the preservation movement is creating a form of inter-generational equity through the maintenance and adaptive re-use of buildings and structures from one generation to another, while also contributing to substantial economic and energy savings. For example: 'Even extensive rehabilitation (services, windows, roof) typically costs 3 to 16 per cent less than demolishing and replacing an old building' (Rypkema 1992: 27), while preservation can also help conserve the 'embodied energy' of buildings and reducing the solid-waste burden of demolition (Rathje and Murphy 1992). However, with respect to preservation and recycling of old buildings, cultural and aesthetic arguments only go so far, 'economic' issues tend to remain at the forefront of site preservation (Hall 2000).

In examining impacts the temporal and spatial scale of analysis therefore becomes highly significant (Lew and Hall 1998). Figure 18.1 indicates the importance of temporal and spatial resolution in assessing mobility related phenomena and highlights that the primary scale of research in tourism studies generally fails to intersect with the scale of analysis usually required to understand processes of change. Moreover, the more typical scale of analysis of research of tourism also fails to examine potential relationships between daily leisure mobilities and social and environmental change, even though such mobilities are also related to tourism. Figure 18.2 emphasises, for example, where tourism-related research is concentrated in terms of scales of analysis with respect to socio-economic systems, biodiversity and climate. Such clear failings in the underlying ontology and epistemology of much of tourism studies, at least with respect to potential contributions

to understanding processes of global change and mobility, have begun to be substantially critiqued (e.g., Frändberg 1998; Coles *et al*. 2004). Nevertheless, the existence of this disconnect between scale of problem and of analysis may go some way to explaining the failure of much of tourism studies and, possibly, even the tourism industry to come to terms with issues of GEC. Perhaps just as critically, the relatively narrow scale within which tourism studies operates and a poorly developed though still utilised 'ergodic hypothesis' of tourism development – an expedient research strategy by which different areas in space are taken to represent stages in time in the 'evolution' of tourism and a tourism destination – also means that it is extremely difficult to adequately integrate data sets to identify 'at-risk' tourism destinations. (Table 18.1 does provide a list of such destinations; however, extreme caution needs to be applied to its use because of the extreme rate of variability of data in time and space that apply to different risk factors.)

Table 18.1 Most at-risk destinations

Land biodiversity loss	*Marine biodiversity loss*	*Urbanisation*
Polynesia/Micronesia	Polynesia/Micronesia	Coastal Mediterranean
Sundaland	Caribbean	Coastal southern China
California	Maldives	Coastal Malaysia
Mediterranean Basin	South China Sea	Coastal California
South African Cape region	Mediterranean	Florida
Water security	*Sea-level rise*	*Regime change/fuel*
South Africa	Mediterranean	Australia
Mediterranean	Gold Coast	New Zealand
Australia	Florida	Polynesia/Micronesia
Central America	Coastal China	South Africa
South-west USA	Polynesia/Micronesia	East Africa
Warmer summers	*Warmer winters*	*Disease*
Mediterranean	European alps	South Africa
California/western USA	Pyrenees	Mediterranean
North Queensland	Rocky Mountains	Western Europe
South Africa	Australian alps	USA
Western continental Europe	Eastern European alpine areas	Northern Australia
Cumulative		
South Africa		
Mediterranean		
Queensland		
South-west USA		
Polynesia/Micronesia		

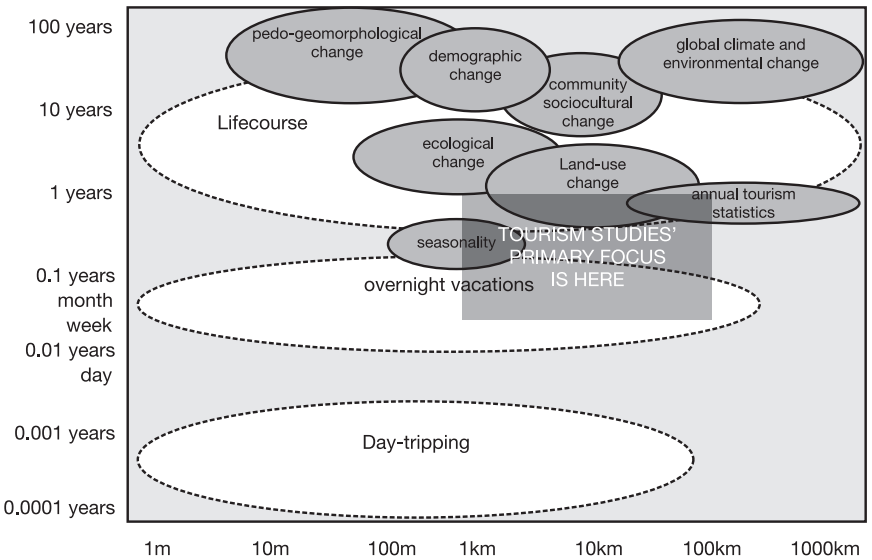

Figure 18.1 The influence of temporal and spatial resolution on assessing mobility-related phenomena

Socio-economic systems	**Biodiversity**	**Climate**
International	Global	macroclimate
Supranational	Continental	
National	Biome	
Regional	Bioregion	
	Landscape	
Local	Ecosystem	
Family	Stand/field/communities	mesoclimate
Individual	Individual species	microclimate

Figure 18.2 Scale in tourism analysis. The relative darkness of shading indicates the relative concentration of research at those scales

Adaption, mitigation and response

The tourism industry is increasingly having no choice but to engage with GEC issues. However, the nature of such engagement is highly variable. At a firm and resort level, interest is highest in those destinations that are already starting to be affected by GEC and climate change in particular (Scott *et al*. 2004; Bürki *et al*. 2005; see also Scott, Chapter 15, and Nöthiger *et al*., Chapter 16, this volume). This means that many alpine winter resorts are starting to attempt to develop technological and product strategies that respond to changes in winter snow cover as well as greater variability in snow conditions (*The Observer* 2004). Similarly, some coastal destinations that are concerned about the impacts of high-intensity storm events are also starting to examine the impacts of GEC. Nevertheless, the reasons for such concerns do not necessarily arise out of a focus on the need to conserve the environment or even address possible changes in the behaviour of current or potential visitors. Instead, the tourism industry is often responding to external factors in the form of bank and lending institutions' interest in the viability of business operations and business risk, insurance company interest in assessing risk, and government interest in meeting international treaty obligations, development implications and the costs of responding to the impacts of GEC (Yohe *et al*. 1996). For example, it was not until 2003 that the World Tourism Organization organised its first conference on climate change and tourism.

At the level of individual firms, especially small business and entrepreneurs, it is also important to recognise that while GEC issues are significant they may not be ranked to be as significant as other, more immediate issues. For example, in a study of marine tourism operators in New Zealand, operators expressed substantial concern over commercial over-fishing, 'cowboy' operators and pollution of the marine ecosystem, and moderate concern as to the impacts of global warming. Interestingly, another area of significant concern was that the marine tourism industry would be overregulated (Orchistron 2004). Similarly, in a review of perceived threats to food and wine tourism operators in British Columbia, Western Australia, Victoria and New Zealand, Hall *et al*. (2003) reported that GEC issues such as biosecurity, climatic change and urbanisation were regarded as potential threats. Nevertheless, such threats were not regarded as being as significant as those that related to wine quality, service quality and increased competition. The relative ranking of threats to business will have substantial implications for how operators perceive the risks associated with GEC and are therefore willing to undertake mitigating responses that would otherwise be regarded as an unnecessary cost to business (see Burton 1997; Reilly and Schimmelpfennig 2000; Clark *et al*. 2001a, b; White *et al*. 2001; Yohe and Tol 2002; Berkhout *et al*. 2004).

Tourism and climate change are clearly interrelated: tourism contributes to climate change and it will be affected by climate change. Nevertheless, there appears to be a low level of support for measures that are aimed at reducing emissions of GHGs. This is, for the industry as a whole, highly irrational from an environmental point of view. In a recent study, Gössling *et al*. (2005a) analysed the eco-efficiency of tourism – emissions of CO_2-equivalents per unit of financial

value generated – finding that eco-efficiencies can vary by several orders of magnitude. For example, in France, eco-efficiency ranges from 0.04 $kgCO_2$-e/ for Swiss tourists in the French countryside to 16.01 $kgCO_2$-e/ for Latin American visitors. Hence, the eco-efficiency of different tourist types in France varies by a factor of at least 400. The study also attempted to identify sectors of the tourism industry that are particularly harmful for the environment and economically less beneficial. The case studies included – from France, the Seychelles, Rocky Mountains National Park, Val di Merse/Italy and Amsterdam – suggest that the longer the travel distance, the less favourable become eco-efficiencies, confirming that air travel is the most important factor negatively influencing tourism's environmental sustainability. Long stays improve eco-efficiency, as do high expenditures per day, but these two factors need to be particularly high in order to counter the negative effect of long travel distances. In summary, large parts of tourism may be favourable from an environmental and economic point of view, but another share of tourism, generally based on long-distance air travel, is characterised by low value generation and high environmental damage. The study concludes that minor changes in the tourism production system could lead to great reductions in CO_2-e emissions at very low economic costs.

Currently, an eco-tax is under discussion to reduce the rapid growth in air travel and its environmental impact. However, it is questionable whether relatively small increases in prices for oil or eco-taxation would have a substantial impact on further growth of air travel. Rather, the growing perception in the developed world of air travel as a relatively cheap means of transport, fostered through campaigns by low-fare airlines to fly at zero cost or to give away seats, help create the perception that flying is cheap. This results in the paradox that oil prices hit a new high at US$55 a barrel for the first time in human history, while on the very same day a Swedish tabloid press headline can read 'fly wherever you want for 1 Swedish Crown' (1 Swedish Crown being equivalent to €0.11). As long as this perception of cheap flying dominates – in contrast to the perception that trains are expensive – there is little hope that only relatively small increase in prices, for example, in terms of 'temporary' aviation fuel price levies used by some major airlines in 2004 and 2005, will lead to a change in travel behaviour. On the contrary, currently ongoing changes in society, including air commuters – people living in one place and working in another – as well as children and a majority of young people becoming used to flying as a standard means of transport, will make it difficult to break with this trend and encourage substitution of transport modes.

There is little doubt that GEC will have far-reaching consequences for human activities (IPCC 2001). Options and opportunities for adaptation are thus of great importance. Global environmental change is both a long-term process, including, for instance, increasing temperatures, sea-level rises and biodiversity loss, as well as a process characterised by more sudden changes, as for example, land-use change, the rapid diffusion of disease, heat waves, storms and other weather extremes. While long-term processes such as increases in temperature are moderately slow and comparatively easy to consider in planning, extremes are not. Hence, it is far more difficult to deal with extremes, which are far more

unpredictable but have a far greater impact (Changnon *et al*. 2001; Changnon 2003a, b; Hovarth 2003; Schär and Jendritzky 2004; Schär *et al*. 2004; Moberg *et al*. 2005). Nevertheless, any strategy dealing with adaptation needs to consider both processes. Stakeholders can basically act in two different ways: they can continue operations until they become unfeasible and react when extremes hit, or they can adopt a precautionary attitude. The first option will largely be based on technology, and is already widely used in specific environmental situations. For example, making snow with snow cannons has now become standard practice in most low-level alpine resorts (e.g. Scott *et al*. 2003, 2004). However, it is clear that technological fixes are usually cost- and energy-intensive and thus hardly sustainable in the medium or long term. As Hasselmann *et al*. (2003: 1923) reported:

> Even if forcefully implemented, currently available low-cost technologies have limited capacity for substantial global emission reduction and will not be able to counter the rising emissions projected for the long term. Future emissions will be driven mainly by the expanding populations of the developing world, which strive to achieve the same living standards as the industrial countries. An emissions reduction of 50% applied to a projected BAU increase in this century by a factor of four … still leads to a doubling of emissions, far from the long-term target of near-zero emissions. Furthermore, the mitigation costs for today's technologies are estimated to rise rapidly if per capita emissions are reduced by more than half … although the Kyoto protocol will boost technologies that are cost-effective in the short term, further emission reductions in the post-Kyoto period could be limited by prohibitive costs. Without affordable new technologies capable of higher global emission reductions, stricter emission reduction targets will be considered impossible to meet and will not be adopted.

In this context, it should also be noted that there might be great differences in the adaptation capacity of tourists, tour operators and tourist infrastructure stakeholders, such as hotels and resorts. Tourists might be the most flexible of these categories, being less spatially constrained in terms of mobility – they have the capacity to adapt both spatially and temporally to GEC (Madison 2001; Elsasser and Bürki 2002; Lise and Tol 2002; Hall and Higham 2005). For example, if desired conditions no longer exist during a certain month of the year, the tourists might simply choose to travel to that place in the main season. When destinations no longer provide desired conditions, tourists can substitute these places for other places. Tour operators might be able to direct tourist flows to new destinations, making contracts with new hotels and redirecting flights. Hotels and resorts might be the least flexible in this process, as they might not be able to move when, for example, snow fall is greatly reduced, and they represent substantial amounts of sunk costs. However, they might, particularly if privately owned, be able to create and find new visitor attractions and marketing strategies, as for example under prolonged summer seasons. Once again, there is great uncertainty, because the level of expected changes is not easily predicted. For example, snow fall reduction

might go along with increasing rainfall, which might cause landslides. These could become by far more relevant to tourist industries. However, the most relevant parameter might be the specific characteristics of destinations.

Destinations might be unique in the sense that they offer sights or landscapes that cannot be found anywhere else in the world. For example, the Taj Mahal is an important World Heritage Site in India, and people might continue to visit it even if general conditions for vacation making in the area become less favourable, thereby leading to new seasonal demand patterns. Similar is true for a great range of unique sights worldwide. Such unique places, which will often be human made, can be assumed to generally be more resilient as long as they are not hit by extremes. Coral reefs, on the other hand, can be found all around the tropics, and as long as they are not very special in character – for example, with respect to specific species – diving and snorkelling tourists might seek to visit those places where reefs are still intact (Gössling *et al*. 2005b). The capacity to substitute destination attributes will therefore become an extremely important factor in the longer-term competitiveness of attractions and destinations under GEC (Hall and Higham 2005). Other variables will also continue to shape travel decisions, however. For example, many people have favoured destinations, where they have visited regularly over long periods. Such destinations relying on a large number of recurrent tourists might be able to maintain the tourist system even under less favourable conditions because of customer loyalty. Similarly, certain types of tourism related to business travel and visiting friends and relations is also likely to be reasonably resilient in the face of GEC, although new patterns of visitation over time are still likely to emerge.

In this context, the relative costs of vacation making will need to be considered. At the moment for example, within Europe, long-distance travel is still cheap in comparison to most inner-European destinations. This might change when prices for air travel increase along with the possibility of new taxation regimes, although such regimes are meeting substantial opposition from airlines (Seager 2005). For example, Giovanni Bisignani, Director General and CEO of IATA (International Air Transport Association) commented:

> Environmental responsibility is a pillar of the air transport industry … All industries are being challenged to do better. But air transport is under particular attack. We must set the record straight on our industry's excellent environment record with facts and figures.
>
> (Bisignani 2005)

As yet, little is known of how such increasing prices will affect tourism, because there is some uncertainty about the price-elasticity of certain categories of tourists (Brons *et al*. 2002). Adaptation might then become relevant in terms of lifestyles, where recreation at home or nearby will become relevant. Furthermore, in the longer term, destination substitution might be difficult in cases where local and regional markets are replaced by long distance markets because mitigation policies are likely to focus on reductions of GHGs within specific jurisdictions. Because air

travel causes substantial emissions, taxes and increasing energy prices might turn such substitution strategies into cases of maladaptation.

This *is* serious

In concluding a book such as this the editors would love nothing more than to be able to say that government and industry are willingly implementing the solutions that are in hand. Unfortunately, that is not the case. The media focus on the Kyoto Protocol coming into force in early 2005 seemed to suggest that something had been done – an example of good media coverage is that in *The Guardian* (2005). Indeed, it had, but it was only a very short-term holding mechanism which the largest energy consumer and GHG emitter in the world, the USA, deliberately chose to ignore, while it also did not apply to two of the world's fastest growing energy consumers, China and India. Moreover, from more of a direct tourism perspective, aviation fuel is exempt from the Kyoto Protocols. As Hasselmann *et al*. (2003: 1924) have stressed:

> Because the global political-economic system exhibits considerable inertia, a transition to a sustainable climate can be achieved without major socioeconomic dislocations only if the introduction of appropriate measures addressing the long-term mitigation goals is not delayed.

However, it is significant to note that since Hasselmann *et al*. (2003) gave their warning the situation regarding rapid climate change in the near future has begun to look more serious (Arctic Climate Impact Assessment 2004; Cox *et al*. 2004; Kerr 2004; Leemans and Eickhout 2004; Parry *et al*. 2004; Challenor *et al*. 2005; Leemans and van Vliet 2005; Pachauri 2005; Parry 2005; Rapley 2005; Stainforth *et al*. 2005). For example, Leemans and van Vliet (2005) reported that in the previous decade more ecological consequences have occurred than expected from the observed average 0.7°C warming trend and that current impact assessments of climate change are likely to underestimate ecological impacts and vulnerabilities.

Given the overview of GEC that this book presents it is readily apparent that the world, and tourism as a part of the global socio-economic system, is facing some grave challenges. Although there is an international system of governance in place for global environmental change concerns such as climate change, biodiversity, health and wetlands (Young 2002; Jagers and Stripple 2003), the place of tourism within this is poorly understood. Perhaps of even greater concern is that the tourism industry, for the greater part and for all the official statements regarding sustainable tourism and ecotourism, does not even seem unduly concerned by global environmental change issues. The fundamental goals of the World Tourism Organization (2001) and the World Travel and Tourism Council (2003) are to encourage and promote tourism mobility, perhaps with somewhat of a green tinge so as to assauge industry and individual guilt, because then you can travel to help people through pro-poor tourism or help the environment.

Please forgive the editors for what may seem academic cynicism. It is not. There is probably nothing more that the authors would want in relation to tourism than for it to contribute to alleviating poverty and encouraging a healthier environment. However, the reality is that concentrating on tourism alone, and by that we mean the tendency to focus just on what is happening at the destination, is one of the great problems with sustainable tourism. For tourism to really contribute towards security and sustainable development it needs to be placed within the bigger picture of human mobility, lifestyle, consumption and production. The consumption and production system that seeks to use 'pro-poor tourism' by those from the developed countries to help those in the developing world is the same consumption and production system that has often led to the situations that have contributed to inadequate development practices and poverty in the first place. The most sustainable forms of tourism in many cases may well be no tourism at all, rather focussing on other dimensions of development and a full consideration of alternatives.

The forecasts suggested for travel and tourism in the foreseeable future (Table 18.2) are just not sustainable if there is also the wish to mitigate the contribution of tourism to global climate change, biodiversity loss, health and disease impacts as well as other aspects of GEC. There is a desire in many people in developed countries, which is where the majority of tourists come from, to consume more sustainably. But to do so means to think about the totality of their consumption, where it occurs and its overall environmental and economic impact (Alfredsson 2002, 2004). This may well mean changing not only lifestyles but also seeking to change the consumption and production systems that, at times, actually give us very little real choice about what we consume and its impacts. Sustainable tourism does not necessarily mean no travel, but it does mean full costings of the impact of when you do travel and seeking to use low per capita energy pathways. In terms of the tourism industry it is also time that tourism was treated realistically like any other industry in terms of its costs and benefits and that its impacts were also fully charged for (Gössling 2005). This will not necessarily mean that there will be less tourism and leisure but it is likely that it will have different patterns to those that exist at present (Høyer 2000). Although it is time that the tourism industry became fully responsible for its actions this is not to single the tourism industry out for criticism. Indeed, issues surrounding religious and moral aspects of population growth, the role of major multinational corporations, particularly in the energy industry, government inaction, and the lack of sufficient media attention on GEC are all part of the reason why GEC is such a serious challenge to human welfare and security. And when, as at the time of writing, the trial of Michael Jackson receives more media coverage on most 'news' channels and evening reports than the empirical consequences of climate change, biodiversity loss and emergent diseases, such as avian flu in Asia, then you know that you have a problem.

Human evolution has been profoundly influenced by natural processes of environmental change. The human genus diverged from that of the other Great Apes in Africa 5–6 million years ago as the cooling of the Pliocene produced an ecological niche 'for an ape able to survive mostly out of the forest' (McMichael 2001: 39). It is now generally agreed that a succession of Homo species migrated out of Africa

Table 18.2 United States passenger and travel forecasts

Year	*Total passenger traffic to/ from the US (US and foreign flag carriers)*	*US commercial air carriers actual and forecast system average passenger trip length*	*US commercial air carriers: total scheduled US passenger traffic system revenue passenger miles*	*US commercial air carriers: total scheduled US passenger traffic system revenue passenger enplanements*	*Total jet fuel and aviation fuel consumption US civil aviation aircraft**	*Total jet fuel and aviation fuel consumption US civil aviation aircraft**	*Total CO_2 equivalent emissions*
	(millions)	*(miles)*	*(billions)*	*(millions)*	*(millions of gallons)*	*(millions of litres)*	*(million kg)*
1999	131.4	979.9	652.4	665.8	20,743	78,521	614,671
2000	140.6	995.7	694.6	697.6	21,350	80,818	632,652
2001	128.8	1,011.6	691.4	683.4	21,094	79,849	625,067
2002	120.8	1,008.8	631.3	625.8	18,761	71,018	555,937
2003	120.0	1,010.3	648.6	642.0	19,128	72,407	566,810
2004	134.0	1,042.1	717.4	688.5	19,372	73,331	574,043
2005	145.4	1,056.1	757.8	717.5	20,332	76,965	602,490
2006	155.0	1,067.1	805.5	754.9	21,536	81,523	638,171
2007	163.2	1,075.6	845.0	785.6	22,533	85,297	667,714
2008	170.8	1,083.3	878.6	811.0	23,405	88,598	693,555
2009	178.2	1,090.8	913.4	837.4	24,278	91,902	719,419
2010	185.6	1,098.5	950.1	864.9	25,199	95,389	746,716
2011	193.1	1,105.1	986.4	892.6	26,124	98,890	774,122
2012	200.7	1,111.8	1,023.9	921.0	27,069	102,467	802,123
2013	208.4	1,118.2	1,063.1	950.7	28,038	106,135	830,836
2014	216.4	1,125.2	1,104.9	981.9	29,063	110,015	861,210
2015	224.5	1,132.7	1,149.4	1,014.7	30,144	114,107	893,242
2016	232.9	1,139.4	1,194.8	1,048.6	31,237	118,245	925,635

* includes both passenger (mainline air carrier and regional/commuter) and cargo carriers.

Source for passenger and fuel consumption numbers
US Department of Transportation Federal Aviation Administration (FAA) (2005) *FAA Aerospace Forecasts: Fiscal Years 2005–16*, US Department of Transportation Federal Aviation Administration Office of Aviation Policy and Plans.

and in many cases co-existenced until around 27,000 years ago, or perhaps even more recently in some parts of the world. Here again climate and environmental change, along with competition, played a major role. Since that time *Homo sapiens* has been the sole survivor of the Homo genus and, as McMichael (2001) poignantly observes, if the current scale of anthropogenic change continues and species and ecosystems come under increasing pressure, it could become the sole representative of the whole great ape family in the very near future.

Increased mobility has been central to the capacity of humans to move to almost every environment on the planet. Mobility also lies at the heart of global anthropogenic environmental change, with tourism being a significant contributor to such change even though it often promotes itself as being environmentally friendly and a key factor in species conservation through 'ecotourism'. It would therefore be strangely ironic if the impact of tourism mobility also becomes the factor that leads to irreversible environmental change that will take not only many species and ecosystems with it, but possibly even humans themselves.

References

Alfredsson, E. (2002) *Green Consumption, Energy Use and Carbon Dioxide Emission*. GERUM kulturgeografi 2002:1, Umeå: Department of Social and Economic Geography, Umeå universitet.

Alfredsson, E.C. (2004) '"Green" consumption – no solution for climate change', *Energy*, 29(4): 513–24.

Arctic Climate Impact Assessment (2004) *Impacts of a Warming Arctic*. Cambridge: Cambridge University Press.

Berkhout, F., Hertin, J. and Gann, D.M. (2004) *Learning to Adapt: Organisational Adaptation to Climate Change Impacts*. Tyndall Centre Working Paper 47. Norwich: University of East Anglia.

Bisignani, G. (2005) 'Aviation and the environment', *Environment Summit*, 17–18 March, online. Available at: www.iata.org/pressroom/speeches/2005-03-17.htm (accessed 19 March 2005).

Brand, S. (1997) *How Buildings Learn: What Happens After They're Built*. London: Phoenix Illustrated.

Brons, M., Pels, E., Nijkamp, P. and Rietveld, P. 2002: 'Price elasticities of demand for passenger air travel: a meta-analysis', *Journal of Air Transport Management*, 8(3): 165–75.

Brown, G. (2005) 'Fulltext: Gordon Brown's speech on climate change,' *Guardian Unlimited* March 15. Available at: www.guardian.co.uk/climatechange/story/0,12374,1438296, 00.html (accessed 16 March 2005).

Bürki, R., Elsasser, H., Abegg, B. and Koenig, U. (2005) 'Climate change and tourism in the Swiss Alps', in C.M. Hall and J. Higham (eds) *Tourism, Recreation and Climate Change*. Clevedon, Channelview, pp.155–63.

Burton, I. (1997) 'Vulnerability and adaptive response in the context of climate and climate change', *Climate Change*, 36: 185–96.

Ceron, J.-P. and Dubois, G. (2003) 'Mobility patterns prospects and their impact on climate change'. Paper presented at Climate Change and Tourism: Assessment and Coping Strategies, Warsaw, 6–8 November, NATO Advanced Research Workshop.

Challenor, P., Hankin, R. and Marsh, B. (2005) 'The probability of rapid climate change'. Paper presented at International Symposium on the Stabilisation of Greenhouse Gases, Hadley Centre, Met Office, Exeter, 1–3 February.

Changnon, S.A. (2003a) 'Present and future economic impacts of climate extremes in the United States', *Environmental Hazards*, 5: 47–50.

Changnon, S.A. (2003b) 'Measures of economic losses from weather extreme', *Bulletin of the American Meteorological Society*, 84: 437–42.

Changnon, S.A., Changnon, J.M. and Hewings, G. (2001) 'Losses caused by weather and climate extremes: a national index for the US', *Physical Geography*, 23: 1–27.

Clark, W.C., Dickson, N., Jäger, J. and Eijndhoven, J.v. (eds) (2001a) *Learning to Manage Global Environmental Risks Volume 1: A Comparative History of Social Responses to Climate Change, Ozone Depletion, and Acid Rain*. Cambridge, MA: The MIT Press.

Clark, W.C., Dickson, N., Jäger, J. and Eijndhoven, J.v. (eds) (2001b) *Learning to Manage Global Environmental Risks Volume 2: A Comparative History of Social Responses to Climate Change, Ozone Depletion, and Acid Rain*. Cambridge, MA: The MIT Press.

Coles, T., Duval, D. and Hall, C.M. (2004) 'Tourism, mobility and global communities: New approaches to theorising tourism and tourist spaces', in W. Theobold (ed.) *Global Tourism: The Next Decade*, 3rd ed. Oxford: Butterworth Heinemann, pp.463–81.

Cox, P.M., Betts, R.A., Collins, M., Harris, P.P., Huntingford, C. and Jones, C.D. (2004) 'Amazonian forest dieback under climate-carbon cycle projections for the 21st century', *Theoretical and Applied Climatology*, 78: 137–56.

Doering, D.S., Cassara, A., Layke, C., Ranganathan, J., Revenga, C., Tunstall, D. and Vanasselt, W. (2002) *Tomorrow's Markets: Global Trends and Their Implications for Business*. A collaboration of World Resources Institute, United Nations Environment Programme, World Business Council for Sustainable Development.

Elsasser, H. and Bürki, R. (2002) 'Climate change as a threat to tourism in the Alps', *Climate Research*, 20: 253–7.

Frändberg, L. (1998) *Distance Matters: An inquiry into the relation between transport and environmental sustainability in tourism*. Humanekologiska skrifter no.15. Göteborg: Section of Human Ecology, Göteborg University.

Fyfe, M. (2005) 'Wake up – this is serious', *The Age* 12 February.

Gössling, S. (2005) 'A framework for the assessment of the global environmental costs of tourism', in B. Amelung, K. Blazejczyk, A. Matzarakis and D. Viner (eds) *Climate Change and Tourism: Assessment and Coping Strategies*. Dordrecht: Kluwer Academic Publishers (in press).

Gössling, S., Hansson, C.B., Hörstmeier, O. and Saggel, S. (2002) 'Ecological footprint analysis as a tool to assess tourism sustainability', *Ecological Economics*, 43: 199–211.

Gössling, S., Helmersson, J., Liljenberg, J. and Quarm, S. (2005a) 'Diving tourism and global environmental change. A perception case study in Mauritius', *Tourism Management*, submitted.

Gössling, S., Peeters, P., Ceron, J.-P., Dubois, G., Pattersson, T., and Richardson, R. (2005b) 'The Eco-efficiency of Tourism', *Ecological Economics*, (in press).

Hall, C.M. (2000) *Tourism Planning*. Harlow: Prentice-Hall.

Hall, C.M. (2005a) 'Time, space, tourism and social physics', *Tourism Recreation Research*, 30(1): 93–8.

Hall, C.M. (2005b) *Tourism: Rethinking the Social Science of Mobility*, London: Prentice-Hall.

Hall, C.M. and Higham, J. (eds) (2005) *Tourism, Recreation and Climate Change*, Clevedon: Channelview.

Hall, C.M., Sharples, E. and Smith, A. (2003) 'The experience of consumption or the consumption of experiences?: Challenges and issues in food tourism', in C.M. Hall, E. Sharples, R. Mitchell, B. Cambourne and N. Macionis (eds) *Food Tourism Around the World: Development, Management and Markets*. Oxford: Butterworth-Heinemann, pp.314–35.

Hasselmann, K., Latif, M., Hooss, G., Azar, C., Edenhofer, O., Jaeger, C.C., Johannessen, O.M., Kemfert, C., Welp, M. and Wokaun, A. (2003) 'The challenge of long-term climate change', *Science*, 302: 1923–5.

Hovarth, R.B. (2003) 'Catastrophic outcomes in the economics of climate change', *Climate Change*, 56: 257–63.

Høyer, K.G. (2000) 'Sustainable tourism or sustainable mobility? The Norwegian case', *Journal of Sustainable Tourism*, 8: 147–61.

IPCC (Intergovernmental Panel of Climate Change) (2001) *Climate change 2001: the Scientific Basis*, contribution of the working group I to the third assessment report of the Intergovernmental Panel of Climate Change. Cambridge: Cambridge University Press.

Jagers, S.C. and Stripple, J. (2003) 'Climate governance beyond the state', *Global Governance*, 9: 385–94.

Kerr, R.A. (2004) 'Three degrees of consensus', *Science*, 305: 932–4.

Lanzendorf, M. (2000) 'Social change and leisure mobility', *World Transport Policy & Practice*, 6(3): 21–5.

Leemans, R. and Eickhout, B. (2004) 'Another reason for concern: regional and global impacts on ecosystems for different levels of climate change', *Global Environmental Change*, 14: 219–28.

Leemans, R. and van Vliet, A. (2005) 'Responses of species to changes in climate determine climate protection targets'. Paper presented at International Symposium on the Stabilisation of Greenhouse Gases, Hadley Centre, Met Office, Exeter, 1–3 February.

Lew, A. and Hall, C.M. (1998) 'The geography of sustainable tourism: lessons and prospects', in C.M. Hall and A. Lew (eds) *Sustainable Tourism: A Geographical Perspective*. Harlow: Addison Wesley Longman, pp.199–203.

Lise, W. and Tol, R. (2002) 'Impact of climate on tourist demand', *Climatic Change*, 55(4): 429–49.

Lynch, K. (1972) *What Time Is This Place?* Cambridge, MA: MIT Press.

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

McMichael, A.J. (2001) *Human Frontiers, Environments and Disease: Past Patterns, Uncertain Futures*. Cambridge: Cambridge University Press.

Moberg, A., Sonechkin, D.M., Holmgren, K. Datsenko, N.M. and Karlén, W. (2005) 'Highly variable Northern Hemisphere temperatures reconstructed from low- and high-resolution proxy data', *Nature*, 433: 613–7.

Mowforth, M. and Munt, I. (1998) *Tourism and Sustainability: New Tourism in the Third World*. London: Routledge.

Orchistron, C. (2004) 'Marine Tourism in New Zealand', unpublished Master's thesis, Dunedin: Department of Tourism, University of Otago.

Pachauri, R.K. (2005) 'Avoiding dangerous climate change: 2nd keynote address'. Paper presented at International Symposium on the Stabilisation of Greenhouse Gases, Hadley Centre, Met Office, Exeter, 1–3 February.

Parry, M. (2005) 'Avoiding dangerous climate change: Overview of impacts'. Paper presented at International Symposium on the Stabilisation of Greenhouse Gases, Hadley Centre, Met Office, Exeter, 1–3 February.

Parry, M.L., Rosenzweig, C., Iglesias, A., Livermore, M. and Fischer, G. (2004) 'Effects of climate change on global food production', *Environmental Change*, 14: 53–67.

Rapley, C. (2005) 'Antarctic Ice Sheet and sea level rise'. Paper presented at International Symposium on the Stabilisation of Greenhouse Gases, Hadley Centre, Met Office, Exeter, 1–3 February.

Rathje, W. and Murphy, C. (1992) *Rubbish!* New York: HarperCollins.

Reilly, J. and Schimmelpfennig, D. (2000) 'Irreversibility, uncertainty and learning: portraits of adaptation to long-term climate change', *Climatic Change*, 45: 253–78.

Rypkema, D. (1992) 'Making renovation feasible', *Architectural Record*, January: 27.

Schär, C. and Jendritzky, G. (2004) 'Hot news from summer 2003', *Nature*, 432: 559–60.

Schär, C., Vidale, P.L., Lüthi, D., Frei, C., Häberli, C., Liniger, M.A. and Appenzeller, C. (2004) 'The role of increasing temperature variability in European summer heatwaves', *Nature*, 427(2 January): 332–6.

Scott, D., McBoyle, G. and Mills, B. (2003) 'Climate change and the skiing industry in Southern Ontario (Canada): Exploring the importance of snowmaking as a technical adaptation', *Climate Research*, 23(2): 171–81.

Scott, D., McBoyle, G., Mills, B. and Minogue, A. (2004) 'Climate change and the ski industry in Eastern North America: A reassessment', in *Proceedings of the International Society of Biometeorology Commission on Climate, Tourism and Recreation.* 9–12 June, Kolimbari, Crete, Greece.

Seager, A. (2005) 'Airlines warn of fuel tax meltdown', *The Guardian*, February 7.

Stainforth, D.A., Aina, T., Christensen, C., Collins, M., Faull, N., Frame, D.J., Kettleborough, J.A., Knight, S., Martin, A., Murphy, J.M., Piani, C., Sexton, D., Smith, L.A., Spicer, R.A., Thorpe, A.J., and Allen, M.R. (2005) 'Uncertainty in predictions of the climate response to rising levels of greenhouse gases', *Nature*, 433: 403–6.

The Guardian (2005) 'What is this Kyoto thing all about anyway?', *The Guardian*, February 3.

The Observer (2004) 'Fight to the last resort as Alpine crisis looms', *The Observer*, September 19.

White, G.F., Kates, R.W. and Burton, I. (2001) 'Knowing better and losing even more: the use of knowledge in hazards management', *Global Environmental Change B: Environmental Hazards*, 3: 81–92.

WTO (World Tourism Organization) (2001) *Tourism 2020 Vision – Global Forecasts and Profiles of Market Segments*. Madrid: WTO.

World Travel and Tourism Council (2003) *Blueprint for New Tourism*. London: World Travel and Tourism Council.

Yohe, G., Neumann, J.E., Marshall, P.B., Ameden, H., (1996) 'The economic cost of greenhouse induced sea level rise for developed property in the United States', *Climatic Change*, 32: 387–410.

Yohe, G. and Tol, R.S.J. (2002) 'Indicators for social and economic coping capacity – moving toward a working definition of adaptive capacity', *Global Environmental Change*, 12: 25–40.

Young, O.R. (2002) 'Evaluating the success of international environmental regimes: where are we now?' *Global Environmental Change*, 12: 73–7.