IMPLICATIONS OF GLOBAL CLIMATE CHANGE FOR TOURISM AND RECREATION IN WETLAND AREAS

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Abstract. Tourism and recreation are important economic activities which are major agents of change globally and, more specifically, in wetland areas. There is a regular round of activities associated with the seasons and anything which influences operating seasons is likely to have substantial consequences for tourism businesses. Atmospheric conditions influence both whether or not people will participate as well as the quality of the experience. In marine coasts, wetland recreations may be threatened by rising sea levels but recreation in inland water bodies may be affected more by deficiencies rather than superabundance of water. Marinas and recreational boating are harmed by extremes of both high and low water, particularly the latter which is the most likely situation under global climate change. Two main groups can be considered with respect to the potential to adapt to climate change. These are the participants themselves and the businesses which cater to them. It is argued that the former are likely to be much more adaptable than the latter.

Keywords: marinas, natural areas, tourism, seasonality.

1. Introduction

Tourism and recreation are major economic activities and important contributors to global change. Although the terms are sometimes used interchangeably, global change and climate change are not synonyms. Nor is global change restricted to physical phenomena. There are many other forms of global change which also deserve attention. Examples include population growth, rural-urban migration, technological change, economic restructuring and political realignments. Tourism and recreation are one form of such change. At a global level, international tourism has been growing steadily and, according to some estimates, is exceeded only by oil in the magnitude of its contribution to world trade (Pearce, 1981). Furthermore, it has been predicted that tourism will become the largest industry in the world by the twenty-first century (Leisure Industry Digest, 1985; Papson, 1979). In 1996, according to the World Tourism Organization, there were 591,864,000 international tourists which was a growth of 4.8 percent over the previous year. These tourists spent US$ 423 billion which was an increase of 7.6 percent over 1995 (World Tourism Organization, 1997). To these international travelers one should add somewhere between four and ten times as many domestic travelers. Thus, when we are considering tourism, we are discussing one of the largest movements of population in human history.

Studies of leisure, recreation and tourism are plagued by imprecise terminology (Wall, 1989b) and there is a substantial literature devoted to their

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definition and differentiation. However, this will not be pursued here for, in practice, recreationists, including tourists, often end up in the same locations doing similar things and the terms will be used interchangeably in this paper.

It is difficult to think of almost any area of land or water which, with or without human modification or management, does not have potential to provide some recreation opportunities. At the same time, the range of recreations is extremely large and each has its own environmental requirements. This makes generalization difficult. Although isolated studies exist of aspects of tourism in wetland areas, and a rapidly-expanding literature on nature tourism and ecotourism has emerged, data do not exist to indicate the relative importance of wetlands as providers of tourism and recreation opportunities. Nevertheless, it can be said with confidence that wetlands, both directly and indirectly, make a substantial contribution to outdoor recreation and, at the same time, wetlands may be threatened by the proliferation of recreation. One only has to view the modification of wetlands to build marinas and summer homes to find evidence of the latter. As pressures on wetlands increase from many sources, it is likely that different voices from the recreation lobby will be advocating preservation and use in an altered form, both reflecting legitimate but different recreational demands.

2. Assessing the Impacts of Climate Change for Tourism and Recreation

The magnitude of the implications of climate change for tourism and recreation will depend upon both the distribution and importance of tourism and recreation phenomena and the characteristics of climate change. Other things being equal, locations whose economies are highly dependent on tourism appear to be at the greatest risk. Writing in an international context, Wall (1992a) has suggested that domestic travel patterns are likely to be more stable than international travel because the former often take place in relatively short periods of free time, and time limitations place constraints on the destination choices of travelers (Lundgren, 1989).

Similarly, long-haul destinations are more at risk than those depending largely on a local market. In the developed world, even destinations which have an international reputation (such as Niagara Falls), rely heavily upon the regional market for a large proportion of their visitors and it appears that remote locations, distant from large urban markets are likely to be most at risk. Furthermore, destinations which rely primarily upon their natural resource base to attract visitors, such as mountains and coasts, including wetlands, are likely to be more at risk than those which depend upon cultural or historical attractions.

Much tourism and recreation is concentrated in such high energy environments as mountains and coasts and it is these areas which appear to be particularly vulnerable to climate change through modifications in the hydrological cycle, particularly changes in water levels, stream flow and the magnitude and timing of snowfall.

It should also be remembered that the climatic and weather parameters which influence tourism, both singularly and in combination, vary from activity to activity. Also some activities are much more sensitive to meteorological conditions than others. This makes generalization difficult. Although there is some information on the minimum climatic conditions necessary for particular activities to take place (Crowe et al., 1978) and suggestions have been made concerning the responses of participants in different activities to changes in the weather (Paul, 1972), more work in these areas is needed.

Atmospheric conditions influence both whether or not people will participate as well as the quality of the experience. In addition to the direct impacts of climate upon tourism, climate also impinges upon recreation in a less direct fashion. Thus, for example, an abundance of snow may make the skiing conditions very good but the journey to the slopes impossible. On a longer time scale, climatic change will influence the distribution of vegetation types (Neilson and Marks, 1994), wildlife (Brotton and Wall, 1997) and fish species (Meisner et al., 1987) on which some forms of tourism depend. Much tourism takes place on or near the shoreline and the presence of water enhances many forms of tourism even if water contact is not required. Fluctuations in climate at meso and macro scales have implications for water levels and discharge, and influence amenity and property values. Furthermore, the volume of water has implications for water quality and, in some locations, such as parts of the Mediterranean and the Great Lakes where beaches are closed periodically because of pollution, this is already marginal for body-contact recreations.

The above discussion has indicated the far-reaching consequences of weather and climate for tourism. However, most studies to date have been based upon short-term fluctuations in weather and climate and little has been written in the context of tourism on the implications of long-term climatic change. Unfortunately, it is difficult to quantify the possible consequences of climate change for tourism and recreation. In this context, it is useful to distinguish between economic values and economic impacts, both of which may be at risk from climate change. Economic value refers to the benefits derived from the use of a recreation opportunity or even merely knowing that the opportunity exists. Although an economic value can be imputed through contingency evaluation (such as the travel-cost method or willingness-to-pay) (Walsh, 1986), and this type of analysis has been undertaken for current conditions for some wetland areas (e.g. Kreutzwiser, 1981; Butler and Hvenegaard, 1988), this is not the same as actual monetary expenditures which result from the existence of a site. Analyses of impacts attempt to measure the consequences of such expenditures for incomes and jobs. Technical aspects of the methods as well as the fact that use may be displaced in time, location and to new activities as potential users revise their choices under new conditions, it is not possible to cumulate studies of particular sites to arrive at generalizations for large areas. This is true for present as well as for future conditions. In addition, where attempts to undertake economic evaluations of recreational evaluations of tourism and recreational activities and expenditures for large areas, such as those associated with wildlife in Canada (Filion et al., 1985), it is usually not possible to isolate the proportions that are attributable to wetlands. Similarly, the useful study of risks to recreational fisheries and aquatic environments undertaken for The Recreational Fisheries Institute of Canada (Bailey and Kerr-Upal, 1997) does not isolate the contribution of wetlands, and the quantitative information which it contains concerns awareness of issues associated with global climate change rather than the magnitudes of possible consequences. In such circumstances, it is not possible to provide quantitative values for the possible consequences of climate change for tourism and recreation in and around wetland areas, or even to provide ball-park estimates; to do so would be to fall into the trap of false precision. However, it can be safely assumed that future climates will influence the viability of alternative types of tourism, providing challenges and threats to some destination areas and enhanced opportunities for others. This paper draws upon existing studies to illustrate some of the risks and likely consequences which may be associated with climate change and variability and, of necessity, does this in a primarily qualitative manner.

3. Seasonality

One of the major attributes of most tourist destinations is seasonality. (Butler, 1994). Not only is there a regular round of activities associated with the seasons, there is also variation in activity in areas lacking a marked seasonal climate. This is because seasonality in areas of demand results in seasonal variations in visitation to areas of supply. Thus, for example, the desire for many Canadians to escape the Canadian winter to warmer climates creates a seasonal demand in temperate and tropical areas which do not have the same degree of annual variation in temperature.

The length of the season is of crucial importance, particularly for private sector operators of tourist facilities (McBoyle and Wall, 1986). Capital is invested all year round but, for many activities and destinations, the operating period is limited and profits must be made in a short period of time. Furthermore, use is further peaked in a limited number of holidays and weekends, and a few inclement weekends may tip the balance between profit and loss. Anything which influences the length of operating seasons, be they climatic factors or otherwise (such as the length and timing of school holidays) is likely to have an impact upon the viability of tourist businesses.

4. Wetlands

Almost all forms of recreation are enhanced by the presence of water Some, such as bathing and fishing, cannot be undertaken in the absence of water of appropriate quantity and quality. Other activities, such as hiking and camping often are attracted to shorelines and may be enhanced by the presence of water even if no direct contact with water is involved. It follows that anything which impinges upon the quantity or quality of water is likely to affect outdoor recreation. Furthermore, if water is in short supply, recreation will come increasingly into competition with other uses of this scarce resource.

Against the general background which has been presented above, attention will now be turned to the specific examples of the possible implications of climate change for recreation in selected wetland environments. Examples will be presented concerning marine wetlands, interior wetlands, Luther Marsh, marinas and boating, and natural areas.

4.1. MARINE WETLANDS

One likely consequence of global climate change is sea-level rise. Given the high concentration of people and recreational provision on maritime coasts, this may have considerable consequences for the provision of recreational opportunities. Marine wetlands are one recreational setting which has received some limited attention in the context of global climate change, particularly from the perspective of rising sea levels (Titus, 1988). These are environments which have been declining in area as a result of subsidence and the encroachment of other land uses. According to Titus (1988), there are three major ways by which sea level rise can disrupt wetlands: inundation, erosion, and saltwater intrusion. In some cases, wetlands will be converted to bodies of open water; in other cases, the type of vegetation will change but a particular area will still be wetland. However, if sea level rises sufficiently slowly, the ability of wetlands to grow upwards - by trapping sediment or building upon the peat the sediment creates - can prevent sea level rise from disrupting the wetlands. The factors principally responsible for determining accretion rates are sediment loads, current velocity, and flooding frequency and duration. Tidal range, tidal regularity and substrate type also influence marsh boundaries and therefore help to determine adjustments to rising sea levels (Armenato et al., 1988).

Along undeveloped coasts, rising sea levels will drown the seaward wetlands but will allow new wetlands to be created inland as formerly dry land is flooded. However, the impact of sea level rise on coastal wetlands will depend largely on whether developed areas inland of the marsh are protected from rising sea levels by levees and bulkheads. Along developed coasts, there may not be land available for wetland creation.

Sea level rise could become a major cause of wetland loss throughout the coastal zone of the United States. The coastal wetlands of Louisiana appear to be the most vulnerable to a rise in sea level and the coastal wetlands of the Mississippi River delta are already converting to open water at a rate of 50 square miles per year because of the interaction between human activities, such as the construction of levees and navigation channels, and current relative sea level trends caused by land subsidence. (Titus, 1988). Sanitation systems and fresh water supplies may be threatened by rising water levels and salination of coastal estuaries, and potable fresh water supplies may be reduced when sea water infiltrates subterranean water tables, as in parts of Florida. Should the frequency of tropical storms increase then there may be additional threats to coastal infrastructure from storm and flood damages.

Lindh et al. (1989) have reviewed the efficacy of structural measures for beach protection in a Finnish context and Coker et al. (1989) have succinctly summarized coastal policy options as do nothing, planned retreat or protect. However, the viability of these options is likely to vary with the site. A current policy dilemma is that many coastal protection schemes, and other tourism investments, have long lives and there is a need to make investments such that future options are not unduly foreclosed.

4.2. INTERIOR WETLANDS

In contrast to maritime coasts where water levels are expected to rise, regardless of possible changes in precipitation which are at present poorly understood, increased temperatures may increase evapotranspiration and thereby reduce the water in inland lakes and streams and increase the competition for that water which will exist (Wall, 1991). Thus, inland wetlands may be threatened more by too little water than too much, and a lowering of lake levels will have implications for the character and tourism potential of inland shoreline ecosystems. Some of the greatest impacts of lake level changes will occur along the margins of the Great Lakes where wetlands constitute important waterfowl habitat and a source of recreation for many people.

The author examined the possible implications of climate change for Point Pelee National Park and Presqu'ile Provincial Park on the Great Lakes shoreline in southern Ontario (Wall, 1988). Both parks contain large areas of marsh which are of considerable importance for wildlife and recreation. However they also constitute two different kinds of wetland systems with the potential to respond differently to changes in water levels. Point Pelee is a closed, protected marsh which is separated from the lake by natural barrier beaches. In contrast, the marsh of Presqu'ile is an open wetland system. In both cases the marshes are not influenced to any great degree by run-off from the mainland and water levels in Lake Ontario are a primary determinant of vegetational composition and functioning of the marshes.

In naturally confined marshes such as Pelee, lowered lake levels will cause the marsh to revert to marsh meadow and, eventually, to dry land. Because of the protective sand spits, the marsh will be prevented from moving lakewards and vegetation will shift from hydric to mesic conditions. Some plant species may change growth form to accommodate to drier conditions but vegetation will change dramatically as species intolerant of drying die and are replaced by species emerging from buried seeds. The trees which mark the landward edge of the marsh may advance due to a lowering of the flood line. Wetland species diversity will decline and the suitability of the marshes as a habitat for recreationally and commercially valued species, such as migrating waterfowl and muskrats, will be reduced. Sport fishing may also be affected by the reduced quality of shoreline marshes where fish feed and spawn. Other non-consumptive activities, such as canoeing and ice skating, will decline due to the lack of open water. The frequency of fires is likely to increase. In time, the marsh may lose its wetland character and, under extreme conditions, the waterfowl migration route may change resulting in the collapse of hunting and, more importantly in Point Pelee, birdwatching.

In open shoreline marshes such as Presqu'ile, the effects of lowered lake levels are unlikely to be as severe. Instead of a draining of the marsh and a trend towards dry land, there will probably be a shift in the vegetation in a lakeward direction. The extent of this shift depends upon the magnitude of the lake level change, the slope of the bottom profile and the suitability of the substrate.

It is evident that the impacts of climatic change on shoreline ecosystems will very considerably with the physiography of the littoral, not only because of the differential impacts of declining water levels but also because lakeshores with different characteristics currently support different kinds of recreation. For example, Wall and Costanza (1984) have shown that there are substantial differences in the patterns of recreation on the Lake Huron and Georgian Bay shorelines of he Bruce Peninsula and the former is affected much more than the latter by fluctuating water levels because it possesses a gently shelving coast.

Presumably, should water levels in the Great Lakes fall, then, other things being equal and given sufficient time, a new equilibrium will develop which will include the establishment of new wetlands in locations where the physiography of the littoral is suitable. However, as discussed in the section on marine wetlands, unfortunately, other things are unlikely to be equal and one should not assume that climate change forced by increases in greenhouse gases will terminate at a particular level. Furthermore, many of the major wetlands are currently under protection in national, state or provincial parks or some other heritage designation. There is no guarantee that locations with wetland potential will be under public jurisdiction and existing landowners may discourage the development of new wetland areas adjacent to their property. The requirements of other users, such as navigation and power generation, which may encourage dredging and filling or stabilization of water levels, will also militate against the formation of new wetlands. What are managers of existing wetlands to do if their holdings become less interesting ecologically and the original reasons for their designation as reserves evaporate?

4.3. LUTHER MARSH

Luther Marsh, which is an important, multi-functional wetland complex in southern Ontario provides a good example of a prominent wetland in an area where wetlands are shrinking in size and number and details of an investigation by Martinello and Wall (1993) of the possible implications of climate change for this wetland complex and associated human activities are presented below. Fully 80 percent of southern Ontario's inland wetlands have been converted to alternative land uses over the last century (Pringle 1980, Hooper, 1988). Of the original 2 million ha of wetlands surveyed in southern Ontario, 350,000 ha remain, scattered throughout 10,000 wetlands (Shay, 1981; Environment Canada, 1986). Agricultural reclamation accounts for 85 percent of wetland conversion, the cumulative result of municipal and private landowner decisions (Bardecki, 1981). Ontario wetlands continue to be lost at an annual rate of 2 percent per year, the most rapid rate of loss in Canada (Reid, 1979). The trend is nationally as well as regionally significant because, of the 18 percent of Canada covered by wetlands, 33 percent are concentrated in Ontario (Environment Canada, 1986).

The magnitude and frequency of wetland use conflicts are increasing in Wellington and Dufferin Counties, where Luther Marsh is located. The population of these counties is increasing with urban growth which is putting increasing pressure on the marsh but giving it added value to an expanding adjacent population. Hydrologic functions for summer streamflow augmentation and biological functions as a rich wildlife habitat are augmented by its recreational functions. It is ironic that wetland recreation may be a factor both in wetland conservation and its destruction but hydrologic, biologic and recreation functions are ultimately independent, and recreation use is often one of the strongest economic justifications for wetland conservation. Although the economic value of a wetland may increase with the intensity of recreational use, ecological costs may be incurred with the associated growth in infrastructure for visitors. However, those organizations that promote outdoor recreation and nature appreciation are often instrumental in acquiring and preserving wetlands.

The Grand River Conservation Authority encourages recreational use of Luther Mars. to the extent that it is possible with hydrological management responsibilities. The reservoir and open water support non-motorized boating, sport fishing, swimming and skating. Together with the distinct biotic features, they comprise a regionally significant variety of recreation attractions in a quiet rural setting. Hunting, nature viewing, photography, picnicking, canoeing, hiking, cross-country skiing, and snowmobiling are the main recreational activities within the Luther Marsh Management Area which is accessible from downstream population centers including Kitchener-Waterloo, Guelph, Cambridge and Brantford. Recreational activities do not generally interfere with the hydrologic and biologic functions of the wetland complex, although snowmobiling has resulted in the compaction of the Wilde Lake bog mat.

Facilities are limited to observation towers, canoe routes, picnic area, interpretive displays, hiking and snowmobile trails, and parking lots. To protect biological functions, portions of the internal road system are closed to vehicles at specified times Sanctuaries are marked and closed to the public from 15 March to 15 November, and the park is closed to all watercraft from spring breakup until 31 July.

Using output from General Circulation Models for a doubling of CO2, the water level of Luther Marsh is projected to decline. Increased precipitation would prolong the early spring runoff and increase the water supply. However, evapostranspiration will increase beyond additional supply causing the marsh to retract in area by late summer. Although periodic water level fluctuations and cycles of wet and dry years are necessary to maintain wetland diversity, greater extremes could impair the multi-functional values of Luther Marsh and require a reformulation of dam operation strategy. Lower water levels could affect recreation opportunities and values. The recreational value of wetlands is likely to decline in direct relationship to the number and diversity of species. The reduced variety and distinctiveness of the attractive species and intensified competition between consumptive users could reduce the spectrum of recreation functions. A decrease in the area and depth of water and the duration of snow and ice cover could restrict summer boating and fishing, and winter snowmobiling and skating. Activities such as hunting, trapping, and the perch and bait fishery could be impaired as target species decline in abundance.

No businesses depend upon the recreational functions of the marsh so that the economic impacts of modified recreational opportunities at this particular site would likely not be large. However, this is not to say that the recreation opportunities are without value and, cumulatively, if similar situations were also to arise at other alternative wetland destinations, both the cumulative lost values and economic impacts could be substantial. Furthermore, recreation is a secondary function and it is likely that limited water resources would be directed to low flow augmentation rather than maintaining reservoir levels for recreation. However, Luther Marsh is also valuable to recreationists at a greater distance since its hydrological functions help to maintain conditions for recreation along the Grand, a Canadian heritage river. If climate change impairs the hydrologic, biologic and recreation functions of Luther Marsh, a large but unknown number of recreationists may be forced to consider alternative, possibly non-water-based activities.

4.4. MARINAS AND RECREATIONAL BOATING

The Great Lakes have long been a mecca for recreational boating and fishing, and their shores are the location of recreational facilities such as private cottages and public parks. The lakes are also used for water supply, navigation and power generation, and the levels of the lakes fluctuate in response to climatic variations. Fluctuating water levels are required for the maintenance of ecological processes but some users, such as power generation and navigation, would prefer greater stability and relatively high levels, whereas others, such as cottagers, would prefer relatively stable lower levels. Marinas and recreational boating are harmed by extremes of both high and low water, particularly the latter which is the most likely situation under global climate change.

High water episodes were experienced in 1951-1952, 1973-1974 and 1985-1986 with low water periods in 1934 and 1964. Thus, there is a long history in the Great Lakes of adjusting to climate variability in periods of both flood and drought (Great Lakes Commission, 1990; Scott, 1993; Parker et al., 1993).

Surveys undertaken in 1992 of marina operators and recreational boaters on the Canadian side of the Great Lakes indicated that almost all had incurred costs at some time or other associated with fluctuating water levels (Bergmann-Baker et al., 1992-1993 and 1995). Since they had been operating their marinas (approximately one-third had been a marina operator for less than five years although most marinas were considerably older), in times of low water, 67 percent of respondents had experienced problems of access to docks or berths, 64 percent with inadequate channel depths, 62 percent had ramp access difficulties, 45 percent were forced to use fewer slips, 21 percent experienced short boating seasons and 13 percent had dry rot in wooden structures. In response to these problems, 55 percent had dredged, 45 percent had adjusted their docks, 44 percent restricted the sizes of boats, 44 percent had to relocate boats, 27 percent closed slips, 19 percent constructed floating docks, and 7 percent replaced rotted structures. Unfortunately, it is not possible to put a precise dollar value on these adjustments but clearly it has been substantial. In addition, other adjustments were made in periods of high water. In fact, there are examples of marina operators experiencing low-water problems at times when they are still paying off loans acquired to build breakwaters to protect themselves from high water.

Boaters also accrue a variety of costs but they are more mobile than marina operators and, thus, can adjust more easily. However, they may be affected in other ways. For example, global warming may increase fish productivity if water quality is not adversely affected but some significant species may decline and alien species may find it easier to colonize the lakes (Meisner et al., 1987).

The Great Lakes constitute a dramatic example of the implications of fluctuating water levels and, hence, climate variability, for recreational activities. However, other examples abound. One well-documented case is that of reservoir management on the Missouri River during the drought years of 1989-1990 (United States General Accounting Office, 1992). In spite of its current economic importance, because of historical priorities enshrined in legislation, recreational interests received lower priority in water management than navigation or irrigation even though this resulted in diminished system benefits. Receding shorelines in Fort Peck, Garrison and Oahe Reservoirs left many boat ramps inoperable and reduced use by between 23 and 63 percent even though the Corps of Engineers had spent $1.9 million to extend and relocate public boat ramps. There was a time-lag in the reduction of use because, initially, declining water levels concentrated fish and improved fishing. There was also a relocation of use from the upper to the lower portions of the reservoirs which remained accessible to boats. Thus, in June 1990, Lewis and Clark State Park on the upper portion of Lake Sakakawea was closed because the lake had totally receded from its marina but, in the same period, visitation at Indian Hills state recreation area on the lower portion of Lake Sakckawca, which remained accessible to boats, increased 111 percent from 25,855 to 54,648 visitor days.

As the Garrison reservoir became inaccessible to boats, businesses dependent on tourism, such as bait and tackle shops, marinas, park concessionaires and fishing resorts, lost revenues. For example, as of August 1989, 5 of 11 marinas on Lake Sakakawea had ceased operation and the city auditor of Parshall City, North Dakota, which is located near the reservoir, estimated a decline in revenues of 20 percent from reduced visitation. Conversely, visitors' spending in the six counties bordering Lake Oahe increased from about $6.6 million in 1987 to about $8.4 million in 1989. However, lack of water in the reservoirs resulted in less habitat for all species of fish and decreased spawning. Since much of the recreation on the reservoirs is based on sport fishing, poor spawning is likely to result in further loss of visitation.

A somewhat similar story emanates from California (Gleick and Nash, 1991) with the number of visitor-days of use of State Water Project facilities declining from a peak of 7.2 million in 1987 to about 6 million in 1990 as a result of the drought and the recession. The City of Santa Barbara estimated that they lost $30 million in tourism in 1990 due to publicity about the drought and fires. Declines in the striped bass sport fishery associated with reduced freshwater inflows in to San Francisco Bay and Delta have been estimated to have cost the State of California $28 million since 1970.

4.5. NATURAL AREAS

Natural areas are important tourism and recreation resources whose attractions are based to a considerable extent on the species which they conserve and the ecological processes which they sustain. Biophysical factors play a role in the definition of natural areas, park selection, ongoing management, and interpretation. In addition, management tools such as zoning, the content of interpretive programmes and the determination of appropriate recreational activities are based upon the biophysical attributes of each area. Management of natural phenomena, such as flora and fauna, is directly associated with ecology and habitat and, therefore, climate. Should climate change occur the implications for natural areas are likely to be far-reaching (Peters and Darling, 1985).

Global warming may modify many ecosystems on which outdoor recreationists depend. For example, Botkin et al. (1991) have shown that all of California's natural ecosystems would be modified by climate change. The 1988 drought in the United States, hailed by some as a taste of things to come, created severe problems for water, land and wildlife management. The size of duck breeding populations was severely limited in the northern prairies and, as has already been indicated, many sport fisheries on intermittent streams, small rivers and impoundments were severely depleted. The US Forest Service and Park Service had to deal with a large number of forest fires which adversely affected ongoing campground rehabilitation and caused areas to be closed to visitors (Smith, 1990). However, while there were immediate dislocations and investments may have been destroyed, in the long term, net value changes in recreation resources from fire are probably low (Flowers et al., 1985).

A study of Prince Albert National Park, Saskatchewan (Vetsch, 1986; Wall, 1989a), described future climatic conditions and corresponding vegetation changes and explored the array of potential implications of climate change for the study area and for the management of national parks. Vegetation was selected as the central variable of concern since it is the basis of habitat and a good indicator of environmental change. As is the case for much of the Great Plains and Prairies, climate scenarios suggest that Prince Albert National Park is likely to experience a warmer, drier climate in the future. Detailed examinations of theories of vegetation responses to environmental stimuli, climatic impacts upon vegetation, historical evidence of vegetation distributions, species' ecology, disturbance factors such as fire and grazing, and factors affecting species' distribution constitute the basis for speculating on the vegetation changes to be expected in Prince Albert National Park under the climate change scenarios. Based on these analyses, likely vegetation changes in Prince Albert National Park include an increase in the proportion of grassland in the park at the expense of boreal forest, and special resources within the park will be impacted by climate change with associated implications for park zoning, interpretive themes and recreation. Five such changes are outlined below:

4.5.1. *The transition from Grasslands to Boreal Forest*

The transition zone, or ecotone, between Boreal Forests and Grassland biomes is an important resource management and interpretive theme represented in the park. The edges of the biomes may be among the first areas to respond to an environmental change, with implications for the position and prominence of the transition zone. If climatic change is prolonged it is conceivable that the bulk of the transition zone may move north of the park. These vegetation changes may create the need to re-evaluate the unique and representative features of the park. In the immediate to short-term future, opportunities may exist to increase the emphasis placed on dynamic environmental processes in interpretation.

4.5.2.. *Fescue Grasslands*

The small areas of Fescue Grasslands are regarded as a special feature of the park because they are an outlier of the larger areas of Fescue Grasslands occurring approximately 60 km to the south, and because, for the past several decades, aspen has been encroaching onto the grasslands decreasing suitable habitat for elk and bison. Climatic change will promote the perpetuation of grassland communities in the park and could decrease the need for their special preservation as presently exists. However, continual alterations in the natural state of similar grasslands outside the park suggest that the Fescue Grassland communities contained within the park will still remain an anomaly for the region.

4.5.3. *American White Pelicans*

The only protected breeding colony of American White Pelicans in Canada is situated on Heron Island in Lavalee Lake near the northwestern border of the park. Changes in climate, as depicted in the scenarios, may have deleterious effects by changing lake water levels, exposing nesting islands to the shore and allowing the invasion of predators. However, the 32 degrees F (0 degrees C) April isotherm approximates the southern boundary of American White Pelican range, as it reflects the availability of fish at the time of the birds' arrival in their nesting areas. Climatic change will extend the ice-free period, potentially opening up suitable habitat north of present park boundaries;

4.5.4. *Woodland Caribou*

Woodland caribou in Prince Albert National Park are at the southern margin of their range and are concentrated in the northern portion of the park. They are considered a special feature of the park since they are generally found in more northern regions and because they are considered to be a rare species in Canada. The herd of approximately 38 animals migrates in and out of the park but does not move great distances. Preferred habitat is mature coniferous forest, such as black spruce muskeg, but this should decrease under warmer, drier climatic conditions. This might force caribou to find suitable habitat farther north, leaving no woodland caribou in the park;

4.5.5. *Free Roaming Bison*

The park supports a herd of free roaming bison whose primary habitat is the ecotone between grassland and forest. Encroachment on grassland by aspen and other woody growth has decreased bison habitat, causing them to move out of the park more frequently onto neighboring agricultural lands. Bison in this situation are not protected and have caused some conflicts with landowners. A future warming trend should increase the area of bison habitat in the park, reduce their need to roam, and help to reduce land use conflicts.

Thus, under doubled CO2 scenario conditions, changes could occur in the resources currently deemed special or rare. For instance, the Fescue Grasslands may no longer require special management for preservation but portions of the Boreal Forest may increase in significance. The summer recreation season will elongate and the winter season shorten, possibly resulting in greater recreation pressures. Increased land use pressures brought on by more frequent drought (as depicted in the scenarios) might result in a desire to convert currently marginal lands to agricultural uses. Such pressures may be manifest in increased conflicts between parks and uses of land for other purposes.

Climatic change also has implications for the amount of land devoted to parks and other natural areas, the size of each individual park, park selection and designation, and boundary delineation. The parks have a mandate to protect endangered species and act as ecological reserves. Prospects of climatic change and increased vulnerability of resources to such change, suggest a greater relevance of climatic criteria to the processes for designating parks and other reserves. For example, where possible, boundary designation should allow for the migration of species. The scenarios suggest a greater magnitude of climatic change in more northerly latitudes; hence, in such situations, greater emphasis should be given to placing parks in locations which are climatically optimal for the species being protected. There is a greater need for large parks with ecologically responsive boundaries. In northern regions, the concept of ecological islands is not viable because of the extensive migratory paths of many animals. How does one successfully design ecologically optimal locations when the impending climatic change is wide-ranging and the animals that are being protected are highly mobile? It is clear that climatic change has far-reaching consequences for individual parks and for park systems which are beyond the scope of this paper but which merit further investigation.

The points which have been made with respect to wetlands and Prince Albert National Park are applicable in a more general form to other ecosystems. A warming trend should lead to a poleward movement of biomes but individual species are unlikely to move at the same rate so that it is simplistic to view the process as one of intact ecosystems marching northwards (and upwards). In many parts of the world, natural areas are islands embedded in vast areas of modified landscapes, and in the absence of obvious routes for the spread of species or assemblages, it is unclear how the relocation of flora and fauna will occur. In fact, changes in the frequency of extreme events, such as fires or pest infestations, may be critical agents of change (Wall, 1992).

What is natural in an era of pervasive, human-induced change? What is to be protected and why? Climate change thus poses fundamental questions concerning both the designation and management of natural areas and the natural resource base for tourism and recreation.

5. Adapting to Climate Change

Both natural and human systems are adapted to an unknown extent to much of the variability in current climates and it is changes in the magnitude and frequency of extreme events through which the implications of climate change will most likely be imposed.

Two main groups can be considered with respect to the potential to adapt to climate change. These are the participants themselves and the businesses which cater to them. Each will be considered in turn.

5.1. PARTICIPANTS

A great deal of money is invested in recreational equipment. However, much of this equipment is mobile. By definition, recreational participation is a result of choice and, although choices are not unconstrained, a great deal of flexibilty is involved. Recreational participants have considerable choice concerning whether or not to participate, what activities to participate in, when to participate and where to participate. In fact, since the product of recreation is an experience, participants may be able to substitute activities and locations without a great deal of loss in the quality of their recreation. It is true that those wishing to observe particular species of plants and animals may find them less accessible or replaced by others, and fishermen may be required to change their quarry in particular locations, but in so far as there are still wild spaces and provision of recreational opportunities, most potential participants are likely to be able to satisfy their leisure needs.

5.2. BUSINESSES

The flexibility of participants may be a problem for those catering to recreational demands. Much recreational provision, be it a ski hill, a campground, a marina or a national park, is fixed in location with sunk capital that cannot readily be liquidated and re-invested. If the quality of the recreational resources and associated experiences are degraded or if the length of operating seasons is curtailed below economic viability, then there may be considerable economic dislocations for recreational businesses and the communities on which they depend. However, there are likely to be both winners and losers as participants exercise their choices in modified ways.

6. Research Needs

The following recommendations have been made in a draft report prepared for the Office of Technology Assessment of the US Congress (Wall, 1993). There is no question that greater spatial resolution, a greater variety of climate and climate-related variables, and a reduction in the uncertainty associated with climate scenarios generated from General Circulation Models are required if improved estimations of the likely implications of climate change for tourism and recreation are to be made. However, the improvement of such information is insufficient, by itself, to further such understanding. In fact, complementary research strategies are required, such as investigation of the adaptation of participants and recreation businesses to existing climatic variability.

Climate is only one factor among many which influence tourism and recreation. There is a need to assess the relative importance of climate as compared to other variables for different recreations and different locations.

Much might be learned through the use of existing climate data to assess current lengths of operating seasons, their temporal and spatial variability, and the associated economic viability of recreation businesses. Such studies would have considerable practical applications. One outcome of such analyses might be the more widespread acceptance of the utility of including climate change as one factor among others in assessments of the viability of recreation investments. However, even if climate change could be reliably forecast now, it is doubtful if the industry has, at present, sufficient understanding of its sensitivity to atmospheric variability to plan rationally for future conditions.

Since recreation involves, by definition, activities undertaken by choice, it is important to understand how alternative opportunities are evaluated by potential participants. Choices are not unconstrained and, if future choices are restricted by a modified climate, participants may be able to substitute one activity for another or one location for another. The assessment of the extent to which particular recreations and locations may be substitutes may thus be a fruitful area of research.

Assessment of the implications of climate change for natural area designation and management is an important research area which has yet to receive the attention which it deserves.

Other topics which are worthy of investigation include: assessment of the means by which recreational provision can be diversified to reduce vulnerability; evaluation of the role of extreme events in influencing recreational provision, and the influence of land use zoning, insurance and other social adjustments in influencing recreational provision in high-energy locations such as shorelines and mountains.

7. Summary and Conclusions

There is a dearth of rigorous studies of the possible implications of climate change for tourism and recreation, and given the intractable challenges involved in deriving quantitative assessments, this paper has adopted a predominantly qualitative approach and has examined likely issues through the presentation of synopses of case studies. More details of these studies can be found in the citations. Given the existing state of knowledge, it may be premature to make recommendations for policy but some pertinent observations can be made. Shoreline areas appear to require careful attention given their susceptibility to changing water levels and their significance for recreation. Summer activities in middle and high latitudes may benefit from extended seasons provided that coastal processes are not disrupted and water is not in short supply.

Global climate change will present both problems and opportunities for destination areas. The climate changes which have been discussed are projected to occur within the lifetimes of many current investment projects and within the lifetimes of many of the earth's present residents. Although the implications for tourism are likely to be profound, very few tourism researchers have begun to formulate relevant questions, let alone develop methodologies which will further understanding of the nature and magnitude of the challenges which lie ahead.

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