

# Water quality impacts of de-icing salt in Lake Champlain and its tributaries

Vermont Senate Natural Resources and Energy Committee



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**February 4, 2025**

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# De-icing salt: NaCl

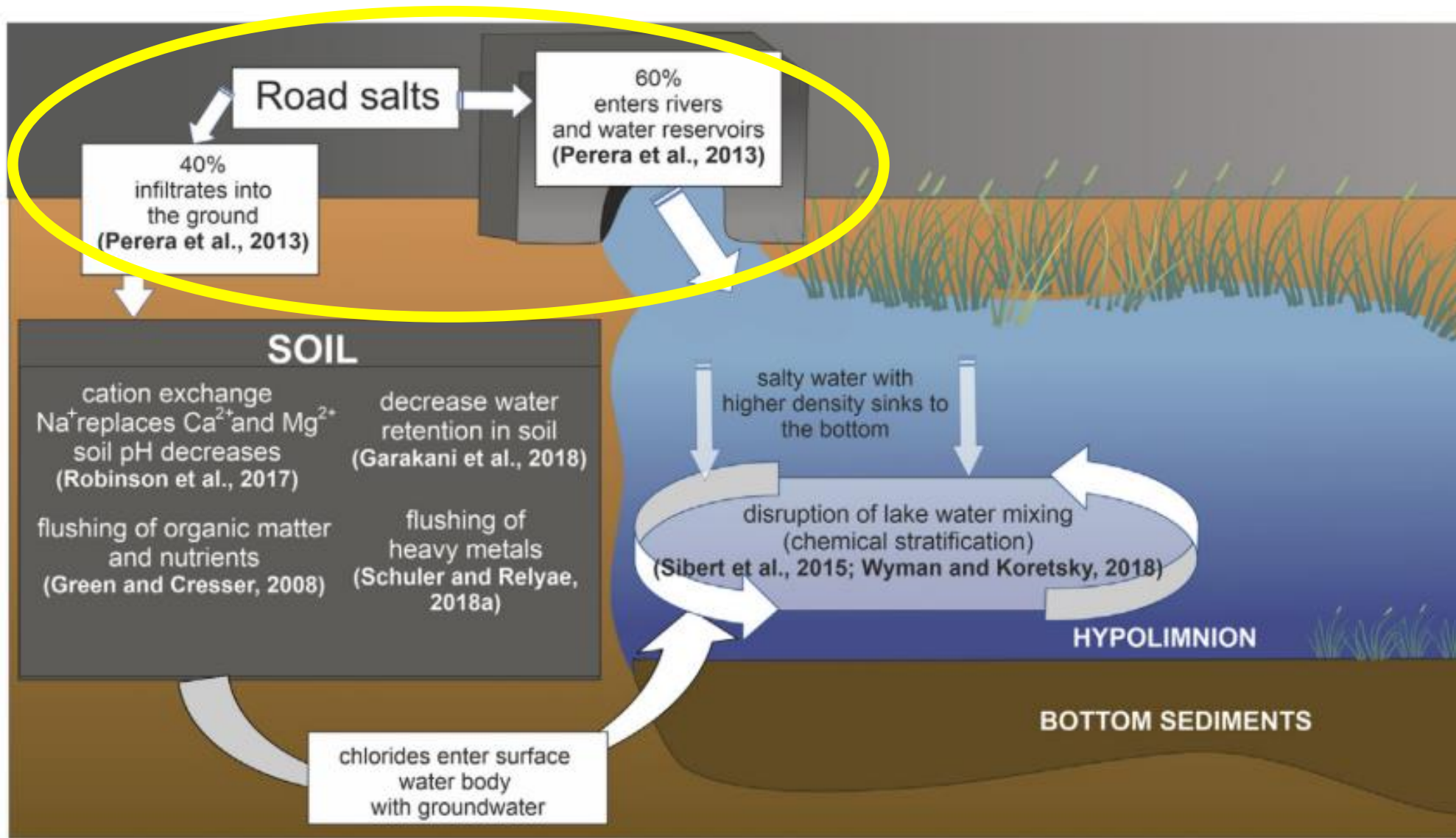
Common worldwide,  
widespread impacts  
documented

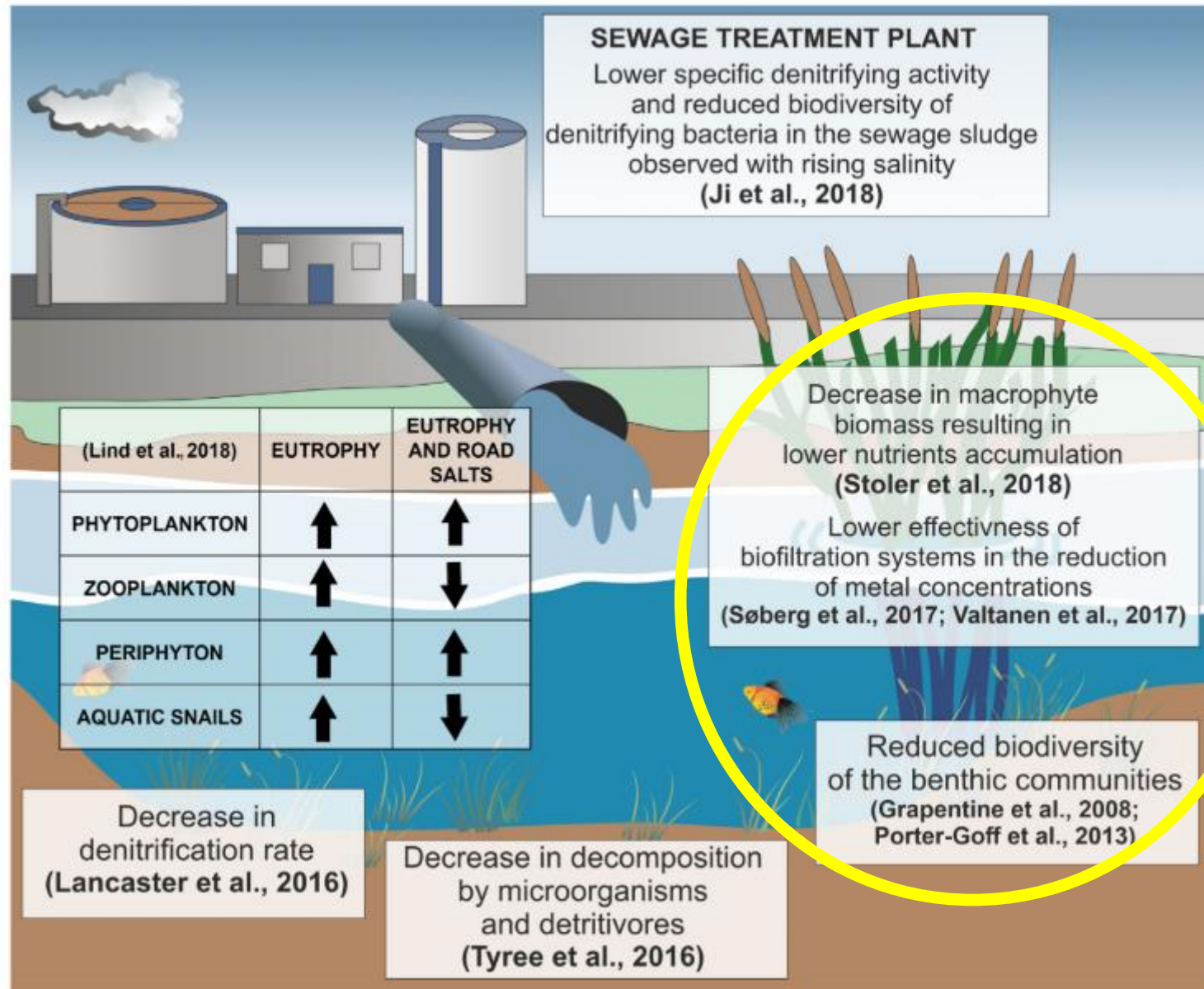
## Biological impacts

- Adversely affects all forms of life
- Reduces biodiversity

## Physical impacts

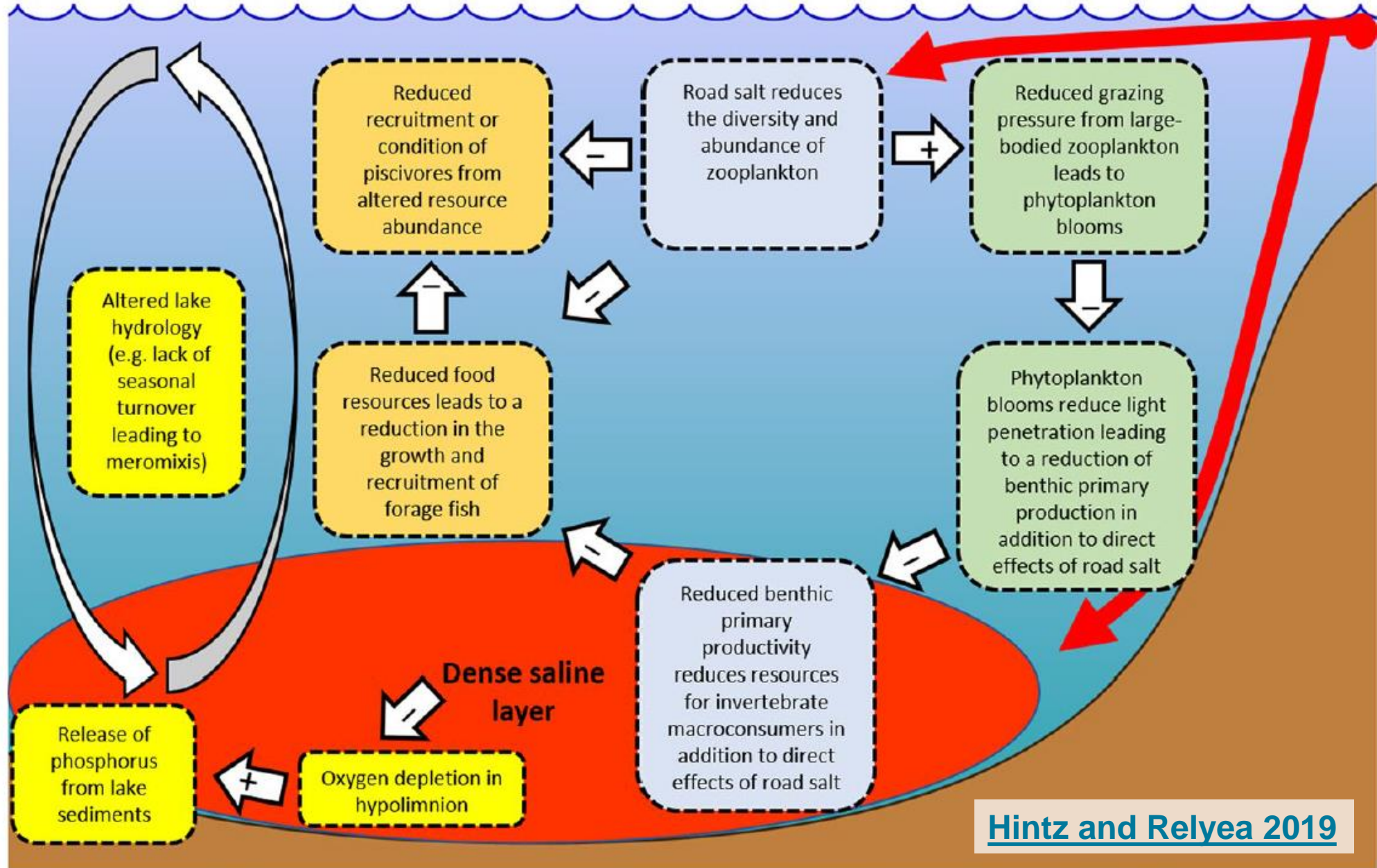
- Mixing

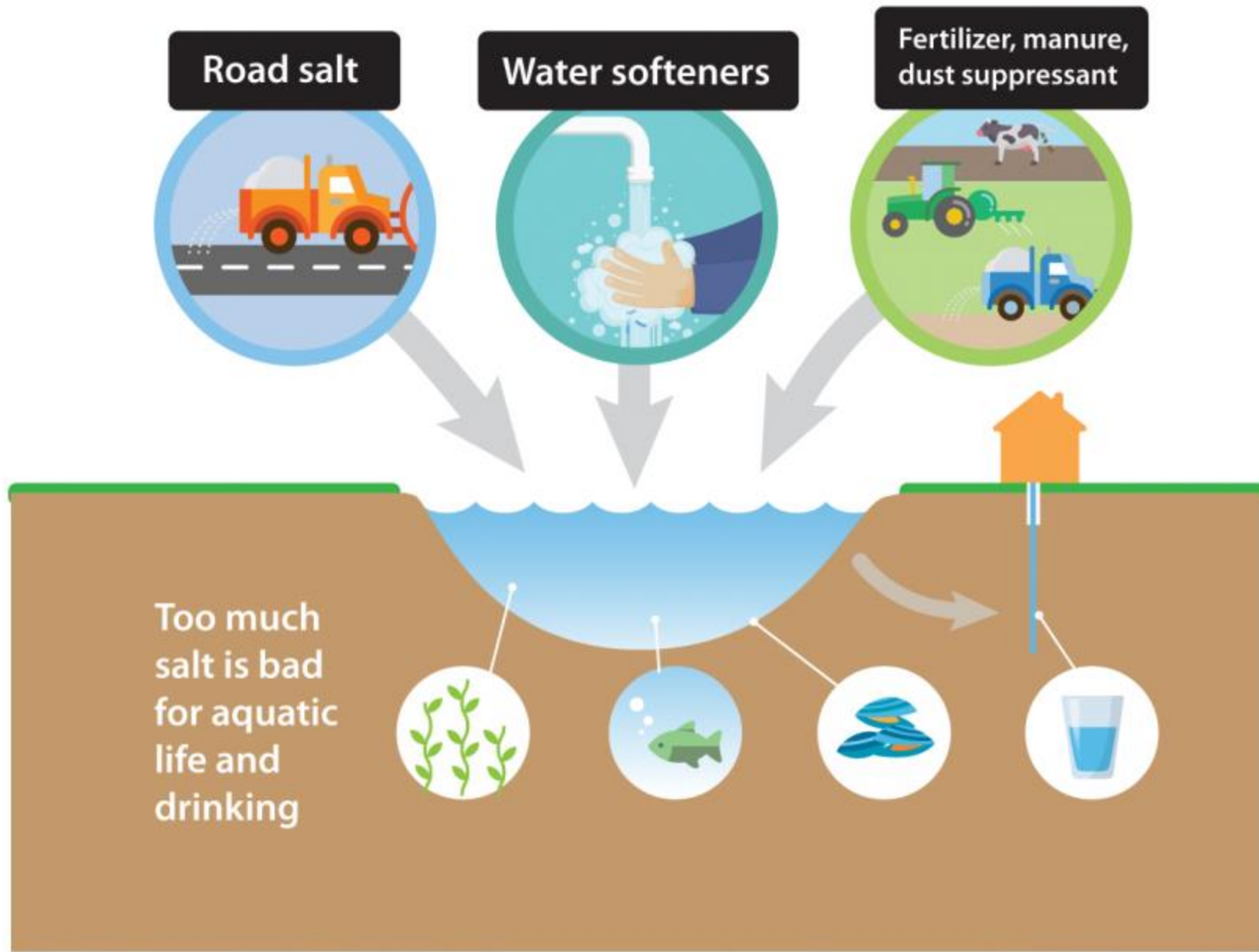




# Lake Ecosystem

Road salt inputs





# Lake Champlain long-term monitoring program

How is the lake's water quality? Is it changing?

Multi-decadal monitoring reveals salinization impacts of road de-icing salt application in the Lake Champlain watershed

**Authors:** Matthew C. H. Vaughan<sup>1</sup>, Brendan Wiltse<sup>2</sup>, Frederick W. Sutor<sup>3</sup>, Mae Kate Campbell<sup>1</sup>

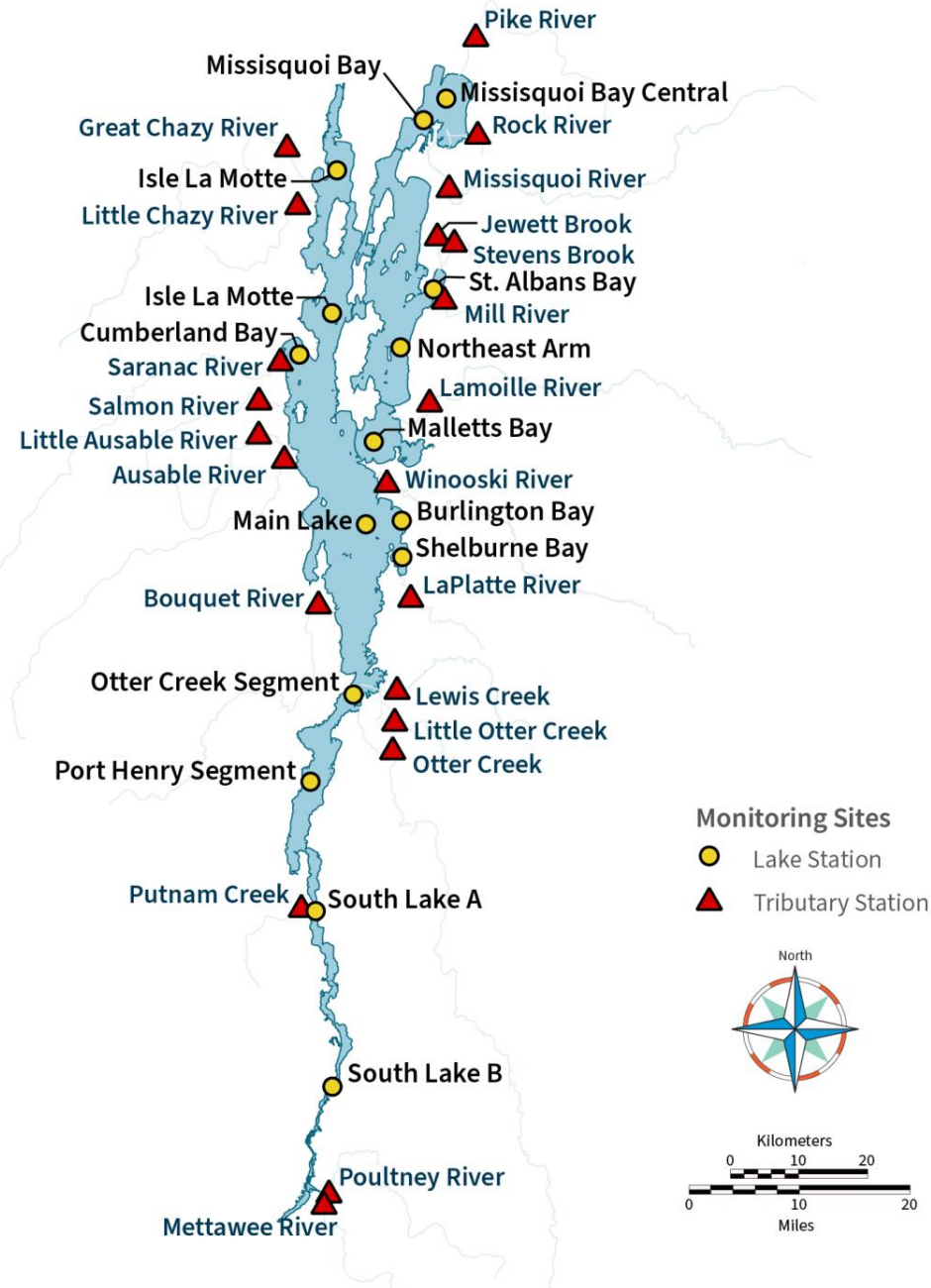
<sup>1</sup> Lake Champlain Basin Program, Grand Isle, VT, USA; Corresponding author

<sup>2</sup> Paul Smith's College Adirondack Watershed Institute, Paul Smiths, NY, USA

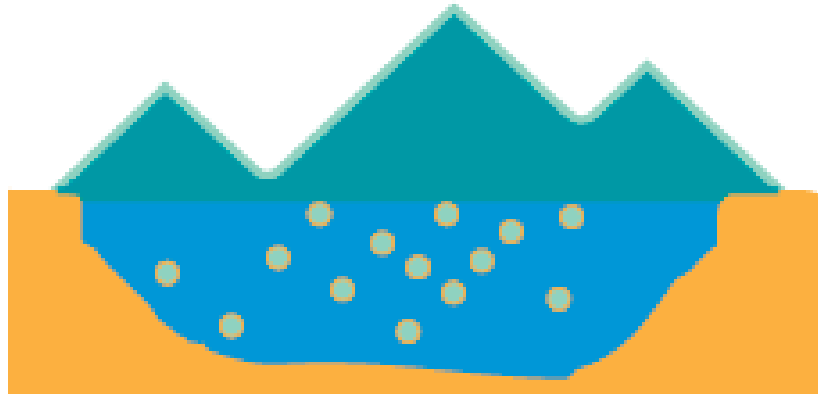
<sup>3</sup> University of Vermont, Burlington, VT, USA

# Chloride concentration data

- Starting 1991
- 18 tributaries
- 8,000 samples
- 15 lake sites
- 7,250 epilimnion or unstratified samples







## Concentration:

The amount measured in  
a unit volume of water

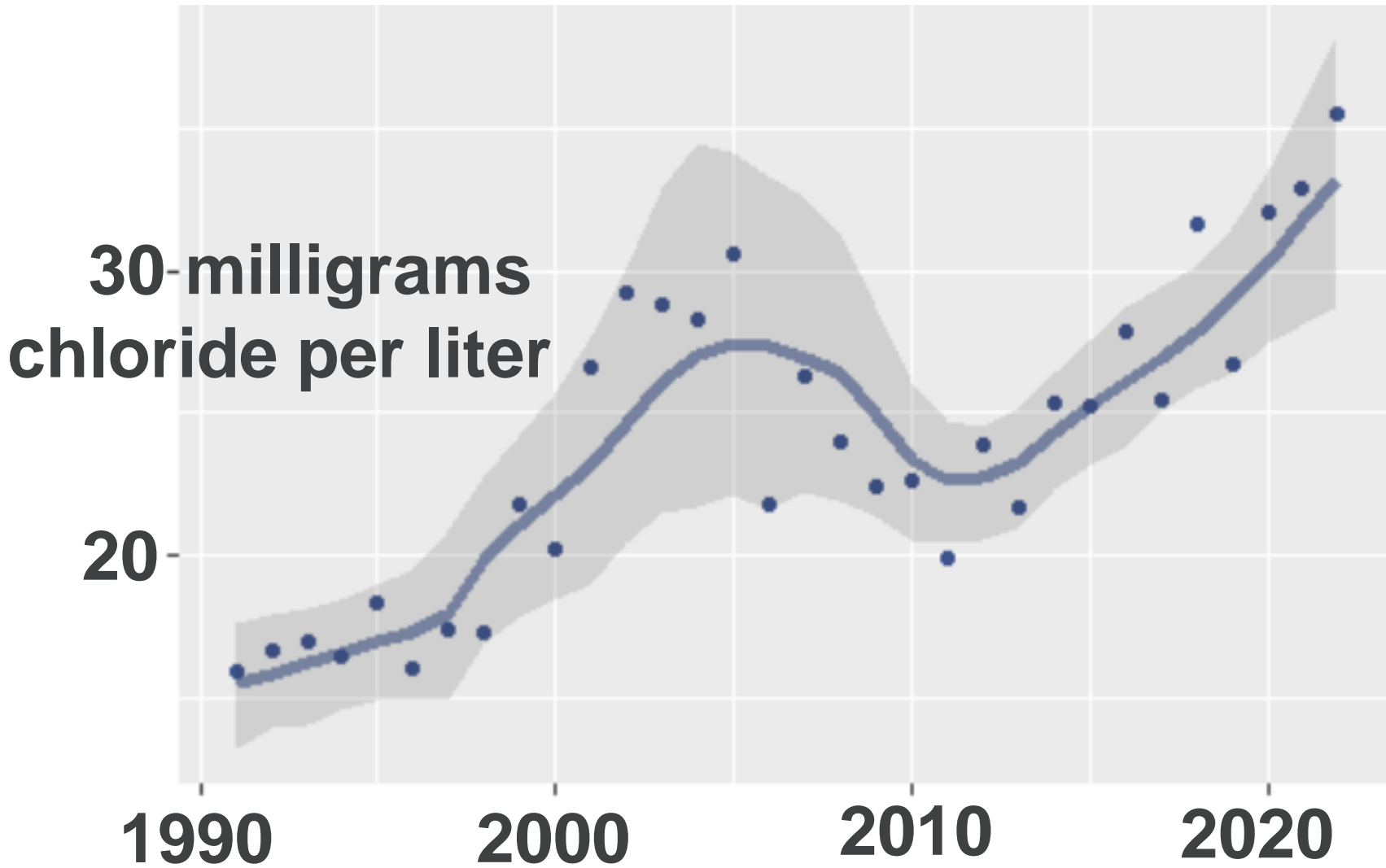
**Milligrams chloride per  
liter**

# Chloride concentration trends

- Increased since 1990 in 15 out of 18 tributaries
- 41 to 163% increase

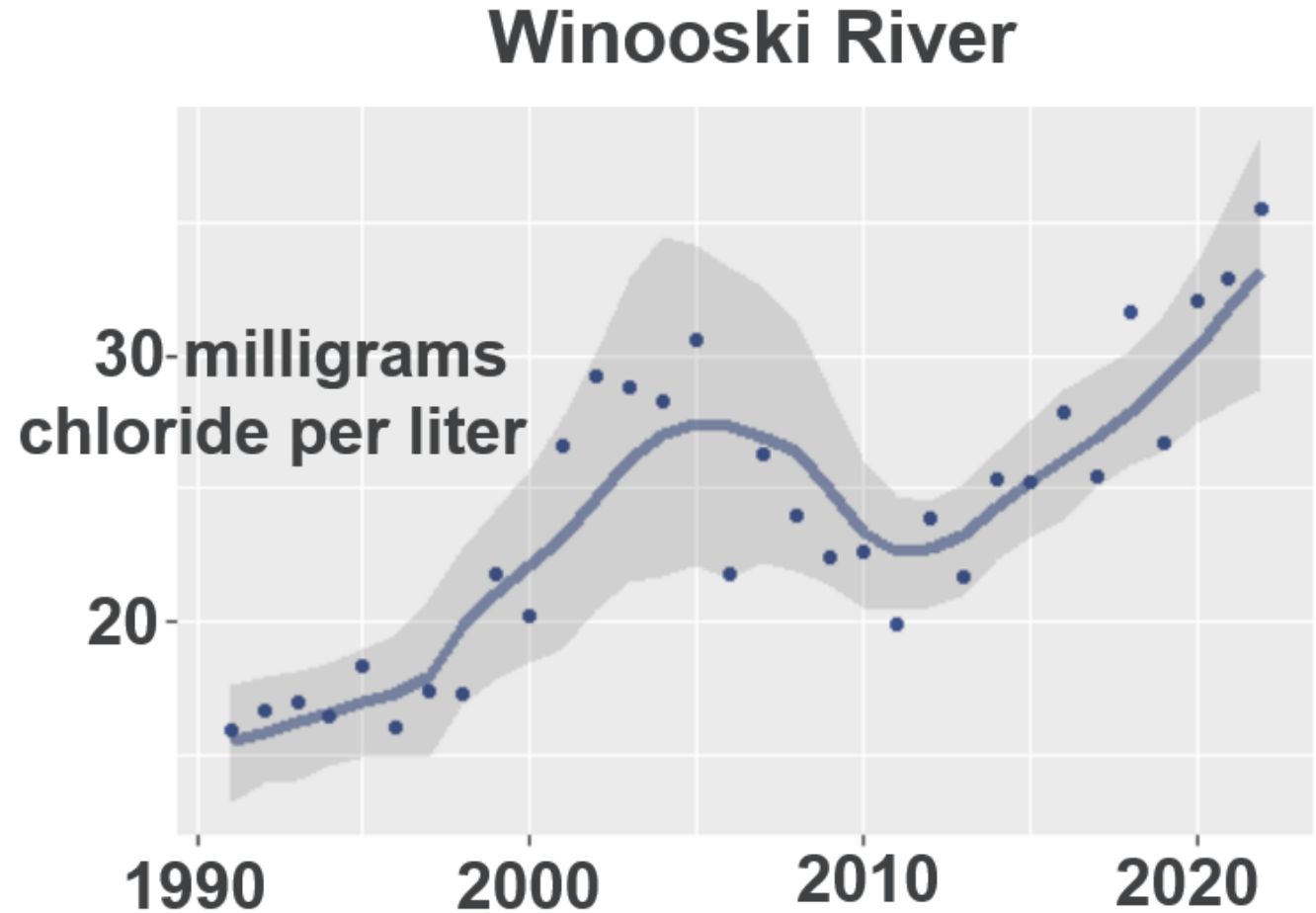


# Winooski River

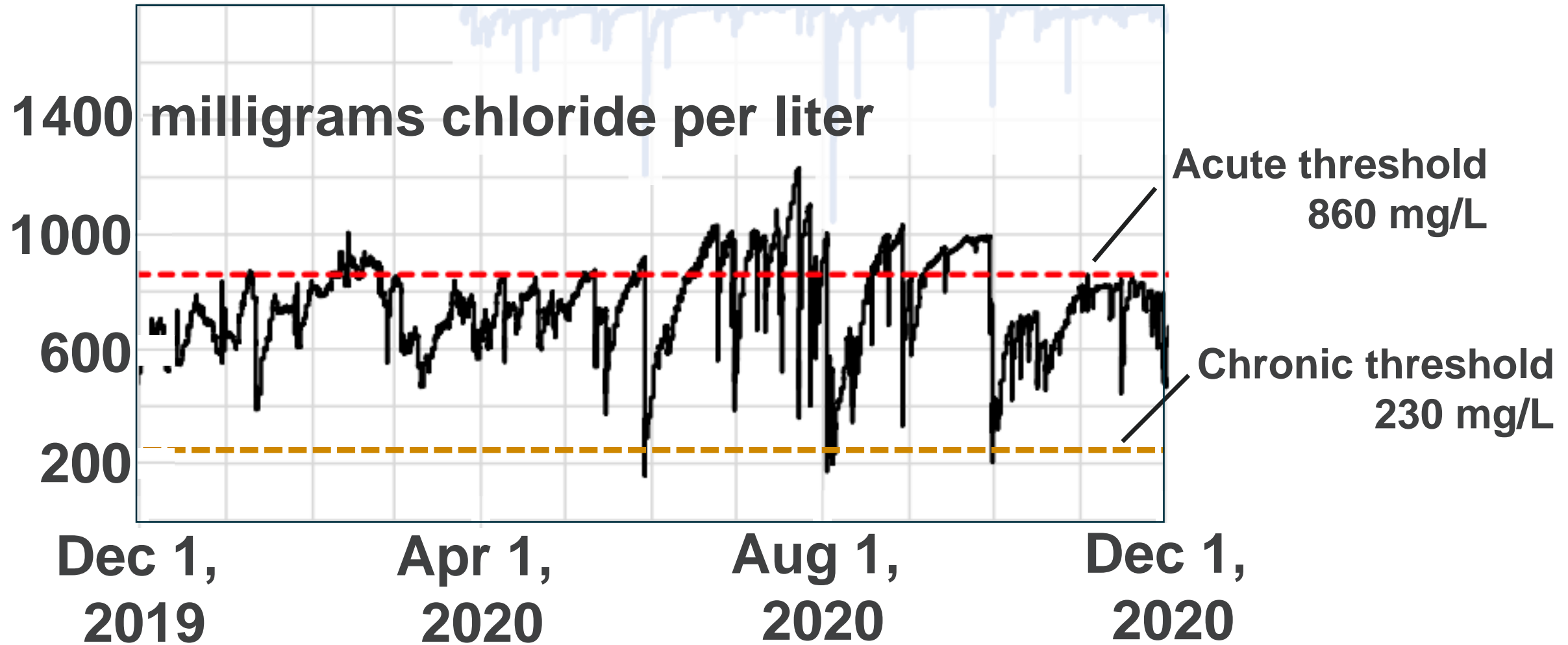


## Chloride concentrations (milligrams chloride per liter)

- **< 10** – natural background
- **> 20** – elevated
- **> 35** – documented impacts to biodiversity
- **230** – EPA *chronic* threshold for aquatic toxicity
- **250** – EPA secondary drinking water standard (taste)
- **860** – EPA *acute* threshold for aquatic toxicity



# Sunnyside Brook

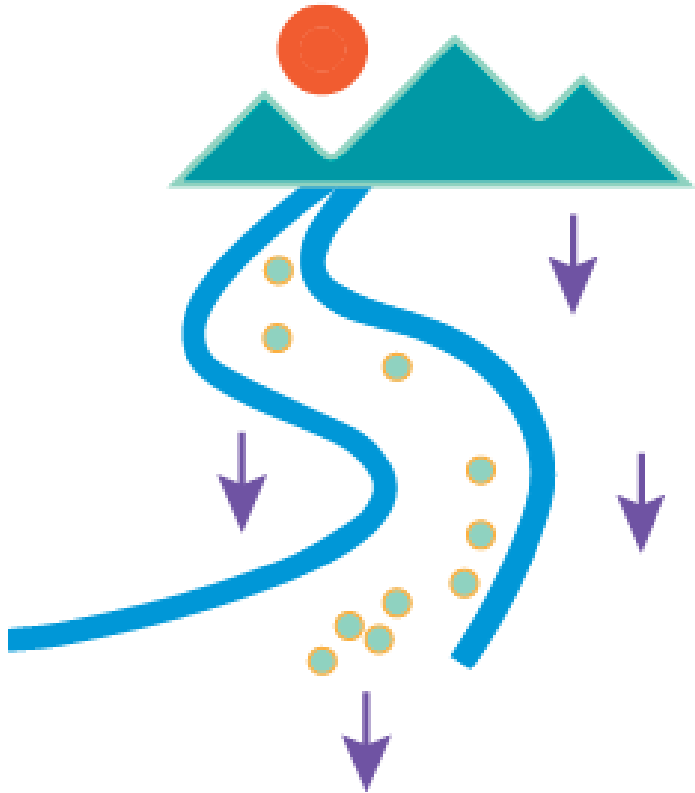


Adapted from [Sunnyside Brook TMDL](#)

# Sunnyside Brook

Year:	2019	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020
Month:	<u>Dec</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>July</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>
Ave Cl (mg/L)	642	701	847	674	734	743	810	911	739	893	633	787
Acute exceedences (% of time)	0.0%	1%	46%	0%	0%	13%	45%	70%	40%	78%	0%	0%
Chronic exceedences (% of time)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Adapted from [Sunnyside Brook TMDL](#)



## Load:

Total amount delivered to a receiving water body in a period of time

**Metric tons chloride per year**

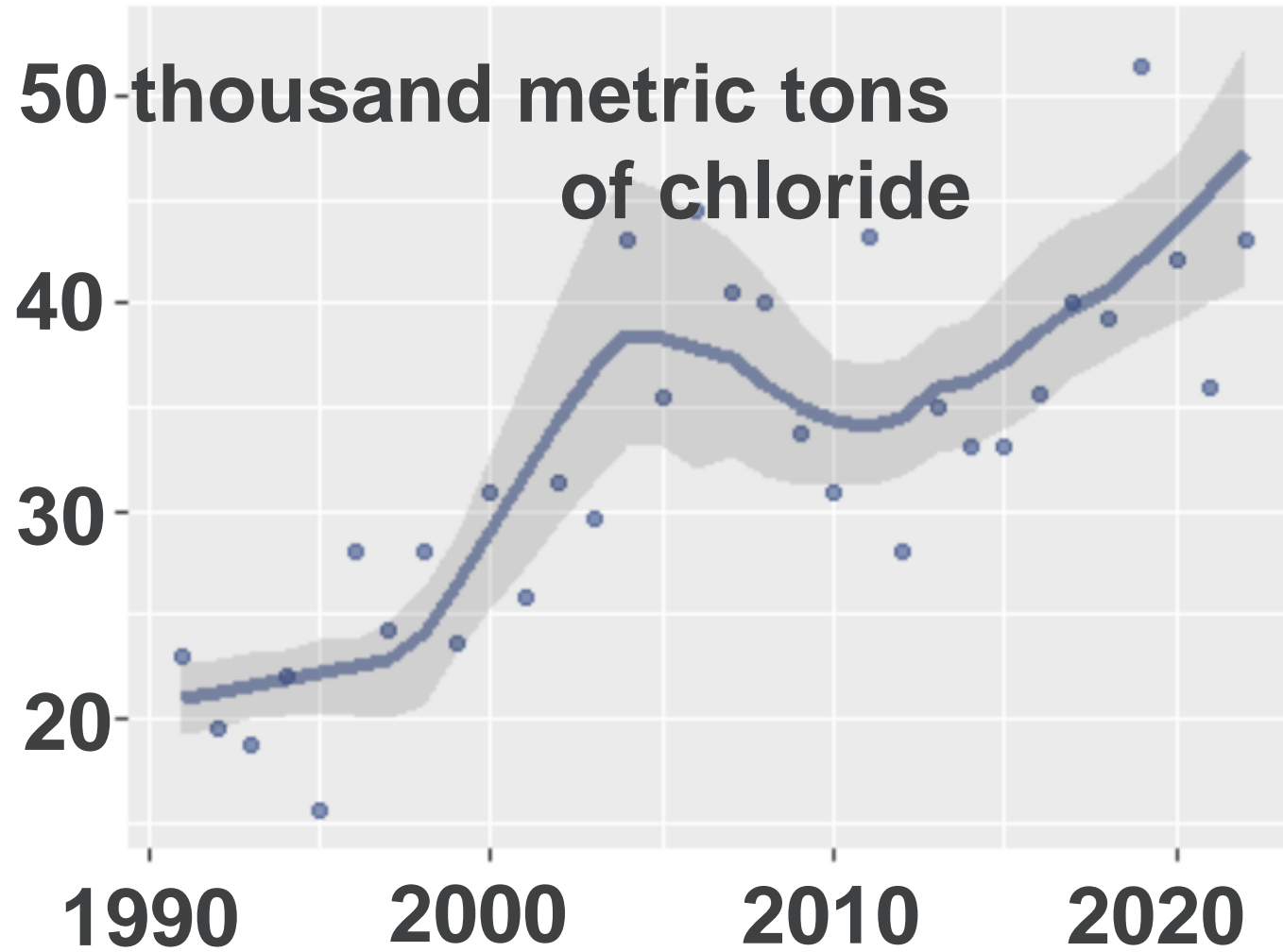
# Chloride load trends

- Increased since 1990 in 15 out of 18 tributaries
- 1.9 to 127% increase





# Winooski River



# Lake Champlain

15 milligrams  
chloride per liter

10

5

0

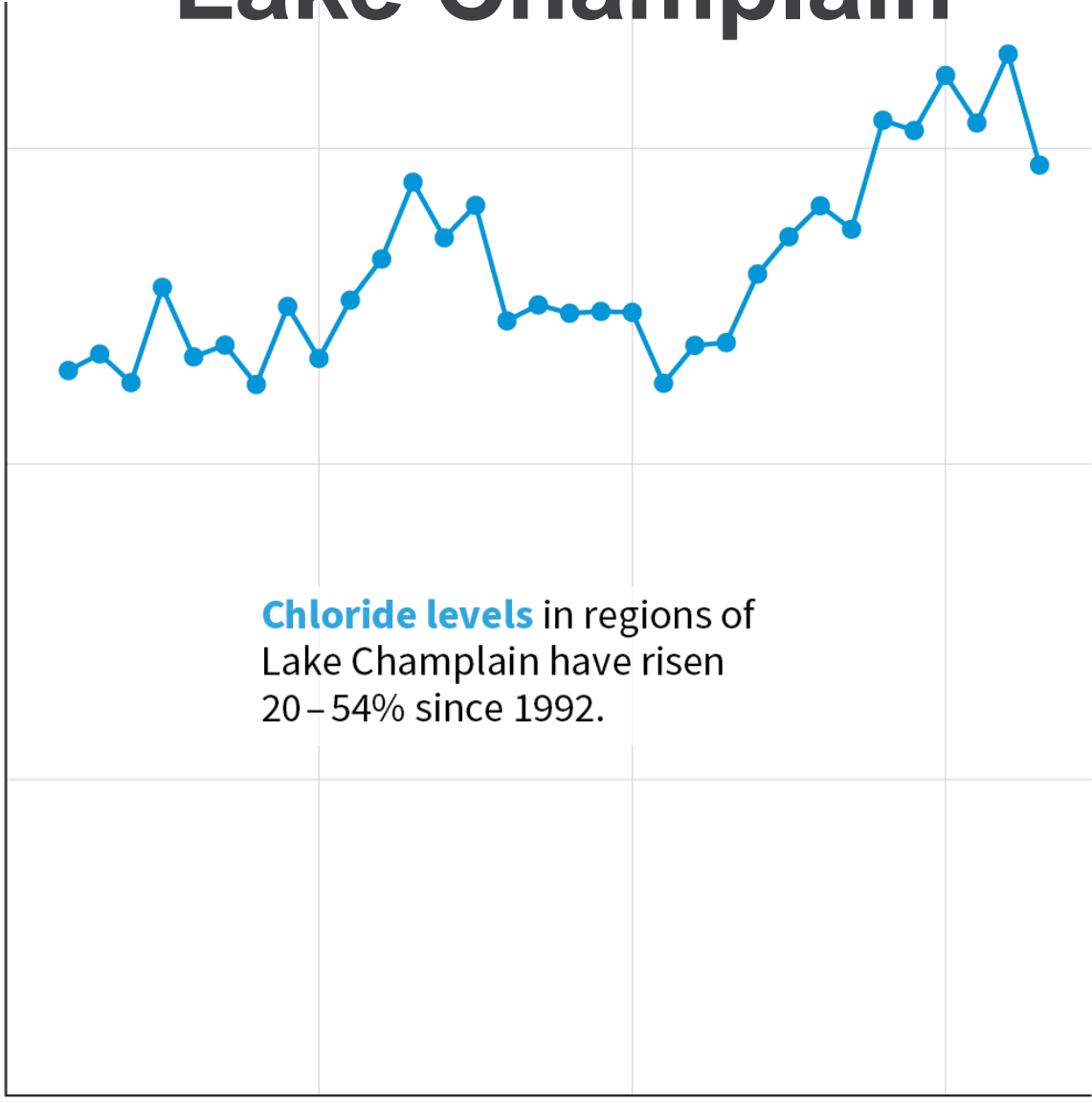
1990

2000

2010

2020

Chloride levels in regions of  
Lake Champlain have risen  
20 – 54% since 1992.



## Overview of LCBP ongoing chloride research

- Research article
- Mirror Lake study and monitoring (AsRA, AWI)
- Basin-wide study of chloride data - long-term trends, inform BMP implementation (AWI)
- Forecast future road salt use with downscaled climate models (AWI)
- Study on chloride sources and impacts to macroinvertebrates (Middlebury College)



**Questions?**

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