



# The Lake Book

A HANDBOOK FOR LAKE PROTECTION





Maine Lakes is a statewide membership organization dedicated to lake conservation through education, outreach, and advocacy. Formed as a non-profit charitable membership organization in 1970, Maine Lakes has historically catalyzed and supported the state's grassroots lake associations; collaborated with watershed organizations across the state; provided science-based lake and watershed information to the public, lake users, and government decision-makers; and promoted science-based watershed stewardship and wise land-use. Maine Lakes, along with its individual and lake association members, form a nexus of lake conservation activity that is deep, impactful and statewide.

This fourth edition of *The Lake Book* was developed by Maine Lakes and FB Environmental Associates with funding provided by the Margaret Burnham Charitable Trust and the Maine Outdoor Heritage Fund. Graphics by L. Diemer, FB Environmental Associates, unless otherwise noted. Photos generously provided by numerous Maine nature enthusiasts. Photo credits listed on page 52.



The Lake Book  
4<sup>th</sup> Edition  
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Susan Gallo, Editor



Maine Lakes is grateful for the assistance of many collaborators in bringing this edition of *The Lake Book* to press. We are lucky that local, regional, and state-wide lake conservation organizations in Maine work together to maximize our reach and efficiency. This edition of *The Lake Book* is better for having had many contributors and collaborators, and illustrates the power that many small organizations have when they work together. In particular, we thank the organizations below that provided feedback on content and helped us acquire the needed funding for this publication. Special thanks to Mary Wicklund, Drew Morris, Kathy Hoppe, Lidie Robbins, Tristan Taber, Roberta Hill, Scott Williams and Danielle D’Auria for their careful review of earlier drafts.



For a complete list of regional lake organizations with staff in Maine, a map of their locations, and more about what they do, see pages 50 and 51.

Visit [lakes.me/map](https://lakes.me/map) to find locations and contact information for active lake associations in Maine that belong to Maine Lakes.

# LAND AND WATER ACKNOWLEDGEMENT

We would like to acknowledge and thank the people of the Penobscot, Passamaquoddy, Micmac, and Maliseet tribes, and their Wabanaki ancestors, for stewarding, protecting, and preserving the lakes, ponds, and watersheds within Pasamkuk, now known as the State of Maine, for thousands of years before the arrival of settler colonists.

We acknowledge that their land and water are still not ceded and that tribes in Maine do not have the same sovereignty enjoyed by other federally recognized tribes. To that end, Maine Lakes supports Maine Tribal Sovereignty efforts in the Maine Legislature and also pledges to steward lakes in the spirit of, and in collaboration with, the Wabanaki people long into the future.

# DEDICATION

This edition of *The Lake Book* is dedicated to the youth of Maine, who hold in their hands the ability to shape a positive future for clean and healthy lakes not just in Maine but around the world.



*The people of the state of Maine always should keep in mind that they are the actual owners of the lakes of Maine and of the water contained in them. These lakes and this water are public property of inestimable value.*

~Percival P. Baxter





# MAINE'S LAKES NEED YOU

Clean water, abundant wildlife, and extraordinary natural beauty make Maine's almost 6,000 lakes special. These sparkling gems bring us joy, peace, and lifelong memories as we paddle, swim, float, motor, ski, skate, fish, or just enjoy them from afar. It's easy to be complacent and believe that they will remain clean and blue forever. But the truth is our lakes are fragile. They are living ecosystems, constantly changing each year, each season, and even each week as they try to stay in balance. A lake in balance hosts many different plants and animals (from the tiniest algae to the majestic loon) along with a full array of unseen nutrients. No one part of that complex system grows out of control or takes over or destroys the other parts.

Maine's lakes may look healthy from a distance, but many are approaching (or have passed) a "tipping point" where they are no longer able to maintain that fragile balance. Too much phosphorus causes algae growth that turns lakes green. Invasive plants outcompete native plant communities and degrade wildlife habitat and water quality. While it is often our actions that push lakes toward that "tipping point", we are also empowered to bring them back in balance. When one single act of planting a vegetative buffer or fixing an eroding road is combined with many others around a lakeshore and throughout a watershed, lake balance can be restored. *The Lake Book* is here to help you keep your lake healthy, resilient, and in balance long into the future.

Read on to learn more about living lakes, what helps (and hurts) them, and how you can take action now to protect them long into the future. Engaging your neighbors, friends, town officials, and other community members in these actions is essential to success. Share this book with others. Create a LakeSmart program. Join your lake association or local watershed group or Maine Lakes. Get involved with Courtesy Boat Inspections. Volunteer for events and activities that promote lake health. No action is too small. They will make a difference!

This book is dedicated to the youth of Maine. Before we know it, they will be our leaders and decision-makers. With your help, we can leave them a legacy of lakes in good health, in balance, and with a future that is long, clean, and clear.

Thank you for acting on behalf of Maine's lakes.





Susan Gallo  
Executive Director, Maine Lakes  
April 2022

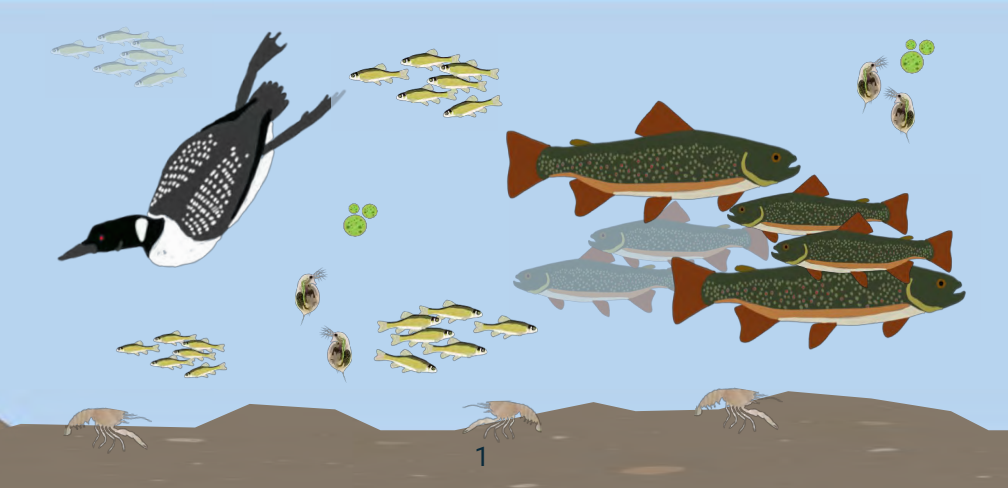
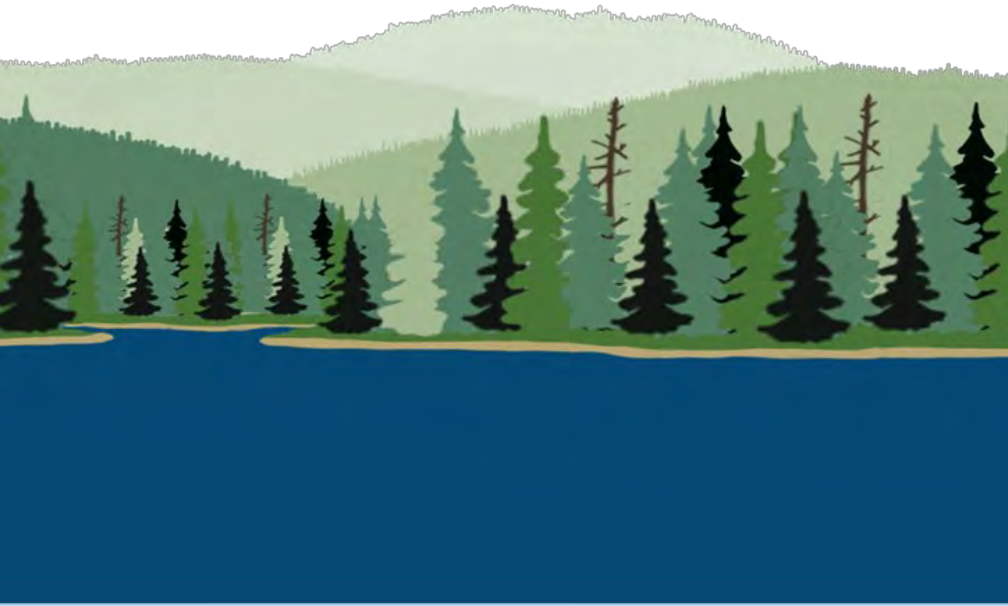
*A lake is a landscape's most beautiful  
and expressive feature. It is Earth's eye;  
looking into which the beholder  
measures the depth of [their] own nature.*

~Henry David Thoreau



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## THE VALUE OF A WATERSHED

A lake's **WATERSHED** is the area of surrounding land that channels rainfall and snowmelt via creeks, streams, rivers, ditches, storm drains, and groundwater to the lake. Watersheds supply the water that replenishes our lakes, along with other elements critical to supporting life, such as nutrients and organic matter. Water moves through a never-ending loop from sky to land and back in various states of gas, liquid, or solid, through a process known as the **WATER CYCLE**.

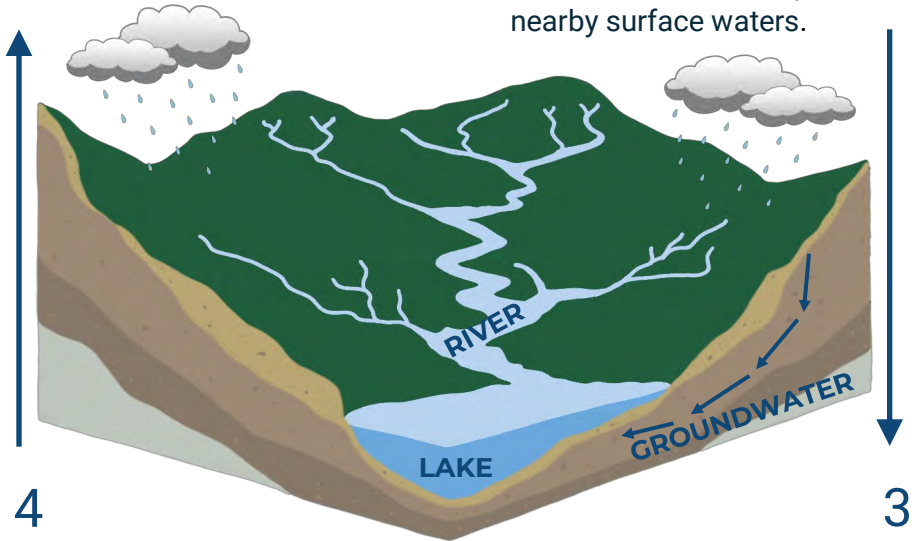
### THE WATER CYCLE IN AN UNDEVELOPED WATERSHED

#### 1 PRECIPITATION

Water vapor in the atmosphere condenses to form rain and snow that fall to the earth.

#### 2 INTERCEPTION, INFILTRATION & RUNOFF

Most rain and snow is intercepted by vegetation and soaks into the ground (infiltration). Very little runs over the ground and directly into nearby surface waters.



#### 4 EVAPOTRANSPIRATION

Water evaporates from the surfaces of plants and water bodies, moving water from a liquid to vapor in the atmosphere.

#### GROUNDWATER

In the ground, water is taken up by plants or absorbed into groundwater, which flows underground into waterbodies.

An **UNDEVELOPED** watershed, like the one pictured on the previous page, helps keep lakes and rivers clean by absorbing rainfall and keeping excess nutrients, such as phosphorus, out of the water. Multiple layers of vegetation, from the tallest trees to tiny seedlings and from shrubs to ferns and perennials growing on the forest floor, help intercept rain, reducing the amount of water hitting the forest floor. Loose, deep layers of duff, the accumulation of leaves on the forest floor, absorb water and nutrients, minimizing flow directly into waterbodies.

However, every one of us lives in a **DEVELOPED** watershed. Developed watersheds have roads, manicured lawns, rooftops, houses, driveways and parking lots that create **IMPERVIOUS** surfaces. These surfaces prevent rain from soaking into the ground. Rain then channels over land. Those channels gather speed and size as well as excess nutrients as they erode soils. Culverts, ditches and storm water systems help reduce erosion and direct the flow of rainwater, but many smaller sources of erosion around homes and camps are sources of pollutants and excessive nutrients to our lakes and ponds.

We all live in a watershed. Even if we are miles away from a lake, our actions can have consequences downstream to lake water quality. The health of Maine's lakes and ponds is determined by what happens in their surrounding watersheds.

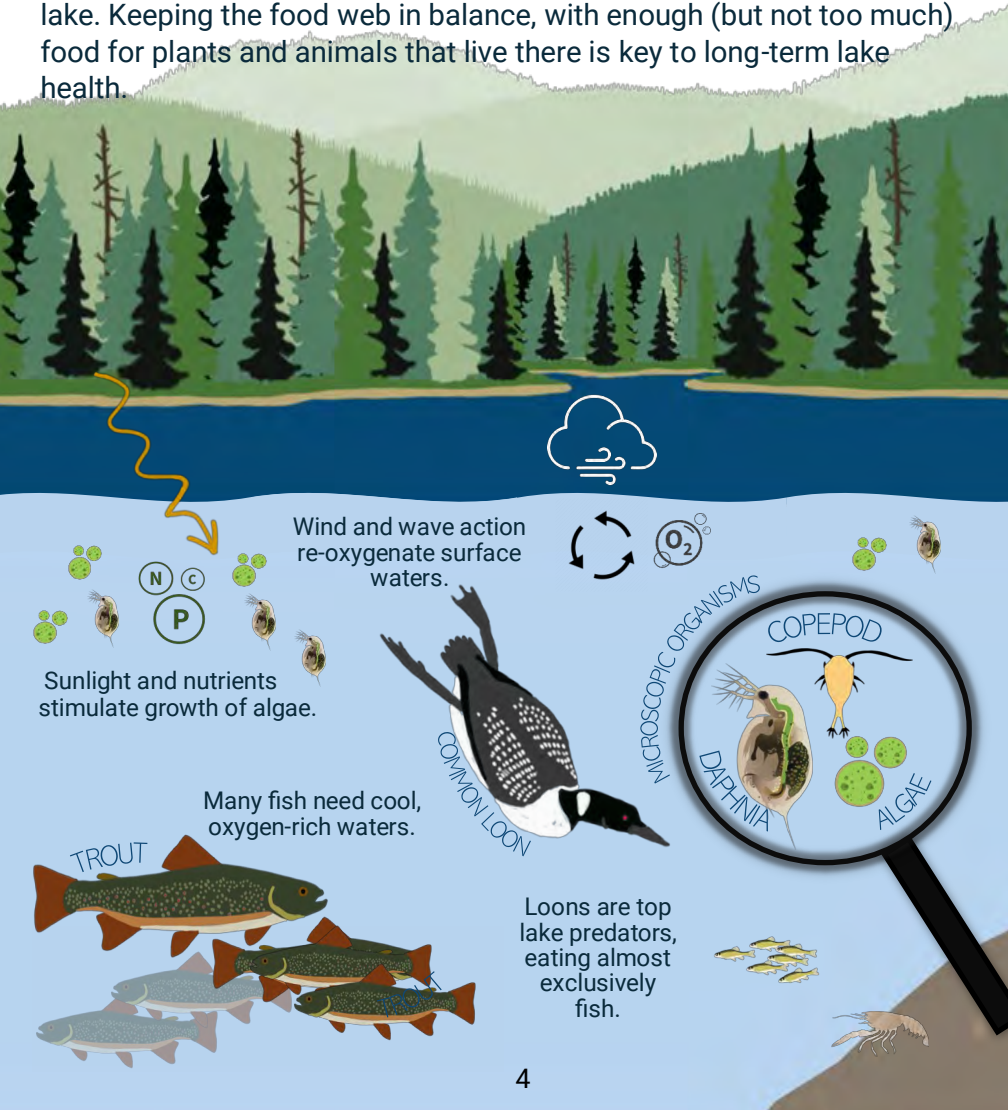


*This plume of sediment washing into Schoodic Lake after a storm deposits excess phosphorus into the lake that can knock the lake out of balance. [Bluth on Ponds](#)*

# LAKES ARE LIVING ECOSYSTEMS

Organisms that live in lakes—from microscopic algae to top predators such as loons—interact with many forces, including wind, sunlight, rain, snow, nutrients, oxygen, temperature, and alkalinity to create vibrant, balanced, but ever-changing ecosystems. Without people, homes and roads in a watershed, a lake's water quality is determined only by the interactions among the many living and non-living parts of a lake ecosystem.

Maintaining a healthy population of microscopic organisms (including plants such as algae that use the sun to produce energy and animals such as copepods and daphnia that eat plants or other animals to survive) are the basis for a balanced food web. These tiny creatures feed larger animals who feed even larger animals in and around the lake. Keeping the food web in balance, with enough (but not too much) food for plants and animals that live there is key to long-term lake health.





Graphics by L. Diemer, FBE.  
Crayfish, Daphnia, and Copepod  
Images by IAN symbols.



**WIND** helps oxygen mix into surface layers, and promotes lake mixing, especially in spring and fall, bringing nutrients up and oxygen down into the water column to replenish the entire lake.



**SUNLIGHT** provides energy for plants to grow, and drives seasonal temperature shifts that trigger new growth. The amount of sunlight varies by season and with the depth and clarity of water.



**RAIN AND SNOW** replenish water throughout the watershed, transporting nutrients needed for growth of aquatic organisms and plants.



**NUTRIENTS** and organic matter (from dead, decaying plants and animals) are critical elements required for growth for all life.



**OXYGEN** is necessary to all animal life, including fish, which “breathe” oxygen through their gills. Oxygen in lake water is replenished by wind action and plant photosynthesis.



**TEMPERATURE** of water affects where organisms live in a lake and how productive they are. For instance, cold water fish seek deeper, colder waters in late summer when surface temperatures are too warm.

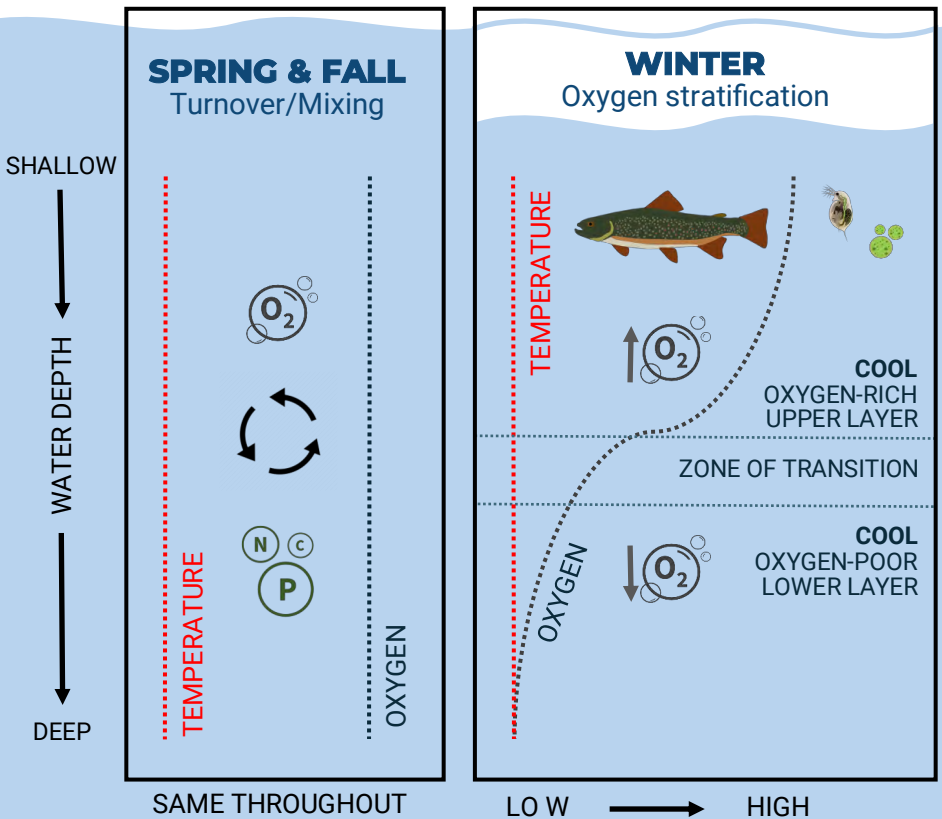


**ALKALINITY** is a measure of a lake’s capacity to buffer against major swings in acidity or **PH**. Many Maine lakes are naturally low in alkalinity, making them sensitive to acid rain, mercury contamination, and acidification due to increases in carbon dioxide in the atmosphere.

# SEASONS OF A LAKE

**FALL** The surface of the lake cools and winds pick up causing the lake to mix or “turn over.” Fall turnover occurs when there is complete mixing of the warmer top surface layer of water with the colder bottom layer, yielding uniform water temperature from the surface to the bottom of the lake. The process of turnover also mixes oxygen throughout the water column. Deeper water with little or no oxygen is mixed with oxygen-rich water in the upper layer. Much lake life is dependent on this redistribution of oxygen into the water column.

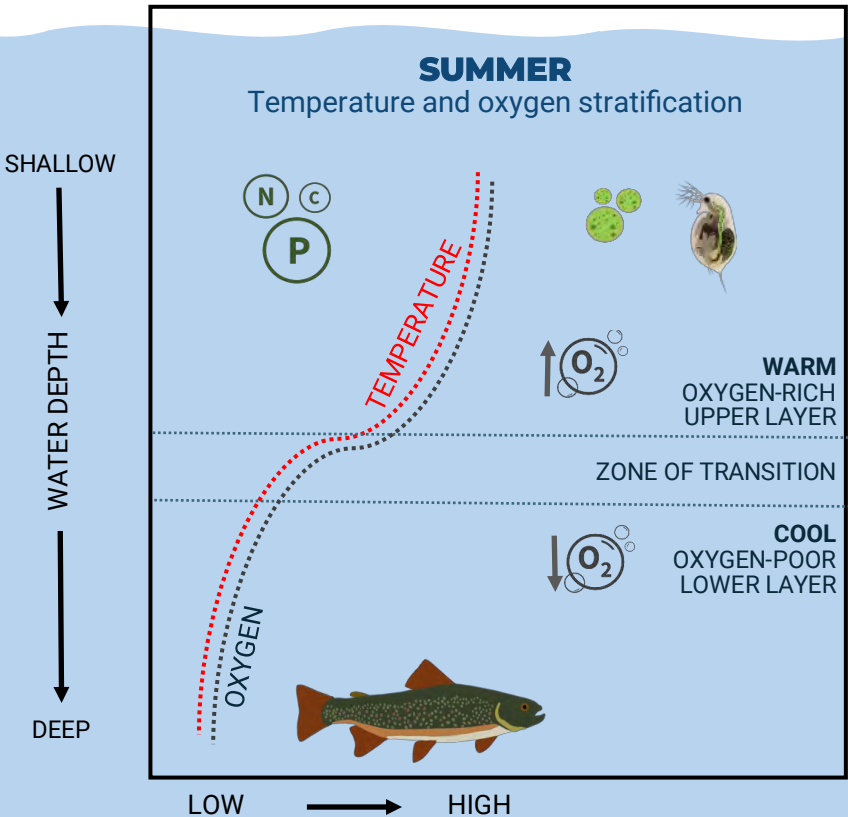
**WINTER** During winter, lakes often freeze over. The ice insulates the lake from the mixing effect of wind. Water temperature remains fairly uniform from the surface to the bottom. Because biological processes continue under the ice with no wind to mix the water and replenish oxygen, decomposers at the bottom deplete available oxygen, causing winter stratification of oxygen-rich water on top and oxygen-poor water below. Lake life is still active under the ice! Microscopic organisms feed and grow, and lakes can even “bloom” with algae while covered in ice.





**SPRING** As ice melts, the temperature of the water at the surface begins to warm. Without ice as a barrier, and with warmer, denser water at the surface, spring winds help mix the water once again in a process called spring turnover. Spring turnover carries nutrient-rich waters to the surface and oxygen-rich water to the bottom, equalizing conditions from the surface to the bottom of the lake.

**SUMMER** Have you ever jumped into a lake and been surprised by the cold water below the surface? As the sun warms the lake surface in summer, the temperature differential between surface and bottom waters increases. In lakes more than about 12' deep, these differences create stratification in the water column that resists the wind's mixing force. Oxygen in the water (dissolved oxygen) is both produced and consumed during the summer by biological processes throughout the lake, but in the cooler, deeper waters at the bottom of the lake it is eventually depleted. Dissolved oxygen at this bottom layer will not be replenished until fall turnover.



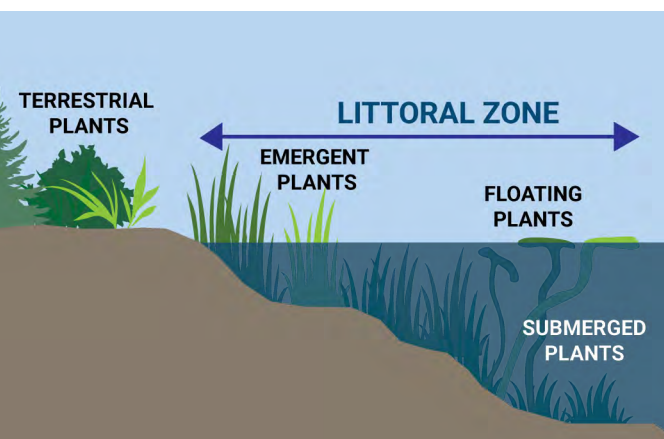
# THE LITTORAL ZONE

The littoral zone is the shallow water area near lake shores where light reaches the lake bottom. The habitat in littoral zones is crucial for lake life. Fish, frogs, turtles, and aquatic invertebrates like dragonflies all use the littoral zone for feeding and as nursery grounds for their young. Animals might hide in woody structures such as downed trees and branches that are in the littoral zone, or they might live or deposit eggs in the spaces between rocks on lake bottoms. Plant beds that grow in littoral zones provide wildlife habitat as well, and also help keep lake water clear by absorbing nutrients and stabilizing lake edges and bottoms.

There is a strong positive effect of natural riparian vegetation, or vegetation along the shoreline, on the littoral zones of lakes. Riparian vegetation filters nutrients from stormwater runoff and also reduces erosion along lakeshores. Without trees and other riparian vegetation, shoreland erosion increases and more sediment enters the lake. This fills in the spaces between rocks, eliminating that habitat and preventing oxygen from reaching eggs. Shoreline trees are sources of future woody habitat in the littoral zone, either as branches or whole trees that fall into the water. Shoreline trees also provide important shade for the littoral zone, keeping water temperatures cooler. Leaves falling into the littoral zone are also an important source of nutrients as they decompose. Loss of natural plant



*Plants, woody debris, and rocks in the littoral zone make fishing near shore much more rewarding!*



beds from within the littoral zones diminishes habitat quality and can contribute to murky water and mucky bottoms. Conversion of lakeshores to unbuffered development of impervious surfaces - buildings, lawns and roads - is the primary cause of riparian

# Dragons or Damsels?

Hearing the buzz of dragonflies and damselflies, and watching their aerial maneuvers over and around the water, is a given if you spend any time near the littoral zones of Maine's lakes and pond. More than 150 species in the family *Odonata* are native to Maine. While closely related, see the caption and pictures below for the key features that differentiate these two groups.

Dragonflies and damselflies start their lives in lakes and ponds as nymphs, where they are voracious predators. They feed on various insects, worms, and even small animals such as tadpoles and minnows. They emerge from the water to hatch into adults. Riparian vegetation provides safe places to hide while their outer skeleton dries and hardens. Once fully dry, adults continue as their role as top predators, using their legs to scoop insect prey out of the air while they fly. They'll also catch (and eat) spiders, bees, butterflies, and smaller *Odonates*.

Shorelines are more hospitable to *Odonates* when there are branches and vegetation allowing them to perch and rest. Adding stakes or even just sticks that emerge above riparian vegetation will provide excellent perching sites. Native plants that flower and attract insects as a source of prey also improve *Odonate* habitat (see p. 11 for more information).



*Dragonflies like the 12-spotted Skimmer (upper left) or the Canada Darner (lower left) have larger eyes and bulkier bodies than damselflies like this Blue-fronted Dancer (upper right) or this Azure Bluet (lower right). They also hold their wings in the "airplane" position at rest, and their hind wings are broader at the base, and larger, than their fore wings.*



# NATIVE PLANTS

Native plants, both in the water and along shorelines, are essential to the health of lake ecosystems. Native plants can be part of a beautiful landscape, often requiring less water and maintenance than their cultivated relatives. Because native plants share a long evolutionary past with native insects, they host hundreds of native insect species. Many of these native insects are adapted to live on just a single native plant species.



Maine's native plants host many types of pollinators, including birds, insects, moths, and butterflies. These native pollinators fertilize plants and promote genetic diversity. Native plants also host many caterpillar species, the primary food source for nearly all baby songbirds in Maine.

*Above: Cutleaf Coneflower; Left: Blue Vervain; Below: Humming-bird Moth on Rose Milkweed; Far Right: Fragrant Waterlily)*

Planting new native plants along the shoreline and encouraging the ones already there not only sustains natural food sources and habitats, but also requires less maintenance - saving time, money, and effort. Shoreline plantings help stabilize soil and promote infiltration of storm-water, which reduces runoff, improving water quality and the quality of the lake's littoral zone.



Maine has more than 190 species of native aquatic vascular plants that are part of natural lake ecosystems. They grow in littoral zones of lakes and ponds, and provide food for moose, ducks and many other species of wildlife. They also provide hiding places for fish and amphibians. Native microscopic plants (phytoplankton and algae) are also present in healthy lakes and are an important food source for many species higher in the food web.



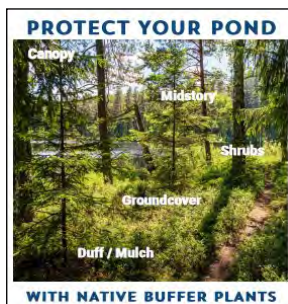
## Planting Native Species

Many local nurseries now carry good selections of native plants. If yours doesn't, let them know they should! The best plan is not to drastically change your shoreland all at once. In fact, Maine rules require a permit if you're planting more than 24 plants within 100' of the shore. Just add a few each year and watch what happens. A few good resources to help you get started are below.



**Maine Audubon's Native Plant Finder** is a searchable database where you can look for native plants by soil type, sun, size or wildlife benefit, and find excellent information for planting and maintenance. Visit [mainenativeplants.org](http://mainenativeplants.org).

**Wild Seed Project** is a Maine non-profit whose mission is to repopulate landscapes with native plants. Great informational resources and events. Visit [wildseedproject.net](http://wildseedproject.net).



**Protect Your Pond** is a brochure with an excellent planting guide as well as a page of the most common hardy native plants for the shoreline. Visit [lakes.me/protect](http://lakes.me/protect) for a PDF and for many more native plant resources.

# NATIVE ANIMALS



Maine is home to 28 species of amphibians and reptiles, 47 fresh-water fish species, and 58 species of terrestrial wildlife. Insects and invertebrates number in the thousands. Habitats along lake shorelines are some of the most important and active habitats for these species, with 85% of terrestrial animals using the shoreland zone at some point in their lifecycle. The shoreland zone is where loons nest, beavers harvest trees, and otters den. It's also where we can improve habitat with buffers of native vegetation.

Shoreland Zoning rules (see p. 46 FMI) regulate land use within 250' of lake shores (and 75' of rivers and streams), protecting water quality and quality wildlife habitat. However, many species use habitat well beyond this zone. Aquatic birds may travel up to 1,000' from shore to find nesting habitat, and amphibians and reptiles may travel up to 1,500' during the fall and winter. Travel corridors for many species can extend up to 330' from the shoreline.



*Species such as Wood Ducks and Hooded Mergansers (pictured here) nest in the uplands, often many hundreds of feet from shore, in natural cavities or nest boxes.*



*A Common Yellowthroat with caterpillars for his nestlings.*

Most songbirds rely on insects (particularly caterpillars and spiders) to feed their young. These insects in turn need native plants to thrive. All our native animals are important parts of lake ecosystems and food webs. They transfer energy up through the food web, from plants to smaller animals to larger animals.



*Hibernating Big Brown Bat, one of several species of "house bats" found in Maine.*

The insects that live on and over Maine's lakes make lakes ideal habitat for bats. Bats are non-stop insect eaters, averaging close to their body weight in insect consumption each night. Maine has eight bat species, some that roost in old tree cavities and crevices, and some that look for human structures (attics, barns, garages) to roost communally in large groups. These "house bats" have been hit hard in the last decade by a fungus that causes White-nose Syndrome, a disease that has killed up to 90% of Maine's bats since its arrival here in 2011. Bat houses can help provide lakeshore habitat for these bats, who in turn help keep insect populations in check.

Many species of wildlife use cavities in large dead trees or snags for denning and nesting. Insects boring into snags also provide an important food source for woodpeckers and other insect-eaters. Leaving these "legacy" trees in place, where safe to do so, can help provide much needed habitat along shorelines.



## FISH-EATING ADVISORIES

The health of aquatic organisms reflects the quality of water in which they live. Many Maine lakes contain elevated levels of mercury. Fish-eating advisories for pregnant/nursing women and children under age eight advise a limit of one meal/month for brook trout/land-locked salmon and no meals for other fish species. For all others, the advisory recommends no more than two meals/month (one per week for trout and salmon). There are additional recommendations specific to 14 other lakes and rivers in the state. Visit [maine.gov](http://maine.gov) and search "fish eating advisory" for more information.



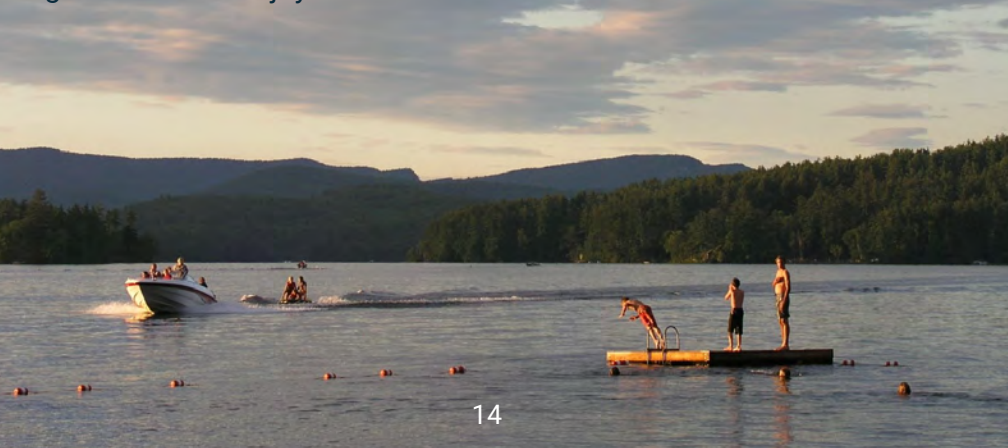
## OUR RELATIONSHIP WITH LAKES

The last chapter reviewed how our lakes are living and ever-changing ecosystems, providing important habitat for native plant and wildlife species, from the smallest microscopic algae to the majestic moose and wailing loon. Maine lakes are also incredibly important to people, and they provide innumerable benefits to all who live in or visit Maine.

Lakes are where we go on hot summer days to cool down, or visit with friends and family at lakeside camps. We make memories that last a lifetime at lakes, and many would say clean and healthy lakes are a priceless resource for us all. However, we also know we can put a price tag on lakes as an economic engine for many Maine towns, as we spend money in lakeside communities, work for or create businesses that rely on lakes for their revenue, buy lakeside camps, and pay property taxes. The latest estimate of the total value of Maine's lake economy was more than \$11 billion dollars per year. In addition, more than half of Mainers rely on drinking water from lakes and ponds. These benefits, however, depend on clean water and healthy lake ecosystems, which in turn depend on our own actions and behaviors.

As residents or visitors of lakes and their surrounding watersheds, we are intimately connected to the well-being of these fragile systems. While many of our lakes appear pristine and immune to algal blooms or declines in water quality, nearly all our lakes are at some level of risk. More than 350 Maine lakes are listed as at risk from development pressure, priority watersheds due to water quality issues, or at high or very high risk of algal blooms. Chances are you might be living on or visiting one of them soon.

Read on for more about our relationship with lakes and how we can and must protect these treasured natural resources for future generations to enjoy.



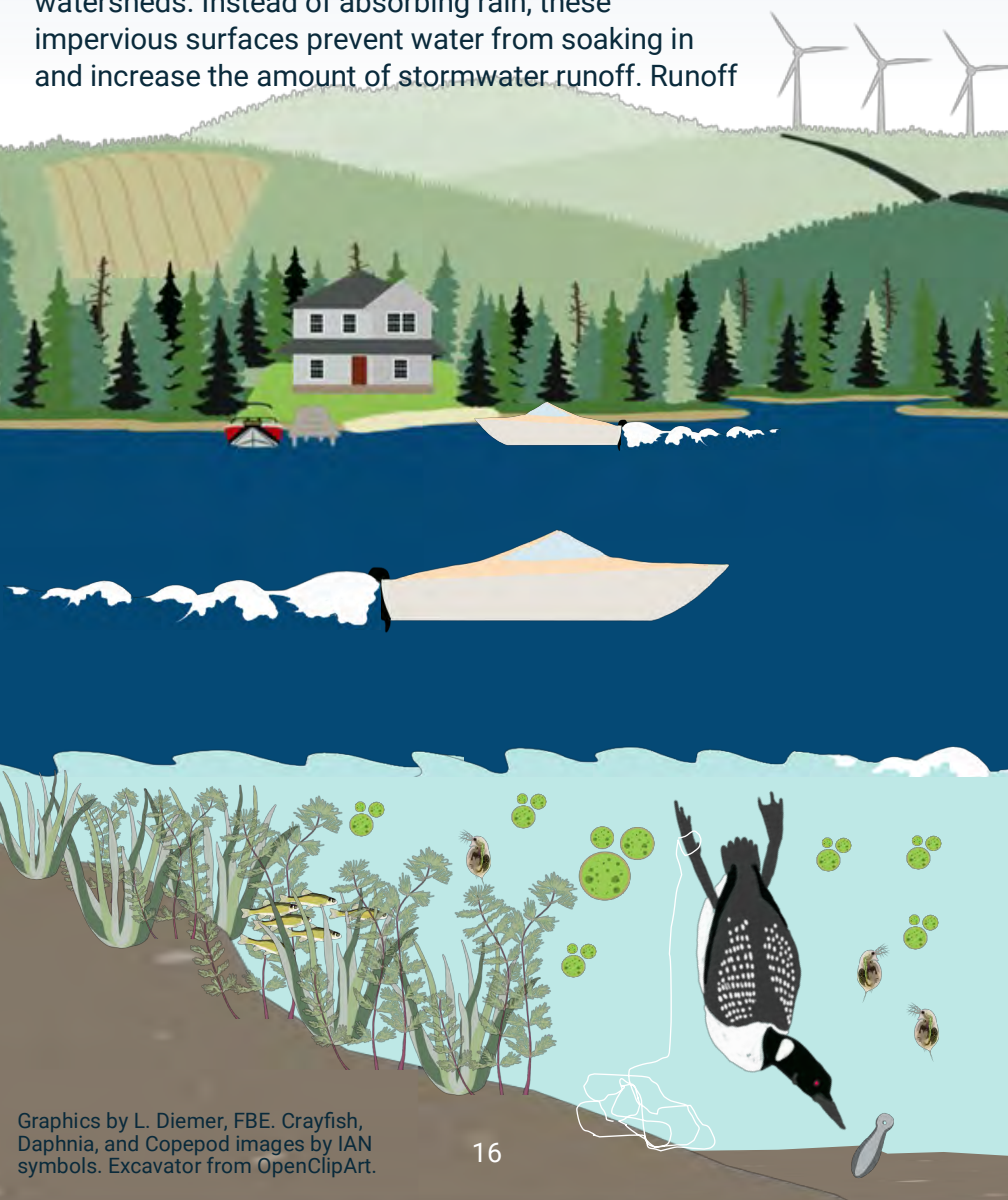




# OUR IMPACT ON ECOSYSTEMS

For many thousands of years, from the time the ice sheets receded until European colonization, our lakes were protected by the forested watersheds around them. Vegetation intercepted rain so less fell to the forest floor. Loose soils and duff (accumulated leaves on the forest floor) absorbed excess rain. The little remaining runoff carried minimal nutrients to lakes. Lakes were in balance.

After colonists arrived, land was cleared for farming and forests were cut on an unprecedented scale. More recently, roads, bridges, parking lots, and homes have reduced the amount of forests in many lake watersheds. Instead of absorbing rain, these impervious surfaces prevent water from soaking in and increase the amount of stormwater runoff. Runoff



then gathers speed as it channels, eroding soils and carrying nutrients and other pollutants into lakes. When water quality is degraded and ecosystems damaged, loons can't see to find fish. Fish eggs suffocate and die. Human health is at risk.

While erosion is likely the biggest impact we have on our lakes, our other actions matter too. Tossing fishing line and lead sinkers, transporting invasive species, and creating excessive wakes all impact the health of lake ecosystems. Lucky for us, we can act to protect our lakes and all the things that live in and around them, including ourselves.



# EROSION AND SEDIMENTATION

Unlike pollution from an easily identifiable single source like a mill or an industrial plant, **NONPOINT SOURCE POLLUTION (NPS)** comes from a combination of many small sources over a large geographic area. **SOIL EROSION**, the gradual wearing away of soil by forces like water or wind, along shorelines or in watersheds is one type of NPS pollution that is a big problem for Maine's lakes. Stormwater runoff can both cause soil erosion and be a vehicle for transporting soil into the lake. You might see evidence of soil erosion when lake waves undercut a bank or when rainwater leaves little rills or larger channels on a pathway, driveway, or yard. Soil from unstable shorelines, artificial beaches, poorly maintained gravel roads, and other areas of exposed, bare ground can erode into our streams, rivers, ponds, and lakes.

Soil particles in the water act like sandpaper to scar fish gills, smother aquatic plants, and cloud water. Murky water reduces the amount of sunlight going through the water, making it more difficult for fish to find food and for aquatic plants the fish need to grow. Soil particles may also carry a variety of pollutants, including fertilizers, pesticides, herbicides, oil, grease, heavy metals, pet waste, and manure.

Most notoriously, eroding soils also carry phosphorus, an important nutrient for plant growth, but one that can result in explosive algae and plant growth if too much accumulates in the water.

Keeping soil covered and bound with woody vegetation, as well as slowing down the erosive power of stormwater runoff, are key to reducing soil erosion to Maine lakes. Best management practices that reduce the amount of rainwater reaching the ground (by providing tree canopy cover or other layers of vegetation) or that increase the ability of the ground to soak up or **INFILTRATE** stormwater runoff can help reduce erosion. An added bonus is that rainwater that soaks into the ground is **FILTERED** by the soil, trapping unwanted pollutants and improving the overall health of our waterbodies.



*Soil erosion like this brings excess phosphorus into lakes.*

*What begins as minor rills on a camp road (below) can become significant gullies (right) in a short period of time when roads are not properly maintained (see page 31 for more information).*



*Waves erode unstable shorelines and deposit nutrient-laden soil directly into the lake (above).*

*Compacted and exposed soil on pathways (left) allows stormwater to carry nutrients directly to a lake.*

# PHOSPHORUS & EUTROPHICATION

**PHOSPHORUS** is an essential nutrient for plant growth that occurs naturally in soils and organic material and in products like fertilizers and petroleum products. The right amount helps plants, including algae, grow and thrive as part of a healthy, balanced ecosystem. Too much phosphorus causes excess algae or cyanobacteria growth, leading to **ALGAL BLOOMS** that make the water cloudy, green, and smelly. Severe algal blooms of some species may be classified as **HARMFUL ALGAL BLOOMS (HABS)** when they dramatically reduce water clarity. Some can produce toxins harmful to humans and pets.

Lakes naturally become more productive or “age” with the accumulation of nutrients and organic matter over thousands of years, a process known as **EUTROPHICATION**. In recent times, humans have increased the rate at which this nutrient enrichment happens, dramatically accelerating the natural processes and prematurely aging our lakes.

As large amounts of algae and plants die and sink to the bottom, especially after a bloom, tiny animals (decomposers) break down plant matter and consume oxygen, potentially reducing available oxygen in the water at the bottom of the lake. When these waters reach low levels of oxygen, or **ANOXIA**, a chemical reaction occurs at the interface between the water and lake sediment. During this reaction, phosphorus bound to sediments is released into the water column, feeding even more algae and plant growth in a process called **INTERNAL LOADING**. Keeping lakes in balance when internal loading is high can be challenging.

## **ALUM TREATMENTS: NOT AN EASY OPTION**

Landowners in a lake’s watershed should do all they can to stop “feeding” the lake

excess phosphorus. But some lakes in Maine have chronic algal blooms, especially where internal loading of phosphorus is high. Alum treatments, where a mix of aluminum and other chemicals is released into the lake to trap phosphorus under a “blanket” on the lake bottom, are one option. However, alum treatments are complex and can cost millions of dollars. Even with assistance from agencies and research institutions, they can require significant fundraising on the part of lake residents. And while successful treatments can get up to 20 “bloom-free” years, the alum treatment will eventually have to be repeated unless sources of phosphorus into the lake are further reduced.

# ALGAE I.D.

When algae live in a healthy, balanced lake with a functional food web, the water remains blue and safe for swimmers. “Blooms” of algae due to excess phosphorus turn water green and smelly. They should be avoided. A good rule of thumb is to get out of the water if you are knee deep and the water is so murky that you can’t see your feet.



**METAPHYTON** are filamentous algae that typically appear in shallow areas, often resembling cotton candy. They tend to appear early but may persist throughout the summer. The size of the “pillows” can vary from a few inches to several feet. They are most commonly seen below the water, though sometimes they float on the surface. Local observations of metaphyton growth have increased over the last decade.



**CYANOBACTERIA**, also known as “blue-green algae”, seem to be on the rise in Maine lakes, probably due in part to warmer temperatures and longer growing seasons. Look for light green to bluish murky water as individual cells can be too small to see, often accompanied by a foul smell. Some cyanobacteria produce microcystin, which is highly toxic to humans, pets, and wildlife.



**GLOEOTRICHIA** is a colonial cyanobacteria that forms tiny spheres, which can be seen without magnification in lake water. Observed in late summer, “gloeo” blooms appear to be on the rise in lakes throughout much of New England. Blooms are also occurring earlier in the summer.

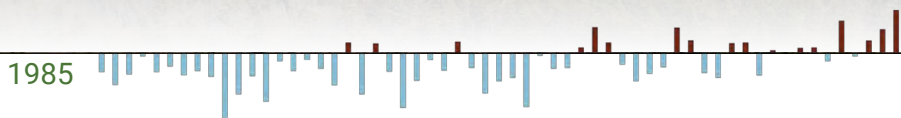
## **If you observe or suspect a bloom:**

Call the Maine Department of Environmental Protection (DEP) at (207) 287-3901 or (800) 452-1942. Ask to speak to the “on-call” person in the Division of Environmental Assessment. For a link to the DEP report form, visit [www.lakes.me/bloom](http://www.lakes.me/bloom).

For more information on apps to report blooms, see page 39.



Maine's southern interior has experienced persistent, above average annual air temperature since 1998. The line below represents a timeline from 1985 on the left to 2019 on the right, and the average annual air temperature. Each bar represents a year, and the height of the bar indicates degrees away from the average. Maroon bars indicate years with above average temperatures and blue bars represent years with below average temperatures. Note that there are more maroon bars as years progress from 1985 to 2019. (NOAA Climate Divisional Database).

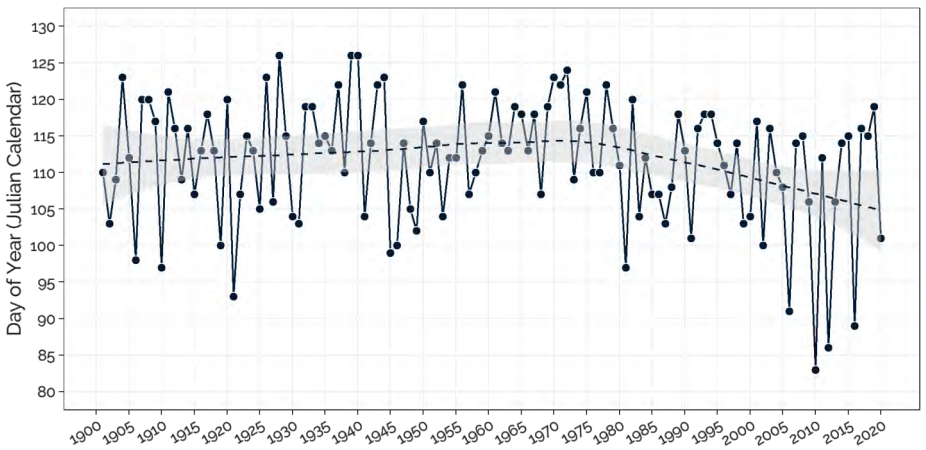
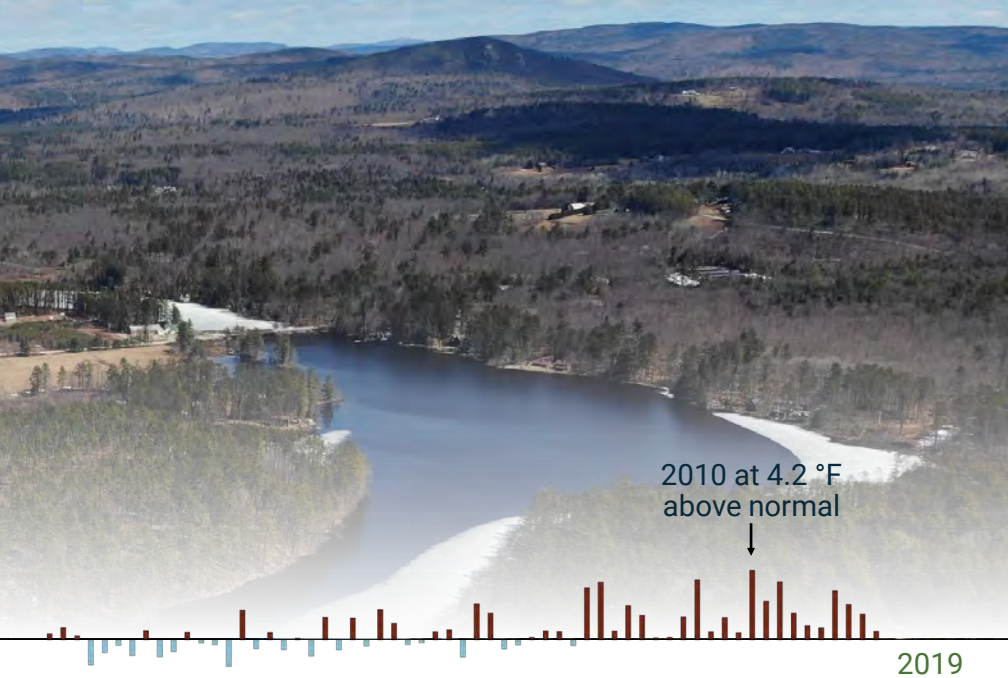


## LAKES AND CLIMATE CHANGE

Climate change is not a friend to Maine's lakes. Warmer air temperatures mean warmer waters, extending the growing season for aquatic plants and algae, increasing the severity of algal blooms, and giving invasive species more time to survive and spread. Warmer waters are also more hospitable for the explosive growth of HABs (see p. 20). Ice out dates are coming earlier in the spring, from one day earlier on Eagle Lake in northern Maine to three weeks earlier on Worthley Pond in western Maine (Maine's Climate Future 2020 Update). That means a longer growing season for algae and invasive plants. Increases in the intensity of storms are likely to cause more and bigger soil erosion events that dump phosphorus, sediments, and other pollutants into lakes. Periods of drought between those storms change soil structure, making them less stable and more likely to erode.

More resilient shorelines with deeper vegetative buffers and best management practices in place for erosion control will help mitigate the effects of climate change now and in the coming decades. For more information, check out Scientific Assessment of Climate Change and Its Effects in Maine [www.maine.gov/future/sites/maine.gov/future/files/inline-files/GOPIF\\_STS\\_REPORT\\_092320.pdf](http://www.maine.gov/future/sites/maine.gov/future/files/inline-files/GOPIF_STS_REPORT_092320.pdf).





Ice out dates generate much enthusiasm and interest. That's a good thing, because it means we have recorded ice out dates for many Maine lakes dating back more than 100 years. In the graph above from Kezar Lake in western Maine, earlier ice out dates are lower values. The dashed line shows the trend over time. Ice out on Kezar Lake has been occurring much earlier in the last few decades. Between 1901-2019, ice out has shifted earlier by 2.4 days (for more information, check out Kezar Lake Watershed Association's Climate Change page at [kezarwatershed.org/local-climate-trends](http://kezarwatershed.org/local-climate-trends)).

## MAINE'S LAKES NEED YOU!

As part of a vibrant community of lake enthusiasts, you have the power to change your behavior and take action to protect the health of Maine's lakes, for today and for future generations. Get started today with the ideas and resources listed in this chapter.

<b>BE LAKESMART</b> .....	<b>25</b>
Start a LakeSmart program on your lake.	
<b>BUILD BETTER BUFFERS</b> .....	<b>26</b>
Maintain a deep, natural buffer with native plants.	
<b>RETIRE THE LAWN MOWER</b> .....	<b>30</b>
Save time. Save money. Enjoy your lake!	
<b>MAINTAIN ROADS AND DRIVEWAYS</b> .....	<b>31</b>
Control and capture stormwater runoff.	
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Get your boat inspected. Become a volunteer monitor.	
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Use technology for citizen science.	
<b>BOAT LAKE FRIENDLY</b> .....	<b>40</b>
Watch your wake and boat responsibly.	
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## BE LAKESMART

One of the best ways to make sure your property is not a source of nonpoint source pollution to your lake is to make your property LakeSmart. LakeSmart properties have best management practices (BMPs) in place to protect the lake ecosystems by reducing erosion and providing fish and wildlife habitat. Maine Lakes oversees the program, which is non-regulatory and completely voluntary, and provides training and support for lake association volunteers who carry out the LakeSmart program in their communities.



*Presentation of a LakeSmart Award on Pushaw Lake in 2021.*

Participating landowners get a property visit from a trained community evaluator. The evaluator looks at structures, outdoor areas, driveways, paths, and shoreline buffers to identify any sources of erosion. They share their findings with homeowners and help identify steps to make the property more lake friendly.

Properties that meet evaluation standards earn a LakeSmart award, with signs for display along the road and waterfront. The signs let everyone know that the property owner cares about the lake and is doing the right things to keep it healthy.

**Want to know more?** Email [lakesmart@lakes.me](mailto:lakesmart@lakes.me) to learn how to start a LakeSmart program on your lake. Maine Lakes offers information sessions throughout the year to groups interested in learning more about how to protect their lake through the LakeSmart program. They also provide training, materials, and ongoing guidance and support to LakeSmart teams and volunteers.

**No lake association?** Recruit a team of volunteers from your lake to start one (see page 45)! Maine Lakes can help. Email [info@lakes.me](mailto:info@lakes.me) for more information.

Visit [lakesmart.org](http://lakesmart.org) to learn more.

# BUILD BETTER BUFFERS

A **SHORELINE BUFFER** ideally starts at the water's edge and extends 75' or more into the uplands. The best shoreline buffers are deep, wide, and continuous (with only a narrow path or other small break). They have many layers of vegetation, including tall trees (canopy), shorter trees (midstory), shrubs, perennials, and groundcover. A layer of duff (twigs, fallen leaves, and pine needles) accumulates on the ground in a buffer.

Vegetation in a buffer intercepts raindrops so less rain reaches the ground. The uneven duff layer absorbs rain, and loose soils filter out pollutants. Tree roots help anchor soil in place, and absorb water and nutrients. Buffers act like a sponge, soaking up rainfall, absorbing nutrients and runoff, and reducing the flow of stormwater into the lake.

But that's not all they do! They also provide habitat for insects, birds, small mammals, and believe it or not, even fish! Overhanging branches provide cover for fish that need safe, cool places to hide. Dropped leaves provide food for bugs and dropped limbs provide habitat structure. Ideally, shoreline buffers are composed of native vegetation, which is easier to maintain and better for wildlife.

A robust shoreline buffer





The best buffers have many layers of vegetation

It can be tempting to “limb up” trees in the buffer to increase lake views. Although you can trim the lower 1/3 of branches and remove dead limbs, consider removing less. Remember, each branch left on the tree enhances the integrity of the buffer and provides more habitat value for wildlife. Let the trees frame your view!

Buffers are the last line of defense for a lake against nonpoint source pollution and runoff coming from your property! You can make your buffer bigger and better by adding plants to fill in thin spots, a few at a time. In fact, you can plant up to 24 plants along the shore each year without a permit from the Maine Department of Environmental Protection. Let leaf litter accumulate in the buffer, and limit the use of fertilizers, pesticides and herbicides on your property. Note that pesticides and fertilizers are not allowed within 25’ of shore. With a healthy buffer, you are helping to ensure your view is of a clean, healthy, blue lake!

### **A THOUGHT ABOUT SHORELAND ZONING**

Shoreland Zoning regulations protect Maine’s lakes. However, the regulations are the *minimum* protection standards for the health of the lake. Consider doing *more* to protect the health of *your* lake.

And remember, always check with your local Code Enforcement Officer, as local ordinances might be more stringent than the State of Maine. For more information on Shoreland Zoning, see page 46.

# HARDY PLANTS FOR THE LAKESHORE

There are many resources available to find native species for your shoreline buffer (see page 11 for more information). On this and the following page are a few popular options to consider. For more information, visit [www.lakes.me/protect](http://www.lakes.me/protect) for a full planting guide and additional plants to consider.

## CANOPY TREES



**Northern Red Oak**  
*Quercus rubra*  
Full Sun  
Moderate to Dry Soil  
Wildlife Friendly

**Yellow Birch**  
*Betula alleghaniensis*  
Full to Partial Sun  
Moderate Soil  
Wildlife Friendly



## MIDSTORY



**Shadbush**  
*Amelanchier canadensis*  
Full to Partial Sun  
Moderate to Dry Soil  
Wildlife Friendly

**Witch-hazel**  
*Hamamelis virginiana*  
Full to Partial Sun  
Moderate Soil



**Black Chokeberry**  
*Aronia melanocarpa*  
Full to Partial Sun  
Moderate to Dry Soil  
Wildlife Friendly

**Northern Bayberry**  
*Myrica pennsylvanica*  
Full to Partial Sun  
Wet to Dry Soil



## SHRUBS



### Common Winterberry

*Ilex verticillata*

Full to Partial Sun

Moderate to Dry Soil

Wildlife Friendly



### Bog Rosemary

*Andromeda polifolia*

Full to

Partial Sun

Moderate to Wet Soil

### Redosier Dogwood

*Cornus sericea*

Full to Partial Sun

Moderate to Wet Soil

Wildlife Friendly



### Buttonbush

*Cephalanthus occidentalis*

Full to Partial Sun

Wet Soil

Wildlife Friendly



### Summersweet

*Clethra alnifolia*

Full to Partial Sun

Moderate to Wet Soil



### Highbush Blueberry

*Vaccinium corymbosum*

Sun to Shade

Wet to Dry Soil

Wildlife Friendly



## GROUNDCOVERS



### Lowbush blueberry

*Vaccinium angustifolium*

Full to Partial Sun

Moderate Soil

Wildlife Friendly



### Bearberry

*Arctostaphylos uva-ursi*

Full to Partial Sun

Dry Soil



## RETIRE THE MOWER

Maine's lakes evolved with forested shorelines, and the more we can promote these natural habitats, the better off your lake will be. We know that lakes like less lawn. And you should, too. There is so much to enjoy when you live near a lake. Go for a swim! Paddle your canoe! Take the kids on a boat ride! Don't spend time maintaining a landscape that provides no benefits to your lake.

While not a roof or a driveway, lawns essentially act like impervious surfaces. The shallow roots of cultivated turf grasses do little to absorb rain or hold soil in place to prevent erosion. Lawns provide no habitat and very little benefit to wildlife or pollinators. They also require lots of time, attention, money and gas.

You may want a lawn for recreation, where family and friends can gather, or over your leach field. Small lawns for these purposes can be managed to reduce the impact on lakes. If you choose to keep a lawn, follow these best management practices:

- ✓ Minimize the size of your lawn, especially near the water.
- ✓ Maintain vegetative buffers between the lawn and the lake to help capture stormwater runoff.
- ✓ After a lawn is established, it is unlikely to need regular fertilizer if you leave the grass cuttings in place.
- ✓ Set the mower blade to the highest setting to increase the lawn's ability to absorb water.
- ✓ Remember—NO fertilizer is allowed within 25' of water.

*A nicely sized and lake-friendly lawn with good vegetative buffers all around.*





# MAINTAIN ROADS & DRIVEWAYS

Poorly maintained camp roads and driveways are one of the largest sources of nutrient-laden sediment into our lakes. When stormwater flows over roads and driveways, it picks up speed and causes erosion. It's all about proper drainage—spread the stormwater out and slow it down!

Stormwater should spread out and flow in sheets off of a well-maintained driving surface into ditches and stable vegetation, where it slows down and can soak into the ground instead of run into the lake.

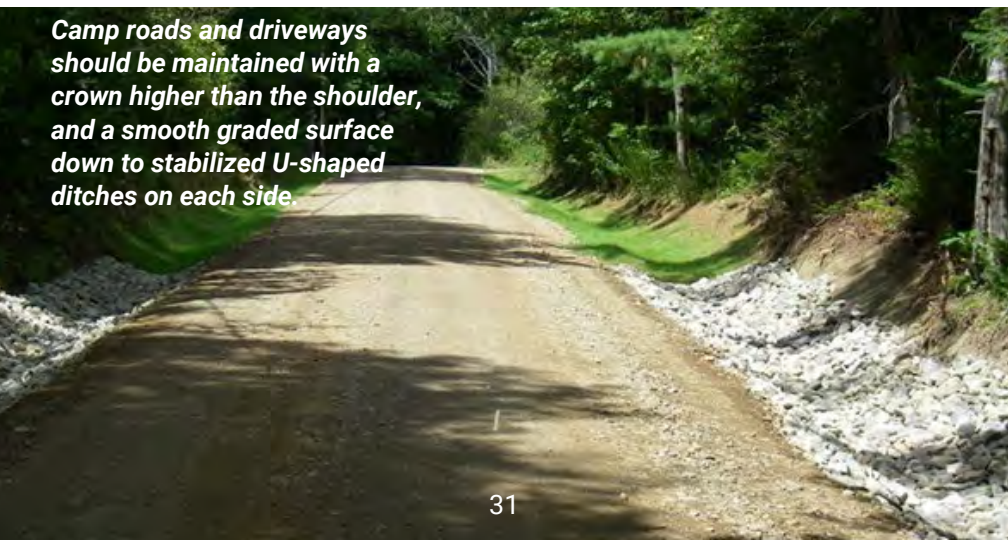
Employ these best management practices for driving surfaces:

- ✓ Maintain a crown in the center of the road so water flows to the edge, preventing ruts from forming down the length of the road.
- ✓ Stabilize ditches with vegetation or rock.
- ✓ Divert water into stable, vegetated areas using rubber razors, open-box culverts, broad dips, or turnouts (visit [lakes.me/BMPs](https://lakes.me/BMPs) FMI).
- ✓ Minimize use of winter salt so it doesn't end up in the lake.
- ✓ Remove berms along edges of roads/driveways created by winter plowing.



*A rubber razor on a well-maintained camp road helps divert rainfall into ditches and forested areas.*

***Camp roads and driveways should be maintained with a crown higher than the shoulder, and a smooth graded surface down to stabilized U-shaped ditches on each side.***



# STOP EROSION

Any time there is an impervious surface or bare soil, there is likely soil erosion that needs to be stopped, reduced and/or captured. There are many options to help manage erosion around structures and yards. For details on these and other ideas, including fact sheets,

**DRIPLINE TRENCHES** (right) are stone-filled trenches under the roof drip line that collect runoff from the roof, allowing it to soak into the ground. These systems also reduce wear on your house by reducing back splash on the foundation.



**RAIN BARRELS** capture rainwater from the roof by redirecting the downspout into the barrel. Save this water to use another day, while also reducing stormwater runoff.



A **RAIN GARDEN** is a depression in the ground planted with water-loving native perennials and shrubs. Water from a downspout or other source flows into the rain garden, where it slowly soaks into the ground. Rain gardens are beneficial for the lake, for wildlife, and for pollinators.



## TAKE A BREAK, RETIRE YOUR RAKE!

Don't rake the duff! This layer of decomposing leaves, pine needles, and other organic material acts as a sponge, absorbing rainfall, slowing runoff, and reducing erosion.

**FOCUS FOOT TRAFFIC** by defining pathways. When the ground is compacted by foot traffic, water doesn't soak in, but runs over the surface, carrying soil to the lake.



Planting vegetation on the downside of the paths and mulching the path will provide opportunities for runoff to disperse and soak into the ground. Additionally, by not walking in some areas, plants can re-establish and roots help hold soil in place.

**MEANDERING PATHS** from your house to the shore stop runoff from having a direct route to the lake. Ideally, paths should be no more than 3' wide. The walking surface should be covered with 3"–4" of crushed stone, wood chips, erosion control mix, or pine needles. This will define the path, guide foot traffic, and reduce soil compaction and erosion.

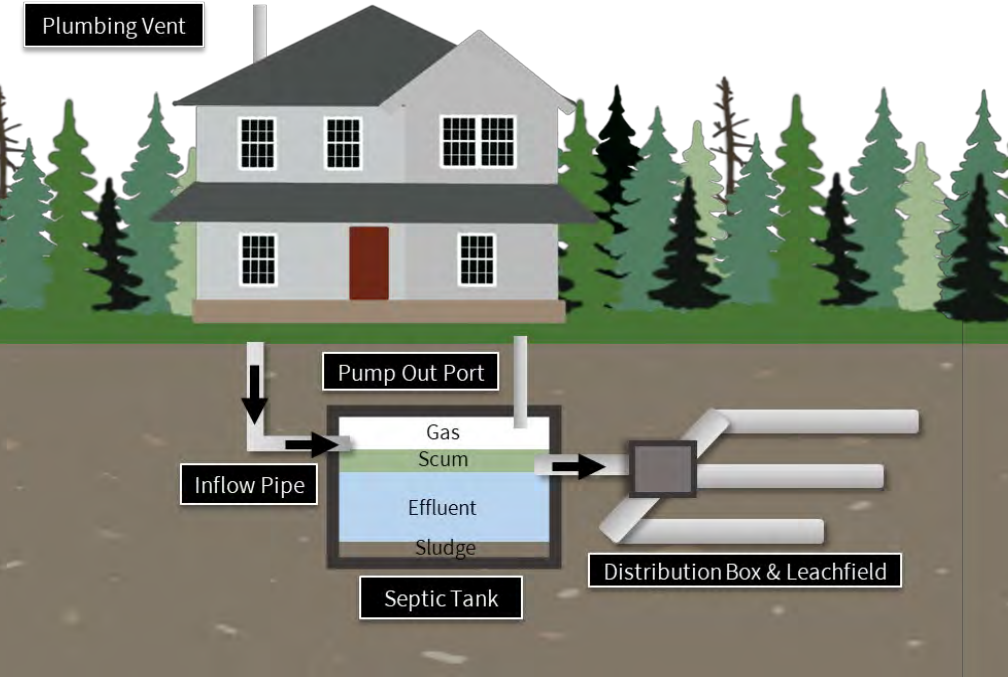


**INFILTRATION STEPS** are built with timbers and backfilled with crushed stone to slow runoff and allow water to soak into the ground. Existing steps can be retrofitted into infiltration steps.

### WORKING IN THE SHORELAND ZONE

Check with your local Code Enforcement Officer and Maine DEP if you plan to stabilize a shoreline, create a new path, or otherwise disturb the soil within 250' of your lake. Even if projects are planned with the intent of protecting the environment, contact the DEP and town to determine if a permit is needed. If you require a contractor, be sure to check the DEP's list of contractors who are certified to work in the Shoreland Zone: [www.maine.gov/dep/land/training/ccec.html](http://www.maine.gov/dep/land/training/ccec.html)

# CARE FOR SEPTIC SYSTEMS



Septic systems are underground wastewater treatment structures that keep you, your neighbors, and your lake safe from the chemicals, bacteria, viruses, and nutrients in your household waste. Your septic system replaces the sewer system more commonly used in urban areas. Septic systems generally have a lifespan of about 25 years, so systems built prior to plumbing code requirements (1974) are well beyond their typical functioning lifespan.

Maintaining your septic system is relatively easy and inexpensive, and will help your system work properly. Ignoring maintenance can lead to system failures, requiring costly replacement of the tank and/or leach field – up to \$20,000 or more. A failing system can let untreated waste seep into lakes, an unwanted additional source of phosphorus, as well as a health hazard for you and your family.

Maine's Shoreland Zoning laws require new septic systems be placed at least 100' from the water's edge, though the further back they can be the better. Many older camps have systems that are grandfathered and may be located much closer to the shoreline. To keep your lake clean, to protect your health, and to save money, make septic maintenance and care a priority at your lakeside home.

## HOW A SEPTIC SYSTEM WORKS

In systems designed after the Maine Plumbing Code was passed (1974), waste water flows from the house through an **INFLOW PIPE** to a **SEPTIC TANK**, where solids settle to the bottom (**SLUDGE**) and oil and grease rise to the top (**SCUM**). **GAS** may accumulate as the waste decomposes. The remaining **EFFLUENT** discharges slowly through the **DISTRIBUTION BOX** and into the **LEACHFIELD**, where it then percolates through the underlying gravel and soil, which filter out harmful bacteria, viruses, and nutrients before the water reaches the groundwater and flows back into the lake. Tanks have **PUMP OUT PORTS** that allow for periodic removal of sludge.

Some tips to care for your septic are listed below. Visit [lakes.me/septic](https://lakes.me/septic) for a brochure outlining these tips in more detail.

- ✓ Have your tank pumped and inspected every 2-3 years
- ✓ Conserve water to help prolong the life of the system
- ✓ Flush nothing but waste—no household chemicals, bleach, menstrual products, diapers, or wipes should ever go down the toilet
- ✓ Do not use a disposal, or wash grease or fat down the drain
- ✓ Ensure the septic system's capacity can support its current usage (visit [lakes.me/septic](https://lakes.me/septic) for table of tank sizes and capacities)
- ✓ Do not add commercial septic cleaning products. They kill the good bacteria needed for your septic system to function
- ✓ Keep deep rooted vegetation (trees and large shrubs) off of leachfields
- ✓ Divert storm drains, basement pumps, and runoff away from systems
- ✓ Keep cars and other heavy machinery off tanks and leachfields

### A NOTE ABOUT RENTAL PROPERTIES

Most people who rent Maine camps are not aware of the fragility of lakeside septic systems and may push systems beyond their capacity. This shortens the life of the system for the camp owner and threatens lake water quality for everyone. Let renters know about the septic system and its limits. Encourage renters to protect the lake (and your system) by minimizing water use. Be sure your rental capacity matches the capacity of your system and adjust your maintenance schedule accordingly. The EPA has resources to share with renters. Visit [lakes.me/septic](https://lakes.me/septic) to find EPA links and more.

# PREVENT SPREAD OF INVASIVES

Invasive plants threaten the aquatic biodiversity and health of Maine's lakes. Aggressive species such as Eurasian milfoil and fanwort alter ecosystems, jam up boat propellers, ruin swim areas and water ski routes, and decrease property values. These plants spread quickly even from small fragments to eventually infest large areas. They

## STOP INVASIVE SPECIES!

- ✓ **Remove** all plants from your boat (FMI, see next page!)
- ✓ **Drain** water from the motor, bilge, live wells, tanks, and gear.
- ✓ **Dry** your boat between outings.
- ✓ **Avoid** boating in areas where aquatic plants are dense.
- ✓ **Learn** more as an IPP volunteer!

consume the resources (nutrients, sunlight, space) on which native species depend. And once they are established, they are very difficult to remove. While stopping the spread of invasives in Maine by reducing transport to neighboring lakes is critical (see p. 38), it is also important to find any new infestations as early as possible.

Maine Lake Stewards' **INVASIVE PLANT PATROL** (IPP) program promotes prevention, early detection, and rapid response at the local level by providing training, educational materials, resources, and technical support to volunteers. Thousands of individuals have participated in IPP workshops, which offer training about how to recognize the invasive aquatic plants on Maine's "eleven most unwanted" list and how to distinguish these invaders from their native Maine look-alikes (For more information, visit [www.lakestewardsofmaine.org/ipp-resources/](http://www.lakestewardsofmaine.org/ipp-resources/)).



*IPP volunteers on the search for invasive plants.*

Though anyone interested in learning about aquatic invaders is welcome to participate in a Lake Stewards of Maine IPP workshop, those who wish to become active members of Maine's early detection team are encouraged to make a formal commitment to the statewide endeavor by becoming a Certified IPP Volunteer. To learn more, visit [www.lakestewardsofmaine.org/training-certification/](http://www.lakestewardsofmaine.org/training-certification/) or email [steward@lakestewardsofmaine.org](mailto:steward@lakestewardsofmaine.org).



### EURASIAN WATER-MILFOIL

*Myriophyllum spicatum*

Dense, submersed aquatic plant with long, abundantly branched, reddish or olive-green stems and finely feathered, divided leaves. Flowers June to September. Similar to many native water-milfoils. Current infestations in Cobbosee Lake, Grondin Pond, and Pleasant Hill Pond (2021).



### VARIABLE LEAF MILFOIL

*Myriophyllum heterophyllum*

Submersed bottle-brush appearing aquatic plant with sturdy reddish or green stems up to 4 m long. Leaves are green and finely feathered. Tiny flowers June to September. Current infestations in 22 lakes and ponds in southern and central Maine and one infestation Downeast on Big Lake (2021).



### EUROPEAN FROGBIT

*Hydrocharis morsus-ranae*

Small free-floating aquatic plant with stems up to 20 cm long. Small leathery kidney or heart-shaped green leaves, veined on top and dark purplish-red with spongy coating underneath. Flowers spring to fall, three white petals with a yellow center. Currently found only on Cobbossee Lake (2021).

If you suspect an invasive aquatic species has found its way into your lake, email a photograph showing the full plant (base to leaves and flowers/fruit, if applicable) along with your name, the name of the waterbody, and your phone number to [Milfoil@Maine.gov](mailto:Milfoil@Maine.gov). To find instructions on how to mail an invasive aquatic plant specimen to the Maine DEP, please see [maine.gov/dep/water/invasives/whatif.html](http://maine.gov/dep/water/invasives/whatif.html). Early detection can lead to higher likelihood of eradication.

# GET YOUR BOAT INSPECTED

**COURTESY BOAT INSPECTORS** are the first line of defense against invasive aquatic plants such as variable leaf water milfoil, Eurasian water milfoil, hydrilla, water chestnut and Brazilian elodea. These dedicated paid and volunteer staff work for lake associations and watershed organizations, funded in part by fees from the Lake and River Protection sticker required of all boat operators in Maine. New infestations of fast-growing invasives most often occur in shallow

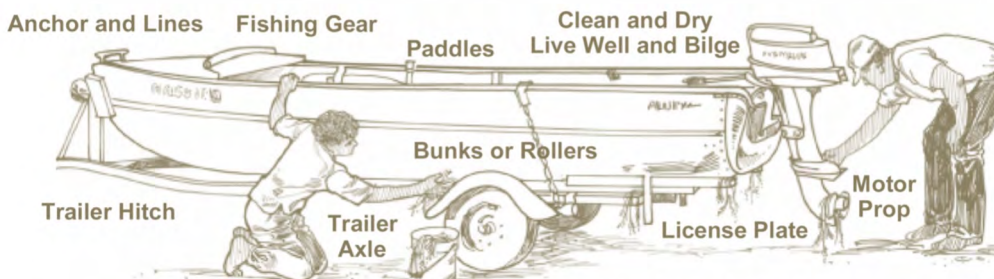


waters near public boat launch facilities, so we know they are moving from lake to lake on the boats and equipment of unsuspecting boaters. While transporting plant material on boats and trailers is illegal in Maine, we know from CBI experience that it still happens all too frequently.

Help CBI staff by proactively cleaning your boat, trailer, and gear to ensure that no plants, including small fragments or pieces, go into the lake. You can also do your part by following the tips below:

- ✓ Search all parts of your trailer and boat, including the key locations shown in the diagram below.
- ✓ Allow your boat to dry between launches, ideally for a week to kill microscopic larvae that might have escaped inspection.
- ✓ If you bring a boat in from out of state, buy and display your required Lake and River Protection Sticker to help support the CBI program and other invasive species prevention efforts.
- ✓ Join a CBI team! Email [info@mainelakes.org](mailto:info@mainelakes.org) to learn more.

**CLEAN** boat, trailer, and gear. **DRAIN** and let **DRY**.



*Funds from invasive species sticker sales protect native Maine plants, animals and habitat.*



# USE APPS! FIND LAKE DATA!

**BLOOM WATCH:** Local knowledge of when and where algal blooms are happening is key to finding out more about these unfortunate phenomena. Developed by EPA, the Bloom Watch App gives everyone with a smart phone the opportunity to report suspected blooms quickly, easily, and in real time. The app is easy to use and allows the observer to take pictures and report the location, date, and size of suspected blooms.



**SEEK:** An App created by National Geographic and the California Academy of Sciences, Seek uses the power of image recognition technology and a massive natural history database to identify the birds, amphibians, plants, and fungi all around you. Just take a picture of a plant or animal with your smartphone (or use a photo already on your camera roll) and you'll be amazed by the results!



## MAINE FIELD GUIDE TO AQUATIC PHENOMENA:

Lake Stewards of Maine has developed an app and a companion website ([maineaquaticfieldguide.org](http://maineaquaticfieldguide.org)) that lets you search for, and identify, a wide array of flora, fauna, and other lake phenomena. The app lets you search phenomena by type, including an "other" category that includes bryozoans, whale burps, foam, and slime.



**LAKES OF MAINE:** Lake Stewards of Maine maintains [lakesofmaine.org](http://lakesofmaine.org) as a clearinghouse for hundreds of datasets relating to Maine's lakes. You can search for lakes by name or town and look up data on water clarity, water chemistry, invertebrates, fish, loons, and much, much more. Search for your favorite lake today and learn something new!



Apps are available for free from Google Play and the Apple Store.

## BOAT LAKE FRIENDLY

Boating is a much-loved past time in Maine, and boating and boat-related expenditures contribute millions each year to state and local economies. Boating has been growing in popularity too, with more people than ever before accessing Maine's waters on canoes, kayaks, and motor boats. While boating rules focus primarily on safety, there are many that also help protect wildlife habitat and water quality.

Following the rules can help you enjoy your time on the water, while protecting the very lake resource you need to enjoy your boating experience. Some rules to keep in mind:

**HEADWAY SPEED IN WATER SAFETY ZONE:** No one may operate a watercraft at greater than headway speed within 200' of any shoreline of the mainland or of an island. This rule helps minimize wakes along shore that can erode shorelines and damage property. Even outside of the water safety zone, boaters must consider the effect of their wake to piers, floats, other property, and shorelines.

**CLEAN, DRAIN AND DRY YOUR BOAT:** While it is against the law to transport plant materials on your boat or trailer (see p. 38), no one wants to be the one who contaminates a lake with a new invasive species. Clean your boat and trailer, drain water from bilges and live wells, and let your boat dry after each trip.

**WILDLIFE HARRASSMENT:** Boating may be fun for people but it's not so fun for wildlife. Please be thoughtful and don't chase, molest, harass, drive, or herd wildlife with your boat. Such activities are prohibited by law.

**KNOW THE RULES:** Before operating boats on Maine's waters, be sure to read through the complete list of laws and responsibilities. They can be found at [maine.gov/ifw/docs/maine-boating-laws.pdf](https://maine.gov/ifw/docs/maine-boating-laws.pdf).



# LOOK OUT FOR LOONS

The common loon (*Gavia immer*) is one of Maine's most beloved birds. Its majestic black and white coloring and haunting calls are an iconic symbol of Maine. The number of adult loons in Maine has been increasing over the last 35 years, but biologists remain concerned about the long-term health of the population, as the number of chicks produced each year during that time has remained relatively flat. Lead poisoning from the ingestion of lead sinkers and lead-headed jigs and blunt trauma likely from boat strikes are the two leading causes of death for loons in Maine. It's up to us to improve their outlook:



*A pair of loons at their lakeside nest.*



*A loon parent feeding its offspring.*

- ✓ Fish with lead-free tackle. Visit [fishleadfree.org](http://fishleadfree.org).
- ✓ Host a lead-free tackle exchange in your community. Email [info@lakes.me](mailto:info@lakes.me) for more information.
- ✓ Join Maine Audubon's Annual Loon Count on the third Saturday in July to tally up how many loons are on your lake. Visit [maineaudubon.org/loons](http://maineaudubon.org/loons).
- ✓ Stay away from loon nests so you don't drive parents away, exposing eggs to predators or the elements.
- ✓ Use headway speed for boats near the shore as waves can wash eggs out of shoreline nests.
- ✓ Monitor nesting rafts as part of an oil spill recovery project looking to increase loon productivity in Maine. Email [info@lakes.me](mailto:info@lakes.me).

## CONCERNS?

Incidents involving loon harassment or entanglement in fishing line can be reported to the Maine Warden Service. Contact the dispatch center nearest you:

**Augusta** 1-800-452-4664

**Bangor** 1-800-432-7381

**Houlton** 1-800-924-2261

# MONITOR WATER QUALITY

Local volunteers in communities throughout the state are helping scientists gather long-term water quality monitoring data this is used to assess the health of our lakes. Gathering accurate data helps us document changes over time and identify ways to address problems and issues. See a sample of the most important water quality data collected by volunteers on the next page.

## WANT TO BECOME A WATER QUALITY MONITOR?

Lake Stewards of Maine (LSM) trains and certifies volunteers to collect water quality data. Each volunteer participates in an initial training workshop and is then re-certified on a regular basis in following years. Most volunteers collect Secchi disk data from spring to fall. Data are reviewed, then passed onto the Maine DEP. Water quality data can be viewed on the Lakes of Maine website at [lakesofmaine.org](http://lakesofmaine.org).

Some volunteers are also trained and certified to collect other types of water quality information, including temperature, dissolved oxygen, phosphorus and chlorophyll *a*. Volunteers can also be trained to monitor other important physical, chemical, and biological characteristics of lakes.

## More Information About Volunteer Water Quality Monitors:

- ✓ Volunteers attend a half-day orientation to learn more, then a training and certification workshop with LSM staff and volunteers before collecting and submitting data.
- ✓ Workshops are offered in the spring through early summer. Check the date, time, and location of upcoming training workshops at [lakestewardsofmaine.org](http://lakestewardsofmaine.org).
- ✓ LSM provides volunteers a Secchi disk with calibrated tape and a viewing scope. Volunteers are expected to maintain the equipment and to return it to the LSM if they leave the program.
- ✓ Volunteers should plan on taking Secchi disk transparency readings every two weeks from May through September and be able to make a multiple-year commitment to monitoring.
- ✓ Some lakes have more volunteers than they need. You can sign up to be an “alternate” monitor if a primary monitor is already signed up on your lake, or sign up for a lake that is need of a volunteer.
- ✓ To proceed with certification, contact LSM staff at [stewards@lakestewardsmaine.org](mailto:stewards@lakestewardsmaine.org).

Learn more at [www.lakestewardsofmaine.org](http://www.lakestewardsofmaine.org).

**SECCHI DISK TRANSPARENCY:** A measure of water transparency. Obtained by lowering a black and white disk into the water until it is no longer visible. This is an excellent measure of water clarity variation over time.

**DISSOLVED OXYGEN & TEMPERATURE PROFILES:** Obtained by lowering a sensor into the water and collecting readings at each meter from the surface to the bottom (see examples of these profiles on pp. 6-7 ). Provides valuable information on the heat stress and availability of oxygen for animal life.

**TOTAL PHOSPHORUS:** The concentration of the element phosphorous (in all its chemical forms) found in water. Excess phosphorus can lead to increased plant and algae growth in lakes.

**CHLOROPHYLL a:** The principal form of chlorophyll found in green plants and algae. It is used as an estimate of algal biomass; higher chlorophyll a means more algae in the lake.

*Water quality monitors learn how to use a scope and Secchi disk to measure water clarity.*



# BE A LAKE ADVOCATE

We are lucky in Maine to have strong lake protection laws that work to protect our lakes. Model laws like Shoreland Zoning and the Maine Natural Resources Protection Act (see pp. 46-47) have set high standards to protect lake water quality. And local ordinances can be even more protective.

However, we can never sit back and relax about lake protection. Every year there are bills aimed to weaken lake protections. We need lake advocates like you to stand up for our lakes!

Your voice matters! And it has never been easier to reach out to your legislator. Find your legislators contact information at

[legislature.maine.gov](http://legislature.maine.gov). Send them an email or give them a call. Let them know how much you value the quality of Maine's lakes and that you want them to work to keep lakes clean and healthy long into the future.

To hear about lake bills during the legislative session and learn more about easy actions you can take, join the Maine Lakes grassroots advocacy team by emailing [info@lakes.me](mailto:info@lakes.me). You'll receive messages only when your voice is most urgently needed for bills targeting issues of vital importance to Maine's

lakes. Recent grassroots activists have spoken up for septic regulations, increased funding for lake education programming, stronger invasive species laws, and strong shoreland zoning. Please consider speaking up for Maine's lakes!



## A VERY SHORT LEGISLATIVE PRIMER

Maine's 35 Senators and 151 Representatives are elected every other (even) year. Each legislature has two sessions. The first one starts right after elections and is a longer session (running until late spring or early summer) that is open to any new bills. The second session starts in January of the following year and is usually adjourned by early spring. This session is restricted primarily to "emergency" and carry over bills.

To look up your senator or representative, current bills, or learn more, go to [legislature.maine.gov](http://legislature.maine.gov).

# START A LAKE ASSOCIATION

## LAKE ASSOCIATIONS ARE KEY TO HEALTHY LAKES

Lake associations are the most powerful tool for keeping lakes healthy. Lake associations bring people together so they can work to protect lake health, property values and the recreational and community benefits that lakes provide. Individually, it can be difficult to inspire others to be good stewards or to influence town officials so they work to prevent water quality degradation or to fund lake protection. But a group of people united in a mission to preserve the lake they love can be a welcomed force ensuring future lake health.

Some lake associations form to address a problem like invasive aquatic plants or a crumbling dam, and that is a good thing. On the other hand, it is easier and a lot less expensive to protect the health and beauty of a lake before problems become established. So, if your lake doesn't have an association, start one now!

Great lake associations are as varied as the lakes and people that live around them. There is no one right way to be great, although Maine has dozens of outstanding models of how to get the job done.

These civic-minded, generous groups help their lakes by:

- ✓ Creating a community that values the lake and has fun together
- ✓ Making connections with all who visit or use the lake
- ✓ Demonstrating ways to protect water quality and wildlife
- ✓ Monitoring lake health
- ✓ Defending against invasive aquatic plants and animals
- ✓ Protecting property values and helping local businesses
- ✓ Rolling out LakeSmart programs for lake residents

Maine Lakes can help you get started with an association today. Visit [lakes.me/association](https://lakes.me/association) for resources that includes a 12-step guide to getting started, sample by-laws, resources for incorporating as a non-profit, and fundraising ideas. Need more? Email [info@lakes.me](mailto:info@lakes.me).

# LAWS THAT PROTECT LAKES

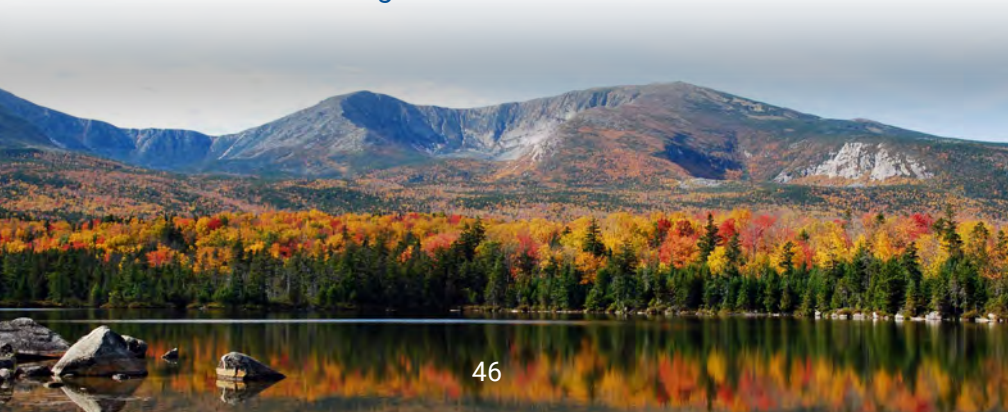
While Maine has strong lake protection rules, they are not always simple or easy to find. Whenever you have a question about the legalities of shoreland activities, always check in with your town's Code Enforcement Officer (CEO) to see if your town has stricter ordinances than the minimum set by the state. In unorganized territories, check with the Land Use Planning Commission, the authority responsible for zoning standards and issuing permits. It is always better to err on the side of caution. Fines for illegal activity are steep, and harm done to a lake may be irreversible.

## MINIMUM SHORELAND ZONE REGULATIONS

Municipalities in Maine are required to create and administer local shoreland zoning ordinances that meet or exceed the minimum standards set by the state. Shoreland Zoning (SZ) regulates activities within 250' of the shoreline and establishes minimum lot sizes and setbacks. A few key minimums set by the state (but always check your local ordinance for more restrictive standards):

- ✓ New buildings/septic systems must be set back 100' from shore.
- ✓ Clearing of vegetation within 75' of shore prohibited in areas zoned for resource protection. Review town maps to locate resource protection zones.
- ✓ In other shoreland zones, vegetation removal is limited based on volume within a period of time. Consult a forester familiar with SZ rules before proceeding with any tree removal.
- ✓ Paths must be winding and no more than 6' wide.

Visit [maine.gov/dep/land/slz/#rule](https://maine.gov/dep/land/slz/#rule) to learn more and see if your town has an ordinance that exceeds minimum protection standards. For a Shoreland Zoning Handbook (dated but comprehensive), visit [lakes.me/shoreland-zoning](https://lakes.me/shoreland-zoning).





## NATURAL RESOURCES PROTECTION ACT (NRPA)

The Natural Resources Protection Act requires a permit from the Department of Environmental Protection (DEP) for projects located in, on, over, and adjacent to protected natural resources, including great ponds (natural lakes larger than 10 acres or 30 acres if impounded by a dam) and freshwater wetlands. Activities in or within 75' of a waterbody or wetland that require a permit include removing or displacing soil, sand, vegetation, or other materials; constructing, altering, or repairing a permanent structure; and filling, dredging, or bulldozing. Two types of NRPA permits include:

**PERMIT BY RULE (PBR):** This permit gives approval for 18 activities that have limited impact and low risk of harm to lakes. The DEP regularly reviews this list so check their website ([maine.gov/dep/land/nrpa/ip-pbr.html](http://maine.gov/dep/land/nrpa/ip-pbr.html)) for updates. The activities now include such things as shoreline stabilization and movement of rocks or vegetation along a shoreline. Applications must be filed prior to beginning work on the activity and agree to follow prescribed standards. The current application fee is \$250, though permit fees may be waived for certain activities. Check with your local DEP office for more information.

**FULL NRPA PERMIT:** A full NRPA permit is required when activities proposed do not qualify under PBR standards, for example, dredging of a channel in a lake or installing a private boat launch ramp. These types of projects generally require review by staff from several state agencies and take longer to process. Among other things, each full NRPA Permit requires that the activity will not cause unreasonable erosion or lower water quality. Visit [maine.gov/dep/land/nrpa/](http://maine.gov/dep/land/nrpa/) for more details.

### NRPA CONTACTS:

For permit questions, or if you need a field determination, call one of the following numbers, and ask to speak with the "on-call" person for the NRPA program.

Augusta: (207) 287-7688 or (800) 452-1942

Bangor: (207) 941-4570 or (888) 769-1137

Portland: (207) 822-6300 or (888) 769-1036

Presque Isle: (207) 764-0477 or (888) 769-1053

### LAND USE PLANNING CONTACTS:

For a map of districts and regional office staff, visit [www.maine.gov/dacf/lupc/index.shtml](http://www.maine.gov/dacf/lupc/index.shtml)

# STATE AND OTHER ENTITIES

Visit [lakes.me/lakebook](https://lakes.me/lakebook) for clickable links to the webpages listed here.

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## DEPARTMENT OF ENVIRONMENTAL PROTECTION

The Maine DEP oversees water quality monitoring, manages blooms, monitors lake and river toxins and pollution, supports invasive aquatic plant programs, and provides outreach materials on a wide variety of lake and water topics. They offer technical expertise on shoreland zoning, stormwater management, septic system permits, watershed planning, and much more. Some helpful links include:



Lake Assessment Program

[www.maine.gov/dep/water/lakes/index.html](https://www.maine.gov/dep/water/lakes/index.html)

Invasive Aquatic Species Program

[www.maine.gov/dep/water/invasives/index.html](https://www.maine.gov/dep/water/invasives/index.html)

Nonpoint Source Water Pollution Grant Program

[www.maine.gov/dep/water/grants/319.html](https://www.maine.gov/dep/water/grants/319.html)

Water Program Areas

[www.maine.gov/dep/water/programs/index.html](https://www.maine.gov/dep/water/programs/index.html)

Lake Contacts

[www.maine.gov/dep/water/lakes/contact.html](https://www.maine.gov/dep/water/lakes/contact.html)

Water Pollution Prevention Publications

[www.maine.gov/dep/land/watershed/materials.html](https://www.maine.gov/dep/land/watershed/materials.html)

Shoreland Zoning Information and Contacts

[www.maine.gov/dep/land/slz/index.html](https://www.maine.gov/dep/land/slz/index.html)

Maine Shoreland Zoning Handbook

[www.lakes.me/library](https://www.lakes.me/library)

To find certified erosion control contractors:

[www.maine.gov/dep/land/training/cccec.html](https://www.maine.gov/dep/land/training/cccec.html)

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## SOIL AND WATER CONSERVATION DISTRICTS

There are 16 SWCDs around the state that work to provide technical expertise for landowners. Several host LakeSmart programs and many offer technical assistance to homeowners. For a map of SWCDs and their contact information, visit the Lake Resources Map at [lakes.me/map](https://lakes.me/map).

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## INLAND FISHERIES AND WILDLIFE

IFW oversees boating and fishing laws on inland waters, as well as the Lake and River Protection Sticker program for boat registrations that provides funding for invasive species management.



Boating Handbook (includes watercraft restrictions): [www.maine.gov/ifw/docs/maine-boating-laws.pdf](http://www.maine.gov/ifw/docs/maine-boating-laws.pdf)

Fishing Handbook: [www.maine.gov/ifw/fishing-boating/fishing/laws-rules/index.html](http://www.maine.gov/ifw/fishing-boating/fishing/laws-rules/index.html)

Fish Consumption Advisories: [www.maine.gov/ifw/fishing-boating/fishing/laws-rules/consumption-advisory.html](http://www.maine.gov/ifw/fishing-boating/fishing/laws-rules/consumption-advisory.html)

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## AGRICULTURE, CONSERVATION AND FORESTRY

ACF, along with IFW, maintains many of Maine's public boat launches and provides both lists and Google Earth maps of boat launches for the state.



Public boat launches: [www.maine.gov/dacf/parks/water\\_activities/boating/public\\_boat\\_launches/index.shtml](http://www.maine.gov/dacf/parks/water_activities/boating/public_boat_launches/index.shtml)

Boating resources: [www.maine.gov/dacf/parks/water\\_activities/boating/resources.shtml](http://www.maine.gov/dacf/parks/water_activities/boating/resources.shtml)

Boating opportunities: [www.maine.gov/dacf/parks/water\\_activities/boating/index.shtml](http://www.maine.gov/dacf/parks/water_activities/boating/index.shtml)

Paddling opportunities: [www.maine.gov/dacf/parks/water\\_activities/paddling.shtml](http://www.maine.gov/dacf/parks/water_activities/paddling.shtml)

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## PORTLAND WATER DISTRICT

PWD ([www.pwd.org](http://www.pwd.org)) provides technical assistance on Shoreland Zoning, the Natural Resources Protection Act, and erosion and sedimentation control to property owners who live around Sebago Lake. PWD also permits and inspects all septic systems within 200' of Sebago Lake. Call (207) 774-5961 to reach a Water Resources Specialist in Naples, Casco, Windham, Standish, Sebago, Raymond, or Frye Island.



Portland  
Water  
District

# REGIONAL AND STATE-WIDE LAKE ORGANIZATIONS

## 30 Mile River Watershed Association

[info@30mileriver.org](mailto:info@30mileriver.org)  
[www.30mileriver.org](http://www.30mileriver.org)  
(207) 860-4043

1

A public-private collaboration of towns, lake associations and land trusts in central Maine, 30 Mile works as a community to keep the 22 lakes, ponds and streams in the watershed clean and healthy. 30 Mile hosts a Youth Conservation Corps, is a regional hub for LakeSmart, monitors water quality, provides technical assistance for road associations and municipalities, and works to monitor and manage invasive aquatic plants.

## Friends of the Cobbossee Watershed

[mail@watershedfriends.com](mailto:mail@watershedfriends.com)  
[www.watershedfriends.com](http://www.watershedfriends.com)  
(207) 395-5239

2

Based in Winthrop and covering the 28 lakes in the Cobbossee watershed, FOCW protects waters through education and conservation action. FOCW helps residents "Slow the Flow" and become LakeSmart, hosts summer programming for kids and adults, and works diligently to stop the spread of invasive species.

## Coastal Rivers Conservation Trust

[info@coastalrivers.org](mailto:info@coastalrivers.org)  
[www.coastalrivers.org](http://www.coastalrivers.org)  
(207) 563-1393

3

Covering the Damariscotta River and Pemaquid region, CRCT is a regional land trust that protects vital shorelands and coastline, acts as a LakeSmart hub and works to promote water quality and engage the public in outdoor programming.

## 7 Lakes Alliance

[info@7lakesalliance.org](mailto:info@7lakesalliance.org)  
[www.7lakesalliance.org](http://www.7lakesalliance.org)  
(207) 495-6039

4

7 Lakes Alliance, a regional non-profit, works in public-private partnerships to conserve the Belgrade Lakes region for all. They collaborate with Colby College and citizens to monitor and research water quality that drives protection and restoration; manage and prevent invasive aquatic plants; prevent erosion through watershed planning, YCC, and LakeSmart; conserve land and connect people with nature.

## Midcoast Conservancy

[info@midcoastconservancy.org](mailto:info@midcoastconservancy.org)  
[www.midcoastconservancy.org](http://www.midcoastconservancy.org)  
(207) 389-5150

5

Midcoast Conservancy is an innovative conservation organization that protects and restores vital lands and waters on a scale that matters in the Sheepscot River, Damariscotta Lake and Medomak River watersheds. They manage LakeSmart programming, water quality monitoring, invasive plant efforts, and host a wide range of

## Lake Stewards of Maine

[stewards@lakestewardsmaine.org](mailto:stewards@lakestewardsmaine.org)  
[www.lakestewardsofmaine.org](http://www.lakestewardsofmaine.org)  
(207) 783-7733

6

A statewide nonprofit protecting lakes and promoting stewardship through widespread citizen participation in the gathering and dissemination of credible scientific information about lake health. LSM trains, certifies and supports hundreds of volunteers who monitor a wide range of indicators of water quality, assess watershed health and function, and screen lakes for invasive aquatic plants and animals.

## Maine Lakes

[info@lakes.me](mailto:info@lakes.me)

[www.lakes.me](http://www.lakes.me)

(207) 495-2301

7

A statewide nonprofit that works to keep Maine's lakes healthy by managing the LakeSmart program, supporting local lake associations, promoting freshwater education initiatives, advocating for sound lake policies, and providing resources and a "lake library" for lake residents and visitors.

## Lakes Environmental Association

[info@mainelakes.org](mailto:info@mainelakes.org)

[www.mainelakes.org](http://www.mainelakes.org)

(207) 647-8580

A multi-lake association based in the upper Sebago Lake region, LEA works to protect water quality on 41 lakes and ponds in western Maine. LEA runs the statewide Courtesy Boat Inspection program, hosts the annual Milfoil Summit, and runs the Maine Lake Science Center. They offer technical services to lakefront landowners, municipalities and are a LakeSmart Hub.

8

## China Region Lakes Alliance

[info@crlamaine.org](mailto:info@crlamaine.org)

[www.crlamaine.org](http://www.crlamaine.org)

(207) 200-8361

CRLA is a nonprofit organization composed of the China Lake Association, the Three Mile Pond and Webber Pond Associations, the Towns of China and Vassalboro, along with the interests of the Three-Cornered Pond Owners Association. CRLA operates Courtesy Boat Inspections, LakeSmart, a Youth Conservation Corps, and a Gravel Road Rehabilitation Program.

10

## Acton Wakefield Watershed Alliance

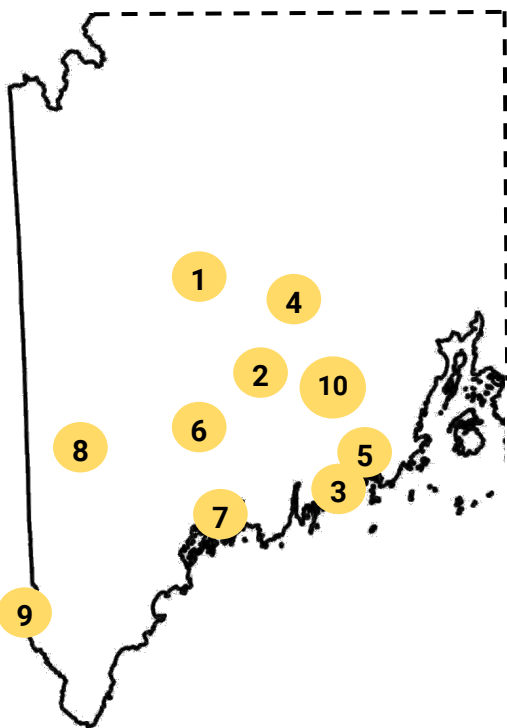
[info@awwatersheds.org](mailto:info@awwatersheds.org)

[www.awwatersheds.org](http://www.awwatersheds.org)

(603) 473-2500

AWWA protects and restores the water quality of lakes, ponds, rivers and streams surrounding Wakefield, NH and Acton, ME. They coordinate pollution control projects, manage Youth Conservation Corps erosion control projects, deliver school programming and community education, support water quality monitoring, and act as a resource for lake associations and town boards.

9



## Local Lake Associations

Maine has more than 120 local lake associations that work on the front lines of lake conservation. To find an association, including contact information and websites, visit the Lake Resource Map at [lakes.me/map](http://lakes.me/map)

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