

## LONG-TERM TRENDS IN CHLORIDE CONCENTRATIONS IN OTSEGO LAKE FROM 1925 TO 2019

Some of the earliest evaluations of Otsego Lake water related to it being a potable water supply for Cooperstown. This included testing for chloride concentrations (Peters 1987). Chloride is a proxy of salinity. It is highly stable and conservative, and at elevated concentrations it can adversely affect aquatic organisms through osmotic disruption. In extreme cases, high salt inputs can disrupt lake mixing, leading to temperature and oxygen stresses. Sodium chloride (NaCl) is by far the most common source of chloride. It is widely used as a winter road deicer. Wastewater effluent, farm runoff and fertilizers may also elevate chlorides in local waterways. Since about 1990, researchers at the Biological Field Station (BFS) continued to collect similar information as part of our regular monitoring which has continued to date.

The earliest data on chlorides suggest that they were present in Otsego Lake at about 1 mg/l (Figure 1, below). We consider that number the natural situation. In the 1940s, concentrations began to increase. This was concurrent with the onset of road salting in NYS (Bubeck et al. 1971); by the 1970s, a "bare pavement policy" was widely adopted, during which salt use skyrocketed. Otsego Lake concentrations increased steadily by about 1 mg/l per year until about 2010. Since then, concentrations have been somewhat variable at about 17 mg/l. And while we might think of Otsego's watershed as being fairly pristine and undeveloped, realize that it takes about 750 tons of road salt to increase chlorides in the lake by just 1 mg/l! The decreased rate of decline is likely related to a steady state between the lake and groundwater, and perhaps to more prudent application rates (see below).

The BFS informed the Village of the situation and articulated potential concerns of increasing sodium chloride concentrations in fresh waters to negative impacts on aquatic organisms and, if concentrations reached high enough, on human health. In an attempt to address the concern, the Village introduced a diversity of strategies to reduce the amount of salts involved in highway deicing, including treating the salt with organic compounds that enhance the performance of salt (meaning less can be used). However, little was done by county and state highway administrators.

While environmental concerns seem appropriate, maintaining safe driving conditions in the winter is expected by all. To provide objective information and to avoid unrealistic concerns, the BFS presented data from the larger Finger Lakes (Seneca and Cayuga) whose basins intercept salt beds. They maintain natural chloride concentrations around 200 mg/l with no documented impacts on the biota, which is similar to that of Otsego. Chlorides are not usually harmful to people unless extremely elevated, however, the sodium in salt has been linked to heart and kidney disease. EPA drinking water standards require chloride levels not to exceed 250 mg/l (France 1996). This is largely based on taste thresholds.

While some might be critical of high salt use on roads, BFS research indicates that chloride is considerably more environmentally safe than the "sand" that has historically been used by the Village and surrounding areas. These abrasive particles and intended to add traction for vehicles. Virtually all this material washes into ditches and ultimately to the lake, where it adds to the muck that rooted plants thrive in, smothers aquatic animals and carries with it substantial amounts of phosphorus, which fertilizes algal blooms.

On a side note, during times of high snowfall, the village has to remove snow from its streets to make room for the next storm. Historically, the most convenient and accessible areas were used for storage, including some right near the shore of Otsego. After BFS reported finding excessive concentrations of chloride, phosphorus and sediment contained within the snow, efforts were made to keep this dirty snow away from the lake. And in 2007, during the development of additional parking south of town, out of Otsego's watershed, one parking lot was designed specifically to accommodate this. That drains to an artificial wetland, and ultimately to the Susquehanna River.

Managing a resource such as Otsego Lake is challenging. A major focus of the BFS is to collect and interpret data so that sound strategies can be recommended. Thanks to the Village for being supportive of our work, and receptive to our input.

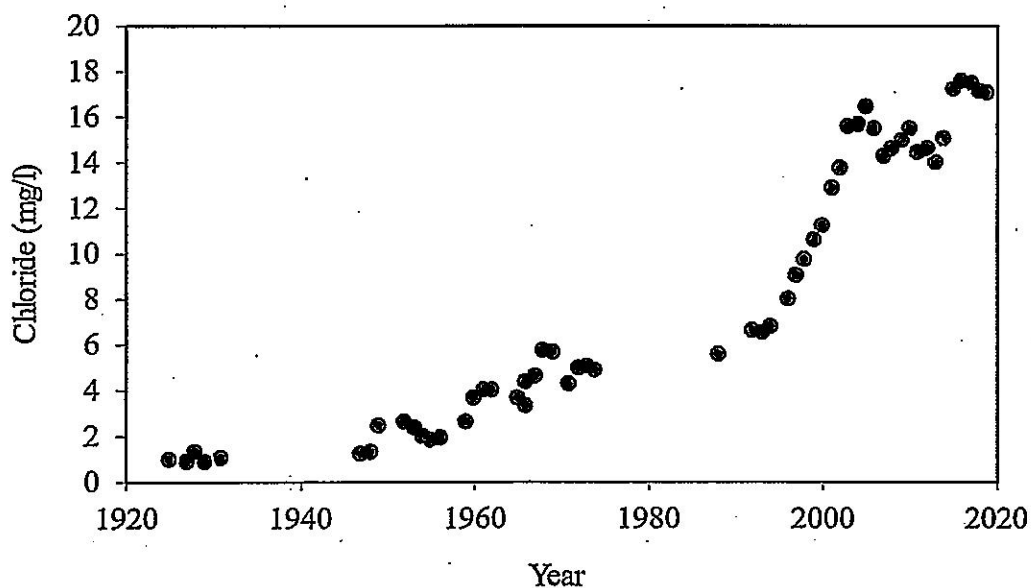


Figure 1. Mean chloride concentrations at TR4-C, 1925-2019. Points later than 1990 represent yearly averages (figure modified from Peters 1987). been attributed to road salting practices, with the greatest influx of the ion during spring snowmelt events (Waterfield and Albright 2020).

References ;

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Waterfield, H.A. and M.F. Albright. 2020. Otsego lake limnological monitoring, 2019. In 52<sup>nd</sup> Ann. Rept. (2019). SUNY Oneonta Biol. Fld. Sta., SUNY Oneonta.



Cooperstown snow pile, April 2015.