



# *Climate Change*

## **A Long-Term Strategic Issue for the NCC**

IMPLICATIONS FOR RECREATION – TOURISM BUSINESS LINES





# Table of Contents

---

Background .....	1
<b>TOURISM EVENTS</b>	
Winterlude .....	6
Canadian Tulip Festival .....	8
Canada Day .....	10
<b>RECREATION and URBAN GREEN SPACE</b>	
Winter recreation .....	12
Warm-season recreation .....	16
Ecological conservation .....	19
Summary of Findings .....	21

## Authors and Affiliations

Daniel Scott<sup>(1)</sup>, Brenda Jones<sup>(1)</sup> and Halim Abi Khaled<sup>(2)</sup>

1 – University of Waterloo (Faculty of Environmental Studies)

2 – National Capital Commission (Corporate Audit, Research and Evaluation Branch)

## For further information, contact:

**Dr. Daniel Scott**

Canada Research Chair in Global Change and Tourism, Faculty of Environmental Studies

University of Waterloo, Waterloo, Ontario CANADA N2L 3G1

519.888.4567 ext. 5497; dj2scott@fes.uwaterloo.ca

**Halim Abi Khaled**

National Capital Commission, Corporate Audit, Research and Evaluation Branch

40 Elgin Street, Ottawa, Ontario CANADA K1P 1C7

613.239.5347; habikhal@ncc-ccn.ca

**This research was funded by the Government of Canada's  
Climate Change Action Fund, Impacts and Adaptation Programme (Project #A716)**

Cite document as:

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

Photo credits: © National Capital Commission

# BACKGROUND



**T**ourism and recreation are vital components of the National Capital Region's economy. Approximately five million people visit the region each year, generating almost C\$1 billion in direct visitor spending<sup>(1)</sup>.

Canada's Capital Region has a broad mix of cultural and natural attractions, which provide a wealth of recreation and tourism opportunities for locals and visitors. Several high-profile events attract hundreds of thousands of visitors each year. These include:

- Winterlude (~first three weekends in February)
- Tulip season (~first three weeks in May)
- Canada Day (July 1)

Recreation opportunities also abound in the National Capital Region's protected lands and urban green spaces. Gatineau Park is the National Capital Region's largest protected urban green space (~36,000 hectares) and offers a wide range of recreation resources, including scenic parkways and public beaches, campgrounds and alpine skiing facilities, and hundreds of km of bicycle, hiking, cross-country skiing and snowshoeing trails. The Rideau Canal is also a popular resource in the National Capital Region, providing recreational boating in the summer and becoming the world's largest outdoor skating rink (Rideau Canal Skateway) in the winter.

## Tourism and Recreation and Climate

Climate is often referred to as average weather. More accurately, it is defined as the long-term average of weather for a specific place and time period, and includes temperature, precipitation, wind, humidity and a range of other weather characteristics.

Many studies document the importance of climate for tourism and recreation<sup>(2,3,4,5)</sup>, and its influence on tourism and recreation in the National Capital Region is no exception. For example, climate affects both the physical resources (e.g., snow cover, ice thickness, water temperature) that provide the very foundation for many of the region's recreational activities and the behaviour of those who participate in these activities (e.g., in a hot summer, more people may go to the beach or go more often). Climate also influences the season length of the region's recreational activities by defining when specific activities can take place and for how long (e.g., canal skating, skiing, golf and beach recreation).

Because of the role of climate in recreation and tourism, many of the National Capital Region's tourism events and recreation sectors are affected by

adverse climatic conditions. Over the last five years, a number of events and recreation sectors have been negatively impacted by unseasonably warm or cool conditions, which have resulted in shortened seasons (see Box 1). The National Capital Commission (NCC) has implemented a diverse range of adaptation strategies to reduce the sensitivity of the region's tourism events and recreation sectors to variable climatic conditions (see Box 2). However, there will be a continued need to review adaptation strategies to meet the challenges that climate change may impose on the National Capital Region's tourism and recreation industry and to determine what new adaptations may be needed.

### Box 1: Negative impact of weather and climate during the winter of 2001/02

- The Rideau Canal Skateway did not open until February 3
- The Rideau Canal Skateway was closed to skaters on the final weekend of Winterlude
- Only 196,000 people skated on the canal during Winterlude, 50% fewer than in previous years
- The skating season was only 34 days

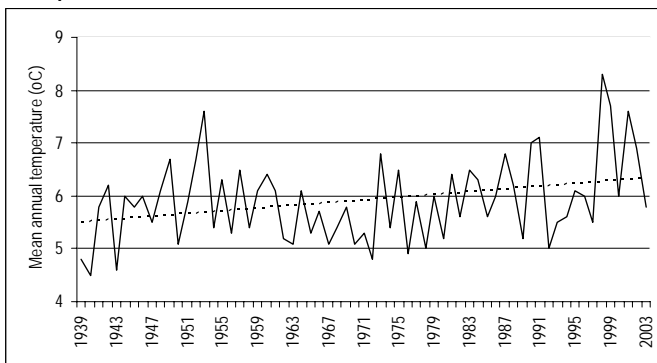
## Is the National Capital Region's Climate Changing?

Climate at a given location is typically determined from at least 30 years of observed weather data. Trends in long-term data allow us to determine if a location's climate is changing.

Trends in archived climate station data for Ottawa suggest that the National Capital Region's climate has been changing. Mean annual temperatures have increased 0.7°C since the 1940s, with minimum temperatures showing the largest increase during this time (Figure 1). Four of the last six years (1998, 1999, 2001 and 2002) were at least 1°C warmer than the region's long-term (1961–90) average annual temperature<sup>(6)</sup>; the mean annual temperature in 2002 was 1.1°C warmer than the long-term average. Winters in the

National Capital Region are also warmer now than they were 60 years ago. On average, winters are 1.5°C warmer now than they were in the 1940s. The winter of 2001/02, for example, was 5.1°C warmer than the region's long-term average. The National Capital Region also receives more precipitation now than it did in the 1940s. Annual precipitation has increased 13% since 1939<sup>(6)</sup>. The duration of ice cover on many of the region's lakes and rivers has diminished over the last century, and are experiencing a trend toward later winter freeze-up and earlier spring break-up. Lake Simcoe, located southwest of Ottawa, currently freezes 13 days later and breaks up four days earlier than it did 140 years ago<sup>(7)</sup>.

Figure 1. Ottawa Region's long-term trend in mean annual temperature (1938–2003)



### What About Future Climate Change?<sup>(8)</sup>

Projections about future climatic changes are based on three time periods — the 2020s, the 2050s and the 2080s. While variability from year to year will continue to occur, the '2020s' (defined by 2010 to 2039) reflect **average** changes that are projected to occur 20 years from now, as opposed to each year for the next 20 years. The '2050s' (defined by 2040 to 2069) reflect **average** changes projected for the middle of the 21<sup>st</sup> century (~50 years from now), while **average** changes at the end of the century (~80 to 100 years from now) are reflected by the '2080s' (defined by 2070 to 2099).

Ottawa's climate is predicted to continue to become warmer and wetter under climate change, with more of the precipitation occurring as rain. Global climate models and climate change scenarios suggest that relative to the 1961–90 baseline period, Ottawa's mean annual temperature will increase between 2.6°C and 6.5°C by the middle of this century (~2050s) and between 3.0°C and 9.9°C by the end of the century (~2080s). Winters are also projected to become warmer. Mean winter temperatures are projected to increase between 2.0°C and 8.5°C in the 2050s, and between 3.6°C and 12.5°C in the 2080s.

Annual precipitation is also projected to increase by as much as 25% in the 2050s and 36% in the 2080s. In the summer, it is projected that 41% more precipitation will occur in the National Capital Region in the 2050s, and as much as 58% more in the 2080s. However, some climate change scenarios do project a 29% decline in summer precipitation in the 2080s. Winters are projected to become wetter. Precipitation during winter in the National Capital Region is projected to increase as much as 29% in the 2050s and 42% in the 2080s.

Ice seasons and ice thickness are also projected to be reduced on the National Capital Region's water bodies. A study of the Great Lakes Region suggests that small lakes will freeze, on average, 14 days later, and break up 30 days earlier by the middle of this century (2050s). Ice thicknesses are also projected to be reduced, in some cases by as much as 40 cm<sup>(9)</sup>.

### Box 2: Examples of adaptive strategies used by the NCC to reduce the impact of climate on tourism programming

#### Winterlude

- Moved attractions/programming from ice to land locations
- Used refrigerated trucks for the ice sculpture carving contest
- Was converted from a 10-day event to a three-weekend event to increase the probability of suitable weather during the celebration
- Implemented snowmaking at Snowflake Kingdom to ensure adequate snow supply
- Removed weeds from the canal that could weaken the ice structure (e.g., strength)
- Developed collaborations with local museums to offer package deals that promote non-climate-dependent activities

#### Tulip season

- Planted bulbs in shady locations
- Heavily mulched flower beds
- Erected snow fences to increase snow cover on flower beds to delay bulb maturation
- Planted bulbs with different rates of maturation
- Irrigated flower beds during warm/early springs to delay bulb maturation

#### Canada Day

- Educated the public about heat stress
- Provided shade tents and cooling stations

#### Gatineau Park

- Implemented snowmaking on alpine ski areas
- Developed a cross-country ski track setter for low-snow conditions
- Developed cross-country ski trails in shaded and smoothed-terrain areas that required less snow

## Research Scope and Objectives

Climate change has implications for many of the NCC's business lines (e.g., building and bridge maintenance, building and fleet energy costs, snow removal and greenhouse gas mitigation policies). However, this study was proposed to the Government of Canada's Climate Change Action Fund (Impacts and Adaptation Programme) tourism sector call. Consequently, the focus of the project is the NCC's tourism and recreation business lines. As a major stakeholder in the tourism and recreation industry in the National Capital Region, the NCC is responsible for planning and promoting public events such as Winterlude, and delivering recreation opportunities in Gatineau Park and elsewhere.

This executive summary provides the key results of a climate change impact assessment conducted by the University of Waterloo in collaboration with the NCC to assess the potential impact of climate change on the region's recreation and tourism industry. Specifically, the assessment sought to address two important questions:

1. What are the implications of climate change for major tourism event planning and programming (Winterlude, Canadian Tulip Festival and Canada Day celebrations) in the National Capital Region?
2. How will climate change influence the season length of major winter (skating and skiing) and warm-season (camping, swimming, golf and park visits) recreation and tourism sectors in the National Capital Region?

This executive summary identifies sectors that will be negatively affected under climate change and will continue to require new adaptation strategies to remain sustainable in the decades to come. It also highlights where opportunities may exist to expand some current recreation sectors. The broader implications of climate change for the NCC's tourism and recreation business lines are discussed as well.

## Overview of Methods<sup>(10)</sup>

### Statistical Analysis and Climate Indicators

Two main methodological approaches were used in the climate change impact assessment — statistical modelling and climate-based indicators.

When reliable recreation-tourism data were available from stakeholders in the National Capital Region, statistical analysis (regression) was used to develop models of the current relationship between climate and the years for which recreation data were available for the respective activity.

Models were then validated by comparing their performance with observed recreation data (e.g., Figure 2, Rideau Canal Skateway season). The regression models were also used to model the 1961–90 baseline period (denoted as ■ on graphs in this document) for the respective activity; this value was used as a benchmark for comparing changes in the recreation activity under climate change. By assuming that a similar relationship would continue to exist in the future (i.e., all else remaining equal), the models were then used to project changes in the operating season of the recreation sector under a range of climate change scenarios.

Figure 2: Modelled season of the Rideau Canal Skateway



When reliable recreation-tourism data were unavailable, climatological thresholds for impact indicators were established based on consultations with experts at the NCC and the scientific literature. The thresholds defined minimum climatic conditions required for specific recreation seasons (e.g., swimming), events (e.g., cross-country ski races) or management needs (e.g., snowmaking) (Figure 3). The thresholds were used to define a 1961–90 baseline (denoted as ■ on graphs) for each respective activity, and changes in these impact indicators were examined under the same climate change scenarios.

Figure 3. Examples of climate thresholds for climate change impact indicators

**Efficient snowmaking<sup>(4)</sup>**  
 Number of days with minimum temperatures colder than -10°C

**Operation of the cross-country ski races during Winterlude<sup>(11)</sup>**  
 Number of days with:  
 15 cm of snow (regulation track setter) and  
 8 cm of snow (non-regulation track setter)

**Swimming season<sup>(12)</sup>**  
 Number of days warmer than or equal to 23°C

**Peak bloom of tulips<sup>(13, 14)</sup>**  
 At least 120 growing degree days

### Climate Change Scenarios

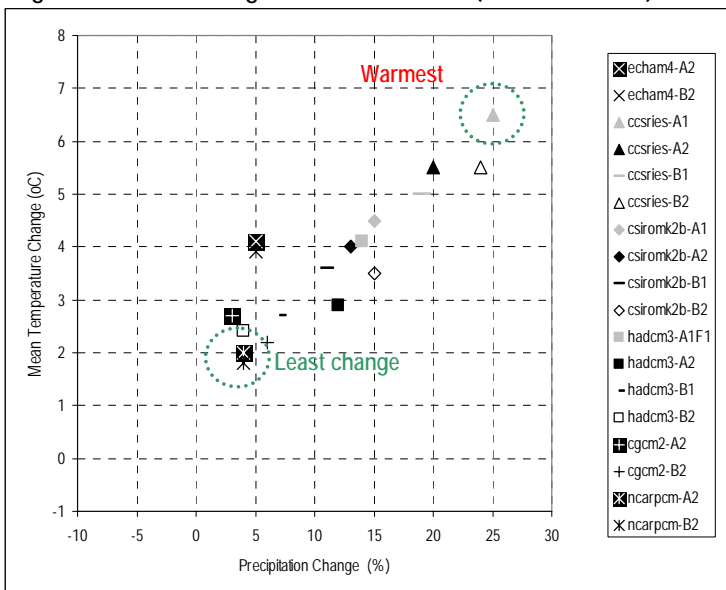
The potential impacts of two climate change scenarios are presented in this executive summary in order to capture the range of future climates projected for the National Capital Region. The scenarios are from the National Center for Atmospheric Research (NCAR) in the United States and the Center for Climate System Research (CCSR) in Japan. Both research centres are approved by the United Nations Intergovernmental Panel on Climate Change's Task Group on Scenarios for Climate and Impact Assessment. The scenarios themselves are the NCARPCM B21 and CCSRNIES A11 scenarios. Figure 4 illustrates how these two scenarios (identified by dashed circles) compare with all other climate change scenarios available.

The NCARPCM B21 scenario generally assumes lower global greenhouse gas emissions and projects a small increase in temperature over the course of this century. In contrast, the CCSRNIES A11 scenario assumes higher global greenhouse gas emissions and projects a substantial warming this century. As a result of these differences, in this document, NCARPCM B21 is referred to as the 'least-change' climate change scenario, while CCSRNIES A11 is referred to as the 'warmest' climate change scenario. In this executive summary, changes under these two scenarios are compared to the 1961–90 baseline.

### Report Format

This executive summary is divided into two sections. Section one summarizes the important impacts of climate change on three of the primary tourism events in the National Capital Region — Winterlude, the Canadian Tulip Festival and the Canada Day celebrations. Section two summarizes the impacts of climate change on a range of winter and warm-season recreation activities that occur in the National Capital Region's urban green spaces (e.g., Gatineau Park). In addition, section two provides a short discussion on the potential impacts of climate change on the ecological resources in Gatineau Park.

Figure 4. Climate change scenario selection (annual — 2050s)





# Tourism Events

*High-profile tourism events attract hundreds of thousands of visitors to the National Capital Region each year.*

*Three such events are:*

*Winterlude — celebrates winter*

*Canadian Tulip Festival — celebrates spring*

*Canada Day — celebrates Canada's birthday*

*This section examines the projected impacts of climate change on critical aspects of each of these three events.*

# WINTERLUDE

*Winterlude is the main reason many visitors come to Ottawa in February<sup>(15)</sup>*

*Over 616,000 people attended Winterlude in 2004, generating more than C\$150 million in economic benefits<sup>(16)</sup>*



Temperature is critical to the success of many of Winterlude's attractions. For example, temperature influences how long ice sculptures will last once carved and whether snowmaking will be necessary to sustain snow slides at Snowflake Kingdom. Temperature also plays an important role in influencing the length of time it takes for ice on the Rideau Canal to form so that the skating season can begin.

In the National Capital Region, winter temperatures are expected to become warmer under climate change. During the February period in which Winterlude is currently held, mean temperatures are projected to increase 2.1°C to 2.7°C in the 2020s (Figure 5). Under the least-change climate change scenario, mean temperatures during Winterlude increase slightly through the rest of the century. Under the warmest climate change scenario, it is projected that mean temperatures during Winterlude could be close to 0°C in the 2080s.

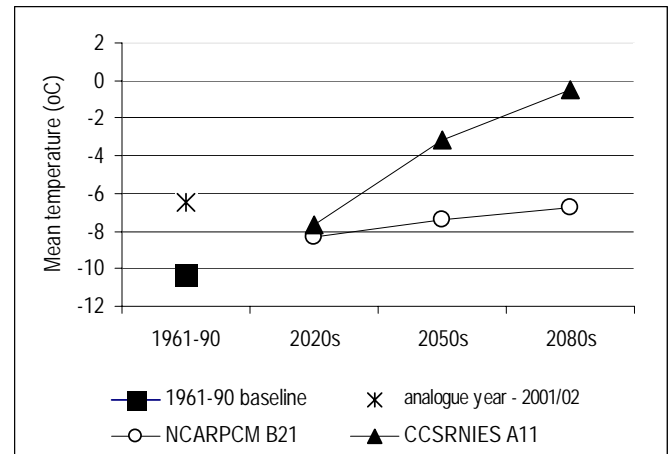
## Winterlude Attractions

There are a variety of attractions at Winterlude for locals and visitors to see and to participate in. These attractions include the ice-carving contest and ice sculptures, snow slides at Snowflake Kingdom and cross-country ski races.

Really cold temperatures (i.e., <-20°C) tend to reduce overall attendance at Winterlude, while balmy February temperatures (i.e., >0°C) can attract more people to come out and participate. Analysis of temperature regimes for Ottawa suggest that temperatures will become more comfortable for visitors during Winterlude as the occurrence of days with maximum temperatures colder than -10°C decline in the 2020s, 2050s and 2080s (Figure 6).

By comparison, the number of days above 0°C substantially increases. Warmer conditions are projected to become more prominent in the 2050s, with between one and seven additional days above 0°C. Under the warmest climate change

Figure 5. Projected mean temperature during Winterlude<sup>a</sup>



<sup>a</sup> Average dates: defined as February 1 to 21

scenario, maximum temperatures are projected to be above 0°C for at least half of the celebration (12 of the 20 days) as early as the 2050s.

The improvement in thermal conditions during the day may entice more people to participate, but it could also negatively affect many of the attractions people come out to see. Current adaptation measures, such as refrigeration, will become increasingly important for Winterlude's ice sculptures under climate change. The number of days with maximum temperatures colder than -5°C, which is considered ideal for sustaining the ice sculptures, is projected to decline considerably, while days with temperatures warmer than 5°C are projected to increase (Figure 6). In the 2020s, on average, one to two fewer days will be colder than -5°C, while in the 2050s two to seven fewer days will occur. By comparison, between one and four additional days during Winterlude will have maximum temperatures warmer than 5°C in the 2050s.

Natural snow cover is expected to decline in the National Capital Region as the climate warms. As this happens, Winterlude attractions that are reliant on natural snow will increasingly be affected. For example, cross-country ski races

require at least 15 cm of natural snow to set a regulation track for a classical ski race. It is likely that this threshold will continue to be met in the 2020s (Figure 6). However, the least-change scenario projects four fewer days during Winterlude with a 15-cm snow base in the 2050s and 2080s. Notably, the warmest climate change scenario projects that days with a natural snow pack of at least 15 cm will be eliminated by the 2050s, putting cross-country ski events in jeopardy unless snowmaking is used.

If organizers and participants in the cross-country ski races are willing to use a non-regulation classical ski track (i.e., 2.5 cm depth instead of 5 cm), then the impact of climate change on the races will be reduced somewhat. All 20 days of Winterlude are projected to continue to have 8 cm of snow in the 2020s under both climate change scenarios. The least-change scenario projects an 8-cm snow base in the 2050s and 2080s as well. As early as the 2050s though, the warmest scenario projects that snow conditions will again be unsuitable to hold cross-country ski races (Figure 6).

Snow slides at Snowflake Kingdom are also popular Winterlude attractions. The slides are usually built using natural snow, but snowmaking has been employed in the past during unseasonably warm periods. Snowmaking has also been used in recent years to expand the size of the winter theme park. Snowmaking is possible at temperatures between 0°C and -5°C when relative humidity levels are low or with the

addition of special additives (e.g., Snowmax). Snowmaking at these warmer temperatures is much more costly however, because of the higher energy requirements and additives.

Snowmaking will still be possible in the future. The average number of days that snowmaking will be available in January (snowmaking operation period) at -5°C does not change substantially under the least-change climate change scenario, with two fewer days even in to the 2080s (Figure 6). The warmest climate change scenario did not see a large decline in the 2020s, but 41% fewer snowmaking days are projected in the 2050s and 52% fewer days in the 2080s. The number of days defined as being most efficient for snowmaking (i.e., colder than -10°C) will be reduced under climate change. The least-change climate change scenario projects a minimal change in days with temperatures colder than -10°C in the 2020s and 2050s, but 32% fewer snowmaking days are projected in the 2080s. Efficient snowmaking days are reduced 32% in the warmest scenario in the 2020s and by at least two-thirds in the 2050s. In the 2080s, optimal conditions for efficient snowmaking are reduced to less than one week in the warmest climate change scenario.

Figure 6. Projected trends in important temperature thresholds for Winterlude<sup>a</sup>

Winterlude activity	Thresholds	1961–90	2020s (days)		2050s (days)		2080s (days)	
		Average (days)	NCARPCM B21	CCSRNIES A11	NCARPCM B21	CCSRNIES A11	NCARPCM B21	CCSRNIES A11
Thermal comfort for visitors	Max temperature	5	3	3	2	1	2	0
	-20°C to -10°C >0°C	5	5	6	6	12	7	15
Ice sculptures <sup>b</sup>	Max temperature	10	9	8	8	3	7	1
	<-5°C >5°C	1	1	2	2	5	3	9
Cross-country ski race events <sup>c</sup>	Snow depth	21	21	21	21	0	21	0
	8 cm 15 cm	21	21	20	17	0	17	0
Snow slides <sup>d</sup>	Min temperature	29	28	25	27	17	25	14
	<-5°C <-10°C	25	22	17	21	9	17	6

<sup>a</sup> Defined as February 1 to 21 (except for snow slides); snow slides defined as January 1 to 31 (critical snowmaking period)

<sup>b</sup> Temperature for sustaining sculptures: <-5°C (ideal)

<sup>c</sup> Snow depth required for track setters: 8 cm (non-regulation track setter); 15 cm (regulation track setter)

<sup>d</sup> Snowmaking potential: <-5°C (feasible); <-10°C (most efficient)

# CANADIAN TULIP FESTIVAL

*Largest tulip festival in the world*

*Second-largest festival in the Capital region after Winterlude<sup>(17)</sup>*

*Attracts 500,000 to 700,000 people, generating C\$30 million in economic benefits<sup>(18)</sup>*



**T**ulips are among the first flowers to emerge from the ground in the spring and bloom, providing a colourful indication of changing seasons and climatic conditions. Temperatures between 10°C and 15°C maintain blooms well, while temperatures warmer than 20°C tend to shorten their lifespan. Tulips will also tend to shrivel when exposed to short periods of frost.

The Canadian Tulip Festival is a charitable, non-profit corporation with a community volunteer Board of Directors, representing both Ottawa and Gatineau. Founded in 1953, it organizes the 19-day celebration. The two weeks leading into the Canadian Tulip Festival are critical for the final stages of tulip growth, and as a result, temperature variations can delay or advance development. Average maximum temperatures during this period (defined as April 16 to 30) are projected to increase between 1.0°C and 4.0°C in the 2020s and between 1.5°C and 4.7°C in the 2050s (Figure 7). Under the warmest climate change scenario, the average maximum temperature is projected to be 23.2°C in the 2080s, almost 10°C warmer than current climatic conditions. Minimum temperatures will also increase. Average minimum temperatures are projected to increase 0.9°C to 3.8°C in the 2020s and between 1.4°C and 7.4°C in the 2050s. In the 2080s, the minimum average temperature under the warmest climate change scenario is approaching the current average maximum temperature.

## Tulip Season

The timing, duration and quality of tulip blossoms are sensitive to climatic conditions. In the National Capital Region, tulips will likely sprout and bloom much earlier under a warmer climate. Currently, tulips tend to emerge from the ground, on average, around April 17, when the number of 5°C growing degree days exceeds 20

(Figure 8). Tulips are projected to emerge, on average, 10 to 24 days earlier in the 2020s. In the 2050s, the first appearance of tulips will be even earlier. Under the least-change scenario, tulips are projected to appear, on average, 12 days earlier than at present. Under the warmest climate change scenario, tulips are projected to emerge 54 days earlier, which places the date

Figure 7. Projected temperatures 2 weeks before the Canadian Tulip Festival

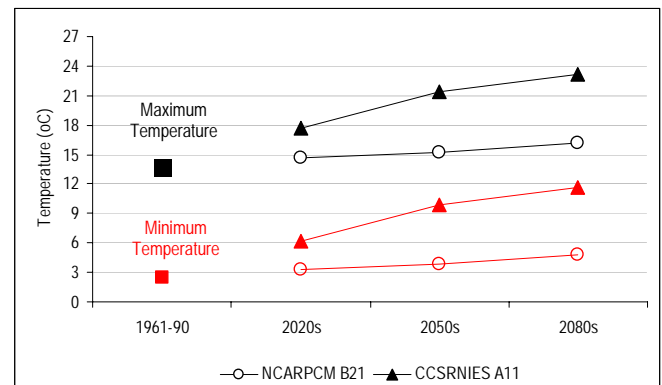
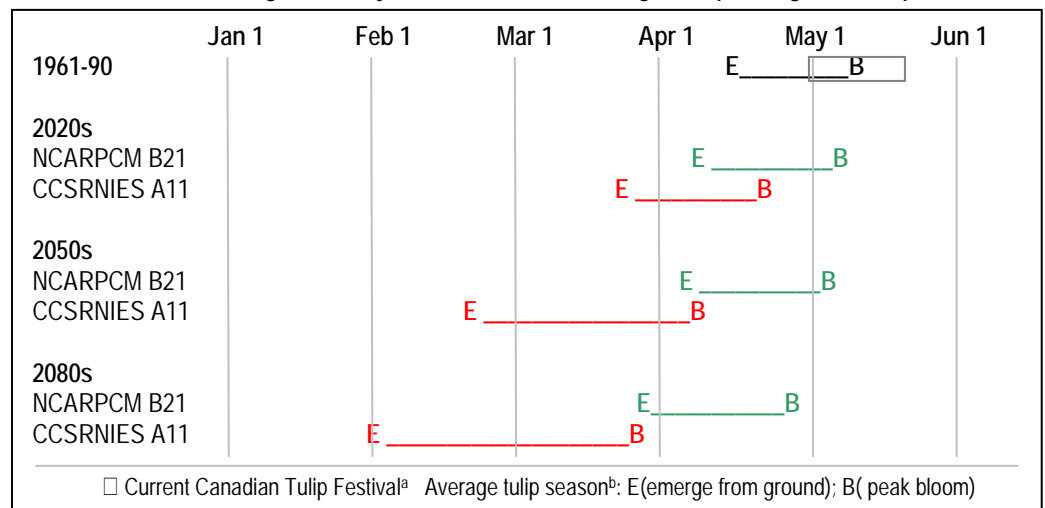


Figure 8. Projected trends in the timing of tulip emergence and peak bloom



□ Current Canadian Tulip Festival<sup>a</sup> Average tulip season<sup>b</sup>: E(emerge from ground); B( peak bloom)

<sup>a</sup> Average dates: defined as May 1 to 21

<sup>b</sup> Dates based on growing degree days (GDD) calculated from January 1 (base temperature 5°C) Emergence (GDD>20); Peak bloom (GDD>120)

Figure 9. Variability in the timing of tulip development

		Modelled (1961–90)		2020s	2050s	2080s
DATE OF EMERGENCE	Earliest	Mar 27	NCARPCM B21	Jan 20	Jan 20	Jan 20
			CCSRNIES A11	Jan 20	Jan 4	Jan 2
	Latest	May 1	NCARPCM B21	Apr 21	Apr 18	Apr 18
			CCSRNIES A11	Apr 17	Apr 4	Mar 19
DATE OF PEAK BLOOM	Earliest	Apr 19	NCARPCM B21	Apr 25	Apr 23	Apr 13
			CCSRNIES A11	Apr 11	Mar 17	Jan 21
	Latest	May 27	NCARPCM B21	May 18	May 18	May 15
			CCSRNIES A11	May 6	Apr 16	Apr 2
Probability peak bloom occurs during the Canadian Tulip Festival		80%	NCARPCM B21 CCSRNIES A11	70% 7%	53% 0%	27% 0%

tulips first sprout from the ground close to early March. In the warmest climate change scenario for the 2080s, it is possible that tulips will emerge around February 1; this is ten weeks earlier than current conditions (Figure 8).

Tulips reach peak bloom around May 9 in the National Capital Region, which is when the number of growing degree days (5°C base) exceeds 120 (Figure 8). This average date for peak bloom occurs just before the mid-point of the current Canadian Tulip Festival. When warmer-than-normal temperatures have occurred, NCC staff has used a range of adaptations to shift the peak bloom closer to mid-May (see Box 2). Tulips are projected to achieve peak bloom five to 16 days earlier in the 2020s, and seven to 31 days earlier in the 2050s. Under the warmest climate change scenario, peak bloom is projected to occur at the end of March in the 2080s.

Based on these results, it would appear that as early as the 2050s, tulip phenology and the Canadian Tulip Festival may no longer correlate as tulips could regularly reach peak bloom before the Festival even begins. Having tulips in bloom is critical to the credibility of the Canadian Tulip Festival. Staff with the NCC has noticed that a peak bloom that is too early or too late, one or two years in a row, has a notable impact on the Festival's reputation to deliver the spring experience visitors seek.

The dates summarized in Figure 8 reflect **average** tulip seasons, but there has been inter-annual variability in the timing of tulip emergence and peak bloom in the National Capital Region. In 2003, most tulips had not bloomed by the start of the Festival, due largely to a cold spring that delayed plant development. Conversely, tulips emerged early and reached peak bloom by the start of the 1998 Canadian Tulip Festival because of above normal spring temperatures, and then quickly wilted in the May heat.

In the future, there will continue to be variability in the National Capital Region's tulip season. For instance, under the least-change climate change scenario, the **average** date of emergence in the 2020s is April 7 (Figure 8), but the earliest and latest dates of emergence could be January 20 and April 21, respectively (Figure 9). Similarly, under the same climate change scenario, the average date of peak bloom in the 2020s is May 4, but could range from as early as April 25 to as late as May 18.

It is important for the NCC that tulips reach peak bloom during the Canadian Tulip Festival. The probability that peak bloom will occur sometime during the current May dates of the Canadian Tulip Festival decreases substantially under some climate change scenarios. Under the least-change climate change scenario, there is a 70% chance that peak bloom will occur after May 1 in the 2020s; this probability decreases to 53% and 27% in the 2050s and 2080s, respectively. Under the warmest climate change scenario, it is unlikely that the region's tulips will reach peak bloom during the current May dates of the Festival, even as early as the 2020s.

The NCC's adaptation strategies for the tulip season have been successful thus far (see Box 2). This report reflects the NCC's perspective as the organization responsible for the tulip displays throughout the Capital Region. The Canadian Tulip Festival is a separate entity that manages and promotes the festival. Its Board of Directors would make any decisions relating to the Canadian Tulip Festival.

# CANADA DAY

*Canada Day celebrations attract over 300,000 people to the National Capital Region each year<sup>(19)</sup>*

*Direct visitor spending from the July 1 festivities generates about C\$20 million for the local economy<sup>(19)</sup>*



**E**vent planners with the NCC currently must plan for heat-related emergencies during Ottawa's Canada Day celebrations. Contingency plans typically involve having cooling systems (e.g., water stations and misting units) and medical staff on site to treat people who experience heat-related stresses during the festivities.

It is projected that climatic conditions will become warmer throughout the summer months in the National Capital Region under climate change. Warmer average climatic conditions around the beginning of July could lead to a greater need for emergency support to deal with more occurrences of heat-related discomfort among participants at Canada Day celebrations. In the two weeks surrounding July 1 (Julian days 177 to 191), average maximum temperatures are projected to range between 26.8°C and 27.9°C in the 2020s and between 27.3°C and 30.2°C in the 2050s (Figure 10). Under the warmest climate change scenario, the average mean temperature in the 2080s is projected to be 32°C, 7.6°C warmer than at present.

A base temperature of 30°C is often used as a heat-stress threshold in Ontario, and under climate change the number of days that reach this threshold is projected to increase. Currently, only two of the 14 days in the two weeks surrounding July 1 reach this threshold on average. In the 2020s, an average of three to four days will reach this threshold (Figure 11). However, under the warmest climate change scenario, the number of days with temperatures of at least 30°C triples in the 2050s and quadruples in the 2080s. Consequently, the probability of a heat emergency occurring during Canada Day celebrations increases from 14% today to 57% in the 2050s and to 71% in the 2080s under the warmest climate change scenario.

Figure 10. Projected average maximum temperature in the National Capital Region in the two weeks surrounding Canada Day

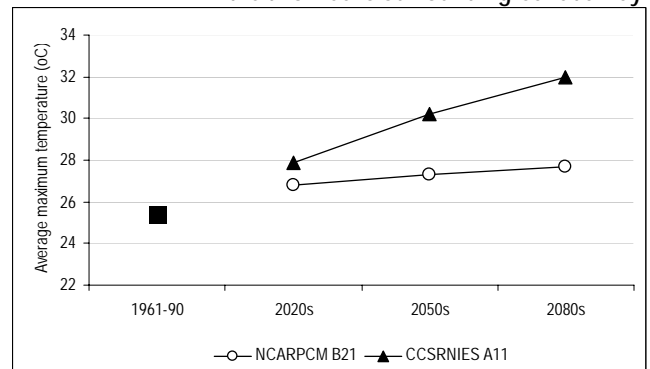
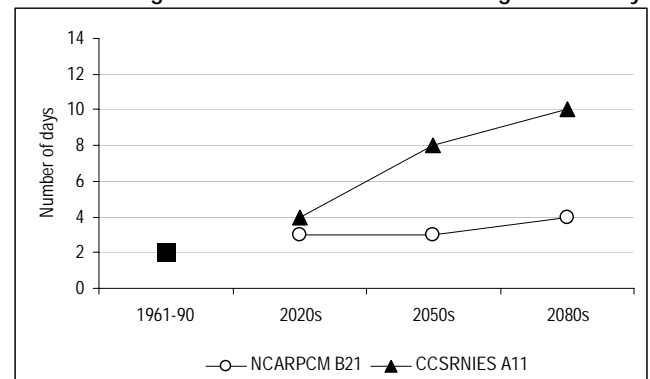


Figure 11. Projected number of days with maximum temperatures of at least 30°C in the National Capital Region in the two weeks surrounding Canada Day





# Recreation and Urban Green Space

*There are more than 50,000 hectares of protected land and urban green space in the National Capital Region, including the Rideau Canal, Gatineau Park and an extensive urban greenbelt.*

*These natural attractions provide a wealth of winter and warm-season recreation and tourism opportunities for locals and visitors.*

*This section examines the impact of climate change on the region's major recreation sectors. The discussion pertains primarily to Gatineau Park, unless otherwise specified. It is projected that changes identified for Gatineau Park will also occur in the region's other green spaces that offer similar activities.*

# WINTER RECREATION



**W**inter recreation opportunities make the National Capital Region a popular winter tourism destination. The opportunity to skate on the Rideau Canal Skateway, the world's largest outdoor skating rink, is the main reason many visitors come to the region during the winter season. The region also offers both alpine and cross-country skiing opportunities; Gatineau Park has an extensive network of cross-country ski trails. Under a warmer climate, the environment for skating and skiing will become increasingly challenging, with the overall trend being toward shorter recreational seasons.

## Skating on the Rideau Canal Skateway

### Looking Back

The Rideau Canal Skateway is the quintessential symbol of winter in the National Capital Region. As a result, the timing of its opening garners a great deal of local, national and international media attention. Above-normal temperatures in December 2001 and January 2002 delayed the Skateway's opening until February 3, just as Winterlude was beginning<sup>(16)</sup>.

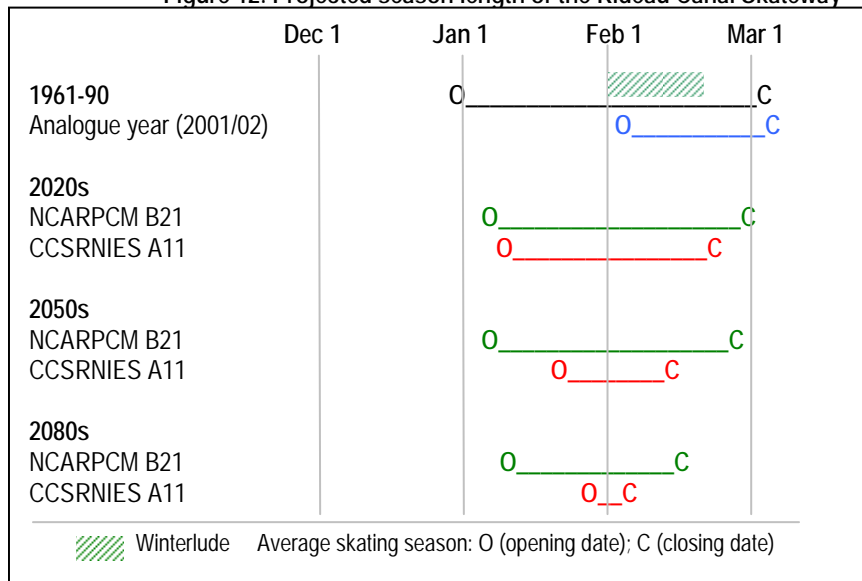
### Today and 20 Years and Beyond

The season length of the Rideau Canal Skateway is projected to become shorter under climate change. The Skateway currently opens, on average, around January 1 and operates for 61 days (Figure 12). In the 2020s, the average operating season is projected to range between 43 and 52 days. As the climate continues to warm, further reductions are expected. In the 2050s, the Skateway is projected to be open between 20 and 49 days. A skating season of 20 days represents a six-week reduction from current conditions. In the 2080s, the warmest climate change scenario projects that the average skating season will be reduced to just one week, while the least-change scenario still projects a 42-day season.

As winters in the National Capital Region become warmer, the Skateway is also projected to see a trend toward later opening dates. Rather than opening around January 1, the Skateway is projected to open between January 7 and 12 in the 2020s (Figure 12). In the 2050s, the Skateway's opening date does not change much more under the least-change climate change scenario. However, in the 2050s under the warmest scenario, the Skateway is projected to remain closed until January 23. The warmest scenario also projects that in the 2080s, the Skateway's opening will be delayed until the start of Winterlude.

From year to year over the last decade (1994/95 to 2004/05), there has been substantial variability in the season length of the Rideau Canal Skateway. During the winter of 2002/03 for example, the Skateway was open for 72 days. Comparatively, the Skateway was only open for 34 days during the record-warm winter of 2001/02.

Figure 12. Projected season length of the Rideau Canal Skateway



Like the tulip season, the seasonal information summarized in Figure 12 reflects projected **average** operating conditions for the Rideau Canal Skateway under climate change. However, there will continue to be inter-annual variability in the winter operation of the Skateway as the National Capital Region's climate changes. For instance, under the least-change climate change scenario, the **average** season length of the Skateway in the 2020s is 52 days (Figure 12), but the longest and shortest seasons in this scenario could be 68 and 39 days, respectively (Figure 13). Similarly, under the same climate change scenario, the opening day of the Rideau Canal Skateway is January 7 on average, but ranged from as early as December 17 to as late as January 18.

Figure 13. Variability in the winter operation of the Rideau Canal Skateway

		Modelled (1961-90)		2020s	2050s	2080s
SEASON LENGTH	Shortest	49 days	NCARPCM B21	39 days	36 days	29 days
			CCSRNIES A11	30 days	7 days	--
	Longest	70 days	NCARPCM B21	68 days	65 days	58 days
			CCSRNIES A11	59 days	36 days	24 days
OPENING DAY	Earliest	Dec 17	NCARPCM B21	Dec 17	Dec 15	Dec 21
			CCSRNIES A11	Dec 18	Dec 31	Jan 5
	Latest	Jan 17	NCARPCM B21	Jan 18	Jan 18	Jan 23
			CCSRNIES A11	Jan 23	Feb 5	Feb 9
Probability the Skateway is open in time for Winterlude		100%	NCARPCM B21 CCSRNIES A11	100% 100%	100% 87%	100% 53%

The Rideau Canal Skateway is the primary attraction for people attending Winterlude. An important question for the NCC is whether the Rideau Canal Skateway will continue to be open by the beginning of Winterlude. Under climate change, the least-change climate change scenario projects that the Skateway will likely open by Winterlude each year until the end of the century. However, under the warmest climate change scenario, the probability of the Skateway being open by the beginning of Winterlude is reduced by the end of the century (to 53%).

## Skiing

### Alpine Skiing

Like all alpine ski areas in Ontario, the alpine skiing industry in the National Capital Region has adapted to variations in the climate by investing in snowmaking technology, which allows ski areas to extend their seasons and provide reliable snow conditions year to year. By using snowmaking, the region's alpine ski season is approximately 146 days long (~21 weeks) per year. Under warmer climatic conditions, the average ski season is reduced to between 122 and 140 days in the 2020s, and to between 86 and 135 days per year in the 2050s (Figure 14). Even with current levels of snowmaking, the alpine ski season is projected to be as short as 63 days in the 2080s under the warmest climate change scenario.

Snowmaking helps reduce the negative impact of climate change on alpine skiing, but more machine-made snow will be needed in the future to minimize reductions in the alpine ski season. If it is assumed that no change occurs in current snowmaking technology, the amount of snow required to maintain shortened seasons illustrated in Figure 14 increases an average of 15% to 35% in the 2020s (Figure 15). In the 2050s, between 20% and 103% more machine-made snow will be required. With additional warming by the 2080s, the warmest climate change scenario projects a 128% increase in snowmaking over current requirements.

Snowmaking represents a significant proportion of the annual operating expenses at any downhill ski area in the National Capital Region. Snowmaking will still be possible in the future, but there are projected to be fewer days suitable for efficient snowmaking as winters in the National Capital Region become warmer. Making additional snow at warmer temperatures will increase the cost of snowmaking substantially under the warmest climate change scenario. The potential impact of additional water requirements for snowmaking will also need to be considered in future Gatineau Park planning.

Figure 14. Projected alpine skiing season

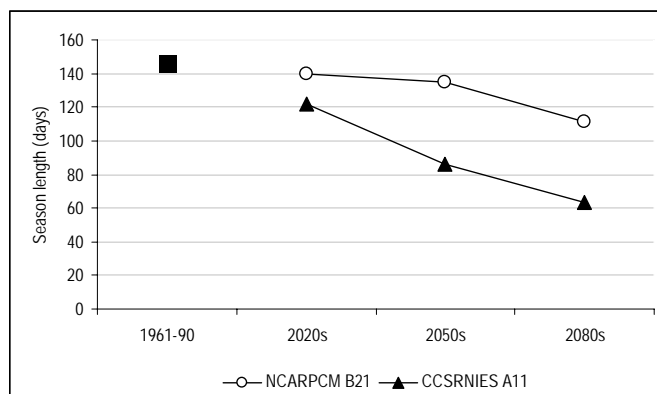
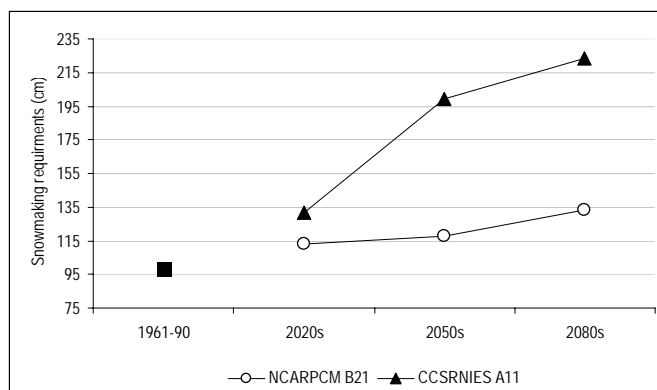


Figure 15. Projected snowmaking requirements for alpine skiing



## Cross-Country Skiing

Cross-country skiing in the National Capital Region is reliant on natural snow because the linear nature and long distances of its trails make widespread implementation of snowmaking systems technically difficult and very expensive. As a result, analysis indicates that cross-country skiing tends to be more adversely affected by climate change than alpine skiing.

The NCC uses two track setters to groom its 200+ km of classic cross-country ski trails in Gatineau Park. A regulation (5-cm depth) track setter, which requires a snow depth of at least 15 cm, is currently used when conditions allow. A non-regulation (2.5-cm depth) track setter that only requires 8 cm of snow is used early in the ski season or when there is less snow cover.

As natural snowfall diminishes under climate change, the number of days when a natural 15-cm snow base is available in the National Capital Region will decrease. Based on a snow depth of 15 cm, the current average cross-country ski season is 94 days (Figure 16). The cross-country ski season is projected to be reduced to between 48 and 81 days in the 2020s. In the 2050s, the cross-country ski season is reduced by half under the least-change climate change scenario. Under the warmer climate change scenario, a 15-cm-based cross-country ski season is no longer feasible as early as the 2050s.

It is probable that the non-regulation track setter will be used more often under climate change as long as cross-country skiing remains possible in Gatineau Park. The magnitude of change in the cross-country ski season length is substantially smaller in the 2020s under an 8-cm base than a 15-cm base. The cross-country ski season is projected to be reduced from a current average of 115 days to between 90 and 109 days in the 2020s (Figure 17). In the 2050s and 2080s, the least-change climate change scenario projects a continued cross-country ski season of approximately 90 days. The warmest scenario, however, projects a complete loss of cross-country skiing from Gatineau Park as early as the 2050s. Similar reductions in the length of the skiing season are likely in other areas of the National Capital Region (e.g., Greenbelt) with cross-country ski trails.

As snow conditions become increasingly marginal for skiing, there is likely to be additional pressure to transfer use of some of the cross-country ski trails to other recreational uses (e.g., hiking and mountain biking) and for the restricted implementation of snowmaking on some high-use trails in order to sustain the season.

Figure 16. Projected cross-country ski season with regulation track setter (15-cm snow base)

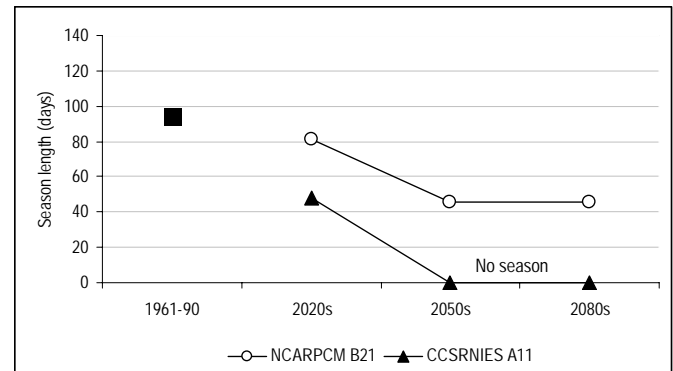
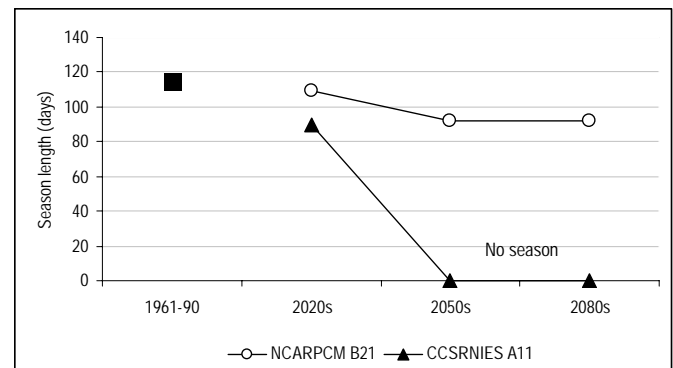


Figure 17. Projected cross-country ski season with non-regulation track setter (8-cm snow base)



If Gatineau Park proceeds with implementing a trail user-fee system similar to that employed in Canada's national and provincial parks, the pressure for the Park to provide good and reliable snow conditions through snowmaking and additional grooming is likely to increase even further. Notably, the cross-country skiing season is currently shorter in other lands managed by the NCC (e.g., most Greenbelt locations) and so the projected impacts of climate change are likely to be experienced earlier and more severely in these areas.

# WARM-SEASON RECREATION



The extensive network of parkland and urban green spaces in the National Capital Region provides a wealth of recreation opportunities for locals and visitors during Ottawa's warm season.

Warm-season recreation in the National Capital Region could benefit from a warmer climate. Benefits could occur in two main ways. First, there could be higher public demand for certain warm-season recreation sectors. Second, recreational seasons could be extended, which means that people could participate in their favourite recreational pursuits for a longer period of time each year.

## Camping

Camping is a year-round activity in many parts of the National Capital Region including Gatineau Park, but campground use tends to be highly seasonal. In Gatineau Park's campgrounds such as Philippe Lake, the greatest demand tends to occur during the summer. During the months of July and August, Philippe Lake campground typically operates at 65% capacity (~170 campsites per day)<sup>(20)</sup>.

Under a warmer climate, Philippe Lake campground could come closer to reaching full capacity (~262 campsites) during the peak camping period of July and August. Occupancy rates during these two months are projected to increase to between 67% and 71% in the 2020s and to between 69% and 77% in the 2050s (Figure 18). Under the warmest climate change scenario, Philippe Lake could experience an average summer occupancy rate as high as 83% in the 2080s. If population growth is also considered, the campground would likely be operating at capacity in July and August as early as the 2050s.

Occupancy rates during the shoulder season (September to June) are also projected to increase under climate change. Currently, camping demand is low during the shoulder season, only averaging 5% (~12 campsites per day). In the 2020s, the average shoulder occupancy rate is projected to increase to between 6% and 9% and to between 7% and 13% in the 2050s (Figure 19). Most of the increased camping demand will occur between April and June (Figure 20). Under the warmest climate change scenario, average shoulder-season occupancy rates could be as high as 18% in the 2080s. With increased demand during the shoulder seasons, there may be pressure

Figure 18. Projected summer campground occupancy rate (July and August)

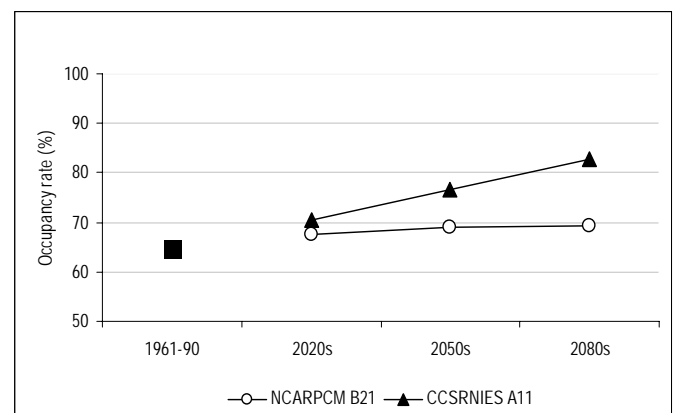
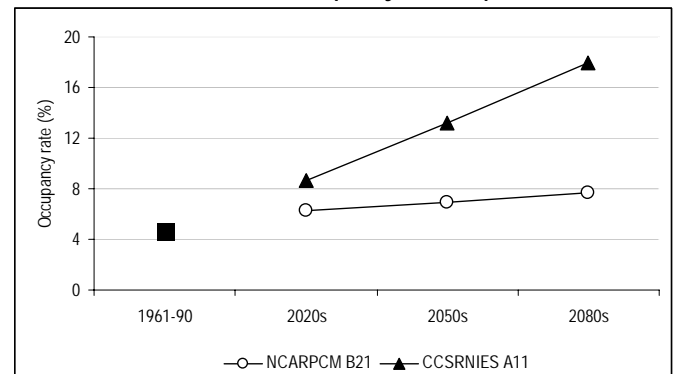
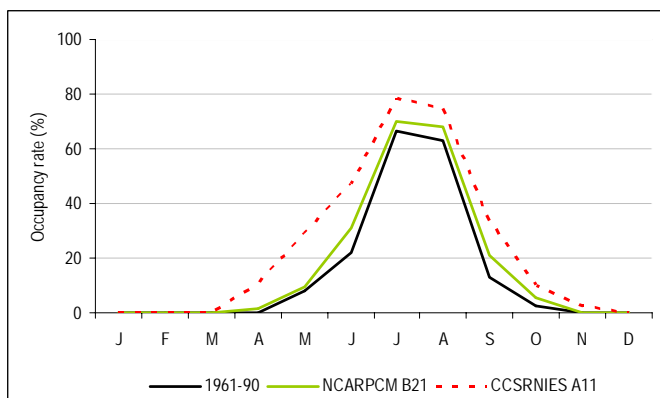


Figure 19. Projected shoulder season campground occupancy rate (September to June)



to extend the campground's operating season and related services. It is likely that other campgrounds in the National Capital Region will also experience similar changes.

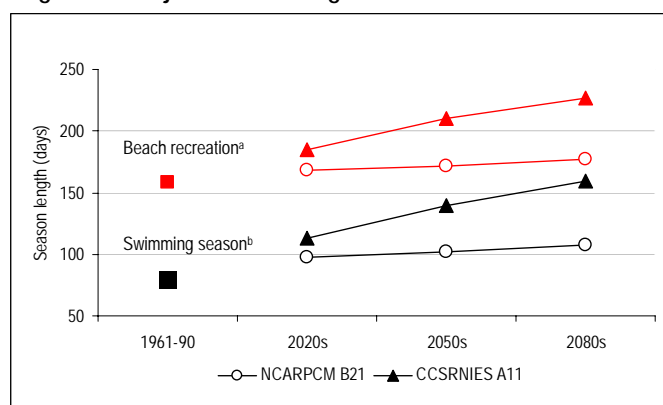
Figure 20. Projected monthly campground occupancy in Gatineau Park in the 2050s



### Public Use of Lakes and Beaches

The popularity of public beaches in the National Capital Region will also increase under climate change. In Gatineau Park, the NCC operates six public beaches that are staffed with lifeguards in the summer. On average, the current swimming season in Gatineau Park is 80 days<sup>(13)</sup>, usually stretching from mid-June to the Labour Day weekend. Under warmer climatic conditions, the swimming season is projected to be extended 17 to 26 days as early as the 2020s, and 22 to 60 days in the 2050s (Figure 21). In the 2080s, both climate change scenarios project swimming seasons in excess of 100 days, with the warmest climate change scenario projecting a doubling of the swimming season (from 80 days to 159 days).

Figure 21. Projected swimming and beach recreation seasons



<sup>a</sup> Defined by maximum temperature  $\geq 15^{\circ}\text{C}$

<sup>b</sup> Defined by maximum temperature  $\geq 23^{\circ}\text{C}$

Public beaches also provide an opportunity for other recreation activities such as sunbathing, sports, leisure walks and picnicking. As the climate in the National Capital Region warms, suitable climatic conditions for beach-based recreation will increase and the season will be extended. Currently, public use of beaches in Gatineau Park takes place 158 days out of the year<sup>(13)</sup>, typically from mid-May to mid-October. In the 2020s, the beach recreation season is projected to be extended 10 to 21 days, and 14 to 52 days in the 2050s (Figure 21). In the 2080s, the warmest climate change scenario projects that the season could be extended 69 days (six additional weeks), contributing to a 200-day beach recreation season in Gatineau Park. Public beaches in other urban green spaces in the National Capital Region (e.g., along the Ottawa River) will likely experience similar extensions in season length.

Although the swimming and beach-use seasons in the National Capital Region would get longer under climate change, warmer summer temperatures as early as the 2020s may also have a negative impact on water quality through increased algae growth<sup>(21)</sup>. How climate change may affect the frequency of beach closures and swimming bans remains uncertain, but increased water testing and public communication may be required in the future.

### Golf

Golf is a popular recreational activity in the National Capital Region. More than 20 golf courses operate in the region, including one located outside of Gatineau Park's eastern border. Several other area golf courses are located on land leased from the NCC.

As the climate warms, the golf season in the National Capital Region is expected to become longer. There is little noticeable extension in the golf season under the least-change climate change scenario. Under the warmest climate change scenario, the golf season is projected to be three weeks longer than at present in the 2020s and six weeks longer in the 2050s. In the 2080s, the golf season could extend through December in the National Capital Region (Figure 22).

Both climate change scenarios also suggest that more rounds of golf will be played in the National Capital Region under a warmer climate. The number of rounds played per year at an average 18-hole golf course is projected to increase between 7% and 18% as early as the 2020s (Figure 23). In the 2050s, the rounds played will increase, on average, between 10% and 35%. This increase represents an additional 3,000 to 9,500 rounds being played at a typical 18-hole golf course, and between 60,000 and 190,000 additional rounds being played in

the National Capital Region. Most of the increased demand will occur during the shoulder season, particularly in April/May and October/November (Figure 24). In the 2080s, golf courses in Ottawa could experience 14% to 43% more rounds per year.

Figure 22. Projected golf season in the Capital Region

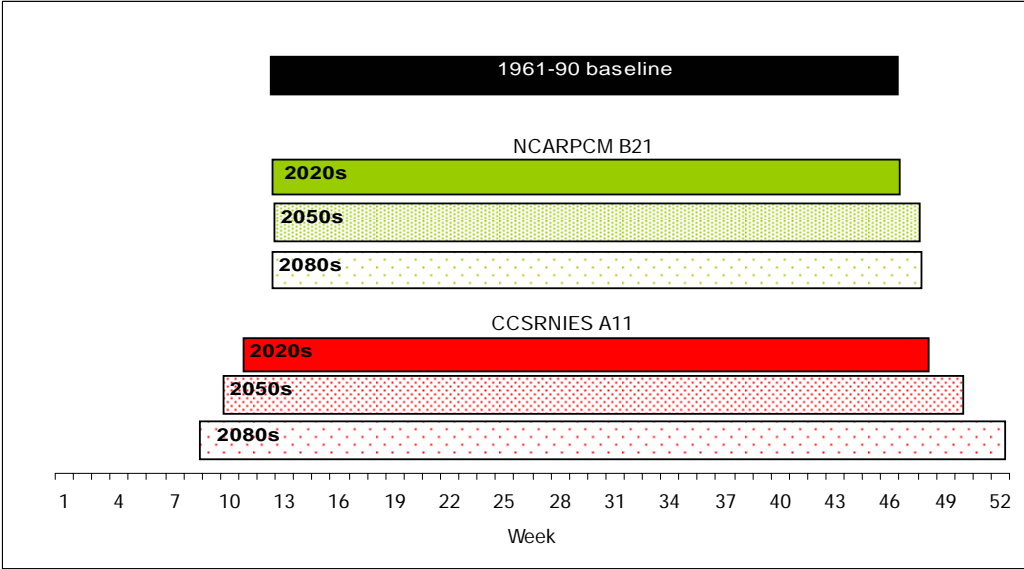


Figure 23. Projected seasonal rounds of golf

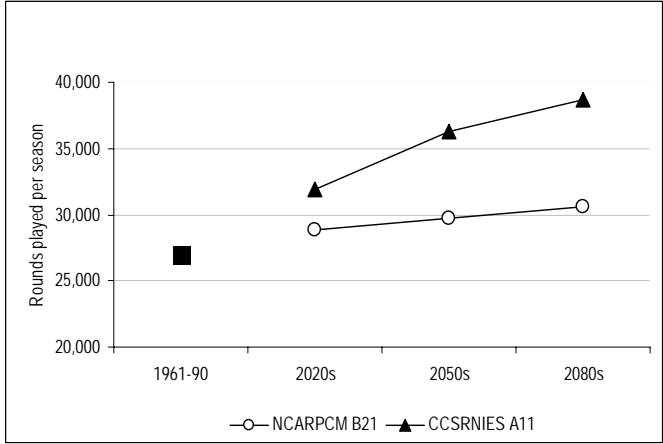
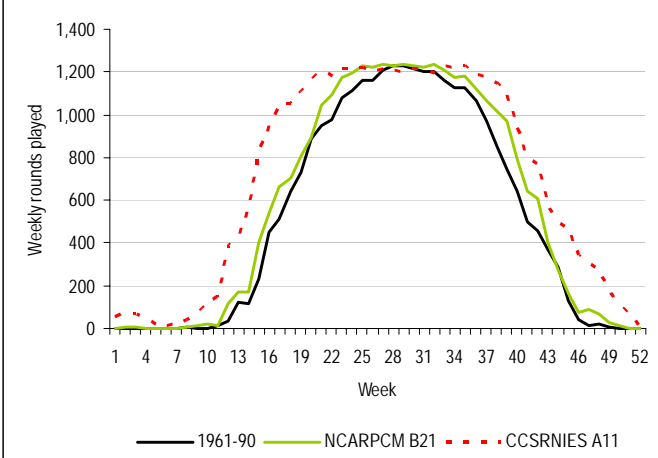


Figure 24. Projected golf demand in the 2050s (per 18-hole course)



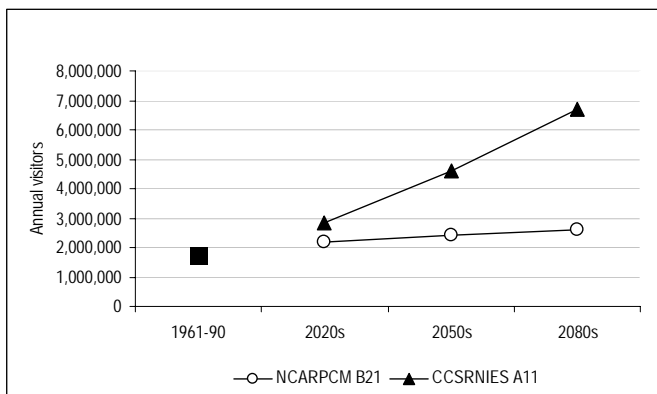
# ECOLOGICAL CONSERVATION



**G**atineau Park is the largest urban green space in the National Capital Region. It is an important recreation and tourism destination in the National Capital Region regardless of the season, and it is also an important ecological resource.

It is currently estimated that almost two million people visit Gatineau Park annually, most engaging in some form of recreational activity<sup>(22)</sup>. As the period for warm-season recreation is extended under climate change, Gatineau Park's current annual visitation is projected to increase to between 2.2 million and 2.8 million in the 2020s, and increase to between 2.4 million and 4.6 million in the 2050s (Figure 25). With further warming by the end of the century, Gatineau Park could expect between 2.6 million and 6.7 million visits in the 2080s. If population growth were also considered, higher visitation increases become even more likely.

Figure 25. Projected annual visitors to Gatineau Park



Gatineau Park is also an important ecological resource in itself, and projected increases in visitors under climate change could influence conservation practices. Over 200 species of birds live in the Park, along with endangered animal species such as the wolf and Canadian lynx. Gatineau Park also contains extensive stands of undisturbed black maple and white oak trees<sup>(23)</sup>.

Under a changed climate, the ecological resources in Gatineau Park are projected to experience change. An ecological assessment of Gatineau Park was not part of this climate change impact assessment conducted by the University of

Waterloo. Further, no ecological climate change impact assessment has been conducted of Gatineau Park. As a result, scientific studies of vegetation and animal species' responses to climate change from Canada and the United States are used here to explore the implications of climate change for Gatineau Park's ecological resources.

### The NCC's Role

The NCC is responsible for protecting Gatineau Park's ecological resources. In its recently adopted **Gatineau Park Master Plan (2004 to 2014)**<sup>(23)</sup>, a vision statement was established that emphasized conservation of the Park's natural and cultural environments. Specifically, the plan specified that in coming decades:

- Gatineau Park would become a natural protected area, managed primarily for conservation and then for recreational use.
- Planning and management of Gatineau Park would become consistent with the International Union for Conservation of Nature's (IUCN) Type 2 protected areas. These protected areas are comparable to Canada's national parks, where the maintenance of ecological integrity is the primary management objective.

A shift toward a stronger conservation mandate means that the biophysical implications of climate change are salient to the long-term future management of Gatineau Park. Thus, there will be a continued need for the NCC to consider the implications of climate change in the Park's conservation and management plans.

### Ecological Implications of Climate Change

Over the last decade, climate change has been identified as posing a critical threat to the continued survival of some existing ecosystems and species<sup>(24-30)</sup>. A number of scientific studies and internationally recognized nature-based organizations have concluded that climate change is an important issue of consideration for protected areas. For

instance, the Intergovernmental Panel on Climate Change concluded that climate warming “ranks alongside other recognized threats to global biodiversity”<sup>(25)</sup>.

In Canada, park and protected area systems were developed to protect specific natural features, species and communities in-situ. In-situ conservation planning is based on the assumption of current climate and biogeographic stability, which implies that what is currently protected will remain for future generations to enjoy. Master plans for Gatineau Park are based on similar assumptions. However, under climate change, these assumptions are no longer valid.

Sufficient evidence exists to suggest that climate change will significantly alter the spatial extent and composition of current ecological communities. Vegetation modelling studies have consistently projected major shifts in vegetation types across Canada. In Canada's national parks, substantial changes will occur in biome representation. A biome is an ecological community characterized by specific climatic conditions and a dominant group of plant and animal species. A new biome type is projected to appear in half of Canada's 39 national parks under climate change<sup>(31)</sup>. Similarly, over two-thirds of Ontario's provincial parks could also experience a change in biome type<sup>(32)</sup>.

Biomes themselves do not shift as entire units, but rather through the responses of individual species. A study of 80 relatively common tree species in the eastern United States found that 36 of them would shift their range northward by more than 100 km under climate change, while seven were estimated to move north more than 250 km<sup>(33)</sup>. Spruce-fir forests are projected to disappear from New England and maple-beech-birch forests showed near extinction from that region. In Ontario, more southerly dominant species (e.g., red maple) are projected to increase their distribution and density in the province, while more common northerly species (e.g., black spruce) could decrease. It is suggested that as many as 30 tree species that are not currently located within Ontario's political boundaries could appear under projected climate change<sup>(34)</sup>. If the warmest climate change scenarios are realized, by the end of the 21<sup>st</sup> century, Ontario's forests may be characterized by ecological communities undergoing transition.

These findings have implications for conservation policy and planning in Ontario and potentially protected areas in the National Capital Region such as Gatineau Park. For example, the northward shift of species from the United States, with ranges not currently in Canada, would meet Parks Canada's definition of 'alien species' and therefore could subject these species to management interventions. Conservation planning

based on protecting representative samples of ecosystems would have to deal with the challenge of 'hitting a moving target' of ecological representativeness. What is to be considered a representative natural area in an era characterized by transitory ecosystems? In addition, changes in ecosystems will need to be examined in the context of park objective statements, wildfire management strategies, individual species management plans and contingencies for species at risk, non-native species management programs, visitor management plans and species reintroduction programs.

### Conservation in Gatineau Park under Climate Change

The ecosystems of Gatineau Park will be affected by climate change in many of the same ways as Canada's national and provincial parks. Of the four principal concerns related to the environment in the **Gatineau Park Master Plan**, three will be directly affected by the impacts of climate change.

- **Risk of habitat loss:** Habitat loss will be exacerbated for some species as climatic conditions become less suitable. Vegetation and species composition will also evolve in response to the changing climate.
- **Risk of disrupting natural processes:** Climate change would alter some natural processes in the Park, including important disturbance regimes like fire and insect-disease cycles. The historical range of many species will also change which will lead to an increase the number of 'new' species in Gatineau Park.
- **Risk of biodiversity loss:** Climate change will alter the biodiversity in Gatineau Park. Some cold-adapted rare species in the Park may be put at risk by climate change, while some of the rare southerly species (e.g., on the Eardley Escarpment) may benefit from a warmer climate.

# SUMMARY OF FINDINGS

Climate change mitigation is an important priority of the international community. Both the United Nations Intergovernmental Panel on Climate Change and the Government of Canada have indicated that despite efforts to reduce greenhouse gas emissions, some level of human-induced climate change will need to be realized in the 21<sup>st</sup> century. As such, climate change adaptation is a necessary policy strategy. Climate change adaptation can be thought of as any planned adjustments in socio-economic processes, practices and structures to moderate potential risks or to benefit from opportunities associated with climate change<sup>(35)</sup>.

The summary of findings contained in this executive summary report was presented to NCC managers as the foundation for a dialogue on the subject of climate change adaptation (August 2005). The session was well attended. Those that could not attend provided written comments. Several important themes emerged during the session, each of which is briefly discussed below. A wide range of potential climate change adaptation strategies were discussed, however, these will require further analysis before implementation can be considered.

- **Scientific uncertainty:** The large uncertainty in climate change scenarios was identified as an important challenge to adaptation planning, but was not seen as an insurmountable barrier. Participants agreed that it would be important for the NCC to monitor improvements in the climate change science over time. A need to better understand vulnerabilities to climate change and determine critical climatic thresholds or decision points was identified (i.e., under what conditions would the adaptation strategies in Figure 26 be implemented).
- **Further study:** Climate change was recognized as a very complex and rapidly evolving science and policy area. Participants felt that additional attention would be needed to examine in more detail the vulnerabilities of specific NCC tourism events and recreation assets. There was recognition that climate change would have an impact on maintenance practices, the type of services and amenities offered to the public and the dates of certain events or programs. Research would be needed to examine the effectiveness of potential adaptations and to ensure that adaptations are not in conflict with other NCC policies and planning guidelines. It was noted that alternative scenarios already exist for some

events or programs in order to adapt seasonally to changes in weather.

- **Other business lines:** It was also recognized that other NCC business lines could be affected by climate change. The implications for agricultural practices on NCC lands, forest management (urban, Greenbelt, Gatineau Park), energy costs and greenhouse gas emission reductions, and infrastructure maintenance (buildings, roads, canals) would need examination. Long-range plans for Urban Lands, the Greenbelt, Gatineau Park and the NCC vehicle fleet were identified as some other strategic planning areas where climate change should be considered.
- **Adaptation discussions:** It was deemed important for the NCC to engage in future climate change adaptation discussions with its many partners and stakeholders (including government, business and non-governmental organizations). The NCC should also continue to liaise with other federal departments to learn from innovations and to share its unique climate adaptation expertise.

## Final Thoughts

In a 2005 public survey<sup>(36)</sup>, Canadians were asked about their perceptions regarding climate change. One in every two Canadians was found to be very concerned about the issue. Approximately 83% of Canadians indicated that municipal planners, engineers and natural resource managers should consider the importance of climate change in their planning initiatives.

Canada's Capital Region's mix of natural and cultural attractions draws millions of tourists to the region every year, making it one of the most important tourism regions in Canada. This executive summary has demonstrated that climate is important to Canada's Capital Region's tourism and recreation industry and that projected climatic changes over the 21<sup>st</sup> century will create new opportunities and challenges for how the NCC manages its recreation and tourism assets and programming.

This study represents one important initiative where the NCC has begun to integrate climate change into its strategic corporate planning.

Given the range of business lines and the number of potential climate change implications, it is not surprising that the NCC has expressed an interest in pursuing this subject. As referenced throughout the report, over the years, the NCC has developed many excellent adaptation strategies. It has also demonstrated a proactive leadership role through its participation in this study and more recently got involved in a three-year initiative led by Natural Resources Canada to monitor and collect data on tulip bloom in Eastern Ontario

including the Capital relative to climate fluctuations. In addition, its advisory committee membership reflects a wide range of expertise that includes the area of sustainable building design. As such, the NCC is well positioned to track and continue moving forward in response to this evolving issue.

**Figure 26. Examples of adaptation strategies (generated at the adaptation workshop) for further discussion**

<b>Winterlude</b>	<ul style="list-style-type: none"> <li>Integrate more events into that are less climate-sensitive (i.e., indoor events)</li> <li>Downplay the importance of the Skateway as an attraction</li> <li>Increase the use of refrigeration (i.e., for ice sculptures) and snowmaking (i.e., Snowflake Kingdom) to sustain attractions</li> </ul>
<b>Tulip season</b>	<ul style="list-style-type: none"> <li>Experiment with hybrid tulip varieties that are more tolerant of warmer climates</li> <li>Alter some of the Festival's public events (e.g., Tulip Regatta) to reduce reliance on Parks Canada's seasonal operation of the Rideau Canal</li> <li>Consider re-adopting the Festival of Spring theme</li> <li>Adjust current understanding of the science of tulip development and planting</li> <li>Shift the dates of the Canadian Tulip Festival</li> </ul>
<b>Canada Day</b>	<ul style="list-style-type: none"> <li>Alter timing of official mid-day ceremony and other public events to avoid the warmest part of the day (i.e., 12 to 3 pm)</li> <li>Alter the type and location of events (i.e., more shaded environments) to reduce heat-related stresses</li> </ul>
<b>Winter recreation</b>	<ul style="list-style-type: none"> <li>Diversify activities offered at alpine ski hills to reduce sensitivity to reductions in natural snowfall (e.g., mountain biking)</li> <li>Consider using snowmaking on some cross-country ski trails where micro-climate and water resources are appropriate</li> <li>Convert some cross-country ski trails to hiking trails</li> </ul>
<b>Warm-season recreation</b>	<ul style="list-style-type: none"> <li>Extend the camping and beach-use seasons</li> <li>Identify new camping/lake/beach resources inside/outside of Gatineau Park to alleviate crowding issues at existing locations</li> <li>Renegotiate lease agreements for golf courses operated on NCC property</li> <li>Regulate the number of people and recreation activities in Gatineau Park</li> </ul>
<b>Ecological conservation</b>	<ul style="list-style-type: none"> <li>Integrate climate change issues into Gatineau Park's conservation plan (e.g., species at risk), Park research strategy (e.g., indicators of ecological integrity in long-term monitoring) and ecological restoration plans (e.g., sustainability of restored species)</li> </ul>

## Endnotes

1. National Capital Commission. 2002. **Capitalizing on Research: A Compilation of Findings on Canada's Capital Region**. Ottawa, ON: National Capital Commission.
2. Crowe, R., McKay, G. and Baker, W. 1977. **The Tourist and Outdoor Recreation Climate of Ontario: Volume 3: The Winter Season**. Downsview, ON: Environment Canada.
3. Mieczkowski, Z. 1985. The tourism climate index: a method of evaluating world climates for tourism. **The Canadian Geographer** 29(3): 220-233.
4. 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**. Department of Geography Publication Series Occasional Paper 18. Waterloo, ON: University of Waterloo.
5. 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. **Journal of Sustainable Tourism**.
6. Environment Canada. 2003. **Climate Trends and Variations Bulletin for Canada**. Downsview, ON: Meteorological Service of Canada, Climate Research Branch.
7. Canadian Council of Ministers of the Environment. 2003. **Climate, Nature, People: Indicators of Canada's Changing Climate**. Winnipeg, MB: Canadian Council of Ministers of the Environment.
8. Canadian Climate Impacts and Scenarios. 2004. **Climate Change Scenario Scatter Plots**. Victoria, BC: Canadian Institute for Climate Studies, University of Victoria.
9. Fang, X. and Stefan, H. 1998. Potential climate warming effects on ice covers of small lakes in the contiguous United States. **Cold Regions Science and Technology** 27: 119-140.
10. Scott, D., Jones, B. and Abi Khaled, H. 2005. **The Vulnerability of Tourism in the National Capital Region to Climate Change**. Technical Report to the Government of Canada's Climate Change Action Fund (Impacts and Adaptation Programme), Natural Resources Canada. Waterloo, ON: University of Waterloo.
11. National Capital Commission. 2004. **Cross-Country Ski Races**. Personal communication.
12. Paul, A. 1971. **Relationships of Weather to Summer Attendance at Outdoor Recreation Facilities in Canada**. PhD Dissertation. Department of Geography, University of Alberta.
13. University of Massachusetts. 2004. **Landscape Message**, bi-weekly newsletter. Amherst, MA: University of Massachusetts, Landscape, Nursery and Urban Forestry Program.
14. Penn State. 2004. **Growing Degree Days and Pest Management**. Erie, PA: Penn State, College of Agricultural Sciences, Co-operative Extension of Erie County.
15. National Capital Commission. 2002. **Winterlude 2002, Internal Evaluation**. Ottawa, ON: National Capital Commission.
16. Decima Research Inc. 2004. **Final Report – 2004 Winterlude Study**. Ottawa, ON: Decima Research Inc.
17. Coopers & Lybrand Consulting Group. 1988. **Evaluation of the Festival of the Spring. NCR 1988 Festivals Study**. Ottawa, Ontario, ON: Ottawa-Carleton Board of Trade.
18. Wood, M. 2003. Hunting for blooming tulips. **Ottawa Sun**, 2 May.
19. Ottawa Tourism and Convention Authority. 2003. **Canada Day 2003: Visitor Impact Study**. Ottawa, ON: Ottawa Tourism and Convention Authority, Research and Information Section.
20. La Fleur de la Capitale. 2004. **Gatineau Park Campground Statistics, 2002 to 2004**. Ottawa, ON: La Fleur de la Capitale.
21. International Joint Commission. 2003. **Climate Change and Water Quality in the Great Lakes Basin**. Ann Arbor, MI: Great Lakes Water Quality Board, International Joint Commission.
22. Del Degan, Massé et Associés. 2002. **Gatineau Park Master Plan Review**. Ottawa, ON: National Capital Commission.
23. Del Degan, Massé et Associés. 2004. **Master Plan Review – Gatineau Park: Phase 3 – Preliminary Master Plan**. Ottawa, ON: National Capital Commission.
24. International Union for Conservation of Nature (IUCN). 1993. Parks for Life. In J. McNeely (ed) **Report of the IV<sup>th</sup> World Congress on National Parks and Protected Areas**. Gland, CH: International Union for Conservation of Nature.
25. Intergovernmental Panel on Climate Change (IPCC). 2002. **Climate Change and Biodiversity**. IPCC Technical Paper V. Cambridge, UK: Cambridge University Press.
26. Hughes, L. 2000. Biological consequences of global warming: is the signal already apparent? **Trends in Ecology and Evolution** 15: 56-61.

27. McCarty, J. 2001. Ecological consequences of recent climate change. **Conservation Biology** 15: 320–331.
28. Root, T., Price, J., Hall, K., Schneider, S., Rosenzweig, C. and Pounds, J. 2003. Fingerprints of global warming on wild animals and plants. **Nature** 421: 57–60.
29. Parmesan, C. and Yohe, G. 2003. A globally coherent fingerprint of climate change impacts across natural systems. **Nature** 421: 37–42.
30. Scott, D. and Suffling, R. 2000. **Climate change and Canada's National Parks**. Downsview, ON: Environment Canada.
31. Scott, D., Malcolm, J. and Lemieux, C. 2002. Climate change and modeled biome representation in Canada's national park system: implications for system planning and park mandates. **Global Ecology and Biogeography** 11(6): 475–485.
32. Lemieux, C., Scott, D., Davidson, R. and Gray, P. 2004. **Climate Change and Ontario Parks**. Peterborough, ON: Ontario Ministry of Natural Resources.
33. Iverson, L. and Prasad, A. 1998. Predicting abundance of 80 tree species following climate change in the eastern United States. **Ecological Monographs** 68: 465–485.
34. Malcolm, J., Puric-Mladenovic, D. and Shi, H. 2004. **A Climate Change Atlas for 134 Forest Tree Species of Ontario, Canada**. Toronto, ON: University of Toronto, Faculty of Forestry. [http://www.forestry.utoronto.ca/treeatlas/mainpage/main\\_page.htm](http://www.forestry.utoronto.ca/treeatlas/mainpage/main_page.htm)
35. Smit, B., Burton, I., Klein, R. and Wandel, J. 2000. An anatomy of adaptation to climate change and variability. **Climatic Change** 45: 223–251.
36. Ekos Research Associates. 2005. **Public Perceptions of Climate Change: Annual Tracking**. Report submitted to Natural Resources Canada. Ottawa, ON: Ekos Research Associates.



