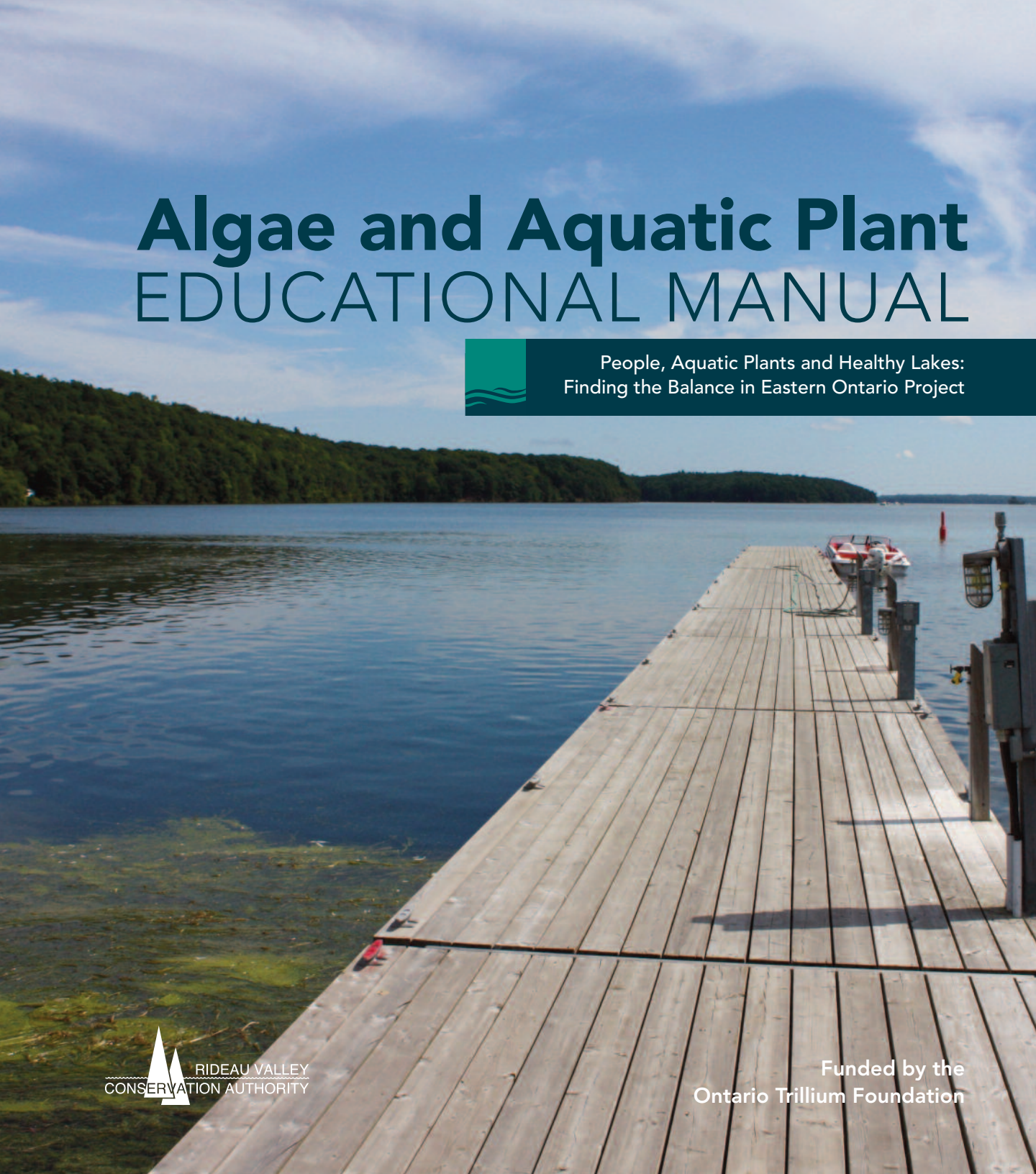
Algae and Aquatic Plant EDUCATIONAL MANUAL

People, Aquatic Plants and Healthy Lakes:
Finding the Balance in Eastern Ontario Project



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Acknowledgments

The *Algae and Aquatic Plant Educational Manual* would not be possible without the hard work and dedication of many individuals.

Thank you to the Ontario Trillium Foundation (OTF) for supporting the People Aquatic Plants and Healthy Lakes Project and for providing the funding to make this educational manual possible.

The local lake and river communities have shown their support and interest throughout this project. Their commitment and dedication to preserving and protecting their local environments helped to develop this project and make it a success. In particular local Lake Associations and the Lake Networking Group have passed along our information and work to their networks to help spread the word. They reviewed this document, providing invaluable feedback.

To the People Aquatic Plants and Healthy Lakes Collaborative and Working Group who reviewed many lengthy copies of the manual, providing insightful comments to help shape the manual into its final product. Many organizations volunteered their time throughout the project to provide advice and guidance as the project moved along. These individuals and their organizations include:

Carleton University
- Jesse Vermaire

Friends of the Tay Watershed Association
- Frank Roy,
- Robert Cosh
- Taro Alps

Lake Networking Group
- Karen Hunt

Lanark Fish and Game Club
- Wendell Crosbie

Ministry of the Environment and Climate Change
- Laurel Rudd

Ministry of Natural Resources and Forestry
- Jeff Ward
- Elizabeth Holmes

Mississippi Valley Conservation Authority
- Alyson Symon
- Kelly Stiles
- Caleb Yee

Ottawa RiverKeeper
- Meaghan Murphy

Rideau Valley Conservation Authority
- Andrea Klymko

Watersheds Canada
- Barbara King

University of Ottawa
- Frances Pick

Upper Rideau Lake Association
- Jayne MacDonald

Kathryn Sweet, a Carleton University Co-op student dedicated a lot of time and energy on the text and layout of this educational manual. Her hard work played a large role in bringing the manual to its completion.

This manual would not have been possible without the supervision of Michael Yee and Sarah MacLeod-Neilson at the Rideau Valley Conservation Authority who have overseen the entire project, providing technical advice, guidance and experience to shape the educational manual into a resource that will be valuable for local water body users.

Thanks to Michelle Paton and Diane Downey from the Rideau Valley Conservation Authority for editing and review. Laurie Dool from RVCA transformed the text of this manual into its great design and layout. The presentation of this manual would not have been possible without Laurie's hard work.

And finally Kaitlin Brady, People, Aquatic Plants and Healthy Lakes — Project Coordinator (OTF funded staff) who completed this manual through her tireless dedication to researching, writing, consulting and re-writing the numerous iterations of this document. She devoted many hours to developing this final version of the manual. Many thanks.

Lakes and rivers in Eastern Ontario are valuable resources that are enjoyed for their beauty, fishing, recreational activities and much more. These water bodies benefit the local economy, attracting tourists to enjoy all of the benefits that they provide. It is important to understand how our lakes and rivers work in order to keep them healthy for future generations.

Algae and aquatic plants play an important role in maintaining the health of our water bodies. They are essential to life in lakes and rivers. But when you have too much algae and aquatic plant growth the health of your aquatic systems can be threatened. In this manual you will learn about the role algae and aquatic plants play in your waterbody, what influences their growth and ways that you can help to keep your lake or river healthy.

Algae and Aquatic Plants

Algae

Algae are similar to aquatic plants; however they do not have roots, stems or leaves. Both algae and aquatic plants produce their own energy through photosynthesis, this means they fix carbon dioxide from the atmosphere in the presence of sunlight to make organic carbon releasing oxygen in the process. Algae are a food source for a number of species and are defined as primary producers — that is, they are at the bottom of the food chain. Algae play an essential role in the advancement and evolution of aquatic ecosystems. They can affect pH and alter oxygen levels in the water. The structure of algae can range in composition from unicellular (a single cell that is microscopic) to multicellular and form colonies that are visible to the naked eye (similar to mosses).

Green Algae

- Typically grass green in colour, but can vary depending on the age and nutrient status (e.g., nitrogen content) of the algae
- They can be unicellular or multicellular, colonial and may form filaments which often appear as thread like fibers
- Can be found free floating, attached to substrate or objects (i.e., rocks, docks, woody debris, etc.) and in filamentous strands, appearing hair like
- Green algae are commonly found in most lakes and rivers in Eastern Ontario and are part of a healthy ecosystem. However, when present in abundance they can be a nuisance, produce unpleasant odors, impede recreational activities and clog water intake pipes

Diatoms

- Microscopic and unicellular throughout their life cycle
- They have a characteristic hard cell wall made of silicates (like glass) that does not decompose. This allows them to be good indicators of past lake conditions as their outer shells are preserved and fossilized
- Some diatoms can cause taste and odor problems and can clog water filters

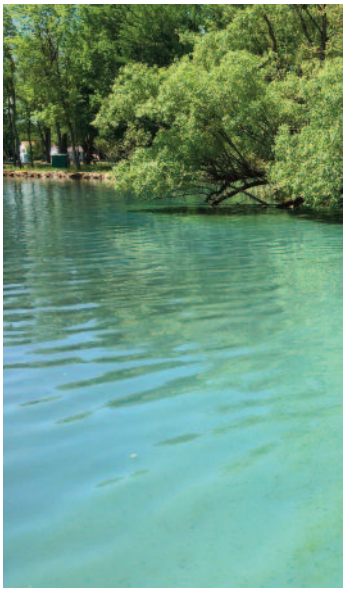
Flagellates

- Unicellular and microscopic in size or can form a colony and be visible to the naked eye
- They will have one or more whip-like "tails" that are used for mobility
- Flagellates, particularly chrysophytes, can cause taste and odor problems in water. Chrysophytes are very common algae in shield lakes and are typically associated with low nutrient conditions

Blue Green Algae or Cyanobacteria

Blue green algae or cyanobacteria behave similar to algae; however they are not actually algae but rather photosynthetic bacteria.

- Most are single celled organisms
- When healthy cyanobacteria can smell like mown grass but as they decompose can give off a foul smell
- A large bloom will often appear blue green in colour and look like spilled paint or pea soup on the water's surface. However, colours can range from olive green to red and some forms can appear as gelatinous floating masses
- Some species can produce toxins, making humans and animals sick if they are exposed to high concentrations.



If you suspect a blue green algal bloom the following precautions outlined by the Ministry of the Environment and Climate Change (MOECC) in their blue green algae fact sheet should be followed:

- Assume toxins are present
- Avoid using the water (swimming/inhalation of affected water)
- Prevent pets and livestock from accessing the water
- Avoid fish consumption
- Do not drink from shore intakes or shore wells until bloom subsides
- Boiling and UV or chlorination are NOT effective at eliminating toxins and may enhance the release of toxins

For more information on blue green algae go to:
www.ontario.ca/environment-and-energy/blue-green-algae.

Who to contact if you notice a blue green algal bloom

If you notice an algal bloom that looks like blue green algae you should make a report to the Ministry of Environment and Climate Change's (MOECC) Spills Action Center at 1-800-268-6060. When making a report the following information will be needed:

1. Your name and phone number
2. Time and date you noticed the bloom
3. The location of the bloom
4. An estimated size of the bloom

When you make a report to the Spills Action Center the following standard procedure is followed:

- Upon receiving a report of a possible blue green algal bloom incident, the District MOECC Office shall undertake follow-up information gathering from those who reported the incident
- If, after the initial evaluation, the District Office suspects or can confirm that a blue green algal bloom is present then the District Office shall proceed with preliminary notifications
- The role of the MOECC is to gather, assess and provide basic scientific and technical information with which the Health Unit can assess risks to humans

If there is a health risk, your local Health Unit will advise lake and river users on what precautions should be taken.

Algae and Blue Green Algae

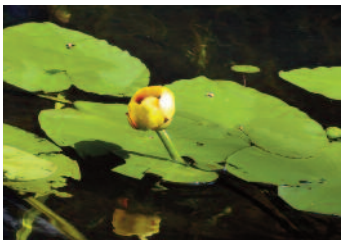
Algae and blue green algae are both found in Eastern Ontario watersheds and it is important to understand both. Some similarities and differences of the two include:

Similarities

- Photosynthetic
- Aquatic
- Capable of forming blooms (rapid growth in favourable conditions) that have detrimental effects
- Blooms can occur due to excess nutrient addition to the waterbody from human activity, such as pollution and runoff from septic beds, manure piles and fertilized lawns

Differences

Algae	Blue Green Algae (Cyanobacteria)
Majority do not release toxins	Some species can release toxins
Blooms appear as: • green filaments (threads) clumped together or attached substrates • fluffy looking green mats, often said to look like cotton candy or clouds, either floating on the surface or submerged just below the surface	Blooms appear as: • bluish green or green pea soup • turquoise, green or red paint spills on water surface • small green dots/globs • can form solid looking clumps
Blooms occur most often in spring to early summer	Blooms occur most often in mid-to-late summer and into the fall
Blooms are often aesthetically displeasing, though rarely directly affect human health	Blooms are aesthetically displeasing and may pose a health risk to humans, domestic animals and wildlife
A food source for some species, key primary producer within the food chain/web	Not a preferred food source for crustaceans



Aquatic Plants or Macrophytes

Aquatic plants or macrophytes are multicellular and possess certain features such as roots, stems and leaves. These plants are often characterized by where they are found within a waterbody. These characterizations can be broken down into three categories: floating, submerged and emergent.

Floating Aquatic Plants

Floating aquatic plants have most or all of their leaves floating freely on the water surface. These plants prefer stagnant or very low flowing water, and are often found in sheltered bays, protected from the wind. Floating aquatic plants provide important habitat conditions including shade and hunting grounds for fish to catch small invertebrates.

Examples of native floating aquatic plants in Eastern Ontario:

- Duckweed *(Lemna)*
- Yellow pond lily *(Nuphar variegate)*
- Fragrant water lily *(Nymphaea odorata)*
- Watershield *(Brasenia schreberi)*

Submerged Aquatic Plants

The majority of submerged aquatic plants grow below the water's surface. They are able to root in many different types of substrates and tend to prefer shallower waters where they are able to receive enough sunlight. They are flexible and buoyant so they are able to remain upright in wave conditions. Submerged aquatic plants create a complex habitat for fish. Some fish species will use these plants for their nests, where other smaller fish and zooplankton will use them to hide from predators.

Examples of native submerged aquatic plants in Eastern Ontario:

- Flat stem pondweed *(Potamogeton zosteriformis)*
- Coontail or hornwort *(Ceratophyllum demersum)*
- Tapegrass or water celery *(Vallisneria americana)*
- Common waterweed *(Elodea canadensis)*

Emergent Aquatic Plants

Emergent aquatic plants are found in the transition area between land and water, generally along the shoreline. Often these plants will have their roots submerged in water, whereas the stem and leaves of the plant are above the water's surface. These plants protect the shoreline against wave action and prevent erosion. They are a food source for some mammals, nesting grounds for many waterfowl species and habitat for fish and insects.

Examples of native emergent aquatic plants in Eastern Ontario:

- Common cattail *(Typha latifolia)*
- Swamp milkweed *(Asclepias incarnata)*
- Hardstem bulrushes *(Scirpus acutus)*
- Pickerelweed (*Pontederia cordata)*

Native Aquatic Plant Removal

For information on aquatic plant removal rules and regulations please visit the MOECC website: www.ontario.ca/environment-and-energy/remove-native-aquatic-plants or Parks Canada if your waterfront is a federal waterbody, like the Rideau Canal: www.pc.gc.ca/eng/lhn-nhs/on/rideau/plan/vegetation.aspx

Similarities and Differences between Algae and Aquatic Plants

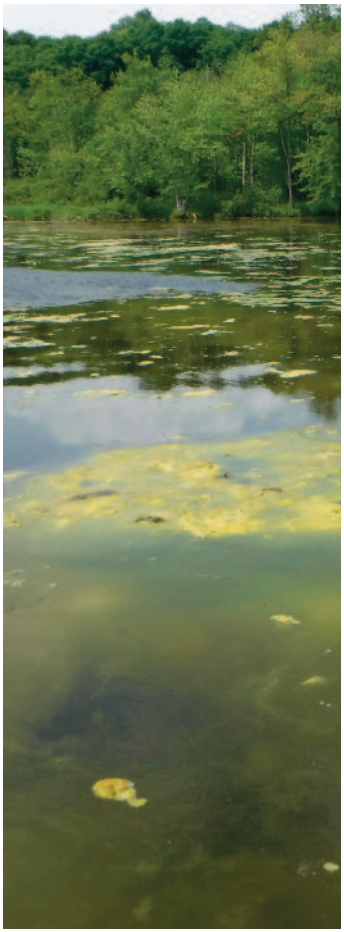
Algae and aquatic plants can be confused with one another as they share similar features and functions. Although they have many similarities there are key differences that distinguish them.

Similarities

- Photosynthetic
- Include species which float and some which attach to substrate
- Source of organic matter and the base for the waterbody's food chain
- Provide oxygen to the waterbody
- Reliant on temperature, water level, season, available nutrients and amount of sunlight penetrating the water column for growth
- May have excessive growth in response to human activity, such as the addition of too many nutrients in the waterbody

Differences

Algae	Aquatic Plants
Unicellular or multicellular	Only multicellular
Lack roots, stems or leaves	Include roots, stems and leaves
Every part of cell can absorb nutrients from surrounding water	Contain specific tissues (e.g., root systems) which are used to absorb and transport nutrients to the whole plant



Balance between Plants and Algae: Good and Bad

Aquatic plants, algae and blue green algae are a natural part of an aquatic ecosystem and are present in healthy water bodies. They are essential to life in a lake or river, acting as shelter, a food source and providing the oxygen necessary for fish and other aquatic organisms to survive. Aquatic plants rooted in the sediment also help prevent erosion. It is only when the plants and algae accumulate to excessive levels than the ecosystem can support that they become a problem. The following section on algal blooms and excessive aquatic plant growth outlines these problems associated with their growth.

Population Growth and Regulation

All species' population densities vary over time depending on available resources and predation. It is common for predator and prey populations to be dependent on one another. A high number of prey will increase the number of predators, as there is more food available; this will result in a decreased number of prey, leading to a decreased number of predators. This will continue in a cyclical pattern.

All populations will also have a carrying capacity, meaning that once their population reaches a certain amount there will not be enough resources to sustain them. This will cause a species to reach a high number and will then have a quick decline and level off.

You may have noticed a rise in a species in your waterbody and witnessed its decline. This is due to population growth and regulation.

Causes of Algal Blooms and Excessive Aquatic Plant Growth

Algal Blooms

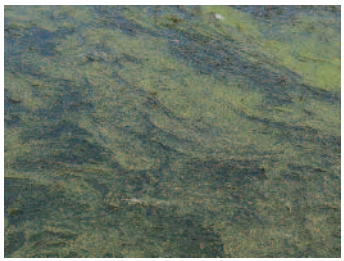
An algal bloom is the rapid accumulation of algae concentrations in a waterbody in response to favorable growth conditions. These conditions include things such as warm air and water temperature, high levels of available nutrients, strong sunlight exposure and extended periods of calm water. This accelerated growth pattern can result in colonies of microscopic algae becoming visible to the eye. At moderate levels, algae play an important role in keeping the balance of an ecosystem. Finding an appropriate balance to ensure the longevity of our lakes and rivers is important so that future generations may continue to benefit from them.

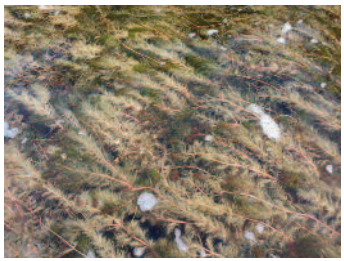
Benefits of having a healthy algae community

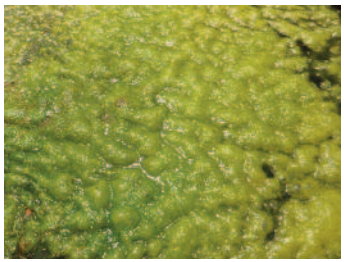
- As a primary producer, algae play an essential role in the food chain.
- Algae help to maintain oxygen levels. As part of their growth through photosynthesis, algae and aquatic plants release oxygen into the water that other organisms rely on.
- Algae are an important component of the ecological food chain. If there are limited amounts of algae, species dependent on it for a food source may be starved. Fish production can be negatively affected. In contrast, if algae are present in abundance, algae feeding species may have a population boom. Both of these scenarios can cause imbalance to the food chain and have a negative impact on ecosystem health.
- Algal blooms are a normal part of seasonal succession in mesotrophic lakes. The spring diatom bloom is important in fueling the growth of crustaceans later in the season that then support newly hatched fish. Also when some of these algae settle out they are important food for bottom dwelling organisms.
- Historic algae populations may also be examined in sediment cores, which allow researchers to understand the water's health and characteristics through time.

Disadvantages of algae overgrowth

- As large algal blooms decompose, the decaying organic matter consumes oxygen. This creates anoxic (oxygen depleted) areas or "dead zones," where oxygen-deficient water makes the survival of fish and other aquatic life difficult.







- Algal blooms may occur which can choke human infrastructure such as water pumps.
- Some types of algae (cyanobacteria) can be toxic, which may cause health issues in humans and animals.
- Blooms decrease aesthetic appeal of the waterbody and surrounding areas, as algae may have a foul smell as well as an unappealing look.
- Interruption of recreational activities

Benefits of Aquatic Plant Growth

Aquatic plant growth at moderate levels can benefit a water system. Plant growth may be defined as excessive when it begins to negatively alter the ecosystem and begins to disrupt recreational use of the body of water.
Benefits of having a healthy aquatic plant community

- Plants can help improve water clarity by trapping suspended sediment and holding sediment on the lake floor, preventing it from being stirred by things like wave action. Aquatic plant roots also help prevent shoreline erosion by holding onto sediment that would otherwise wash away.
- Prevent algal blooms by taking up nutrients and resources that algae would otherwise use for growth.
- Important ecological roles such as:
  - Provide shelter, breeding or nesting sites for many insects and animals including fish
  - Essential food source for many herbivores and omnivores
  - Key contributor to the release of oxygen in the air and water necessary for life to thrive

Disadvantages of excessive aquatic plant growth or lack of growth

- Excessive growth can lead to the disruption of ecological roles such as providing too much shelter for prey, causing predators to have difficulty finding their prey. In contrast, too little shelter may cause over-predation of the prey species. Breeding and nesting sites may also become covered in vegetation or become too bare. Lack of vegetation may also cause starvation in species that depend on it as a food source, decreasing the ecosystem health.
- Excess vegetation can cause damaging effects on the surrounding ecosystem:
  - Dead plant matter from abundant growth uses up oxygen in the decaying process, leading to anoxic (oxygen depleted) conditions that can be harmful to other species and the quality of the water
  - Excessive plant growth may out-compete other nutrient-dependent species causing an imbalance in the ecosystem
  - It can cause unsightly visual conditions
  - Restriction of the recreational use of water bodies
  - It can choke water pumps and foul beaches and boat launches

- Lack of vegetation may indicate that important organic nutrients required in a healthy lake ecosystem structure are absent
- Diminished species diversity due to competition by faster growing native or invasive species that may thrive in nutrient rich conditions

Excessive Nutrient Inputs

Sometimes the increase of algae and aquatic plants come from natural factors. To grow, these organisms need sunlight and nutrients, namely nitrogen and phosphorus. These nutrients can be found naturally within the ecosystem and play an important role in the progression of the natural state of a waterbody. Problems of excessive growth often arise when human activity influences the amount of nutrients that are available in a system. These harmful nutrient inputs can come from things such as:

- Pet and livestock waste running off into a nearby waterbody, carrying nutrients and bacteria
- Storm water runoff, carrying excess nutrients, suspended solids and possibly pollutants into water systems. Hardened surfaces (buildings, driveways, patios, etc.) also allow for increased runoff rather than infiltration of rainwater. runoff carries nutrients from the landscape into the receiving waterbody
- runoff from irrigation and rainfall, particularly lawns and fields where fertilizers or pesticides have been used
- The addition of phosphorus through usage of certain soaps and laundry detergents
- Loss of natural vegetation along the shoreline and surrounding the waterbody
- Failing private sewage disposal systems, permitting excess nutrients to leach into water systems
- Shoreline erosion, permitting soil and nutrients trapped within it to become dispersed into the water
- Lawn fertilizers or fertilizers used for agricultural crops or vegetable gardens

Climate Change

The Earth's climate patterns are changing at a regional and global scale, resulting in more extreme weather events, changes in rainfall patterns and an increase in average air and ocean temperatures. These changes in climate are impacted by the accumulation of greenhouse gases in the atmosphere.

Changes in weather events as a result of climate change are having an impact on lake and river environments. Rainfall patterns, extreme weather events and increased temperatures have been linked to changes in algae and aquatic plant growth.

Ice Off Dates

Increased annual temperatures have shifted the length of time that there is ice cover on lakes. Generally, ice is forming later and melting earlier than in the past. In the spring when the ice melts off of the lake at an earlier date, it will speed up the warming of the lake. Most algae tend to favour warmer waters, so with an increase in water temperatures there can also be an increase in the amount of algal growth. Earlier "ice off" dates also increase the amount of time that sunlight is able to penetrate in the water column. The earlier the ice is off the water, the earlier plants and algae are able to grow. A longer growing season can increase the amount of aquatic plants and algae that are observed. A longer period of lake stratification will also occur which increases the changes that bottom waters will run out of oxygen, even in oligotrophic lakes.

Extreme Weather Events and Precipitation

One extreme weather condition that is occurring more frequently is a large amount of rainfall in a short period of time. This precipitation increases runoff as the soils are not able to absorb large amounts of water in this short timeframe. This rainfall and potential flooding from runoff will therefore increase the amount of nutrients that are entering into water bodies. Higher nutrients can result in increased aquatic plant and algae growth. Hot dry spells are another weather event that can lead to increased algae growth, as many species of algae grow well in warm, stagnant waters. These hot, calm days create optimal conditions for algae growth.

Curly-leafed pondweed (invasive)

Invasive Species

Invasive species are organisms that have been introduced to an area where they were not originally found. They do not have a native competitor and are able to out-compete other native species in the area. This often results in biodiversity and habitat loss. However, not all non-native species are considered invasive. These species do not pose a significant threat to other native species whereas invasive species have a "displacement capacity" where they force out other native vegetation. Invasive species can cause

harm to the economy, society and human health. Once they are introduced it is very difficult and costly to try to remove them.

When invasive aquatic plants are introduced into a lake or river environment they have no natural predators and may out-compete the native plant species. They will often become the dominant plant in the waterbody, replacing the once diverse plant community. These invasive plants will frequently form dense, thick stands that make it difficult for recreational activities such as swimming and boating and will also change the habitat for other life in the waterbody.

Invasive Aquatic Plants Found in Ontario Lakes and Rivers

The following list of aquatic invasive plants are found in Ontario. For a more extensive list please view the Ministry of Natural Resources and Forestry's (MNRF) *Field Guide to Aquatic Invasive Species at* www.ontarioinvasiveplants.ca/files/ 27868_FieldGuide2010_FINAL.pdf.

- Eurasian milfoil *(Myriophyllum spicatum)*
- European frog-bit *(Hydrocharis morsus-ranae)*
- Curly-leaved pondweed *(Potamogeton crispus)*
- European water chestnut *(Trapa natans)*
- Fanwort *(Cabomba caroliniana)*
- Water lettuce *(Pistia stratiotes)*
- Water soldier *(Stratiotes aloides)*
- Yellow floating heart *(Nymphoides peltata)*
- Purple loosestrife *(Lythrum salicaria)*
- Invasive phragmites (European common reed) *(Phragmites australis subsp. australis)*
- Yellow iris *(Iris pseudacorus)*

Eurasian milfoil (invasive)

European Frog-bit (invasive)

Yellow iris (invasive)

Go to www.eddmaps.org/ontario to see what invasive species have been reported in your area.

Invasive Aquatic Plant Removal

Care should be taken when removing invasive aquatic plants from your property, as these plants can easily spread from cuttings that are able to re-root.

Visit the MOECC website to review the rules on invasive aquatic plant removal at www.ontario.ca/environment-and-energy/remove-invasive-aquatic-plants.

If your waterfront is federal land, like the Rideau Canal, please visit Parks Canada for rules on aquatic plant removal at www.pc.gc.ca/eng/lhn-nhs/on/rideau/plan/vegetation.aspx.

Invasive Invertebrates in Eastern Ontario Lakes and Rivers

Zebra Mussels *(Dreissena polymorpha)* and Quagga Mussels *(Dreissena bugensis)*

Zebra and quagga mussels are found in lakes, rivers and ponds attached to hard surfaces such as rocks, wood and some aquatic plants. They are less likely to be found in areas with strong wave action and are usually found at depths of less than 12 metres. Water temperatures greater than 10 degrees Celsius are needed for reproduction. The waterbody must also have calcium concentrations higher than 20 mg/l for zebra mussels to form their shells.

Both zebra and quagga mussels filter the water column, increasing water clarity. This allows sunlight to penetrate further into the water, allowing increased growth in aquatic plants and algae. Their filtering also removes a lot of plankton, which alters the food web and causes declines in native mussels. They can redistribute nutrients from the water column through their filtration and redistribute the nutrients on the bottom of the waterbody through their pseudofeces. This can provide more nutrients for aquatic plants and algae, leading to increased growth. Fish spawning areas can be disrupted if large colonies of zebra or quagga mussels are present. The shells of these mussels are very sharp and can cut people that touch them, and they may also clog water intake pipes.

Invasive Fish Species in Ontario Lakes and Rivers

Photo: Ted Lawrence, Great Lakes Fishery Commission

Asian Carp *(Hypophthalmichthys nobilis, Hypophthalmichthys molitrix, Ctenopharyngodon idella, Mylopharyngodon piceus)*

Carp are bottom feeders, and stir up the substrate when they filter nutrients for food and spit out the remaining sediment and mud. This increases the turbidity in the waterbody, preventing sunlight from reaching aquatic plants for growth. This can have detrimental impacts on the feeding and nesting sites of other organisms and impact oxygen levels. The stirring of sediments can also add additional nutrients to the water, promoting algal blooms. Due to their ability to thrive in eutrophic conditions, other organisms may begin to die off as the nutrient additions continue to occur.

Dayna

Goldfish *(Carassius auratus)*

Goldfish are also bottom feeders, increasing turbidity in waters as they stir the bottom sediment. This causes less sunlight to penetrate into the waterbody which can lead to the death of aquatic plants, altering the ecosystem and biodiversity.

A number of other invasive species also impact and threaten our lake and river ecosystems. Please review our "Activities that Protect Lake and River Health" section for more information on how to help control the spread of invasive species in our lakes.

For more information on invasive species visit www.invadingspecies.com/ invaders.

Activities that Protect Lake and River Health

What Can I Do?

It can sometimes be difficult to identify what we, as active stewards in our ecosystems can do to prevent harm to our lakes and rivers. The first and best thing you can do is to become aware of the issues. Reading the information provided here is a great first step! Here are some more simple tips that will help to protect the health of lakes and rivers in your area.

Choose Sustainable Drainage Systems/Low Impact Development Features

Sustainable Drainage Systems (SDS) are features that help absorb rainwater into the ground instead of running off into local water bodies or storm water systems. Before starting your next landscaping project, consider implementing some of these water-friendly activities at your home.

Rain Gardens

- Capture, clean and help prevent runoff and creates a beautiful addition to your yard
- Rainwater is absorbed by the garden and slowly infiltrates into the ground, rather than creating runoff into a nearby water system
- Select native plants that are adaptable to wet and dry conditions

Permeable Surfaces

- Hard surfaces increase runoff and pollution that will enter nearby water systems
- Similar to hard surfaces like driveways except that they are able to absorb water and slowly infiltrate it into the ground
- Absorbed water decreases runoff and pollution from entering nearby water systems

Grassy Swale

- Vegetated ditches reduce the flow of runoff, promote infiltration and trap sediment and other pollutants
- Developing an inclined area in your lawn where flood-tolerant vegetation is planted can aid in the filtration and lessening of storm water runoff

Rain Barrels

- Capture rainwater from roofs for reuse
- Limit the amount of storm water runoff
- Provide extra water that you are free to use for activities like watering the lawn or washing the car at a later date

Rock Pit (French Drains)

- Capture rainwater and prevents runoff
- One or more holes filled with rocks that allows storm water to gather in between the spaces of the rocks and slowly infiltrate into the surrounding soil

Downspout Re-direct

- Eavestroughs can be connected to nearby storm systems, increasing water volume and runoff into the system that is discharged to local water bodies
- Disconnect these downspouts and re-direct the water to a rain barrel, rain garden, grassy swale or rock pit allowing rainwater to be absorbed back into the ground
- Eavestroughs collect rainwater from the roof and can often be directed to a nearby waterbody

Gradient Terraces

- Help prevent erosion on sloped surfaces
- Rainfall is slowed down and absorbed into the ground by making gradual ridges on a sleep slope
- Before terracing check with your local conservation authority and the Ministry of Natural Resources and Forestry because this may involve work being done in the flood plain or in regulated areas

Water Bars

- Capture water that is flowing down a path and divert it into nearby vegetation
- The steeper the slope of your driveway or walking path, the closer the water bars should be
- Reduce runoff from entering nearby water bodies, by absorbing rainfall landing on hardened surfaces

For more information about sustainable drainage systems visit www.slowrain.ca/en/about-us/ or http://www.creditvalleyca.ca/low-impact-development.

Ensure the Control of Invasive Species

Invasive species are a serious threat to local biodiversity and ecosystem functions. To aid in diminishing these risks, each of us can do our part to prevent them from entering our water systems. Some pro-active things you can do are:

- Avoid planting non-native plant species in your garden and along your shoreline, and replace present ones with a native species alternative
- Ensure your boat is cleaned before entering a new waterbody. Cleaning your boat with a pressure washer or rinsing with water over 50 degrees Celsius will remove any harmful organisms. If you have time before your next excursion, drying your boat in the sun for at least five days will also remove any unwanted animals. Make sure the whole boat is devoid of water (for example, your live well, motor, bilge etc. have been emptied) before going to another lake or river. Make sure there are no plants that are caught on your boat or trailer before heading to a new waterbody.
- Do not empty your bait bucket into your waterbody, indoor aquariums or ornamental ponds
- Clean foot apparel after hiking to ensure nothing is travelling with you to your next destination
- Do not transfer firewood from one place to another as it could be harboring invasive species
- Do not release exotic pets or plants into the wild. This includes things like aquarium fish or plants. Live animals can be returned to stores or given away to other appropriate homes, and plants should be dried or frozen and thrown out in the garbage or green bin

If you notice invasive species in your waterbody report them to Early Detection & Distribution Mapping System Ontario (EDDMapS Ontario) at www.eddmaps.org/ontario/index.cfm.

Shoreline Management

Shorelines that host native plant species help to hold sediment in place, protecting against erosion. Eroding shores can cause an influx of nutrients into systems. Vegetated shorelines also protect water systems by helping to filter runoff, improving the quality of water in a waterbody. They can also aid in preventing flooding to your property by encouraging infiltration into the ground. Shorelines are responsible for 90 percent of lake-dwelling organisms' birthplaces, habitat and food. To preserve important shoreline functions and to avoid the negative impacts of erosion, maintaining these areas is essential. Allow your shoreline to remain in its natural state, or improve it by planting more native terrestrial plants. Remove and replace

any invasive plants on your property with native alternatives. Vegetated shorelines of planted vegetation can be added along stream banks to capture harmful nutrients before they enter the system and help hold on to sediment. Contact your local conservation authority to learn more about shoreline naturalization projects.

Tree Planting

Tree planting is another great way that you can improve the health of your waterbody. Trees act as a buffer helping to absorb and retain water, preventing erosion and the runoff of nutrients that can lead to excessive aquatic plant and algae growth. They also help to combat climate change as they absorb carbon dioxide and release oxygen into the atmosphere. Helping to reduce the effects of climate change like extreme weather events will benefit your waterbody as heavy rain events cause increased runoff. Along a waterbody trees also provide important shade that are beneficial to aquatic organisms in your lake or river. If you have unused fields along a watercourse, consider taking advantage of funding opportunities and contact your local conservation authority to find out more about their tree planting programs.

Livestock Restrictions

It is important to limit livestock from accessing waterways to prevent erosion and contamination of water. When livestock access waterways they erode the shoreline by damaging vegetation. A decrease in vegetation will result in sediment being deposited into the waterbody. The soil can also become compacted from the animals, decreasing the soils ability to absorb water which will increase water runoff into the waterbody as it is not being absorbed into the soil. Increased sediment deposits and runoff may result in increased algae and aquatic plant growth. If livestock have access to waterways, there will be manure that is directly deposited into the waterbody, increasing nutrient and bacteria levels. The quality of the water will be negatively impacted from increased sedimentation and manure inputs from the livestock. Bacteria levels can increase, making the water unsafe for recreational use. For more information on incentive programs for livestock restriction, alternative watering for livestock and other ways that rural land owners can help improve their local water quality, please contact your local conservation authority.

Sewage System Management

Ensuring your private sewage disposal system is in working order is an important function of maintaining water quality. If your sewage disposal system is leaking, it can negatively affect the water quality on your property as well as downstream.

- Tile beds of your sewage disposal system that are not properly maintained or located too close to a waterbody, may discharge into the local watercourse

- Contaminated groundwater from your system can discharge into a local creek, causing harm to that system as well
- Mismanaged wastewater can cause the contamination of your drinking water and cause excess nutrients to be carried as runoff. These nutrients may then result in excessive plant and algae growth in rivers and lakes

There are ways that you can help to ensure the proper operation of your septic system. It is recommended that systems be inspected every three to five years so any issues are detected and corrected before causing any damage to the water system. After your initial inspection, you can determine how often your tank should be pumped. Tanks should be pumped regularly to avoid buildup of sludge and scum, which can overload the system and eventually allow wastewater to leach out before full treatment can take place. Leached wastewater can have harmful effects to your well, land and downstream water quality.

Please contact your local municipality or conservation authority for more information on how your septic system works and what you can do to maintain it.

Watch Your Wake While Boating

It is important to be mindful of the wake that your boat makes. Large wakes can cause damage to shorelines and interrupt wildlife in and around your lake.

- Erosion from wave motion contacting the shoreline results in damaged property and excess nutrients
- Shoreline nesting animals like loons, who build their nests in areas along the shore where wind-driven waves do not normally reach will be negatively impacted from high waves

Maintain the legal maximum of 10 kilometres per hour when within 30 metres of the shore and be aware of the potential of non-wake boats to also contribute to high wake at higher speeds. Try to distance yourself from the shoreline by 50 metres as often as possible. It is also recommended that wake boaters and skiers stay in water with a depth greater than two metres to avoid stirring up sediment which can also add additional nutrients to the water, potentially causing excessive aquatic plant and algae growth. Pay close attention to no-wake zones — these areas are often most sensitive to any wake created by boating.

Get approved for work on your property

When doing any work on your property, including the removal of aquatic plants, it is important to get the needed permits and approvals for these activities. Making sure you get the right approvals is important as conducting some activities incorrectly can cause harm to your local environment.

If you do not get the necessary permits or approvals you may have to be fined and/or remove your work. Contact your local conservation authority as well as the Ministry of Natural Resources and Forestry or Parks Canada depending on where your property is located to get up-to-date information on regulations and permits in your area.

Eliminate Use of Fertilizers

Fertilizers contain nutrients which aid in the growth of your plants. However, they are easily leached from the soil and carried downstream as runoff during a rain event. These nutrients are then incorporated into the water system, where algae and plants use them as fuel for growth. This can lead to the excessive growth of one or both of these types of aquatic vegetation, potentially leading to eutrophic conditions and altering water quality. To avoid contributing to these issues, examine native plant alternatives that grow successfully without the use of fertilizers. If you live on a waterbody you should not use fertilizers; but if you must, use a fertilizer that is phosphate free. Consider implementing a Sustainable Drainage System (SDS) in your yard to aid in the prevention of runoff. For more information on SDSs, please see "Choose Sustainable Drainage Systems" on page 13.

Outdoor Maintenance

Limit activities such as washing your car on hardened surfaces where runoff is more likely. Try to keep organic matter during activities like cutting the grass, leaf piles or weeding at least 30 metres back from the water's edge. This prevents further decaying vegetation from reaching and entering the water table. If you remove aquatic vegetation in front of your property it is important to take the organic matter out of the lake and place it 30 metres back from the water's edge as well.

Wetland Restoration

Wetlands in Ontario are important to both the environment and economy. In the event that a wetland becomes degraded, restoration may become a critical means for the ecosystem to regain its essential balance. Wetland restoration involves trying to improve or enhance the current state of a wetland to previous conditions. In accomplishing this task, a variety of engineering techniques may be used. Structures may be implemented to control the flow of water. Human-made dykes and dams may be developed to replicate and achieve desired conditions. Often restoration projects are directed towards swamps and marshes, as bogs and fens are significantly more difficult to reconstruct due to the complexity of their composition.

It is important to note that even following a restoration project, wetlands do not return to the exact previous state that they may have occurred in before. It often takes many years in restoration attempts for the system to begin to bounce back, as the plentiful biodiversity that was present before takes time to

be restored. Conservation is therefore the most critical approach in maintaining a healthy wetland ecosystem. A variety of incentive programs are also available throughout Ontario for the protection and conservation of wetlands.

Citizen Science Reporting

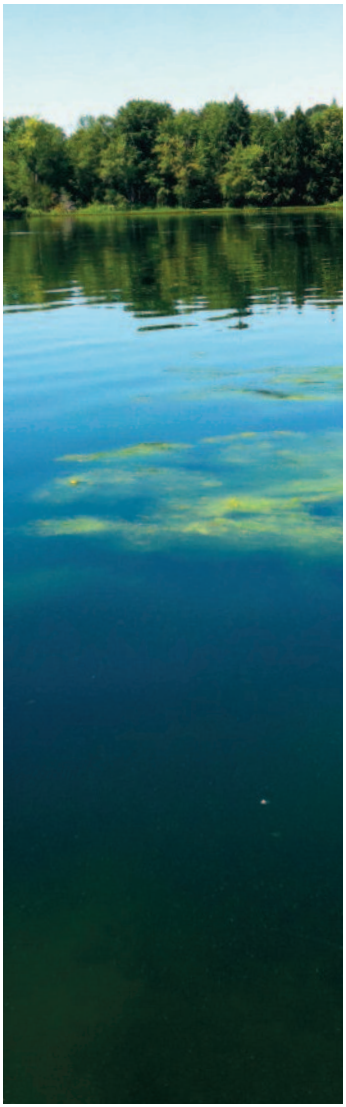
Take an active role on your waterbody and participate in citizen science reporting. As you are spending lots of time around your waterbody, you are likely to notice any changes that may occur. Reporting this information can be very helpful to scientists working in the area. Check out these citizen science reporting websites:

- Report an algal bloom or excessive aquatic plant growth: www.citizenwaterwatch.ca
- Report invasive species: www.eddmaps.org/ontario/index.cfm
- Sample your lake for total phosphorous and record water clarity observations: desc.ca/programs/lpp
- Record Frog and Toads in your area: www.naturewatch.ca/frogwatch
- Report your turtle sightings: www.torontozoo.com/adoptapond/turtletally.asp
- Record bird observations: www.birdscanada.org/volunteer/gbbc
- Report your lake's Secchi depth: www.secchidipin.org
- Record ice freezing and thawing on your waterbody: www.naturewatch.ca/icewatch
- Record flowering times for select plant species: www.naturewatch.ca/plantwatch
- Survey earthworm species in your area: www.naturewatch.ca/wormwatch

Get Into Water!

Educating yourself on the characteristics of your lake or river is an important first step in working towards a healthy waterbody. Developing and understanding algae and aquatic plants and the roles they play will give you a good foundation to begin working on activities to maintain your lake or river's water quality.

This document has outlined water quality influences and what you can do as a waterbody user to improve and maintain a healthy aquatic community. Now that you have this background knowledge it is time to take the activities that could work on your waterbody and apply them and don't forget to share what you have learned with your fellow lake and river users!



Green Algae

Partners

Carleton University
carleton.ca

Friends of the Tay Watershed Association
www.tayriver.org

Lake Networking Group

Lanark and District Fish and Game Club

Ministry of the Environment and Climate Change
www.ontario.ca/ministry-environment-and-climate-change

Ministry of Natural Resources and Forestry
www.ontario.ca/ministry-natural-resources-and-forestry

Mississippi Valley Conservation Authority
mvc.on.ca

Ottawa RiverKeeper
www.ottawariverkeeper.ca

Rideau Valley Conservation Authority
www.rvca.ca

Watersheds Canada
watersheds.ca

University of Ottawa
www.uottawa.ca

Upper Rideau Lake Association
www.urla.ca

Notes

Blue Green Algae

Report Blue Green Algae to the Ministry of Environment and Climate Change's (MOECC) Spills Action Center at 1-800-268-6060

RIDEAU VALLEY
CONSERVATION AUTHORITY

RIDEAU VALLEY CONSERVATION AUTHORITY

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