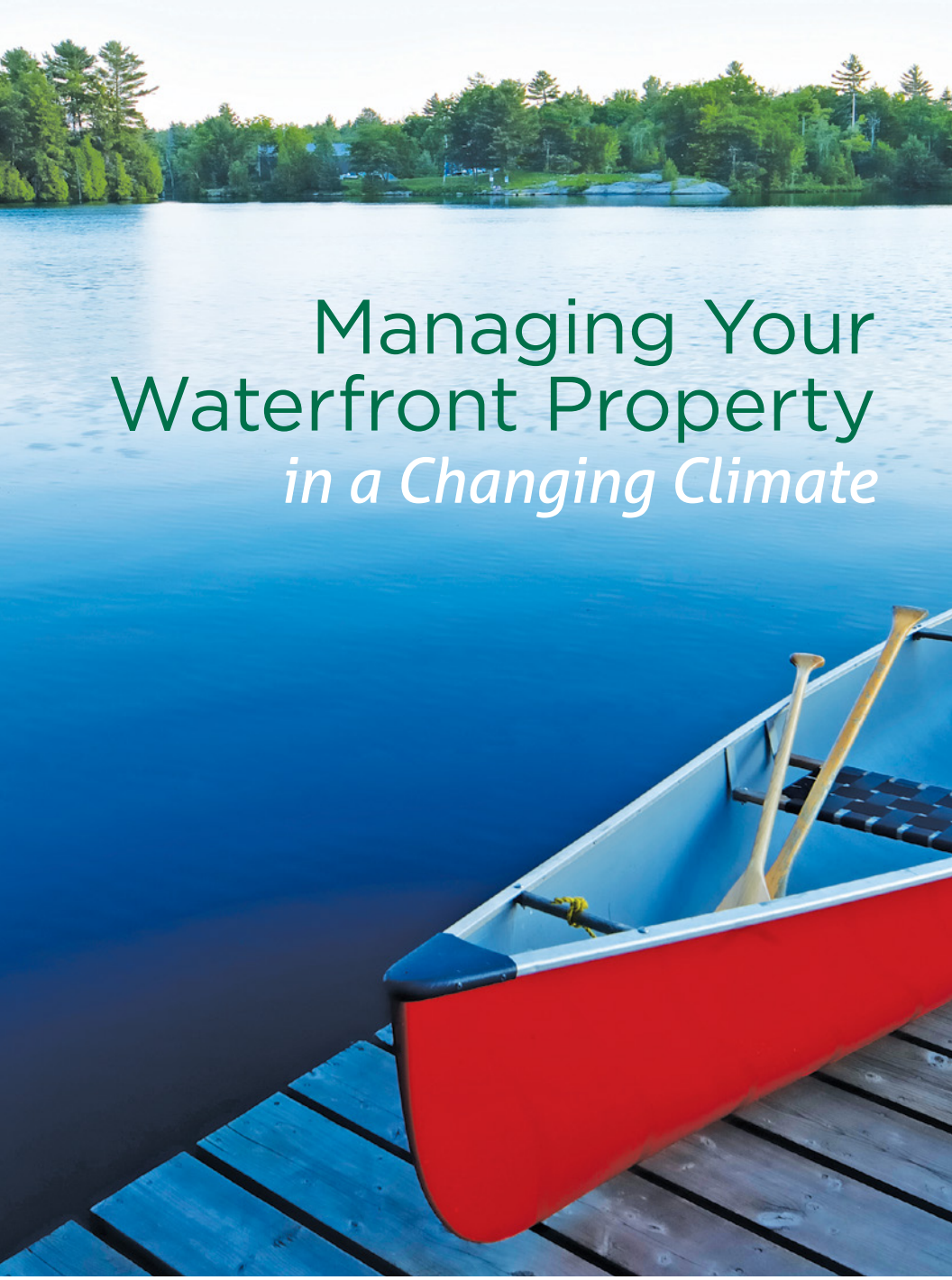


Managing Your Waterfront Property

in a Changing Climate

With support from the Ministry of Natural Resources and Forestry

FOCA
Federation of Ontario Cottagers' Associations

Table of contents

K. Doughty

Climate change is real and it is happening now.

The impacts of climate change in Ontario are already being observed. The impacts of climate change outlined in this document should be considered as part of your waterfront stewardship plan.

As a good waterfront property owner and Lake Steward, you make wise environmental and economic decisions, and implement the most effective strategies to help your waterfront property be more resilient to climate change. Many of these management options are already part of good stewardship practices to enhance wildlife, recreation, and other objectives. You may also want to consider how your shoreline can play a vital role to help capture carbon emissions, reduce erosion and minimize the impacts of climate change in the future.

Now is the time to get informed, make plans, and manage your waterfront property as an informed steward. Shorelines that are well adapted to new and changing conditions will be better able to meet your management goals as you build a more sustainable future for your waterfront property.

Good shoreline management can save you time and money

The choices you make will affect how well your waterfront property can withstand changes or recover after extreme weather. It is important that property owners take steps to keep shorelines healthy even as conditions change. Preparing for these changes now will save time and money in the long run, improve shoreline/lake health, increase your enjoyment of your property, and reduce the risk of shoreline damage in the future.

There are several things property owners can do to enhance the ability of waterfront properties to adapt to climate change and its effects (see the list on the inside of the back page). In most cases, these actions are part of normal shoreline management.

The following pages explain the potential impacts of climate change in Ontario and how they may affect waterfront properties. Management options are described that can help to reduce polluted runoff, erosion and shoreline loss, and impacts from flooding, as well as increase the environmental benefits of a healthy property. In some cases, a management option may be to take minimal-to-no action, and to allow species composition and structure to change naturally over time (natural succession). In other cases, the best management option may be to increase the resiliency of your property through some of the recommendations in this guidebook, such as planting more species, or building a buffer zone to reduce runoff.

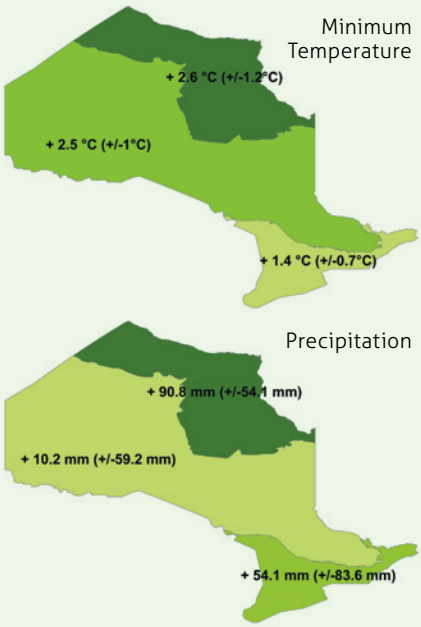
Climate change is already occurring in Ontario

Within the last 40 years, Ontario has experienced changes in temperature, rainfall patterns, and extreme weather events that can have pronounced environmental and economic effects on lakes, rivers, nearshore habitats and wetlands. Within aquatic ecosystems in the Great Lakes Basin, surface water temperatures are on the rise, water levels are in flux, and the composition of plant and animal communities in wetlands, lakes and rivers is changing.

Temperatures are increasing

40 years of data show that Ontario is getting warmer.[1] Minimum air temperatures have increased in northern Ontario between 1.4 and 3.8°C (averages shown on right). By comparison, temperature increases experienced in southern Ontario have been less: between 0.7 and 2.1°C.

Change in Annual Average Climate Trends in Ontario By Ecozone: 1970-2010

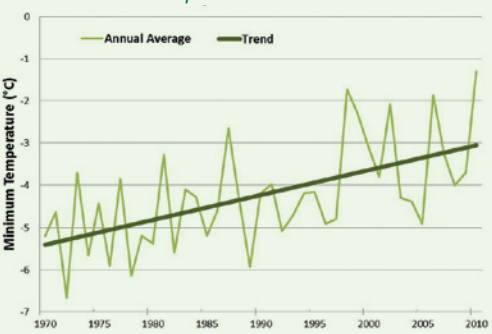


Ontario Ministry of Natural Resources and Forestry (OMNRF), 2014

1. McKenney, D. W., Hutchinson, M. F., Papadopol, P., Lawrence, K., Pedlar, J. H., Campbell, K., Owen, T. 2011. Customized Spatial Climate Models for North America. American Meteorological Society, 1611–1622.

Warming water temperatures have also been observed in Ontario inland lakes and the Great Lakes, reducing the amount of suitable habitat for fish species that are typically found in lakes and streams. In the last century, surface water temperatures of the Great Lakes have increased by as much as 3.5°C.[2]

Minimum Temperature Trend in Ontario



OMNRF (2014)

Rainfall patterns are changing

As temperature increases, we have experienced changes in rainfall patterns. Generally, conditions have become slightly wetter and lake effect precipitation is on the rise which is leading to increases in stream flows. Small increases in precipitation may not be sufficient to offset the more significant rises in temperature and may lead to overall drier conditions. Fluctuating water levels were observed in the Great Lakes between 1985 and 2005, through natural phenomena (precipitation, evaporation and transpiration) and also driven by human activities such as water withdrawals.[3]

Extreme weather events are more frequent

Ontario is experiencing more frequent extreme rain and storm events, and more flooding and drought. During the first half of the 20th century, there were less than 10 flood disasters per decade in Ontario; however by the 1990s, the frequency of floods per decade had increased five-fold.[4] Waterfront properties affected by extreme events such as wind storms, ice storms, summer heat waves, droughts, floods, and wildfires can take decades to recover after disturbance, and ecosystem structure and productivity may change as a result.

2. McDermid, J.L., S.K. Dickin, C.L. Winsborough, H.Switzman, S. Barr, J.A. Gleson, G. Krantzberg, P.A. Gray. 2015. State of Climate Change Science in the Great Lakes Basin: A Focus on Climatological, Hydrological and Ecological Effects. Prepared jointly by the Ontario Climate Consortium and the Ontario Ministry of Natural Resources and Forestry to advise Annex 9 – Climate Change Impacts under the Great Lakes Water Quality Agreement, October 2015
3. International Upper Great Lakes Study. 2009. Impacts of Upper Great Lakes water levels: St. Clair River. Final report to the International Joint Commission, December 2009
4. Cheng, C.S., G. Li, Q. Li and H. Auld. 2012. Climate change and heavy rainfall-related water damage insurance claims and losses in Ontario, Canada. J. Water Resource. 4:49-62.

Natural landscapes store carbon and resist erosion

Scientists agree that our climate is changing and that these changes are caused by human activities, particularly the increase in greenhouse gas emissions from burning fossil fuels.

Nearshore habitats and ecosystems can help with flood storage, erosion control, water filtration and carbon sequestration. Vegetation naturally captures carbon dioxide from the atmosphere, which is then stored as carbon in live plants and trees, downed woody debris, and soil. This carbon can be stored for decades and centuries in living trees or in durable wood products like furniture or building frames until it is released when vegetation either decays or is burned. Maintaining or increasing the amount of carbon that can be stored within your property is crucial to help reduce atmospheric carbon dioxide emissions and the effects of climate change in the future.

If natural shorelines are converted to hardened or manicured shorelines it decreases resiliency to climate change. Natural shorelines also provide other benefits such as producing clean air and filtering water, creating wildlife habitat, and other aesthetic values. With increased temperatures and drought, plants and trees along shorelines may be stressed and less successful at reproduction and seedling survival may decline, which makes maintaining healthy ecosystems so important.

Tracy Logan

Climate change is being observed in nature

Many changes to the natural environment are already being observed in Ontario. These changes may affect the biodiversity on your property as well as both ecosystem and human health. Some examples of observed changes in nature include:

1. The northern range boundaries of warm and coolwater sportfishes in Ontario lakes are shifting northward. Over the past 30 years fish have moved northward at a rate of 12 to 17 km per decade in Ontario.[5] Brown bullhead, bluegill and largemouth bass showed the largest northward shifts, each more than one-half degree of latitude. These species are shifting at rates comparable with other aquatic and terrestrial species around the globe.

2. Ice cover declines on all Great Lakes are affecting biodiversity in coastal wetlands and nearshore habitat, reducing ice fishing opportunities and rendering shorelines more susceptible to extreme storm events in winter. Between 1970 and 2013, mean maximum ice cover declined most on Lake Superior (42%), followed by lakes Ontario (32%), Erie (25%), Michigan (21%) and Huron (19%).[6]

3. Smallmouth bass (shown at left) spawning time in eastern Ontario populations have advanced on average by 2 days per decade since the 1960s as a result of changing ice-out and spring water temperatures. The opening day of bass fishing season has been changed in some areas to protect nesting fish and young until the young disperse from spawning sites.[7]

5. Alofs, K.M., D.A. Jackson and N. P. Lester. 2014. Ontario Freshwater fishes demonstrate differing range-boundary shifts in a warming climate. Diversity and Distributions. 20: 1-14.

6. Ontario Biodiversity Council. 2015. State of Ontario's Biodiversity. http://ontariobiodiversitycouncil.ca/sobr

7. M.S. Ridgeway, personal communication.

4. Several frog and toad species have shifted the timing of spring emergence and calling in southeastern Ontario. In the four decades of observation to date, the northern leopard frog emerges significantly earlier now, by an estimated 22 days. American toads have advanced their start of calling by up to 19 days. This significant shift in breeding behaviour for two species has occurred at the same time as a significant local increase in spring temperatures of an estimated 2.8°C over four decades.[8]


Michael Oldham

5. Expansion of the native orchid nodding ladies' tresses northward since the 1980s has been facilitated by its many small light seeds' ability to disperse naturally in the wind and more northerly areas becoming available with warming temperatures. The orchid's native range was traditionally southern Ontario and US parts of the Great Lakes Basin but it is now thriving on the eastern shores of Lake Superior and Algoma Highlands.[9]


Wasyl Bakowsky

6. Until recently, the risk of Lyme disease, a bacteria spread by some species of ticks, has been restricted to localized areas along the north shore of Lake Erie, Lake Ontario, and the St. Lawrence River due to temperature limitations. However, as the climate changes, Lyme disease is emerging as a serious health risk in many parts of Ontario. Models suggest that the geographic range of tick species that transmit Lyme disease may expand significantly due to climate change, with a northern expansion of about 200 km projected by the year 2020. This expansion would likely be due to longer growing seasons resulting from warmer temperatures and decreased tick mortality during milder winters.[10]

8. Garroway, C., J. Bowman, T. Cascaden, G. Holloway, C. Mahan, J. Malcolm, M. Steele, G. Turner, P. Wilson. 2010. Climate Change Induced Hybridization in Flying Squirrels. Global Change Biology. 16(1): 113-121. 3. Klaus, S. and S. Lougheed. 2013. Changes in breeding phenology of eastern Ontario frogs over four decades. Ecology and Evolution. 3(4): 835–845.
9. Catling, P. and Oldham, M. 2011. Recent Expansion of Spiranthes cernua (Orchidaceae) into Northern Ontario due to Climate Change? The Canadian Field Naturalist.125:34-40.
10. Nituch, L. and J. Bowman. 2013. Community-Level Effects of Climate Change on Ontario's Terrestrial Biodiversity. Ontario Ministry of Natural Resources, Climate Change Resources Report Card-36.

Climate change is projected to accelerate

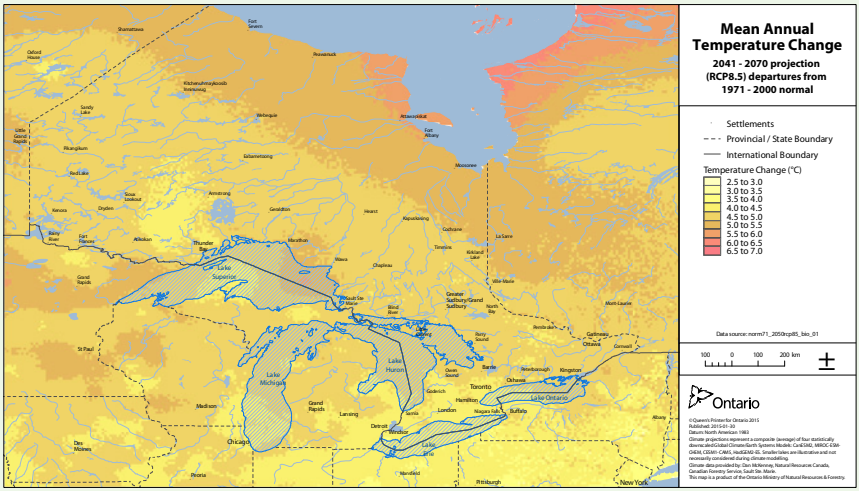
As our climate changes, the projected changes in temperature and precipitation that are most likely to affect shorelines and waterfront properties are:

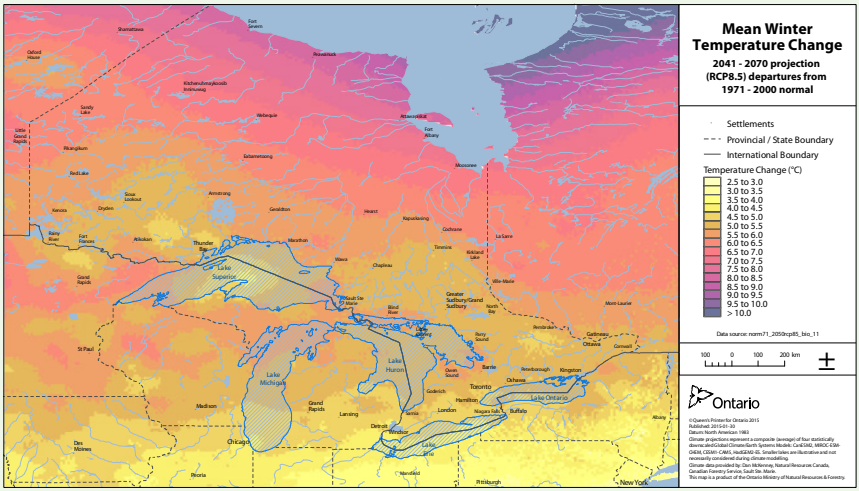
- More frequent extreme weather events including heavy rain, wind and ice storms
- Drier soils in summer
- Increasing invasive species and new pathogens from southern climates
- Changing habitat ranges, particularly for species along the southern edge of Ontario
- Changing ecological processes that may affect shorelines in unknown ways (e.g. insect pollination, breeding, plant hardiness, wildlife interactions)
- Increased erosion of shorelines
- An earlier spring freshet
- More ice free days on inland lakes in the winter months
- Longer growing seasons
- More winter rain and earlier peak stream flows

Patrick Hodge

Researchers with the Ontario Ministry of Natural Resources and Forestry have modeled the projected changes in climate in Ontario.[11] An ensemble of several downscaled Global Climate Models are used to look at possible future climate. Scenarios describing possible future climate are based on assumptions of how the earth's climate operates, future world population levels, economic activity and greenhouse gas emissions.

The maps shown below illustrate the average annual temperature difference comparing a base historical period (1971-2000) to a future period in the 2050's and 2080's using a business-as-usual emissions scenario (RCP 8.5).[11]





For more projections see:
www.climateontario.ca/MNR_Publications/CCRR-44.pdf (download 40 pages)

11. McDermid, J., S. Fera and A. Hogg. 2015. Climate change projections for Ontario: An updated synthesis for policymakers and planners. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, Ontario, Climate Change Research Report CCRR-44.

Suitable habitat for many species will move north

The composition of aquatic and nearshore ecosystems is largely controlled by past land use history and by what species have adapted to the climate in the area.

Slow and subtle changes in ecosystem composition and distribution are determined by a number of factors such as: seasonal temperatures, precipitation patterns, soil moisture patterns, severity of extreme storm events and natural disturbances, and the abundance of pests and diseases. As these factors change, the habitat required for species may shift. Species you find on your waterfront property today may not be there in the future.

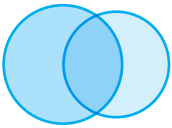
Fish populations that are not adapted to the warmer temperatures may begin to disappear while those who prefer warmer temperatures will expand their ranges. Warmer water temperatures provide more favourable conditions for toxic algal blooms which could make water undrinkable and/or un-swimmable.[12]


K. Doughty

The beloved loon is projected to lose over half of its current summer range and approximately three quarters of its' winter range.

44% of summer 2000 range is stable.

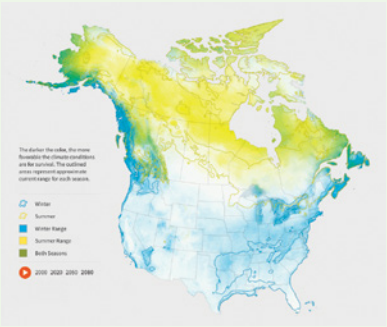
9% increase in summer 2080 from 2000 range.



25% of winter 2000 range is stable.

12% decrease in winter 2080 from 2000 range.

In both seasons the potential to shift northwards in a warming climate is significant. While the loon may be able to keep pace with the rapidly changing climate, it looks all but certain that we will lose the iconic loons in summer by the end of the 21st century.



12. Mark L. Wells, Vera L. Trainer, Theodore J. Smayda, Bengt S.O. Karlson, Charles G. Trick, Raphael M. Kudela, Akira Ishikawa, Stewart Bernard, Angela Wulff, Donald M. Anderson, William P. Cochlan. 2015. Harmful algal blooms and climate change: Learning from the past and present to forecast the future. Harmful Algae; 49: 68.

Variable temperatures lead to unpredictable weather and damage

Warming is projected to continue across Ontario throughout the 21st century. Across the province more precipitation is projected in the winter, though this could vary greatly by region (provincial range is from -56 to 158mm from historical levels). Summers are projected to be drier on average, with a range of -69 to 48 mm less precipitation than historical levels across the province by the 2080s. Higher temperatures in the winter may mean fewer frost days per year. This could mean a longer growing season which could affect plants and fish whose life cycles depend on the temperature.[11]


Patrick Hodge


C. Roshe

It is likely that lake-effect snow will increase in the short term as lake temperatures rise. However, by the end of the 21st century, snowfall will likely be replaced by heavy lake-effect rain events due to the higher temperatures. As well, warmer annual temperatures will cause warmer winters which will lead to precipitation in the form of ice, sleet and freezing rain as opposed to snow.[13] Ice storms will likely occur more frequently with more moderate winter temperatures across most of Ontario in the future. Ice storms occur primarily when surface temperatures are hovering at or just below the freezing point. Changes to rainfall can also affect connectivity within and among streams and lakes.[14]

13. Town of Oakville. 2014. Oakville's Climate Change Primer; 19,22.

14. Chu, Cindy. 2015. Climate Change Vulberability Assessment for Inland Aquatic Ecosystems in the Great Lakes Basin, Ontario. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, Ontario. Climate Change Research Report CCRR-43.


Patrick Hodge


K. Doughty


K. Doughty

Ice accumulations on branches can increase branch weight up to 30 times and cause even large branches to break, severely affecting tree growth. Damages to your home may result from falling branches, power lines could be downed and roadways blocked. Unfortunately this could mean increased power outages and restricted access to your property via cottage roads in severe weather.

Melting and freezing of water in variable temperatures can cause ice jams which may result in flooding of natural creeks and rivers. Historically, in Southern Ontario we have experienced a single spring melt, when the majority of the winter snow and accumulation melts. During this period rivers and lakes are at capacity, and if overwhelmed can cause potentially dangerous situations.

More recently due to variable temperatures, spring melt is not necessarily happening all at once and not necessarily happening only in the spring. There is also evidence that rising air and water temperatures may contribute to more tornado activity in areas not previously prone to this type of activity.[15]

Warmer winters and variable temperatures will make winter activities even more unpredictable and dangerous. Extreme weather events present both health and safety risks and can result in property loss, environmental damage, insurance claims, costly repairs and maintenance.

15. Sills, D., V. Cheng, P. McCarthy, B., Rousseau, J., Waller, L. Elliot, J. Klaassen and Hauld. 2012. Using tornado, lightning and population data to identify tornado prone areas in Canada. 26th AMS Conference on Severe Local Storms, Nashville, TN, American Meteorological Society Paper, 59.

Drought may cause wetlands to dry up and decrease water quality

Wetlands are a vital part of a functioning ecosystem as they play an important role in maintaining local water quality. Wetlands are also capable of slowing the effects of climate change by capturing and storing carbon. A functioning wetland is capable of storing large amounts of water which is then filtered and slowly released into the surrounding watershed. When wetlands are removed or dry due to the effects of climate change, storm water runs directly into the watershed, increasing the chances of flooding and decreasing water quality. In the Great Lakes Basin, many wetlands are projected to be vulnerable to potential drying or shrinkage due to changes in temperature and precipitation, particularly wetlands in southern Ontario and the north-east shores of Lake Superior.[14]

Warmer temperatures help insect pests and disease to overwinter

Insect pests and disease can have a significant impact on shorelines, and a changing climate may affect what kind of pests are seen in Ontario. Many insects and diseases are controlled by winter temperatures, with colder temperatures reducing their populations. As winters get warmer with climate change, the number of these pests and diseases that survive the winter may increase, leading to greater outbreaks and infestations.

Invasive species outcompete

Invasive plant and fish species affect shoreline/lake health and regrowth through competition for light, nutrients, habitat and food. As many of these invasive species have been introduced from other regions, the absence of competitors or predators means that they are able to outcompete and replace many native species. Aquatic ecosystems are especially vulnerable. Once established in an aquatic ecosystem, an invasive species is almost impossible to eliminate and control measures can be costly. A changing climate may also intensify the problem in the following ways:

- A longer growing season can give invasive species a bigger advantage in their competition with native species.
- Higher nitrogen levels are linked to a faster spread of invasive plants and increased resistance to herbicide applications.
- Increasing water temperatures will result in native fish populations being replaced with invasive species that favour warm water.
- Shifting species distributions provides an opportunity for invasive species to outcompete native species.

Three of the most aggressive invasive plants that are already stressing Ontario's shorelines and waters include: Phragmites, Japanese knotweed and Water soldier.

Invasive Species on your waterfront property?

Ontario has an Early Detection and Distribution Mapping System (EDDMapS Ontario) to detect and monitor the spread of invasive species in the province. Through EDDMapS Ontario you can report sightings of invasive species and view their local, regional or provincial distributions. It contains information profiles for over 150 different species, as well as tools for searching and downloading data. You can also set up alerts to be notified when a new species is detected in your area.

Visit www.eddmaps.org/ontario for more information.

Additional Resources

Shoreline Owner's Guide to Healthy Waterfronts

This guide gives a quick and easy overview of ways to make the most of your shoreline property, while living in balance with your lake's fragile ecosystem.

https://foca.on.ca/shoreline-owners-guide-to-healthy-waterfronts/

Take the Plunge – A Guide to Stewardship of Ontario's Waters

This guide includes new topics such as green cottage design, air, light and noise pollution, and new information about today's waterfront issues and solutions. A must-have for the interested waterfront property owner or lake steward.

https://foca.on.ca/take-the-plunge-a-guide-to-stewardship-of-ontarios-waters/

Lake Planning Handbook for Community Groups

The Lake Planning Handbook helps waterfront property owners and associations in building the important relationships around their lakes, Lake Plan development and implementation, and responsible stewardship practices. It also includes support materials such as example templates, lake plans, surveys, workshop agendas, presentations, and more.

https://foca.on.ca/lake-planning-handbook-overview/

Ontario Centre for Climate Impacts and Adaptation Resources

www.climateontario.ca

Forests Ontario

www.forestsontario.ca

Ontario Woodlot Association

https://www.ontariowoodlot.com/

Invasive species at the cottage

Visit the website below to learn more about how to stop the spread of invasive species at the cottage. Includes a link to the Cottagers Invasive Action Plan (PDF) to help you fight the invasion.

https://www.ontario.ca/page/cottager-action-plan/

Top 5 actions shoreline owners can take

1 Keep your shoreline natural and enhance it if possible

A naturalized shoreline is generally considered the best multi-purpose approach to protecting the lake's edge. Protect the natural shoreline by replanting areas that lack vegetation and maintain those areas that already exist.

2 Keep aquatic plant populations intact

Aquatic plants support the insects that fish eat, and are a primary food and habitat source for birds. In addition, aquatic plants help stabilize loose sediment and are an effective natural breakwater keeping waves from eroding the shoreline.

3 Maintain and improve your waterfront property's health and biodiversity

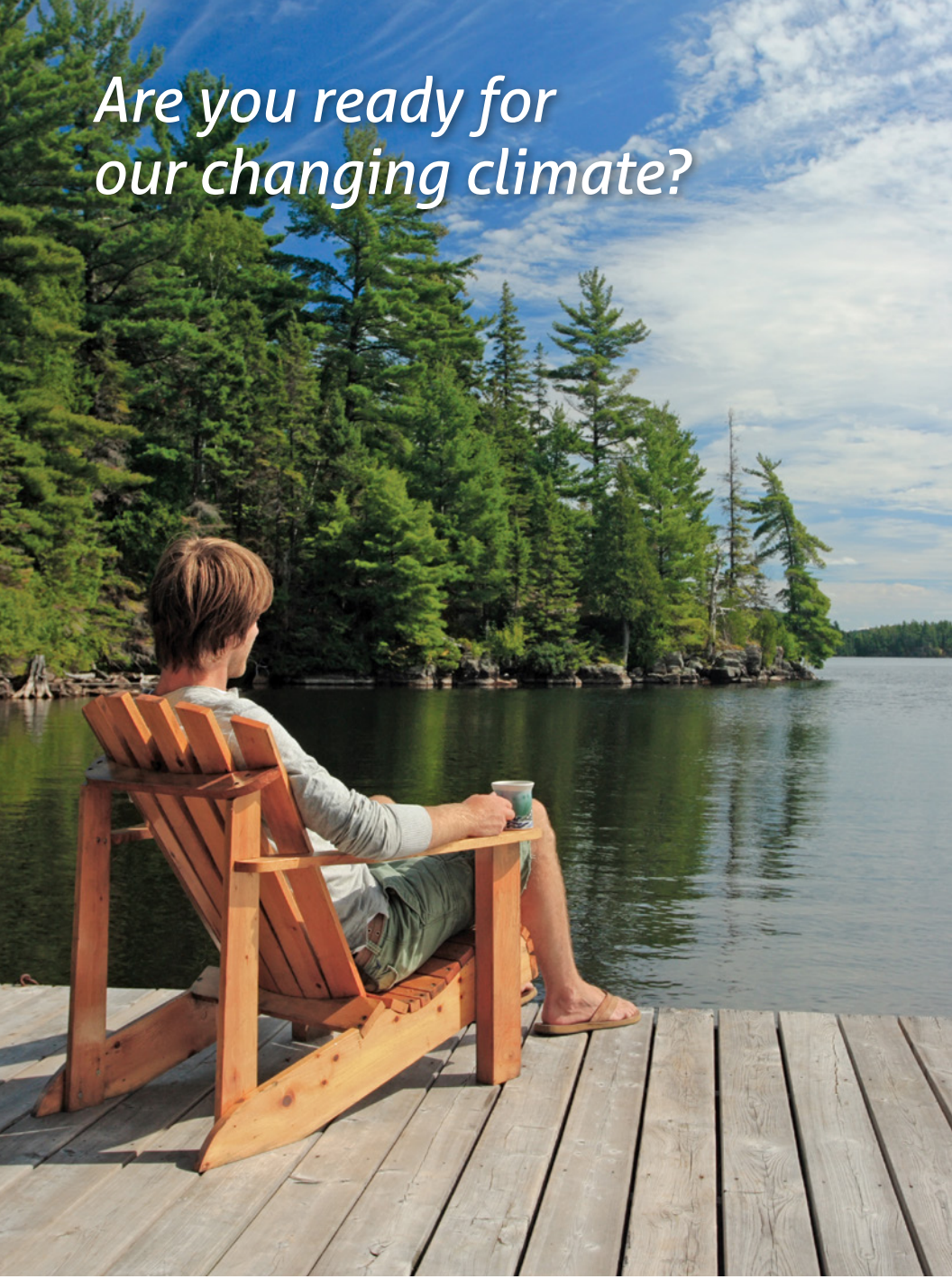
Enhance biodiversity on your property by leaving rock piles, fallen tree limbs and brush piles untouched so they can function as wildlife habitat. Re-vegetate bare grounds near streams, rivers and lakes and encourage native species of flowers, shrubs and trees to limit your maintenance work and provide shelter to native species.

4 Manage pests and disease

Understand which insects, diseases and invasive species might be expected at your waterfront property and be on the lookout for them with regular monitoring to enable early intervention and easier management.

5 Stay informed

It is important to stay informed and attuned to developments in science and research and incentive programs that may affect you and your waterfront property. Sign up to receive FOCA's free monthly Elert (electronic newsletter) today at https://foca.on.ca!



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