Chloride Concentrations in Cayuga Lake Watershed Increasing Slowly but Steadily

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Introduction

Chloride is naturally present at low concentrations in freshwater ecosystems. At higher concentrations, however, it can reduce biodiversity and contaminate drinking water.[1,2] CSI's database is a useful tool for finding historical trends, such as how the chloride concentration in Cayuga Lake and its tributaries has been changing over time.

Understanding these trends, as well as how they are affected by human behavior, can help inform decisions about protecting freshwater ecosystems.

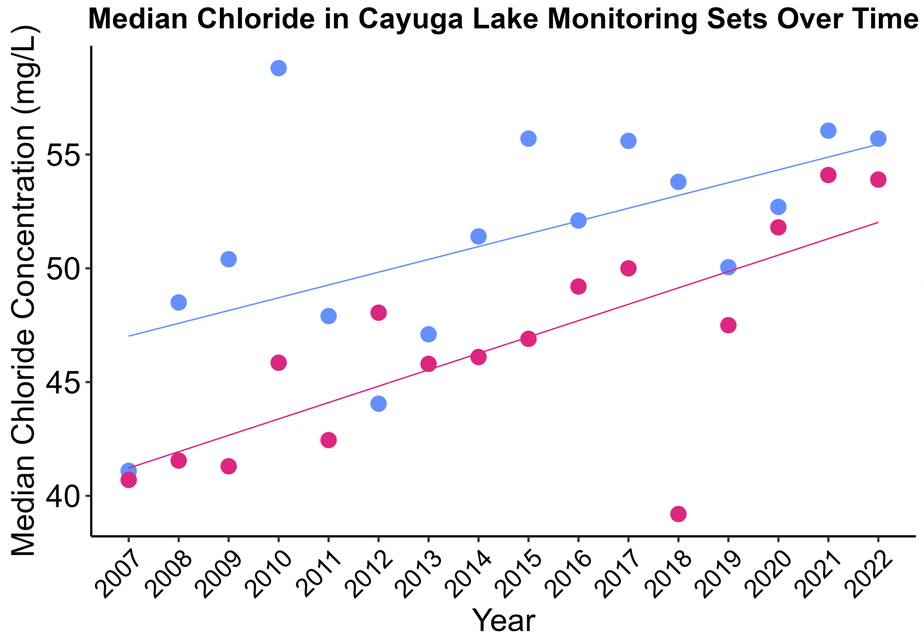
Methods

- Median annual chloride concentration under baseflow conditions was used to asses change over time in two monitoring sets on Cayuga Lake and in each of its tributaries that CSI volunteers have monitored for 10 years or more.
- Simple linear regressions were used to determine trends in chloride concentration over time in these monitoring sets.
- Simple linear regressions were used to determine trends in change in developed land use in the watersheds of certain tributaries.

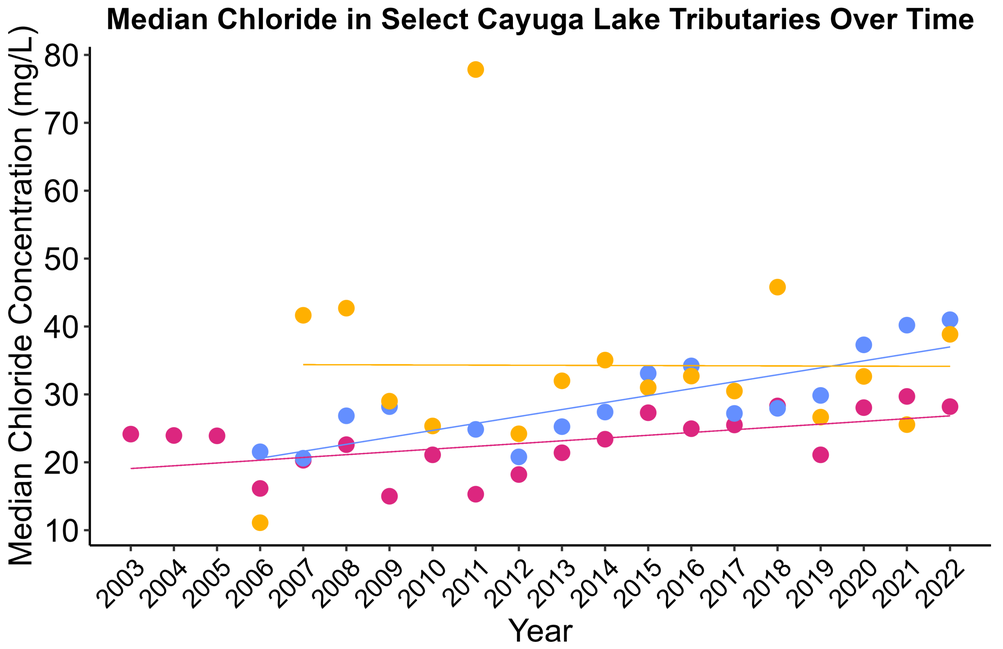
Results

Across the Cayuga Lake watershed, median annual chloride concentrations were found to be increasing over time, except in the case of Trumansburg Creek which showed no change. Rates of change throughout the watershed ranged from 0.41 to 1.27 mg/L per year. We selected three tributaries to highlight in this poster: Salmon Creek, which showed the a relatively high rate of increase, Fall Creek, which showed a moderate rate of increase, and Trumansburg Creek, in which no correlation was observed.

Rates of change in percentage of developed land in Salmon Creek, Fall Creek, and Trumansburg Creek watersheds were increasing and statistically significant but absolute change was small, the largest being 0.32% of total land use over 15 years.

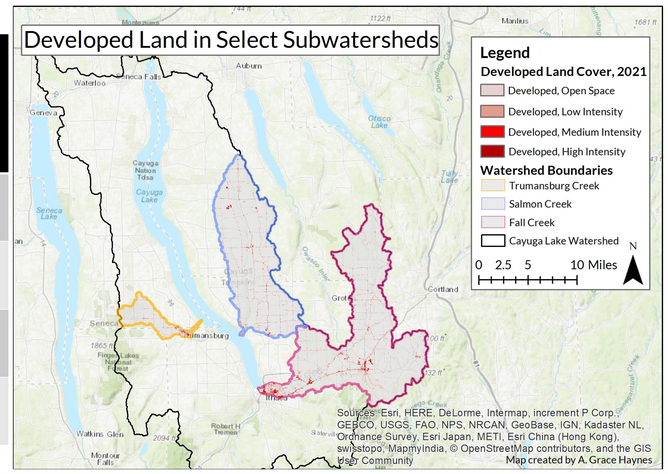


Rate of change in annual median chloride concentration:
Cayuga Lake East Shore:
0.56 mg/L per year
Cayuga Lake:
0.72 mg/L per year



Rate of change in annual median chloride concentration:
Trumansburg Creek:
No correlation
Salmon Creek:
1.02 mg/L per year
Fall Creek:
0.41 mg/L per year

Watershed	Total % developed land cover, 2006	Total % developed land cover, 2021	Change in % developed land cover, 2006-2021
Fall Creek	9.12%	9.44%	0.36%
Salmon Creek	6.19%	6.37%	0.16%
Trumansburg Creek	9.48%	9.56%	0.08%
Cayuga Lake	8.69%	8.96%	0.27%



Discussion

On Cayuga Lake, the rate of change is small, <1 mg/L per year. However, the median concentration of chloride in Cayuga Lake has been increasing over the past 15 years.

Similar trends were observed in the tributaries. Rates of change varied between tributaries, but all tributaries show slow rates of increase in chloride concentration, except for Trumansburg Creek which had no correlation. Like the lake, rates of increase were small, <1.5 mg/L per year.

While the percentage of developed land increased across the watershed from 2006 to 2021, the rate of change observed was low, suggesting that the rate of change was unlikely to be related to increasing chloride concentrations.

Watershed	R^2	F,P
Cayuga Lake	0.519	$F_{1,14}$=17.2, P<0.001
East Shore of Cayuga Lake	0.266	$F_{1,14}$=6.43, P=0.024
Trumansburg Creek	$4*10^{-5}$	$F_{1,15}$=0.06, P=0.8
Fall Creek	0.30	$F_{1,18}$=7.79, P=0.012
Salmon Creek	0.66	$F_{1,14}$=27.5, P<0.001

Explore these data yourself on our database!

A special thank you to all our volunteers whose sample collection makes our work possible.

Community Science Institute
Partnering with Communities to Protect Water

References and Acknowledgements

1. Hintz, WD, Relyea, RA. A review of the species, community, and ecosystem impacts of road salt salinization in fresh waters. Freshwater Biology. 2019.
2. Kaushal et al., Novel 'chemical cocktails' in inland waters are a consequence of the freshwater salinization syndrome. Phil. Trans. R. Soc. B. 2019.
3. National Land Cover Database (NLCD), 2001, 2004, 2006, 2008, 2011, 2013, 2016, 2019, 2021