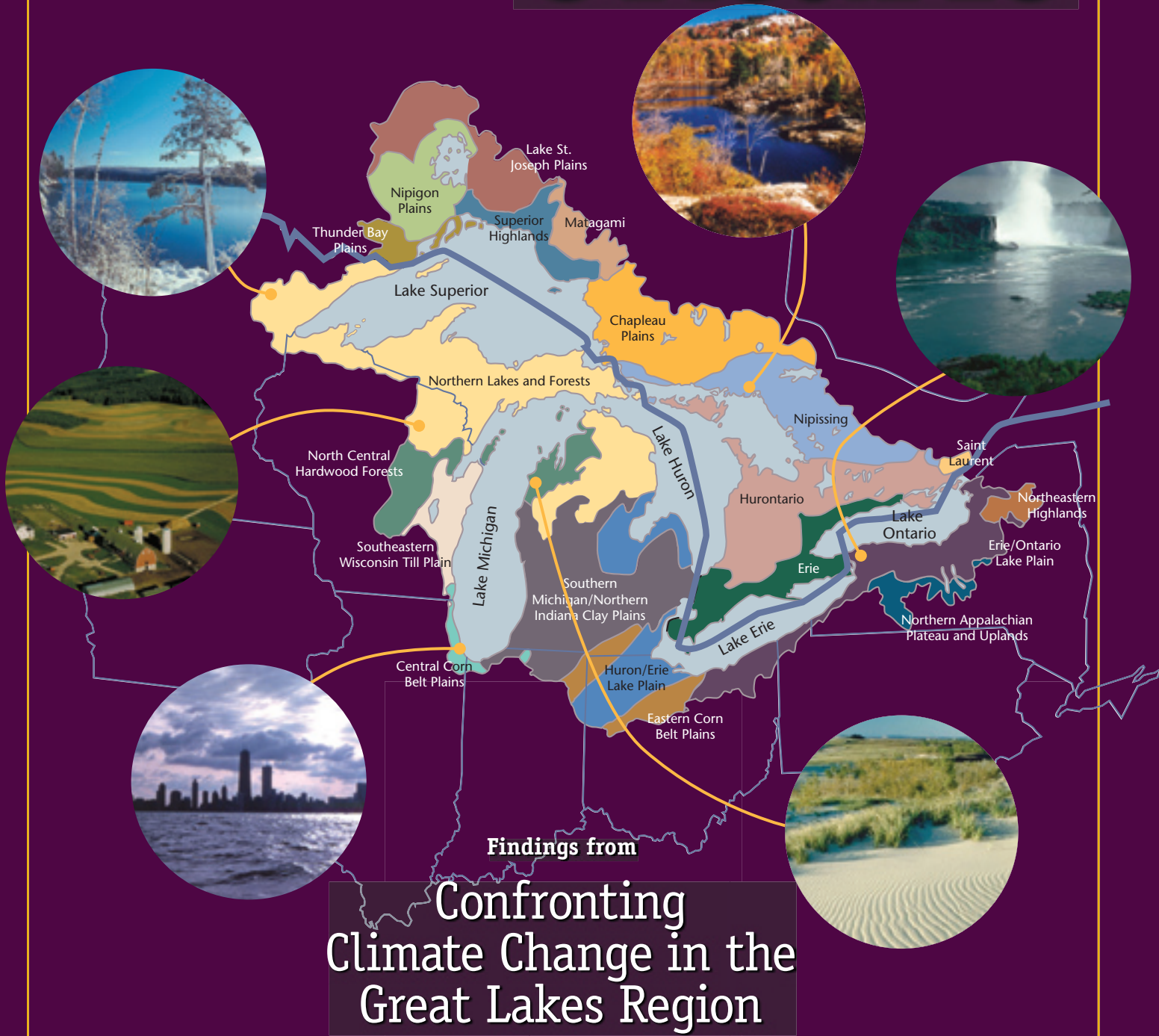


Ontario



Findings from

Confronting Climate Change in the Great Lakes Region

Impacts on Ontario Communities
and Ecosystems

Climate Change in Ontario

Much of Ontario's southern border is defined by four of the five Great Lakes. One of the country's most vibrant cities, Toronto, is located on the shores of Lake Ontario. With its beautiful beaches and bountiful northern forests, Ontario is also a vacation wonderland. This summary highlights the potential impact of climate change on Ontario's economy, its people, and the places they love.

Scientists are now convinced that human activity, primarily burning fossil fuels to produce electricity and drive our cars, is changing our climate. These activities emit gases, principally carbon dioxide (CO₂), that blanket the planet and trap heat. Already, we are seeing signs of climate change throughout the Great Lakes region: average annual temperatures are increasing; severe rainstorms have become more frequent; winters are getting shorter; and the duration of lake ice cover is decreasing.

Climate Projections

The latest, most reliable projections of future climate change combine 100 years of historical data for Ontario with the most up-to-date general circulation models of the Earth's climate system. In general, Ontario's climate will grow considerably warmer and probably drier during this century, especially in summer.

- **Temperature:** By the end of the 21st century, temperatures are projected to rise 3–6°C in winter and 4–8°C in summer. This dramatic warming is roughly the same as the warming since the last ice age. Overall, extreme heat will be more common and the growing season in southern Ontario could be 4–7 weeks longer.

- **Precipitation:** Annual *average* precipitation may slightly increase, with precipitation increasing in winter by 15–40% and possibly changing in summer by +20% to –5% in the southern part of the province. In summer, Ontario may well see drier soils and perhaps more droughts.

- **Extreme events:** The frequency of heavy rainstorms, both 24-hour and multiday, will continue to increase.

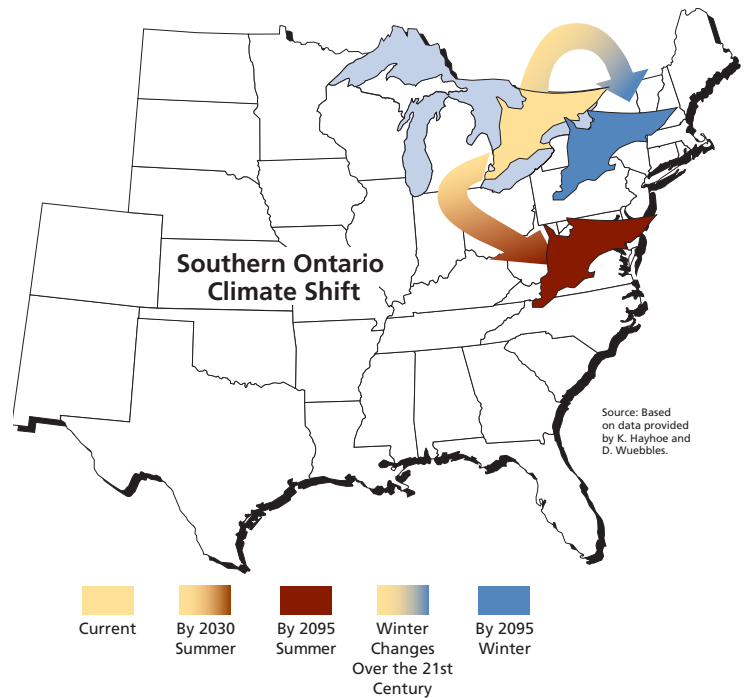
- **Ice cover:** Declines in ice cover on the Great Lakes and inland lakes have been recorded during the past 100–150 years, although this trend has been moderated in areas of lake-effect snow.

The annual heat-related death rate of 19 per year in Toronto alone could increase between 10 and 40-fold by the end of the century.

Ice cover declines are expected to continue.

How the Climate Will Feel

These changes will dramatically affect how the climate feels to us. By the end of the century, an Ontario summer may resemble the hot and humid current-day summers of northern Virginia (United States).



Potential Impacts from Climate Change

Water Supply and Pollution

Ontario's quarter-million lakes and countless rivers and streams hold about one-third of the world's fresh water. The province's 11 million people rely on these waters, as well as on groundwater and rainfall, for drinking, agriculture, and industrial uses. Forty-five percent of Quebec residents take their water from the St. Lawrence River, which flows from the Great Lakes. Projected changes in rainfall, evaporation, and groundwater recharge rates will affect all freshwater users.

- Lake levels are expected to decline in both inland lakes and Ontario's four Great Lakes, as more moisture evaporates due to warmer temperatures and less ice cover.
- Pressure to increase water extraction from the Great Lakes will grow, exacerbating an already contentious debate in the region.
- Reduced summer water levels are likely to diminish the recharge of groundwater, cause small streams to dry up, and reduce the area of wetlands, resulting in poorer water quality and less wildlife habitat.
- Development and climate change will degrade the flood-absorbing capacities of wetlands and floodplains, resulting in increased erosion, flooding, and runoff polluted with nutrients, pesticides, and other toxins.

Agriculture

Southern Ontario's relatively mild climate supports a productive agricultural sector generating more than \$7 billion annually from soybeans, corn, and wheat, as well as fruit and livestock. There are likely to be some positive impacts for agriculture from a warmer climate, although current evidence suggests that the negative consequences could outweigh the positive. In general, however, regional development, technological advances, and market fluctuations will also influence the agricultural sector.

Overall, optimal weather conditions are expected to shift northward and eastward in the region. Ontario agriculture may benefit from warmer temperatures and a longer growing season, but may be constrained by declining soil moisture and thin and acidic soils. Climate variability will likely pose greater risk for smaller farms and may thus reinforce the trend toward increasing farm size and industrialization of agriculture. These changes will affect local farming communities, and, in turn, change the character of rural landscapes.

- Increased atmospheric CO₂ and nitrogen as well as a longer growing season could boost yields of some crops, such as soybeans, corn, and wheat.

- Higher ozone concentrations can damage soybeans and horticultural crops, countering positive impacts of a warmer climate.

- Severe rainstorms and flooding during planting and harvest seasons will likely depress productivity. Similarly, hotter and drier conditions during the main growing season may disrupt production and require irrigation of currently rain-fed crops.

- For perennials such as fruit trees and vineyards, greater climate variability is particularly problematic. Adjustments cannot be made as flexibly and long-term investments are at risk.

- Warmer summer temperatures suppress appetite and decrease weight gain in livestock; warmer winters and less snow cover likely will reduce the quantity and quality of spring forage, and thus milk quality.

- Several climate changes combine to create more favorable conditions for a number of pests and pathogens. The (soy) bean leaf beetle and the European corn borer, for example, will likely expand northward.

Human Health

Climate projections suggest that extreme heat is likely to become more common in a warmer climate, as will severe storm events.

- Winter cold-related morbidity or mortality will decrease, while summer heat-related morbidity or mortality is likely to increase. The number of hot days (above 32°C) in the Toronto-Niagara region could double by the 2030s and surpass 50 days by the 2080s. Of even greater concern is the projected increase in days reaching 36°C or more in Toronto, where extremely high temperatures are now rare. The annual heat-related death rate of 19 per year in Toronto alone could increase between 10 and 40-fold by the end of the century, necessitating improved warning systems and preparation to avoid such severe human impacts.



John Pastor

- Higher temperatures and more electricity generation for air conditioning increase the formation of ground-level ozone and smog, likely exacerbating asthma and other respiratory diseases.

- Some waterborne infectious diseases such as *cryptosporidiosis* or *giardiasis* may become more frequent or widespread if extreme rainstorms occur more often.

- The occurrence of many infectious diseases is strongly seasonal, suggesting that climate plays a role in influencing transmission. Some diseases carried by insects such as Lyme disease (ticks) or, more recently, West Nile encephalitis (mosquitoes) have expanded across the region. While this spread is attributed largely to land-use changes, future changes in rainfall or temperatures could encourage greater reproduction or survival of the disease-carrying insects.

Property and Infrastructure

Cities, where 80% of Ontarians live, are particularly vulnerable to the risks of climate extremes, which exact direct economic losses and require costly adaptations.

- More frequent extreme storms and floods will be exacerbated by stream channeling and more paved surfaces. These climate and land use changes result in greater property damage, place heavier burdens on emergency management, increase cleanup and rebuilding costs, and take a financial toll on businesses and homeowners.

- Municipalities in Ontario will have to upgrade water-related infrastructure including levees, sewer pipes, and wastewater treatment plants in anticipation of more frequent extreme downpours.

- Lower lake levels have costly implications for shipping on the Great Lakes and the St. Lawrence Seaway, requiring more frequent dredging of channels and harbors and adjusting docks, water intake pipes, and other infrastructure. On the other hand, a longer ice-free season will extend the shipping season.

- Decreased water levels could reduce hydropower generation in the Great Lakes region by a conservative estimate of 15% by 2050, profoundly affecting electricity generation in Ontario where hydropower provides one-quarter of the overall electricity supply.

Lakes, Streams, and Fish

Ontario's numerous rivers, streams, and lakes draw millions of visitors each year. Native aquatic plant and animal species will differ in their responses to changing water temperature and hydrology.

- Cold-water species such as lake trout, brook trout, and whitefish may decline dramatically as cool-water species such as muskie and walleye along with warm-water species such as bluegill and smallmouth bass expand their ranges northward.

- These disruptions will likely be compounded by increased invasions of nonnative organisms such as the common carp and zebra mussels, fundamentally changing native fish communities.

- The duration of summer stratification in lakes will increase, adding to the risk of oxygen depletion and formation of deep-water "dead zones" for fish and other organisms—a risk especially for Lakes Erie and Ontario. "Winterkill" in shallow lakes will likely decrease.

- Lower water levels coupled with warmer water temperatures may accelerate the accumulation of mercury and other contaminants in the aquatic food chain.

Wetlands and Shorebirds

Earlier spring runoff, more intense flooding, and lower summer water levels generally translate into growing challenges for Ontario bogs and wetlands and the species that depend on them. Development and agriculture have already reduced wetland habitat significantly.

- The combined pressures of development and climate change will degrade the flood-absorbing capacities of wetlands and floodplains, potentially resulting in increased erosion, additional water pollution, and delayed recovery from acid rain.
- Wetland losses and changes in the timing and severity of flood pulses will likely reduce safe breeding sites for shorebirds such as the sandhill crane, amphibians, and waterfowl, and may cause many migratory species such as Canada geese to winter further north.
- Increased evaporation will likely shrink wetland habitat. New wetlands, however, may be created along lake edges as water levels drop.

Recreation and Tourism

Tourism is one of the province's top income-producing service industries, tallying \$7.7 billion in 2000. Birders, hikers, cottagers, boaters, hunters, winter sports enthusiasts, and beach goers are drawn to Ontario's lakeshores and inland waters.

- Millions of anglers will be affected by range shifts, loss of habitat, and increases or declines of their preferred catch, both on the Great Lakes and inland lakes.
- Loss of habitat or food resources for migratory songbirds, shorebirds, and waterfowl will affect Ontario's multimillion-dollar birdwatching and hunting industries.
- Warmer winters mean trouble for Ontario, where winter recreation has long been an integral part of people's sense of place. Skiing, snowmobiling, and, especially, ice fishing could be hard-hit.
- The summer recreation season will likely expand as temperatures warm further, but extreme heat, heavy downpours, elevated ozone levels, and possible increases in risk from insect- and waterborne diseases may dampen outdoor enthusiasm.

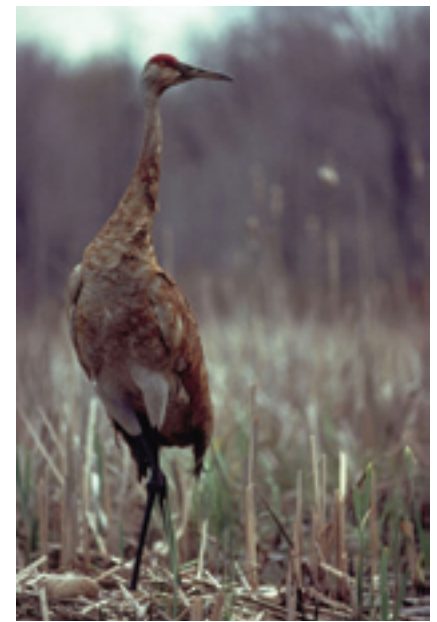
Forests and Terrestrial Wildlife

Much of Ontario is still dominated by forests of spruce and fir, and its forests are a key natural resource. The forest products industry in Ontario employs more than 90,000 people and generates more than \$15 billion annually. Factors other than climate are important drivers of change in forest ecosystems and the forestry sector, but climate change may

exacerbate existing stresses.

- Warmer temperatures will likely cause boreal forests to shrink and other forest species to move northward unless hindered by barriers.
- Increasing atmospheric CO₂ and nitrogen will likely spur forest growth in the short term, but higher concentrations of ground-level ozone, more frequent droughts and forest fires, and a greater risk from insect pests could damage long-term forest health.

- Resident birds such as northern cardinals and chickadees might be able to breed earlier and raise more broods. Bigger resident bird populations, however, could reduce the food available for migratory songbirds.
- Climate warming may benefit some resident mammals such as raccoons, skunks, opossums, and the already prolific white-tailed deer, while moose could be negatively affected by warming and more deer-carried parasites.



Thomas A. Schneider, courtesy Michigan Travel Bureau

Climate Change Solutions

Ontario residents, business leaders, and policymakers can help reduce the potential impacts from climate change by pursuing three necessary and complementary strategies:

- **Reducing heat-trapping gas emissions** by increasing energy conservation; switching to renewable energy sources; increasing vehicle fuel economy; enhancing public transportation; and aggressively implementing the Kyoto Protocol.
- **Minimizing pressures on the environment** by improving air quality, protecting the quality and supply of water resources, protecting habitat, and limiting sprawl.
- **Preparing for those impacts from global warming that cannot be avoided** through better planning and emergency preparedness, adaptations in agriculture and shipping, strengthening public health response, and adjusting infrastructure.

Ontario proved itself an environmental leader when it successfully cut acid rain-causing pollution in half. Toronto has already cut its heat-trapping gas emissions 67% below 1990 levels. With foresight, planning, and a commitment to responsible climate management, Ontario can once again be an environmental leader.



This summary is based on the findings of *Confronting Climate Change in the Great Lakes Region*, a report published in April 2003 by the Union of Concerned Scientists and the Ecological Society of America. The report was written by regional experts under the leadership of George Kling (University of Michigan). Experts from Ontario included Brian Shuter (Ontario Ministry of Natural Resources/University of Toronto) and Katharine Hayhoe (ATMOS Research and Consulting).

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The full report is available from UCS at www.ucsusa.org/greatlakes or call (617) 547-5552. In Canada, the report is also available from the David Suzuki Foundation at 1-800-453-1533 or www.davidsuzuki.org.