WINTERKILL AND THE FACTS

What is a winterkill?

Winterkill occurs when fish suffocated from lack of dissolved oxygen. Winterkill is the most common type of fish kill. When severe, it has devastating effects on fish populations and fishing quality. Trace amounts of dissolved oxygen (measured in parts per million, ppm) are required by fish and all other forms of aquatic life. Even living plants and the bacteria that decompose organic materials on the bottom of the lake require oxygen. Generally, the critical level of oxygen is about 2 to 3 milligrams per liter for most game fish native to warmwater lakes, and levels below 1 milligram per liter for extended periods of time are lethal. Winterkill occurs during especially long, harsh winters. Shallow lakes with excess amounts of aquatic vegetation and mucky bottoms are prone to this problem.

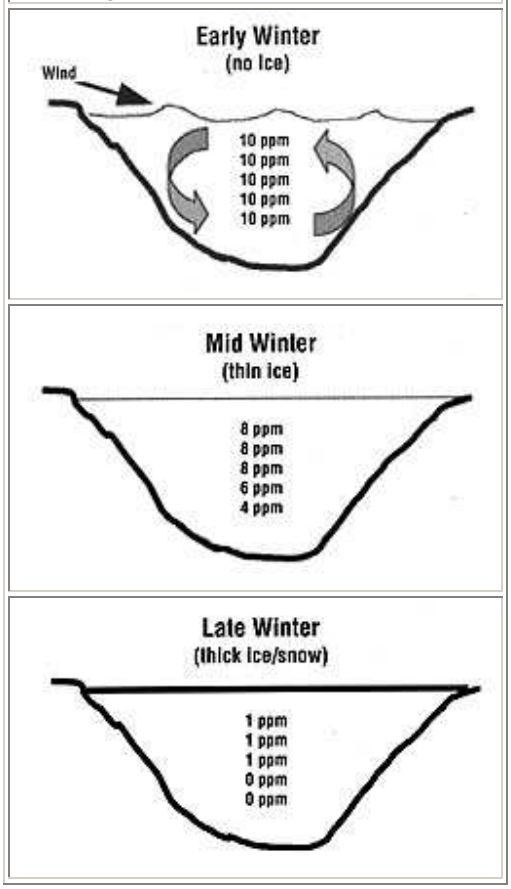
How does winterkill happen?

When snow and ice cover a lake, they limit the sunlight reaching aquatic plants (Figure 1, right). The plants then cut back on the amount of oxygen they produce. If vegetation dies from lack of sunlight, the plants start to decompose, which uses oxygen dissolved in the water. When oxygen depletion becomes severe enough, fish die. Winterkill is worse in winters with abundant or early snowfall. Lower autumn water levels increase the probability and severity of winterkill. Early ice-on and late ice-out dates also increase the winterkill potential.

What are the causes of winterkill?

Winter Severity - This is by far the most important factor in determining the likelihood of a winterkill. A mild winter means little or no ice and thus, no winterkill due to low oxygen levels. A harsh winter greatly increases the chances of problems. Ice thickness and clearness is important. Thickening and increasing cloudiness of ice over time results in less and less light being available for photosynthesis. Perhaps the worst thing that can occur is for snow to cover the ice. Four inches of wet snow on top of the ice nearly eliminates sunlight penetration and oxygen levels will decline quickly.

Figure 1. Oxygen depletion scenario during winter ice cover. Oxygen levels are expressed as parts per million (ppm = mg/l) and show generalized levels and trends.



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Lake Volume—The more water volume (i.e., gallons) in a lake, the less likely the lake will experience winterkill. This is why fish over-winter better in larger and/or deeper lakes.

Decomposition—An important factor is the amount of decaying organic matter that is present on the bottom. Aquatic vegetation and tree leaves account for most of the organic matter undergoing decay during winter. A lake bottom covered with these materials is more likely to experience winterkill than a lake lacking such materials. This is why lakes having a very dense aquatic plant community in summer are the very lakes most susceptible to winterkill during harsh winters.

Fish Biomass—The amount of fish (numbers and pounds) in the lake during winter also influences oxygen decline under the ice. Even though fish metabolism has slowed during winter, they still require oxygen. A lake that contains many pounds of fish will experience a faster decline in oxygen than a lake with fewer pounds of fish.

Worst Case Scenario—Lake owners should be most concerned during a harsh winter in which ice cover persists, there is considerable snow cover on the ice, the lake or bay is small and shallow, and the lake contained a large amount of aquatic plants the previous summer. Less ice and snow, fewer aquatic plants the previous summer, and the deeper the lake, the less likely a winter fish kill will occur.

When is winterkill most likely to occur?

February is usually a critical period and is the best time to check the oxygen content of lakes prone to winterkill. A good midwinter thaw about then often recharges the lake's oxygen supply by means of photosynthesis and melt water. Conversely, a prolonged winter, with continuous snow cover and late ice-out, increases the chance of winterkill.

How can I determine if a winterkill has occurred?

There are several things that identify a winterkill. Taking dissolved oxygen measurements from late January through February is a way to monitor the level of dissolved oxygen to see if it is adequate (greater than 3 ppm) for fish survival. Another sign is that the dead fish may appear fuzzy from a fungus infection, which is normal in winterkills. Also, a lake that has experienced winterkill can usually be detected by the strong smell of sulfur dioxide, which is often equated with the smell of rotten eggs. Additionally, many species and sizes of fish die under winter-kill conditions and after the ice melts, only dead, decaying fish are observed. If you are reading this fact sheet it is more than likely that your lake has experienced or is experiencing a winter kill.

Is my lake susceptible to a winter kill?

Yes. Shallow lakes with large amounts of aquatic vegetation and mucky bottoms are prone to this problem, because they have much lower oxygen capacity and when combined with decaying plants that consume the 'bank account' of oxygen that's left, lower oxygen to points that some fish cannot survive. This lake is the types of lake, that when impacted with a severe winter like we've had in 2009, will be more likely to experience winterkill. Remember it is very unlikely that the lake will experience a total die-off of all fish. Shallow areas of larger, deeper lakes can also have suppressed winter oxygen, and thus some fish mortalities, and shallow tributary or connecting waters might be the original locations of die-offs.

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Have other lakes experienced winterkill this year?
Yes. Taggett Lake, Kirkwood Lake in Oakland County, Merkle Lake and Winnewana Impoundment in Washtenaw County are reported to have experienced winter kill in 2009. These lakes are similar in that they are shallow, support an abundant amount of aquatic vegetation and have very organic lake bottoms. Winterkill often goes unreported until ice out and fish are more visible. The MDNR is receiving more calls regarding winterkill than in previous years (personal communication, MDNR, Jim Francis 2009)

Will a fish community that experiences a winterkill recover?
Yes. Natural fish kills may affect fishing and predator-prey "balance" for years. Winterkill can eliminate all fish in a small lake. In lakes greater than 10 acres in size, winterkills are rarely serious in the long run because lakes contain **thousands of fish per acre**. Fortunately, usually enough fish survive, either in the lake or in connecting waters, to repopulate the lake in a couple of years. Fish kills may be thought of as nature's way of thinning out fish populations. Only for extreme die-offs is fish restocking necessary. Usually, fish kills indicate that the habitat is of marginal quality for certain species because of the broad range of weather conditions we experience in Michigan. Occasionally, fish kills indicate habitat or pollution problems that can be corrected, however fish kills can be beneficial by reducing over-populated, slow-growing panfish and actually increase growth rates and improve fishing.

Did aquatic vegetation management cause the winterkill?
No. One of the most **common misconceptions** is that winterkill occurs because of lake management activity, particularly, the management of nuisance aquatic vegetation. The Michigan Department of Environmental Quality (MDEQ) reviews and approves the aquatic nuisance control program for this lake and thousands of lakes in Michigan. It is the opinion of the MDEQ as well as that of fisheries biologist of the MDNR Lake Erie Management Unit that there is no correlation between aquatic vegetation management and the occurrence of winter kill (personal communication, Eric Bacon MDEQ, Jim Francis MDNR, 2009). Winterkill is not selective and occurs in both managed and unmanaged lakes and its likelihood is dependent on other factors.

What can be done to avoid winterkill?
Any strategy that limits the amount of plant decomposition that will occur during winter is important. There are a number of methods to eliminate or reduce summer aquatic vegetation that will decrease the amount of oxygen-consuming decomposition that occurs the following winter. Ohio State University Extension Fact Sheets A-3-98 Controlling Filamentous Algae in Lakes and A-4-98 Chemical Control of Aquatic Weeds along with the Ohio Lake Management bulletin describe a variety of strategies for controlling aquatic plants.

Another activity to be considered is the installation of an aeration system that helps keep a small area of the lake ice-free. Aeration not only adds oxygen to the water directly via the bubbles and agitation, but the open area allows for considerable diffusion of oxygen into the lake from the air. The aeration system does not need to be run continuously all winter. Rather, turn it on when ice is forming on the lake. Leave it off when the lake is ice-free. Aeration can be used sparingly in winter to minimize ice cover.

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If a lake receives augmentation from a well then an aerator can be placed in at the augmentation input and charge the lake with a source of oxygenated water. Care must be taken to aerate the groundwater from augmentation as it is devoid of oxygen and will increase the likelihood of winterkill if not aerated.

A significant improvement can be made in the oxygen content of about 1 acre of water by running a small outboard motor for about 4 hours. Select a relatively warm day to use the outboard method. Mount the outboard on a dock, frame, or small boat and lower the shaft into a large hole in the ice. Tilt and run the motor so as to push water on top of the ice. Then, at the edge of the flooded area, chop more holes so the water can return. Beware of weakened ice! Move to another location before the outboard hole becomes dangerously enlarged or water is no longer pushed onto the ice. Run the motor over relatively deep water so that bottom mud is not stirred up along with the water.

The only long-term solution for winterkill lakes is to reverse the natural process of filling and enrichment (eutrophication). Dredging or sucking bottom sediments can increase the volume of water, reduce the nutrient-rich sediment, and reduce the growth of nuisance plants. However, such projects are extremely costly, require a site for disposing of the bottom material, and may require a permit. Lake residents can help slow down the rate of eutrophication by keeping all types of plant fertilizers out of the lake

SOURCES:

The information contained herein was compiled by SEAS LLC independent consultant and Senior Aquatic Biologist Gary Crawford. Sources include selections and summarization of information from including the personal communication with the MDEQ Surface Water Quality Division Inland Lakes Management Unit, MDNR Fisheries Division Lake Erie Management Unit and published documents from the sources below.

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