

## Climate Change in Muskoka – Muskoka Watershed Council

### 2018 Report Card

In Muskoka, local ecological, social and economic systems are impacted by changing climatic conditions caused by the global warming trend being driven by modern society's excessive emissions of greenhouse gases. Although climate change science is advancing, the Earth's climate is extremely complex which makes projections of the future climate challenging, especially on a local scale. However, as local data are collected, it is evident that climate change is a reality in Muskoka, and our understanding of its current and future effects are improving with time.

This indicator focuses on physical changes the Muskoka Watershed has undergone due to climate change, measured by lake surface water temperatures in the summer and ice coverage on lakes in the winter.

This section of the Report Card will report on climate-related trends that have been observed across the watershed and what they mean for our weather, lakes, forests and our health.

#### How is Climate Change Measured in Muskoka?

The impacts of climate change can be demonstrated through several measurements. Some of these are the:

- Changing pattern of precipitation
- Increase in air and water temperatures
- Water level changes

While climate change is a planet-scale process, examination of local-scale measurements can clarify our understanding of local climate change and the resulting local consequences for the Muskoka Watershed. Two useful measurements are:

- Duration of ice coverage in lakes during the winter months and
- Surface water temperatures of lakes in the summer months

Data for these measurements are easily accessible for use and include historical records spanning as far back as the early 1980's, providing us with a local long-term trend. Further, ice coverage and summer surface water temperature measurements are widely recognized and recommended by the science community, including the U.S. National Oceanic and Atmospheric Administration (NOAA). Further, *The State of Ontario's Biodiversity 2010 Highlights Report* by the Ontario Biodiversity Council states that "changes in ice cover on northern hemisphere lakes are a strong signal of global climate change. Changes in freeze-up and break-up times can affect the:

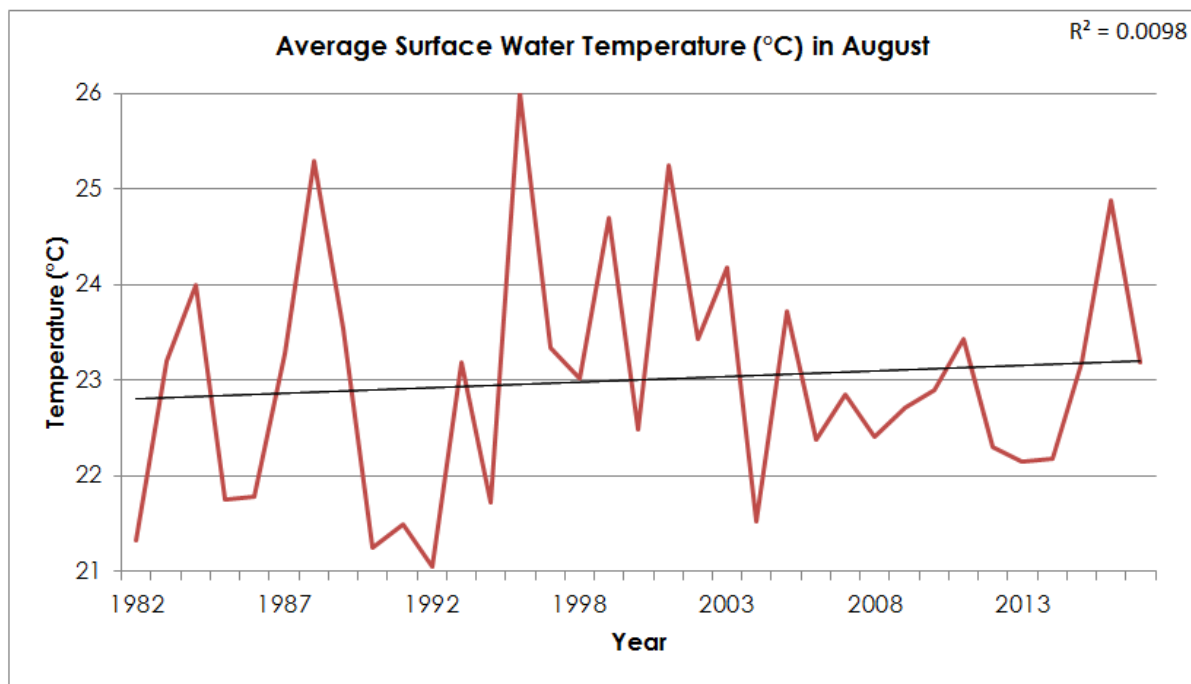
- Food supply for aquatic life
- Alter fish spawning

- Cause birds to change their migration patterns
- Less ice means more water may evaporate and turn into snow which will fall across the area

### August Surface Water Temperatures

Surface water temperature data have been collected by The District Municipality of Muskoka for many area lakes since 1980. Ice coverage data have been collected by the Dorset Environmental Science Center since 1975.

Changes in surface water temperature (°C) were observed using data collected on 164 lakes by the District of Muskoka from 1982 to 2016. Readings were taken during August at 0.5 metres below the surface. If readings were taken more than once on a lake during August, the data was averaged. The data show that summer surface water temperatures in Muskoka’s lakes has increased 0.5 °C on average over the past 35 years.



Average summer surface water temperature (0.5 meters depth) in various lakes in Muskoka. The trend line indicates that surface water temperature is increasing.

While the trend line is not yet statistically significant, this rate of warming is similar to the trend seen in [Georgian Bay Biosphere’s 2018 State of the Bay](#) report, in which summer surface water temperatures in Lake Huron have increased  $0.7 \pm 0.3$  °C per decade between 1980 and 2014. The warming trends observed in Muskoka are not as pronounced. This is most likely due to the

characteristics of Muskoka’s lakes – small, inland, and largely shaded, whereas Lake Huron is larger and wide open for sunlight penetration.

### Ice Coverage

The ice coverage data show that the number of ice covered days for various lakes in the Muskoka Watershed is on the decline.

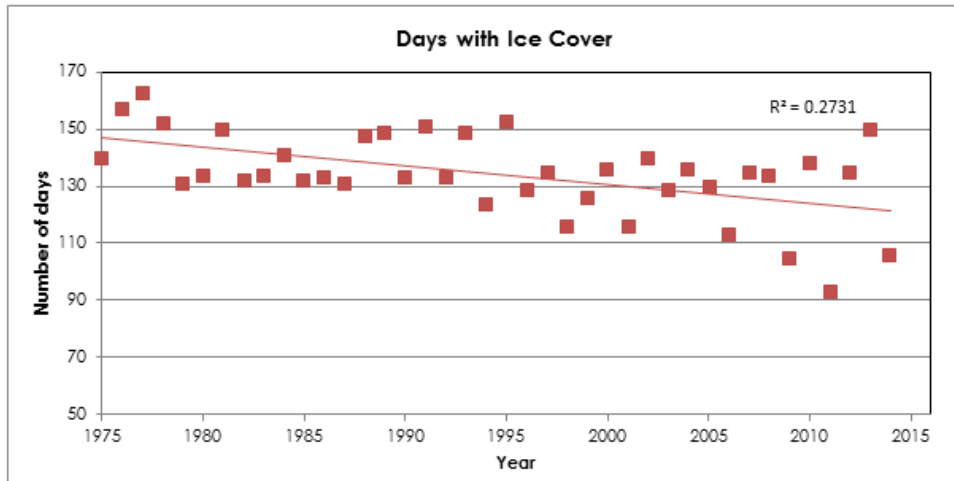


Figure 1. The number of days with ice coverage on lakes from 1975 to 2016. In 1975, there was an average of 140 days with ice on the lakes. By 2016, an average of 121 days of ice coverage was observed.

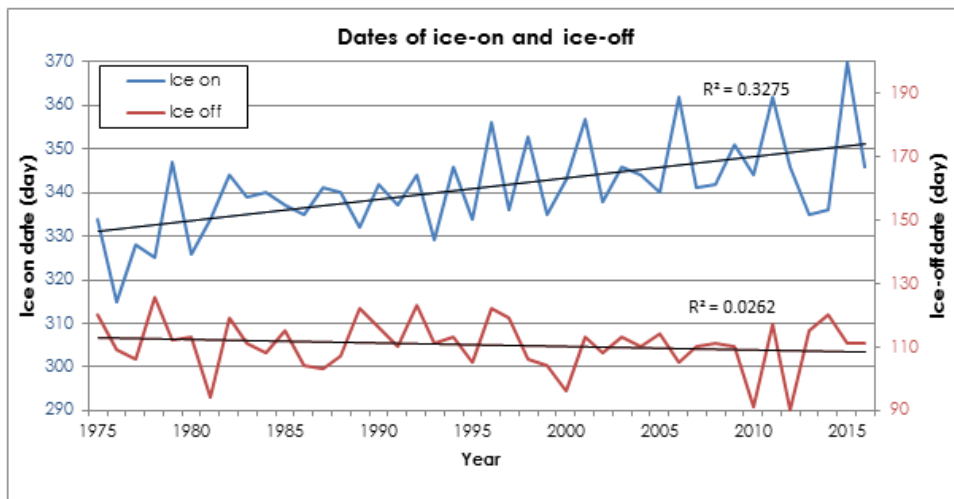


Figure 2. Dates of ice-on and ice-off at various lakes in Muskoka from 1975 to 2017. The date of first ice freeze up (ice-on) is plotted (blue line, left-hand axis) as the Julian day for each year. The date the lake opened in spring (ice off) is plotted (red line, right-hand axis) also as the Julian day for each year. (Julian day is the day number where 1 January = day 1 and 31 December = day 365.) The trend towards a later freeze up in the fall is statistically significant, while the slight advance in ice-off date is not significant.

The red linear trend line in Figure 1 indicates a long term declining trend in the number of days with ice on the lakes. Over the past three decades, the climate in Muskoka has become noticeably warmer, and

the duration of the open-water season has correspondingly increased. That increase in duration has occurred primarily because ice cover is now forming over 3 weeks later in the fall season than it did in 1975. The data points in Figure 1 and the data lines in Figure 2 appear to display more variability in increases and decreases within the last 10 years. This corresponds to fluctuating seasonal variability of temperatures, also a likely indication of climate change.

Although ice thickness is not measured on Muskoka's lakes in the winter, it is expected that changes in the time available between freeze-up and break-up are likely to result in thinner ice today because of the shorter duration of ice cover. No specific data for Muskoka exist, however the Ministry of Natural Resources and Forestry has projected that lakes throughout Fishery Management Zone 15 (which includes Muskoka) will lose 6-9 cm of ice thickness by the end of 2040, and 9-12 cm by 2100. To summarize, ice break up and freeze up dates are responding to a warming climate, increasing the duration of the summer open water period for Muskoka's lakes, and ice thickness is expected to decrease as the duration of ice coverage declines.

To summarize:

- Ice break up and freeze up dates are responding to a warming climate
- Increasing the duration of the summer open water period for Muskoka's lakes and
- Ice thickness is expected to decrease as the duration of ice coverage declines

### **What Does a Changing Climate Mean for Muskoka?**

Both the increase of surface water temperature and the declining ice coverage days indicate that climate change has arrived on our front door step. Changes in our climate will not just lead to changes in the weather. While it is not yet possible to precisely define future climates, the growing expertise in climate science makes it possible to set out plausible and likely climatic conditions for the future, which will have a wide range of impacts on our:

- Environment
- Lives
- Including on our:
  - Weather
  - Lakes
  - Forests
  - Health

## How Will Climate Change Affect our Weather?

While there will still be warm years and cold ones, wet ones and dry ones, the typical year by mid-century is likely to be 3-4 °C warmer each month than the present, and about 10% wetter. As well, precipitation will likely shift toward the winter and spring season, so that summer and fall will be dryer than the present.

The increased precipitation during the winter months, and the expectation that much of this will come as rain rather than snow, may greatly alter the typical annual pattern we currently experience:

- Accumulating snowpack
- Spring thaw
- Summer with sustained but reduced flow through our waterways

Instead, most of the winter precipitation may flow downstream during frequent thaws during that season. The reduced availability of water during summer and fall, and the warmer climate expected, will mean that our lakes during the winter will:

- Be ice free longer
- Midwinter thaws will flood our shorelines
- Forests will experience drought leading to increased risk in fire
- Extreme wind and storms can damage:
  - Habitats
  - Infrastructure and
  - Crops

## How Will Climate Change Affect our Lakes?

The warming climate will influence the physical, biological and chemical characteristics of surface waters, which in turn will influence the rest of the water column. Climate determines the quantity of water in the system through the rate of precipitation, as well as the rate of evaporation and transpiration given an increase in air temperature.

Since the climate is changing, we can expect there to be changes in the functioning of Muskoka's lake ecosystems, as well.

The warming climate will cause noticeable changes in the thermal regimes of some Muskoka lakes, making their surface waters warmer in the summer than at present, which will directly affect aquatic biota. The extent of this warming may prove lethal to some planktonic species, such as *Daphnia*. This may lead to reordering of zooplankton communities, which in turn may change the capacity of those lakes to support fish species.

Moreover, the warming climate may increase stress on cold-water fish species such as Lake trout, and some lakes may be unable to continue to support them all together.

Small lakes will be most affected, since they have a greater potential of becoming anoxic under the warming climate.

Changes in water temperature may also affect:

- Spawning time for some fish species
- Productivity of the lower food web
- Increased presence of invasive species and algal blooms

How our lakes warm during the season, and whether they develop stable thermal stratification through summer and fall, have important consequences for concentrations of dissolved oxygen and nutrients such as phosphorus both in the warmer surface waters and the cooler deep waters.

The change in seasonal patterns and amount of precipitation, combined with the increase in evapotranspiration, are expected to change the amount of water transported through the system to Georgian Bay.

Seasonality of flow will likely be more pronounced, resulting in much more winter and spring and more periods of summer or fall drought.

- In milder than usual years, winter flow may cause nuisance flooding.
- In colder than average years, winter precipitation may result in substantial snowpack and significantly larger spring floods, than at present
- Maintaining flow in rivers and streams during late summer and fall, and keeping water in wetlands may become more difficult
- Changes could have real impacts on certain animal species, especially fish
- Changes in water levels and flow may impact spawning and egg incubation in waterbodies
- Seasonal drying of wetlands is anticipated and will have important consequences for species composition and their ecological functions in the hydrological systems

### **How Will Climate Change Affect our Forests?**

Climate change affects Muskoka's terrestrial environments as well as its aquatic ones. Just as in the aquatic environments, changes in annual patterns of temperature and precipitation are both important factors.

Climate change alters the frequency and severity of disturbances such as:

- Drought
- Fire

- Windfall
- Insect outbreak
- Disease

Climate change will also push the forest into a climatic regime that will favour growth to a different degree for each tree species. Trees adapted to the present day climate in Muskoka are expected to be under increasing climate stress.

Growth rates will be reduced, reproductive success lowered, and susceptibility to disease and insect pests will be heightened. Tree species do shift their ranges when climate changes, but their ability to move depends entirely on the dispersive capabilities of their seeds.

Some tree species may be able to adapt to the changing climate, but it looks as though our forests are going to be 'sorting out' their responses to the changing climate for many decades to come. The consequences of climate change for Muskoka's forests will be a:

- Progressive thinning out of forests
- With fewer trees of currently dominant species
- Insufficient numbers of newly arrived southern species to take their places

Further, the milder winters will be favourable for invasive species and forest pests that would have otherwise been killed off by harsh winter conditions.

Forests will also undergo drought during the summer and fall months, creating dry and unproductive soils. These changes may trump the anticipation of longer and warmer growing seasons that were once seen as an advantage of climate change in North America.

The value of our forests, under these circumstances, will be reduced in terms of:

- Wood production
- 'Leaf viewing' tourism
- The provision of ecosystem services such as:
  - carbon sequestration
  - water management
  - local climate amelioration

The wildlife that call these forests home will also be at risk of losing habitat, especially those that are less adaptable. These changes will force many species to:

- Migrate to a new location

- Change their breeding seasons
- Seek new food sources

### **How Will Climate Change Affect our Lives?**

Milder winters, a longer growing season, and warmer, drier summers might seem ideal for people who value Muskoka primarily for the outdoor recreational possibilities offered in the warmer months. However, these projected changes are substantial relative to any time in human history, and they will bring some negative impacts.

The more variable weather anticipated in the future will challenge:

- Winter road transport
- Greater risk of fire, flood or drought
  - likely increase the cost of home or cottage insurance
- Summer and fall drought will impact the tourism value of iconic streams and rivers
- Will also raise issues for homeowners dependent on wells for domestic water supply

Climate change is also likely to have some significant impacts on public health due to the new opportunities for insect- or tick-borne pathogens that, until now, have been unable to tolerate our climate. Among these are Lyme disease, West Nile virus, and malaria. The risk of West Nile virus is particularly heightened because spring floods give rise to suitable breeding grounds for mosquitoes. More direct effects of warmer weather on human health will come as heat stress and heat-related death, and from deteriorating air quality and smog, which will enhance respiratory diseases such as allergies and asthma. The incidence of respiratory allergies and asthma has already been increasing in Ontario.

The projected shift in seasonal pattern of precipitation toward the winter months and the expected increase in frequency of severe weather events will have major impacts on winter road maintenance and stormwater management. With an expected average increase of 17% more precipitation falling during the winter months, we must plan for a significant increase in cost of winter road maintenance. What is now classified as the 100-year flood event is likely to become far more frequent, and we will have to expand our water management capacity to cope. Drought seen in our warmer summers may reduce the tourism and recreational amenity of the landscape, affecting economic activity, property values, and livelihoods. Warmer summers also call for turning on the air conditioner. Since most buildings are now air conditioned, the warmer climate will increase operating costs and electricity demands, although new construction will be able to avoid this by adopting more appropriate passive solar and other green design elements.

### **Local Spotlight: Simcoe Muskoka Health Unit**

The effects of climate change are not limited to the environment. The Simcoe Muskoka District Health Unit is bringing awareness to the public of how climate change can influence human health at a local



level. For instance, their recent [Climate Change Vulnerability Assessment](#) reported that climate change will increase your risk of:

- Respiratory illness;
  - Exposure to ground level ozone
  - Particulate matter
  - Air pollution caused by traffic
- Heat related illness
- Food-borne and waterborne illness including food and water security
- Injuries due to extreme weather events:
  - Flooding
  - Tornadoes
  - Forest fires
  - Winter storms
  - Drought
- Vector-borne disease
  - Mosquito and tick-borne illness
- UV-related skin cancers

While everyone feels the effects of climate change, factors such as age, gender, health status, and access to resources will make some people more vulnerable to the impacts of climate change than others. Therefore, it's important to not only plan for climate change through a mitigation or adaption strategy for the sake of the environment, but to also protect yourself. Be sure to review their assessment report to learn more about potential climate-sensitive health outcomes, who is vulnerable to these outcomes, and action plans to mitigate the impacts felt by all as a result of climate change.

### **It's Your Turn!**

Help mitigate climate change on a local scale by improving your own understanding of the Muskoka environment and how it will respond to a changing climate, and talk to others about this issue. You can also actively participate in local monitoring programs, seek to reduce your carbon footprint, and support local policies that include climate change adaption strategies.

### **Local monitoring programs**

Far more is known about Muskoka's lakes than most other Canadian regions given the area's extensive and long-standing lake monitoring programs; however, there is still much that is not known about our

shared waters. Building datasets through local monitoring initiatives and broadening them where possible will strengthen our understanding of how climate change is affecting Muskoka's environment and our communities. Become an active citizen scientist by participating in initiatives including the [District of Muskoka's Biological Monitoring Program](#), [Ontario's Lake Partner Program](#), [NatureWatch](#), and other programs supported by your Lake Association or community. Your participation will enhance ongoing monitoring efforts and, in turn, provide a local foundation from which we can collectively anticipate, and perhaps mitigate, changes to our watershed due to our changing climate.

### **Reduce your carbon footprint**

Canadians rank per-capita as one of the largest energy consumers in the world. Consuming excessive energy results in the waste of non-renewable resources and unnecessary emissions of greenhouse gases into the atmosphere. Although the population of Muskoka may be relatively small, everyone still can play a key part in reducing our collective greenhouse gas emissions. Be energy efficient by buying energy efficient vehicles, hang your laundry outside when possible instead of using a dryer, install a programmable thermostat, and change your light bulbs to LEDs.

Our food preferences can also impact our climate. Choose organic and locally grown foods, or better yet, grow some of your own food when possible. Meat and dairy production are responsible for 18% of greenhouse gas emissions, so try a plant-based diet. Further, accumulating garbage in landfills produce methane, a potent greenhouse gas, which can easily be reduced by composting and recycling as much as possible.

### **Advocate for change**

Lastly, become an advocate for change. Write to your area politicians at all levels of government and demand action to address climate change issues.

Climate change initiated by human activities can be slowed with effort.