Winter in Our Watershed

This lesson is designed to allow you to make connections between climate change and various water issues in the Lake Champlain watershed. At 120 miles long and 400ft. deep at its deepest point, Lake Champlain is the 13th largest lake by surface area in the United States, containing about 6.8 trillion gallons of water. The watershed itself is even bigger – covering 8,234 square miles, it contains areas in New York, Vermont, and Quebec. In this lesson we are going to dive deeper into the challenges facing the lake and its watershed, discover our place in the watershed, and learn more about what can be done to protect the lake and those dependent on it.

Climate change is adding additional stress to our already impacted waterways. As the climate continues to warm these additional impacts have the ability to dramatically change many aspects of life throughout the region. The average temperature in New York State has risen about 2.4°F since 1970. Annual snowfall in the Adirondacks is around 175 inches and it's projected that there will be 28% fewer snowstorms per year throughout the region.

It's also estimated that the amount of snow or frozen precipitation per storm would decrease by one-third by the 2090s. By the 2050s, sea level is expected to be as much as 30 inches (2.5 feet) higher in New York's coastal area. By 2100, New York's coast could see up to 6 feet of sea-level rise. These high sea-levels will lead to severe coastal flooding and storm surges. New York is taking steps to mitigate the harmful effects of climate change through community planning, greenhouse gas reduction programs, investing in renewable energy, and creating green jobs. Unfortunately, we have already begun to see the effects of climate change across the world. In the Lake Champlain watershed we are seeing the effects of climate change impact our local lakes, streams, and rivers. In this lesson we will discuss two topics that are connected to the health of our waterbodies: road salt, and temperature. These topics are heavily influenced by the complications that climate change is creating.

Lake Champlain

Instructions:

We are going to evaluate the complex relationships in the Lake Champlain watershed during the winter months. In particular, we will evaluate two key topic areas: road salt and temperature. These topics can give us insight into changes occurring within the watershed, which ultimately impacts our waterbodies and our communities.

- You will be assigned one of the following water and climate topics: road salt or temperature.
- Read through the Factsheet for your assigned water and climate topic.
- As you read the Factsheet, be sure to click on links (Example: Adirondack Watershed Institute).
- There will be three questions in each Factsheet. You will answer the questions for your assigned water and climate topic on page 8.
- Feel free to look through the Factsheets that aren't assigned to you.
- After completing the Factsheet component of this lesson your teacher will give you instructions on the next steps.

DEFINITIONS & CONCEPTS

These definitions will help you better understand the connections between water and climate change.

Community-Based Science
Community-based science is the practice of public participation and collaboration in scientific research to increase scientific knowledge. Through community-based science, people share and contribute to data monitoring and collection programs.

Climate Change
Any significant change in the measures of climate lasting for an extended period of time. In other words, climate change includes major changes in temperature, precipitation, or wind patterns, among other effects, that occur over several decades or longer.

Ecosystem-based Management (EBM)
Ecosystem-based management is an emerging, integrated approach to natural resources management that considers the entire ecosystem, including humans, to achieve improved environmental conditions and sustained ecosystem services that support human needs and social goals.

Watershed
An area of land where all water drains to a central point such as a lake, pond, or river. Also referred to as a drainage basin.

Acid Deposition
Precipitation with acidic components, such as sulfuric or nitric acid that falls to the ground from the atmosphere in rain or snow. This process occurs when sulfuric or nitric oxides are emitted into the atmosphere.

Heavy Precipitation
Instances during which the amount of rain or snow experienced in a location substantially exceeds what is normal. What constitutes a period of heavy precipitation varies according to location and season.

Road Salt
The use of road salt to de-ice our roads is a common practice during the winter months. High levels of sodium and chloride found in road salt cause problems for humans and lake ecosystems.

Temperature
Water temperature influences several other components of a lake ecosystem. Temperature can alter the physical and chemical properties of water.

Factsheet: Road Salt

Due to its low cost and widespread availability, road salt (sodium chloride) has become the predominant de-icing chemical. Its usage on highways has steadily risen since the 1940s. New York State is the largest user of road salt in North America. Despite the elevated usage of road salt, our understanding of its long-term effects on Adirondack ecosystems remains limited, especially when compared to extensively studied issues such as acid deposition. The investigation into road salt pollution is only just beginning to gain deeper insights.

Road salt has the potential for significant negative effects on forest and aquatic ecosystems that may be on par with or greater than those reported for other regional pollutants. In some cases, road salt runoff can disrupt the natural mixing process of lakes, causing less habitat for fish and other organisms. Higher levels of sodium or chloride in our drinking water can result in many long-term health problems for humans. Mixed precipitation events will become more common as the climate changes, likely worsening road conditions. Keeping roadways safe for motorists is a high priority, as is protecting our ecosystems and drinking water.

A long-term study of Mirror Lake in Lake Placid, NY has given scientists an insight into this issue. Of its 1.2 total square miles, 26% of the Mirror Lake watershed is developed, 19% is surface water, and 55% is forested. Surface water chloride concentration has been measured at around 40 mg/L, roughly 167 times higher than a typical Adirondack waterbody. Bottom water concentrations have approached 120 mg/L. Although Mirror Lake is not a direct source of drinking water for the Village of Lake Placid, this elevated concentration has impacted the lake's natural mixing process.

Ecosystem-based Management Solutions:

Mitigating the use of road salt is a complex problem. High concentrations of sodium and chloride impact the biotic communities found in our lakes as well as the communities that depend on these watersheds for clean drinking water and economic opportunity. In December of 2020 the Randy Preston Road Salt Reduction Act was signed into law in New York State. This bipartisan legislation passed with almost unanimous support. This is a step towards setting limits on the amount of road salt that is used to de-ice roadways.

Read:

Winter is Coming! And with it, tons of salt on our roads
How Road Salt Harms the Environment

Factsheet: Road Salt

What are others doing to reduce use?
Although not in the Lake Champlain Watershed, Minnesota has implemented measures to reduce road salt use such as improving winter maintenance practices, dust control applications, and water softening efficiency, which they call Smart Salting. New Hampshire passed the "New Hampshire Road Salt Reduction Initiative" in 2013 to address the high levels of chloride found in state waters. Some results of this legislation include upgrading equipment to better monitor the amount of salt used, lowering speed limits, and mandating snow tires on vehicles.

Waterbodies Impacted in the Adirondack Park

GIS-based road runoff model using topography.

Of the 6,000 miles of streams, 52% of total length would be impacted.

Of the 195,000 acres of lakes, 77% would be impacted.

(Regalado & Kelting, 2015)

Watch:

Is Road Salt Making the Great Lakes Saltier?
Minnesota testing new chemicals to replace road salt
Where our road salt comes from

Reducing road salt pollution is a high priority in the Lake Champlain Basin. Getting community members engaged with this subject is the first step in responding to this issue. Advocacy groups such as ADK Action, and The Ausable River Association (AsRA) have used their platforms to elevate this issue. ADK Action reported in February of 2022 that 49 plow operators and managers have been trained on reducing road salt, and 26 municipalities have signed a pledge to reduce road salt. These are meaningful steps in engaging both community members and stakeholders to understand the impact that road salt has on the watersheds of this region.

Ecosystem-based Management Solutions:

In December of 2021 NY Governor Hochul announced the creation of the Adirondack Road Salt Reduction Task Force and appointed members from across the Adirondacks to serve on its board. The task force was chaired by the Department of Environmental Conservation, Department of Transportation and Department of Health and released a report on its findings in 2023. The report details options to reduce road salt in the region.

Answer:

How are other states de-icing their roads?
Are other states taking measures to reduce the amount used?
Are any steps being taken to reduce road salt in your community?

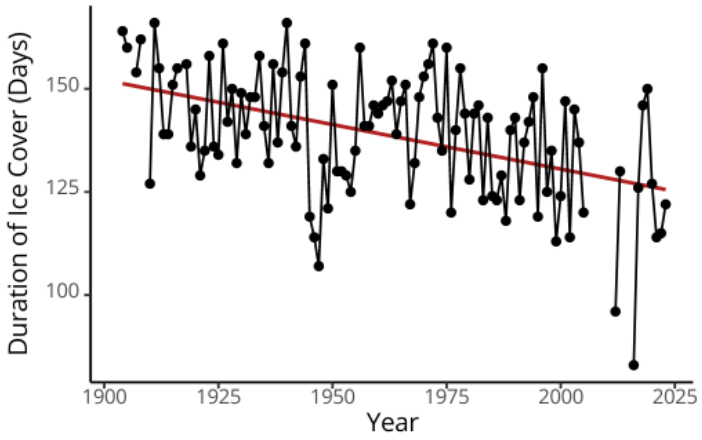
Factsheet: Temperature

Increasing air temperatures due to a warming climate has an impact on the water temperature of lakes, rivers and streams. This warming trend can be observed in different types of available long-term data. Direct temperature measurements of lake surface water are a routine and important part of water quality monitoring. Since 1941, the average temperature in Vermont has increased by 2.7 degrees Fahrenheit (about 0.5 degrees per decade), with the last decade being the warmest on record. Temperatures in the Lake Champlain Basin are projected to increase 3-6 degrees Fahrenheit by the 2050s, and 5.5-8-degrees Fahrenheit by 2100. The surface water temperature has also increased 6.8 degrees Fahrenheit in some locations in Lake Champlain. In winter, the number of days when Lake Champlain is covered in ice is decreasing.

In the winter, the water temperature of lakes is measured indirectly by the number of days of ice cover, also referred to as duration of ice cover. The National Snow and Ice Data Center (NSIDC) maintains a database of snow and ice records submitted by researchers and/or community science volunteers. In addition to this data, Mirror Lake has been extensively monitored for over 100 years. The average duration of ice cover on Mirror Lake has declined by 26 days from 1903 to 2023.

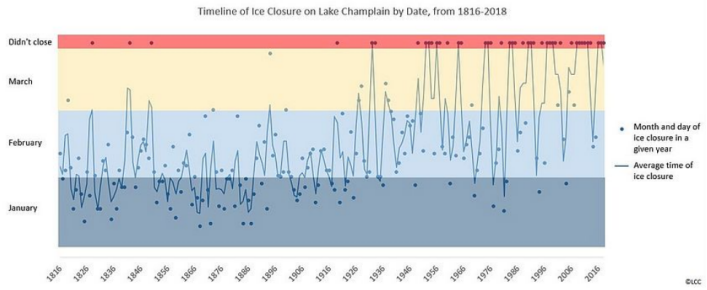
Read:

Can ADK lake trout survive climate change?
200 Years of Lake Champlain Ice Data



Source: Ausable River Association, Mirror Lake Ice Record. Edited by Brendan Wiltse, Senior Research Scientist at the Adirondack Watershed Institute. (https://www.ausableriver.org/watershed/lakes/mirror-lake/mirror-lake-ice-record).

200 years of Lake Champlain ice data also gives insight into long term trends in the Lake Champlain Basin. The average maximum temperature during the winter months (December, January, and February) rose at 0.64 degrees Fahrenheit per decade. This change makes winters both milder and shorter, with the lake not freezing over as often as it once did. The chart below represents a timeline of when ice on Lake Champlain has closed, with dots marking the date of ice closure.



Source: 200 years of Lake Champlain Ice Data - this chart showing a timeline of ice closure on Lake Champlain by date, from 1816-2018, Lake Champlain Committee.

Factsheet: Temperature

Ecosystem-based Management Solutions:
As air temperatures increase, so do water temperatures, especially in shallower water bodies such as creeks and streams. These water bodies provide important habitat to a variety of fish species, including trout. Communities can protect local streams from the effects of a warming climate by planting stream buffers of native trees and shrubs to ensure that there is appropriate shading to keep water cool. In places where stream buffers already exist, communities can enhance the resilience of the buffer by diversifying the type of native vegetation that make up the riparian buffer. Stream Wise is a program that was developed in the Lake Champlain Basin in order to better assist landowners with managing the vegetation and shoreline along streams and rivers.

Listen:

Climate Stories Project interview with long-time Adirondack resident: Joseph Dumoulin,

Visit:

Lake Ice Observation Network

Success Stories:
Fish are an important component of any aquatic ecosystem. In the Lake Champlain Basin, some fish are considered indicator species, or species that can indicate the health of our waterbodies. Brook trout (Salvelinus fontinalis) are one of these species as they need cold, well oxygenated waters and are sensitive to changes in pH, temperature, or oxygen levels. Lake Trout is another native species of fish found in the Adirondacks that is dependent on cold, well oxygenated lakes. Local environmental organizations such as the Ausable River Association (AsRA) are using environmental DNA to answer questions about trout distribution in the Ausable River, a major tributary to Lake Champlain. Along with this data collection, AsRA works to restore native plants along the shoreline of the Ausable River, in order to increase shading and reduce water temperature. Some of this work involves monitoring for invasive species, which can push native species out of a habitat and create challenges for water quality and wildlife. The Vermont River Conservancy is doing similar work to protect shoreline habitat along Vermont rivers.

Answer:

What is the Lake Ice Observation Network and what information does it collect?
What do you notice about the 200-year Lake Champlain ice record dataset?
What efforts are taking place in your community to reduce the impacts of warming water temperatures?

1. After reading your assigned individual issue Factsheet, respond to the questions below:
   a) What is the issue you read about and how does it relate to water and climate change?

   b) In your assigned Factsheet there are three questions. Use the space below to respond:

   c) What supporting evidence did you read about in your Factsheet that connects your issue to water and climate change? Give two examples.

   d) How has this water and climate issue affected local waterbodies in your region?

2. What are two additional things you learned from the individual issue Factsheet?
   a.

   b.