

The Power of Ice

Have you ever come to your cabin in the winter and noticed something was different – pictures were hanging crooked and things have moved? This was probably due to the shifting of the ice during periods of warm weather. When ice warms up after a period of low temperatures, it expands and develops tremendous forces. Ultimately, these stresses relieve and form ice ridges. Depending on water levels, an ice ridge can form along the shoreline or across the center of the lake. The coefficient of linear expansion for ice is approximately $0.00005/\text{degree C}$ (about 5 times greater than that of iron). Although this is a small number, when the width of the lake is considered, this expansion can be quite noticeable. In the case of Pigeon Lake, the width is about 4 km. If the temperature of the ice increases by 10 C, the total linear expansion of the ice would be $4000 \text{ m} \times 10 \times .00005$ or 2 metres. This expansion would either be a thrust of ice on each side of the lake of about 1 metre or a thrust (ice ridge) in the middle of the lake of 2 metres.

This phenomenon can be observed at any time during the winter with a warm period following a period of very cold weather. As the weather warms, the ice starts to expand. Tremendous forces are built up within the ice sheet until these forces are relieved by fracturing of the ice. This fracturing event can be quite dramatic, resulting in loud booms, rapid shaking of the ice and shoreline (ice quakes) and up thrusting of the ice. After the initial fracturing, the ridge continues to grow through the continued creeping of the ice as it cycles between low temperatures at night and higher temperatures during the day. These ice ridges can start forming as early as December if there is a significant warming period.



Ice ridge on Pigeon Lake from thermal expansion

Generally the ice expansion results in a harmless ridge of ice being formed along the shoreline but under certain conditions, and especially during periods when the water level is high, there can be considerable damage done to the shoreline and foreshore as the frozen slab of beachfront is literally pushed away from the lake. There have been many examples of trees being pushed over as this slab moves.



Shoreline ice ridges from thermal expansion

In the springtime, ice movement from high winds can often have disastrous results. As the ice begins to melt along the shoreline, it can start to move about with the wind. Each year, depending on the wind direction, the ice can pile up at various locations along the lakeshore, resulting in quite spectacular ice piles and damage to shoreline buildings.



Wind-blown ice on the shoreline

Ice plays an important part in the formation of a healthy riparian zone. When the ice pushes against the foreshore, the displaced land forms a “lip” along the shoreline. On an undisturbed shoreline, this feature performs the important feature of preventing the direct flow of water into the lake. Rather, it collects the water which slowly permeates into the ground and thus preventing sediment from entering the lake. The shoreline throughout the Pigeon Lake Provincial Park is a good example of a natural shoreline, formed with the forces of ice. It also provides guidance on how all lake residents should consider in protecting our lake from the direct flow of water and sediments.



The start of spring breakup

Enjoying the beauty of the ice is one of the great experiences at the lake and hearing the groans, zings, roars, booms and rumbles that ice makes as it slowly moves will be something you will never forget.

Don Davidson
Donald_d@telus.net