

SECTION 4.0. LAKES AND PONDS AND STILLWATERS

THIS SECTION CONTAINS:

- Definitions of lakes, bogs, fens, marshes, ponds, and swamps
- The importance of wetlands
- Habitat change and problems
- A quiz to test your knowledge

Introduction

Lakes, ponds, and stillwaters (small bodies of water with shallow bottoms where rooted plants are able to grow around the edges) provide habitats for many species of fish and wildlife. These productive areas can dramatically improve the habitat of streams and rivers that flow out of them. After looking at ponds and lakes we will discuss briefly the different kinds of stillwater habitats including bogs, fens, marshes, and swamps.

Remember that water systems are interconnected. Something done in or near a river can affect the lake it flows into. What's done in or near a lake or marsh can affect the stream flowing out of it.

4.1. Lakes

The previous section talked about streams. Streams are basically a flow-through pattern where productivity depends on the plant material that is the basis of the food chain. Lakes and ponds are relatively quiet water by nature. While some of the plant nutrients in a lake will gradually move downstream, a larger portion will circulate in food chains within the lake itself. The species that live in the lake or pond are dependent on the overall balance of nutrients cycling from organic material, seasonal temperatures, amount of available oxygen, and light.

Trout and land-locked salmon prefer cool water with a good oxygen supply so they do well in nutrient-poor lakes.

In lakes with more nutrients their habitats are lost because they can't find cool water with oxygen.

Other species such as white sucker, smallmouth bass, white and yellow perch thrive in nutrient-rich lakes because they prefer warmer surface waters.

In the spring, a lake is the same temperature top to bottom (approx. 4°C). At this temperature, water is at its heaviest. As the summer progresses, the surface water warms and becomes lighter than the cooler bottom water. This prevents further mixing. Plants quickly use up nutrients in the surface water. Plant growth continues in the warm surface water until the phosphorus it requires runs out. As plants die, they sink to the bottom and decay. The cooler bottom water is rich in nutrients, which do not mix with the surface water because of the difference in densities. The warmth of surface water is affected by the heat of the summer and the amount of plant material growing at or near the surface.

Generally lakes in Nova Scotia, shallower than 3m if the water is tea-coloured, and 6m if it is colorless, become too warm in the summer for salmonid production. Lakes deeper than 3m for tea-coloured water and 6m for clear water, keep enough cool water in the bottom for the

salmonids. If the input of organic materials or nutrients to the lake are high, there is the risk that oxygen will become depleted in the cool water and the fish will have to leave. This has become a serious problem in Nova Scotia. Additional organic loading has come from the streams draining into the lakes. If a stream has good physical structure with un-embedded substrates the leaf fall is captured in the interstitial spaces and pools. These organics are processed by the bacteria and insects in the stream and cycle through the stream's food web. As the stream structure has collapsed, the organics the stream used to process now collect in lake bottom to decay and further deplete the oxygen. Increased nutrient runoff from the land due to poor forestry and farming practices and all urban development have place additional loads on the lakes robbing the bottom waters of vital oxygen. Best management practices can prevent the problems but this requires a lot of public education and awareness to change day-to-day practices and changes in the way we design housing developments.

In the fall, surface water cools, becoming denser. Eventually it becomes the same density or heavier than the bottom water and the waters change places. This is called **fall turnover** when nutrients are once again cycled to the top.

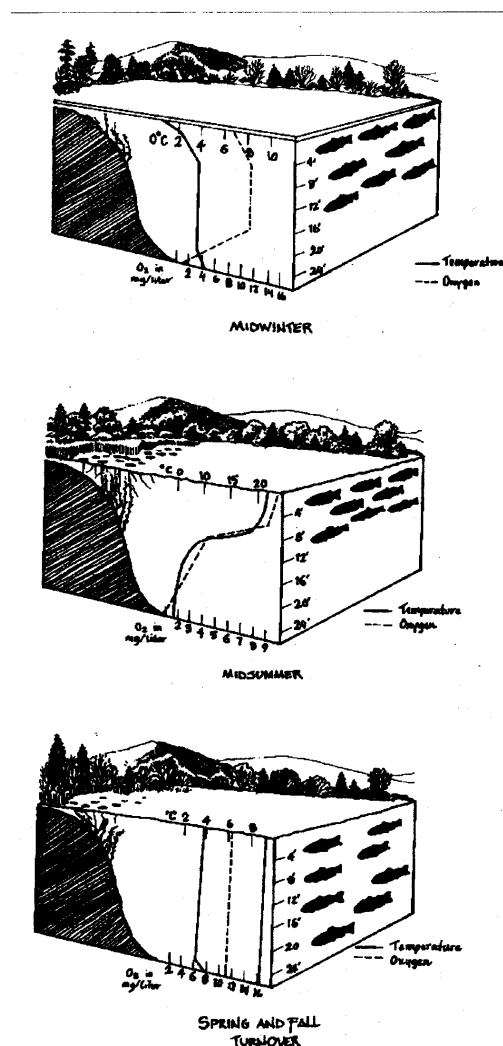
As winter progresses, surface water cools below 4°C. and becomes lighter than the bottom water.

Trout and salmon prefer this warmer bottom water in the winter. However, again decaying material on the bottom often uses up oxygen and fish kills frequently occur under the winter ice because of lack of oxygen.

If a lake or stream requires lime because of low levels of pH, lime is sometimes spread on the ice and mixes with the lake water when the lake turns over. Generally, winter liming must be done annually to maintain its effect. The pH in our lakes often increases with depth, so be sure to do a pH profile of the water column before deciding on the acidity of the lake.

As the lake warms in the spring, the cycle repeats itself. This turnover is illustrated in the figure to the right.

Lakes can be divided into three categories depending on how many nutrients they have cycling through their systems. The amount of nutrients affects a lake's temperature, oxygen



levels, and light supply.

1. **A nutrient-poor lake (oligotrophic)** is a lake that is poorly fed, has little phytoplankton (small microscopic plants) or algae growth. It is usually the coolest lake with depths where aquatic plants can't root, and fewer productive shallow areas. Low nutrient lakes have little build-up of decaying organic material on the bottom so the oxygen isn't used up. These are ideal for land-locked salmon and all trout species.
2. **A moderately nutrient-rich lake (mesotrophic)** is moderately fed and moderately cool. Such lakes are often too warm at the surface for salmonids. Their survival in these lakes depends on how much oxygen remains in the cooler bottom water. Warmer water species such as yellow perch and smallmouth bass can be found in these lakes.
3. **A nutrient-rich or well-fed (eutrophic) lake** is the warmest. Such lakes have very little oxygen in the cool bottom water and usually you can only find warm water species of fish. Or a few salmon and trout along the bottom of the warm water where there is still enough oxygen. The more phytoplankton a lake has the quicker it warms up since the water is darker and absorbs more of the sun's heat.

As the amount of plant material increases and water temperature warms up, the amount of available oxygen decreases. Warm water cannot dissolve as much oxygen as cold water.

The clearness or clarity of the water also affects how much light can reach plants. Light doesn't travel through silty, muddy lakes as well as it does through clean, clear water. Plant production influences insect production, which in turn affects fish populations. All of these factors are delicately linked and a small change can create changes in many areas.

As lakes age, they naturally collect more and more nutrients and organic materials. This is a natural process that takes place over time (tens of thousands of years). Human activities in the watershed (industrial, commercial, residential development, agriculture, forestry) often cause siltation and release of excess chemicals and/or nutrients (fertilizers, pesticides, road salt, hydrocarbons, household and industrial detergents, sewage and manure). As a lake builds up more plant material, it warms up and loses oxygen in the bottom water. This causes a shift in the kind of fish you would find. Trout and salmon may disappear; with a shift to fish that prefer warmer water.

There are basically four types of habitats in lakes of Nova Scotia:

1. **Sandy, Sheltered Shores:** People prefer sandy shores but these are the least productive areas ecologically. The sand is constantly shifting, making it difficult for plants to grow; creating a weak food web.
2. **Exposed Shores:** The wave action here keeps the bottom clean of silt and sand so food chains are similar to streams. You can find some of the same stream insects

(caddisfly, mayfly) on the rocks along exposed shores.

3. Profundal Zone (Littoral zone): The area around the edge of the lake where light reaches the bottom; includes sheltered and exposed shores. In areas where many plants are produced, many insects form the basis of a food chain. Small minnows or lake chub are often seen in groups but this area can also be feeding grounds for trout. Landlocked salmon, trout, and bass will feed here, often at dusk when they can use the low light conditions and plants for cover.

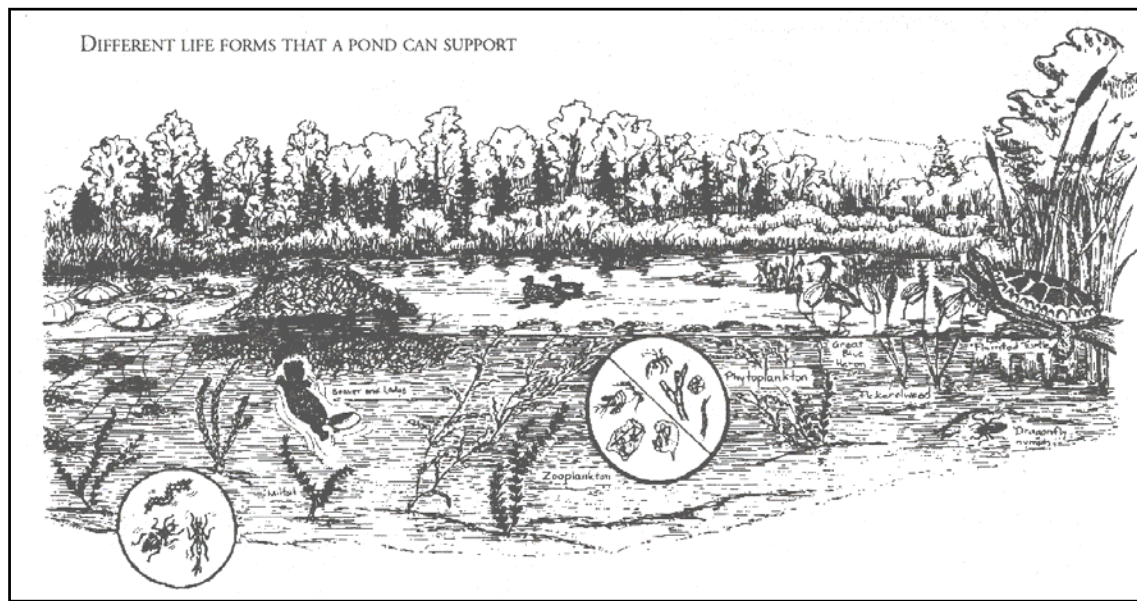
4. Open Water: The open water habitat of the lake was basically described earlier at the beginning of this section when we talked about lake temperatures at different times of the year. The open part of a lake is less productive than the littoral zone.

4.2. Ponds

Ponds are generally formed by depressions in the bedrock or soil, but are sometimes formed from sinkholes in areas where bedrock or substrates are composed of gypsum or limestone. Landslides, floods, or beaver activity also create ponds. Man-made ponds for fishing and fire control are also common around the province.

Ponds are really little lakes. The major difference is that they are smaller and shallower. Light reaches much of the pond bottom, allowing a wide diversity of rooted plants and algae to flourish. The numbers of fish, insects, and other animals found in ponds depend on how easily they can move to other water areas. Ponds are a rich food source for fish, but in many cases summer warming, winter freezing, and low oxygen levels limit year-round usefulness for sport fish. However, if ponds are fed by groundwater and there is not too much plant growth (taking up valuable oxygen) then they will support sport fish year-round and can be stocked.

Removal of vegetation (trees, bushes, rushes, etc.) around ponds leads to warmer water and a premature drying up of the pond. Increased run-off carrying silt and other sediments can also run into the pond and affect the pond's ecology. Re-planting and/or seeding can improve the pond habitat.



4.3. Bogs and Fens

Bogs and fens are formed when organic materials buildup on ground which has poor drainage. They also occur in depressions left by glaciers in areas where the amount of precipitation exceeds the amount of water that evaporates. When organic material, such as leaves, falls into these areas, the wet conditions slow down decomposition or breakdown of the materials, creating peat.

The main difference between a bog and a fen is found in the kinds of plants that grow there according to the available nutrients.

Bogs generally have fewer nutrients and tend to be mossy and peat covered. They usually form on a rocky area.

Fens are usually found along lake and river edges and are covered with mosses and grasses. The closeness of fens to other water systems means that they are occasionally flooded with nutrient-rich water.

4.4. Marshes

The main plants you see growing in marshes are grasses, bulrushes and cattails. Marshes provide food sources for many different wildlife species and are important habitat. There are three kinds of marshes:

1. Marshes that have formed in a basin that catches water. These are usually surrounded by a lot of vegetation and have small brooks coming into them.
2. Marshes that have formed near rivers because of seasonal flooding and the movement of silt. These generally have many different forms of vegetation.
3. Marshes that have formed on coastlines. These marshes are formed when sand, gravel, and soil are deposited into basins, which trap run-off.

4.5. Swamps

Swamps are formed in depressions in the ground and are usually surrounded by higher ground. Springs and water seeping into the swamp from the surrounding area create a habitat that is rich in minerals. Sometimes the water in swamps moves around gently in pools and channels. Plants found in a swamp include black spruce, balsam fir, red maple, ferns, mosses and other small plants and shrubs.

4.6. Importance of Wetlands

- All wetlands discussed in this section are important because they store carbon (decayed plant material) which otherwise might be released to the atmosphere as greenhouse gases.
- Wetlands act as filtration systems, absorbing pollutants like heavy metals and other toxic substances so that they don't get into the rivers and streams. There are, however, limits to how many pollutants any particular system can tolerate. If overloaded for a prolonged period of time, wetland habitats will degrade.
- Wetlands contain important records of climate and vegetation change. Scientists have been able to study pollen trapped for

WHAT'S HAPPENING TO WETLANDS?

Wetlands cover 14% of Canada's land surface.

But these wetlands are disappearing. 71% of Prairie wetlands and 68% of Southern Ontario's wetlands have disappeared.

65% of the marshes along the Atlantic Canada coast are gone.

thousands of years in the bottoms of some bogs. The profiles of these pollens offer important information about our past.

- Bogs and fens in Nova Scotia often contain examples of rare and unusual plants.
- Many wild animals use the edges of wetland areas because they adjoin another habitat. Being on the edge of two habitats gives animals more choices for food and shelter.
- Wetlands can be important in flood control. Bogs, especially, absorb large quantities of rain, which they release slowly throughout drier seasons.
- Marshes are used extensively by waterfowl for nesting and feeding.
- Coastal marshes protect shorelines from erosion.
- Coastal marshes and marshes near streams provide food and shelter for numerous fish.
- Fish are not found in bogs and fens, however, these areas can help stabilize water and temperature levels, which in turn improve river and stream quality in the area.
- The organic acids produced in bogs, fens, and marshes are very important in areas with acid rain problems. These organic acids bind to heavy metals released by the inorganic acids in the rain, reducing their toxic levels.

4.7. Habitat Change and Problems

In the section **The Watershed** we looked at all of the impacts on watercourses in our province. A few of these impacts should be mentioned again with regards to lakes, ponds, and stillwaters. You may be able to correct or help some of these situations during the course of your project.

- In some parts of Nova Scotia, a plant called Purple Loosestrife is taking over wetland areas. This invasive plant, although attractive, is of no use to native wildlife and tends to choke out more useful native plants. Loosestrife can, in fact, take over an entire wetland area. Its growth should be discouraged in wetlands and in private gardens where seeds may be carried to nearby wetland areas.
- Recreational vehicles such as ATV's and snowmobiles can trample, compact, and damage the ground in these sensitive, poorly drained areas. This can result in changes in vegetation and ground structure. Ruts in nearby wet areas can cause silt to enter the water during rainy periods.
- In the past, humans have filled in or drained many wetland areas so that the land can be used for construction, farming, or other purposes. This has resulted in the direct loss of

habitat. It has also increased the rate of storm runoff, and by reducing water storage capacity, increased the length and severity of droughts.

- Harvesting peat from bogs can alter the water flow in nearby streams.
- In the past 30 years forest cutting around wet areas often involved heavy machinery, which created rutting and compaction of the soil. Now, forest workers are more aware of the danger of silt getting into watercourses and are asked to follow guidelines that limit how close they can get to a wet area. New forest sustainability regulations in the Province are having a positive effect of stream protection.
<http://www.gov.ns.ca/natr/forestry/strategy/sustainabilityregs.htm>
- Farmers should not plough to the edge of watercourse areas; a greenbelt buffer should always be left to prevent silt, fertilizers, and pesticides from moving into the system.

4.8. Enhancement and Restoration

- Marsh restoration requires the assistance of a team of professionals including botanist, hydrologist, and geologist.
- Under careful guidance (in terms of selection of the different species) certain plants may be encouraged to grow through either planting or seeding.
- Mud logs may be used nearby to control run-off on skidder or forwarding trails. Mud logs are strategically placed to stop mud from flowing into a water system.
- The best restoration method for stillwaters is to remove whatever is impacting on the system and let time do the healing.
- If a clean-up is planned, follow the guidelines in the section **Restoring the Watercourse**.

For more information of wetlands and how to work to restore them see the Wet kit web page.
<http://www.wetkit.net/modules/1/>

TEST YOUR KNOWLEDGE! HOW WELL HAVE YOU READ THIS SECTION?
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TRUE AND FALSE QUIZ

	True	False
1. Water is at its heaviest when it is 4 ⁰ Celsius.		
2. Fall turn-over refers to the changes in the movement of sap in trees.		
3. A eutrophic lake is a lake that has very few nutrients.		
4. Salmon and trout prefer lakes with few nutrients.		
5. Trout prefer watercourses with lots of plant materials.		
6. The main difference between a bog and a fen is found in the kinds of plants that grow there.		
7. Wetlands and marshes can filter toxic pollutants and clean up water.		
8. One of the problems with ponds, marshes, and other wetlands is that they encourage flooding.		
9. We should be draining more of our marshes.		
10. Wetlands are important habitat for birds and other wildlife.		

ANSWERS CAN BE FOUND AT THE END OF THIS MANUAL