

OUTDOOR HOCKEY IN A CHANGING CLIMATE

What outdoor skating rinks teach us about climate change

Robert McLeman, Colin Robertson, Haydn Lawrence and Karim Malik
Department of Geography and Environmental Studies, Wilfrid Laurier University

Few experiences are more quintessentially Canadian than skating on an outdoor rink. Even if you have only ever done it once, or only many years ago as a child, the sensations are unforgettable: the cold air biting your cheeks and nose; steamy breath floating before your eyes; the near-blinding glare of sun on snow; and, most especially, the sound of steel blades scratching into the ice. Especially that. Not to mention the swirling sensations of spinning and streaking across the rink, laughing and shouting with family and friends, finished off with a mad dash into the house for hot chocolate and more laughs.

Indeed, there is nothing quite like a good skate on a well-made outdoor rink. It has been celebrated in story and in song; it even once appeared on our money (Figure 1). But in recent years, reports have started to crop up in the media warning that the Wayne Gretzkys of future generations will need to practice their skills indoors, for winters may become too mild for people in Brantford, Ontario (or Brandon, Manitoba, or La Beauce, Quebec) to build backyard rinks for their kids. Skating seasons on the Rideau Canal – the world's longest skating rink – have become shorter and more unpredictable. The famous Lac des castors (Beaver Lake) rink in Montreal's Mount Royal Park – a favourite urban skating pond for generations, was permanently closed in 2018 by city officials, the maintenance costs no longer justifiable as the number of skateable days tumbled. It was replaced by an artificially refrigerated ice sheet. Is this a harbinger of things to come?

Figure 1: A girl wears sweater number 9 to honour Canadian hockey legend Maurice Richard



Image source: Bank of Canada. Reproduced here according to the Bank of Canada's educational use policy, www.bankofcanada.ca/banknotes/image-gallery



The famous Lac des castors (Beaver Lake) rink in Montreal's Mount Royal Park – a favourite urban skating pond for generations, was permanently closed in 2018 by city officials, the maintenance costs no longer justifiable as the number of skateable days tumbled.

IMPACTS OF A CHANGING CLIMATE ON OUTDOOR SKATING

Five years ago, we set out to measure the impacts of climate change on backyard skating rinks. As with many questions in environmental science, a key obstacle to finding answers was a lack of data. All of us learn as children that water freezes once it's colder than zero degrees Celsius, but as anyone who has ever built a rink knows, temperatures need to be colder than that – and for an extended period of time – in order to successfully create a skateable surface. But how cold and for how long? We had anecdotal information but lacked any clear evidence of what the critical temperature threshold might be, whether that threshold is universal, or if it varies from one rink or region to another. We also lacked reliable records of historical trends in outdoor skating.

Among the best available records are those kept for the Rideau Canal, though the canal is unique: it does not open for skating until the ice is at least 30cm thick and thus strong enough to support the weight of large crowds and maintenance vehicles. Thermodynamically, it has little in common with either a homemade backyard rink or the local pond where kids play shinny. How were we to predict the future of outdoor skating if we could not say for certain what conditions make for a good rink today, much less what skating seasons were like in the past?

We asked the rink-making public for answers. In January 2013 we launched (with very little fanfare) www.RinkWatch.org, a website that asks people with a rink in their backyard or neighbourhood park to pin the location of their rink on an interactive map and then report skating conditions throughout the winter. We hoped that, with luck, we might get a few dozen participants by the

end of that first winter. Instead, we had more than a few dozen participants by the end of our first week. Five winters and over one hundred media interviews later, RinkWatch has collected data from over 1,500 rinks across Canada and the northern United States. In some cases, the rink maker has entered only a few days of data before ceasing to participate; others have reported every skating (and non-skating) day dutifully each winter. Using the data participants have provided, we are now able to say a great deal about the past, present and future of outdoor skating in Canada. What follows is a summary of what we have learned about rinks and their social importance, some notes on the significance of trees and greenbelts for regulating the outdoor skating season, and suggestions for what you, the reader, can do to help keep the outdoor skating experience alive in Canada for future generations.

BUILDING THE PERFECT RINK

To successfully build a backyard rink requires a combination of expertise (often gained through trial and error), site-specific knowledge, many late nights, and a bit of luck with the weather. The ideal site is a patch of level ground that is shaded on the south and west sides; this keeps the sun off the ice and prevents wind from drifting snow onto the surface. Historically, the most common way of making a rink was to wait until snow covered a lawn, tennis court or back alley, tamp down that snow and then flood it with a hose. Today, rink makers are more likely to lay down a large, single-piece of plastic liner or white tarpaulin, and attach it to wooden boards (Figure 2). This prevents meltwater from draining away from the rink during the inevitable mid-winter thaw, allowing for a quick recovery of the skating surface when freezing temperatures return.

The amount of flooding required depends on how level the site is, for no more than a few inches of ice is required to start skating. The first stage of flooding aims to create a continuous surface across the entire area of the rink. Once that surface has frozen solid, the rink maker applies thin layers of water until the combined ice is solid enough to support the weight of skaters without cracking and sagging. A rink that is heavily used will need to be lightly flooded each night to restore a smooth skating surface. Any snow that falls must be cleared promptly, as it can start sticking to and ruining the ice surface if allowed to sit for more than a day or two.

A knowledgeable rink maker with a level site, plastic liner and boards can get a skating rink up and running within a few days when the weather conditions are right. So, what are the right weather conditions? A continuous

period of four to five days of round-the-clock sub-freezing temperatures is ideal for starting a rink. The timing of this first block of cold winter air varies across the country. In southern Ontario it arrives in late December or early January.

Once the initial mass of solid ice has been created, the rink can withstand some day-to-day temperature fluctuations, including a few midday hours of above-freezing temperatures, so long as the cold returns overnight. Mild temperatures mixed with rain cause the greatest damage to rinks, and the arrival of such conditions beyond the end of February is often the trigger for abandoning a rink until the following winter. Brief mid-winter spells of mild temperatures are inevitable, and these melt the surface layer but do little damage to the underlying mass. During mild spells, people simply stay off their rinks until the cold weather returns, do a quick overnight flood to restore a smooth surface, and resume skating.



Figure 2: Building a typical backyard rink

Photo: R. McLeman

Data from RinkWatch participants helped us identify the specific temperature thresholds within which rinks are either skateable or not. On milder days there is considerable variability between rinks in a given community; those built in exposed locations may be unskateable whereas those in shaded and sheltered areas may be okay. By comparing RinkWatch rink makers' reports with data from their nearest weather stations, we have found that the majority of skating rinks in Canada will be skateable when the average daily temperature is colder than -5.5°C . Rinks may still be skateable at milder temperatures, though this will depend on the given rink's site-specific features. Starting in the month of March, many (though not all) people stop maintaining their rinks, due to five or more continuous days of mild temperatures.

Consequently, we have used the following parameters in our research to estimate the number of skating days for any rink in any winter, independent of site-specific conditions:

- The first skating day each winter is the fifth of five consecutive days where the temperature never rises above zero Celsius.
- The last skating day is the first of five consecutive days with average daily temperatures above -5.5°C , occurring no earlier than March 1st; and,
- between these two dates, any day with an average temperature colder than -5.5°C is potentially a good skating day.

Note that the above parameters are conservative, and only capture days when the probability of a rink being skateable is high; they may therefore underestimate the actual number of skating days on any given rink in any given winter.

OUTDOOR SKATING IN AN URBAN CONTEXT

Temperatures in cities tend to be higher than those in adjacent suburban and rural areas; something scientists refer to as the 'urban heat island effect'. This is due to the additional solar radiation absorbed by pavement, walls, and rooftops, as well as the extra heat generated by automobiles and leaked from buildings. Toronto's 'urban heat island effect' is reflected in the number of outdoor skating days in and around the city. We analyzed daily temperature records from weather stations in Toronto city centre and at Pearson Airport for the winter of 2014-15, which was a relatively good winter for outdoor rinks, as well as for the following winter, which was generally mild and thus bad for outdoor skating rinks. In the 'good' winter we found there were 44 high quality skating days in the city centre, but 48 such days at the airport (plus two more days that were only one-tenth of a degree from being categorized as 'high quality'*).

In other words, people got four or more extra days of skating on suburban rinks as compared with downtown rinks. The difference between the downtown and suburbs was even more pronounced in the following winter, when there were only 11 high quality skating days in the city centre but 17 by the airport.

Is this significant? Ask anyone who has gone to the effort of building a rink and you will get a resounding 'yes'. More importantly, as average temperatures rise over coming decades due to climate change, urban neighbourhoods will be the first to experience winters that are too mild to make building a rink worthwhile. One of the best ways to extend the skating season in any backyard or neighbourhood park – and to counter the urban heat island effect more generally – is to plant trees that provide shade and shelter a rink.

Table 1: Comparison of good skating season (2014-15) and bad skating season (2015-16) in Toronto

	Good winter for skating		Bad winter for skating	
	City centre	Pearson Airport	City centre	Pearson Airport
High quality skating days during season*	44	48	11	17
First potential skating day**	January 9	January 9	January 22	January 22
Last potential skating day***	March 7	March 7	March 4	March 4

* High quality skating day = a day where average daily temperature is -5.5°C or colder

** First skating day = the fifth of five consecutive days after November 1st where maximum daily temperature is below zero Celsius

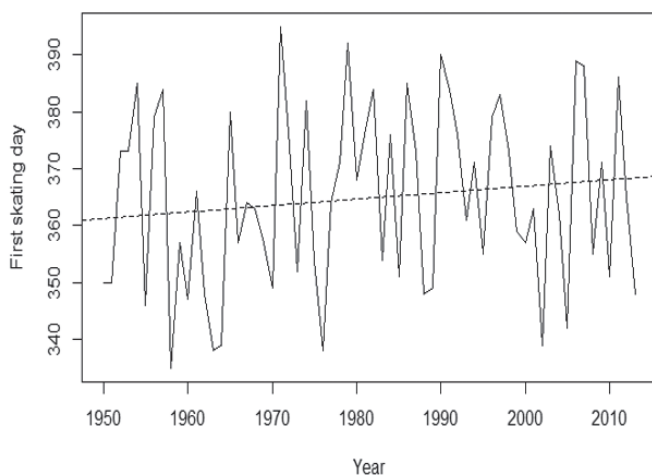
*** Last skating day = the first day of a block of five consecutive days no earlier than March 1st where average daily temperature is warmer than -5.5°C

Note: all data from Environment Canada historical weather records accessed at http://climate.weather.gc.ca/historical_data/search_historic_data_e.html

CHANGES IN THE LENGTH OF THE BACKYARD SKATING SEASON

Using the above-mentioned parameters, we are able to reconstruct historical trends in the backyard skating season and make future projections for backyard rink-making in a changing climate. Taking Toronto as an example, let's first consider historical trends in skating season length by looking at the total number of good quality skating days each year since the 1950s, when backyard rink-making first became popular. As can be seen in Figure 3, the arrival of the first block of freezing-cold temperatures varies considerably from one year to the next, coming as early as the second week of December or as late as the third week of January. The study period shows an overall trend where, more often than not, the first skating day has arrived a few days later each year (although this trend is strongly influenced by a number of consecutive cold winters in the 1960s and 1970s).

Figure 3: Timing of the start of the backyard skating season in suburban Toronto, since 1950



Note: Days are numbered according to the Julian calendar (i.e. January 31st = day 31, February 1st = day 32, etc.). In some winters the first skating day does not arrive until after December 31, in which case additional days are added (e.g. in a non-leap year, a skating season that starts on January 5th starts on day number 370). Data source for Figures 3 and 4 are from Environment Canada's historical weather records for Pearson Airport.

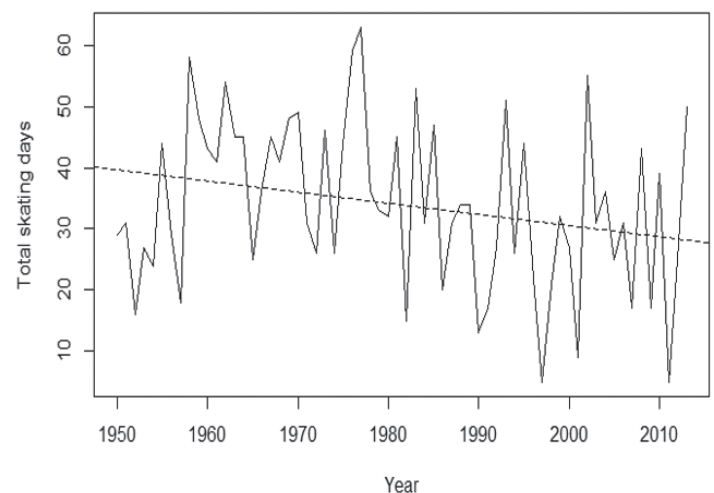


What is more interesting is Figure 4, which shows that the number of high quality skating days each winter has fallen considerably in Toronto in recent decades. From the late 1950s through to the early 1980s, Toronto averaged between five and six weeks' worth of good skating days each winter; in recent years, it has been more like three to four weeks of good skating. At this low number, non-climatic factors such as site-specific conditions play a bigger role in determining a rink's lifespan. Rink makers may decide that such brief skating seasons do not warrant the effort needed to build rinks.

From the late 1950s through to the early 1980s, Toronto averaged between five and six weeks' worth of good skating days each winter; in recent years, it has been more like three to four weeks of good skating.

Interviews with a small sampling of former RinkWatch participants in southwestern Ontario suggest that a recent string of mild winters did indeed lead them to stop making backyard rinks. Figure 4 also shows that the year-to-year variability in skating conditions has become increasingly volatile and that the range in the number of skating days between good years and bad years has also expanded. In other words, southern Ontario winters have become highly unpredictable and unreliable for backyard rink making.

Figure 4: Number of high quality skating days in suburban Toronto since 1950





THE FUTURE OF BACKYARD SKATING RINKS, AND WHY WE SHOULD CARE

To understand the impacts of climate change on backyard skating rinks, we took the data entered into RinkWatch in the 2013-14 and 2014-15 winters for the cities of Calgary, Montreal and Toronto. We combined this data with outputs from a general circulation model implemented under standardized scenarios used by scientists to project future climate conditions.¹ We forecasted skating seasons all the way to 2090, and found that the average number of skating days per winter can be expected to drop by one-third in Montreal and Toronto, and by roughly 20% in Calgary. As enthusiastic outdoor skaters ourselves, these results give us a mix of relief and trepidation. The relief comes from finding that outdoor skating will likely not disappear entirely from southern Ontario; the region we call home. However, our trepidation is that even a small decline in the number of skating days may discourage backyard rink-makers in southern Ontario, where winter weather conditions have already become erratic and unreliable.

We forecasted skating seasons all the way to 2090, and found that the average number of skating days per winter can be expected to drop by one-third in Montreal and Toronto, and by roughly 20% in Calgary.

Most said they build rinks in order to create a place for their kids and friends to play outside in the dead of winter.

This in turn begs an important underlying question: why should we care if winters become too mild for outdoor skating? After all, many Canadians would no doubt welcome milder, shorter winters. Those who want to skate or play hockey can head for indoor arenas, where the conditions are always just right. Indeed, more kids already do most of their skating in indoor arenas as opposed to outdoor rinks and frozen ponds.

In order to answer the above question, we need to understand why people build backyard rinks in the first place. It is no small undertaking to purchase and install eighty linear feet of 2" x 8" boards and a plastic sheet in the yard, spend night after frigid night flooding it with a garden hose, and in the process create another area (in addition to the driveway and walkways) that must be kept clear of snow. Three winters ago we surveyed RinkWatch participants to find out what motivates them.² The answers will warm your heart. Most said they build rinks in order to create a place for their kids and friends to play outside in the dead of winter. Some saw the rink as a way to help their kids improve their skills for organized hockey, though they were a minority. The majority emphasized the importance of having a space for unstructured play and socializing with family and friends. Rink makers almost universally create their rink in the hope that it will become a neighbourhood asset. Let's hope they continue to do so for generations to come.

¹ Readers interested in the specific methods should consult Robertson, C., McLeman, R., & Lawrence, H. (2015). Winters too warm to skate? Citizen-science reported variability in availability of outdoor skating in Canada. *The Canadian Geographer/Le Géographe Canadien*, 59(4), 383-390. <https://doi.org/10.1111/cag.12225>

² For more details, see Fredericksen, A., McLeman, R., & Elcombe, T. (2018). Building Backyard Ice Rinks in Canada: An Exploratory Study. *Leisure/Loisirs*, 42(1).



ACTION YOU CAN TAKE

The fate of the outdoor skating rink is just one of many concerns confronting Canadians in the face of a rapidly changing climate. If preserving this icon of the Canadian winter for future generations is important to you, here are suggestions for what you can do to help prevent backyard rinklessness.

- Do your part to help reduce greenhouse gas emissions, for they are at the root of the problem.
- Volunteer to help maintain an outdoor rink in your local park or schoolyard, or get one started if there isn't one there already. The social benefits of a rink, especially for our kids, is tremendous!
- Encourage your local government to invest in urban trees and parkland, as well as green spaces in surrounding regions, to help buffer the urban heat island effect. Green spaces are not only good for keeping rinks cool in the winter, they also increase biodiversity and help counter the impacts of extreme heat events in the summer.
- Get involved in citizen science. If you have a backyard rink, participate in RinkWatch. If not, join one of the many other citizen-science projects that ask for the public's help with collecting data on the impacts of climate change. Some examples of these are: [FrogWatch](#), [PlantWatch](#), [IceWatch](#), and [SnowTweets](#).

Most important of all, go for a skate outdoors this winter, especially if you haven't in a while. If you do, you might reconnect with your inner child, remember the sheer pleasure of being on ice, and appreciate more deeply that we need to act now to slow climate change and preserve the Canadian winter.

ABOUT THIS SERIES:

The Greenbelt Foundation partnered with experts to understand how climate change is affecting our daily lives, and ways that we can individually and collectively respond to these challenges. For other installments in the series, visit www.greenbelt.ca/changing_climate



Possibility grows here.