

Ecological Effects of Road Salts

Impacts from Alternative Salt Products



Rick Relyea



Freshwater salinization: A global problem

Increased salinization of fresh water in the northeastern United States

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ECOSPHERE

A global perspective on wetland salinization: ecological consequences of a growing threat to freshwater wetlands

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Salinisation of rivers: An urgent ecological issue

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Salting our freshwater lakes

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WATER

Saving freshwater from salts

Ion-specific standards are needed to protect biodiversity

By M. Cañedo-Argüelles,^{1,2} C. P. Hawkins,³ B. J. Kefford,⁴ R. B. Schäfer,⁵ B. J. Dyack,⁴ S. Brucet,^{6,1} D. Buchwalter,⁷ J. Dunlop,⁸ O. Frör,⁵ J. Lazorchak,⁹ E. Coring,¹⁰ H. R. Fernandez,¹¹ W. Goodfellow,¹² A. L. González Achem,¹¹ S. Hatfield-Dodds,¹³ B. K. Karimov,¹⁴ P. Mensah,¹⁵ J. R. Olson,¹⁶ C. Piscart,¹⁷ N. Prat,² S. Ponsá,¹ C.-J. Schulz,¹⁸ A. J. Timpano¹⁹



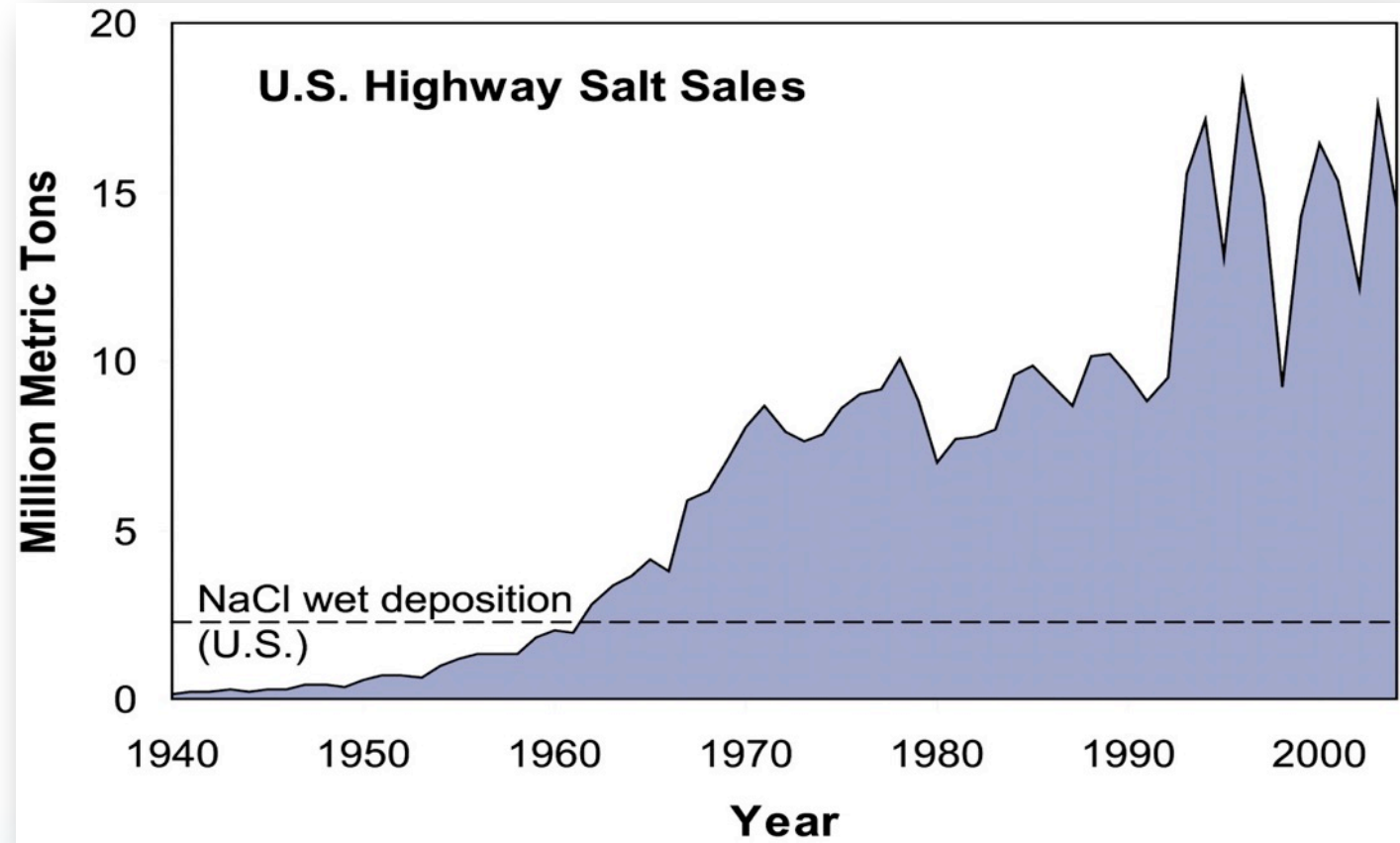
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SALT SUMMIT

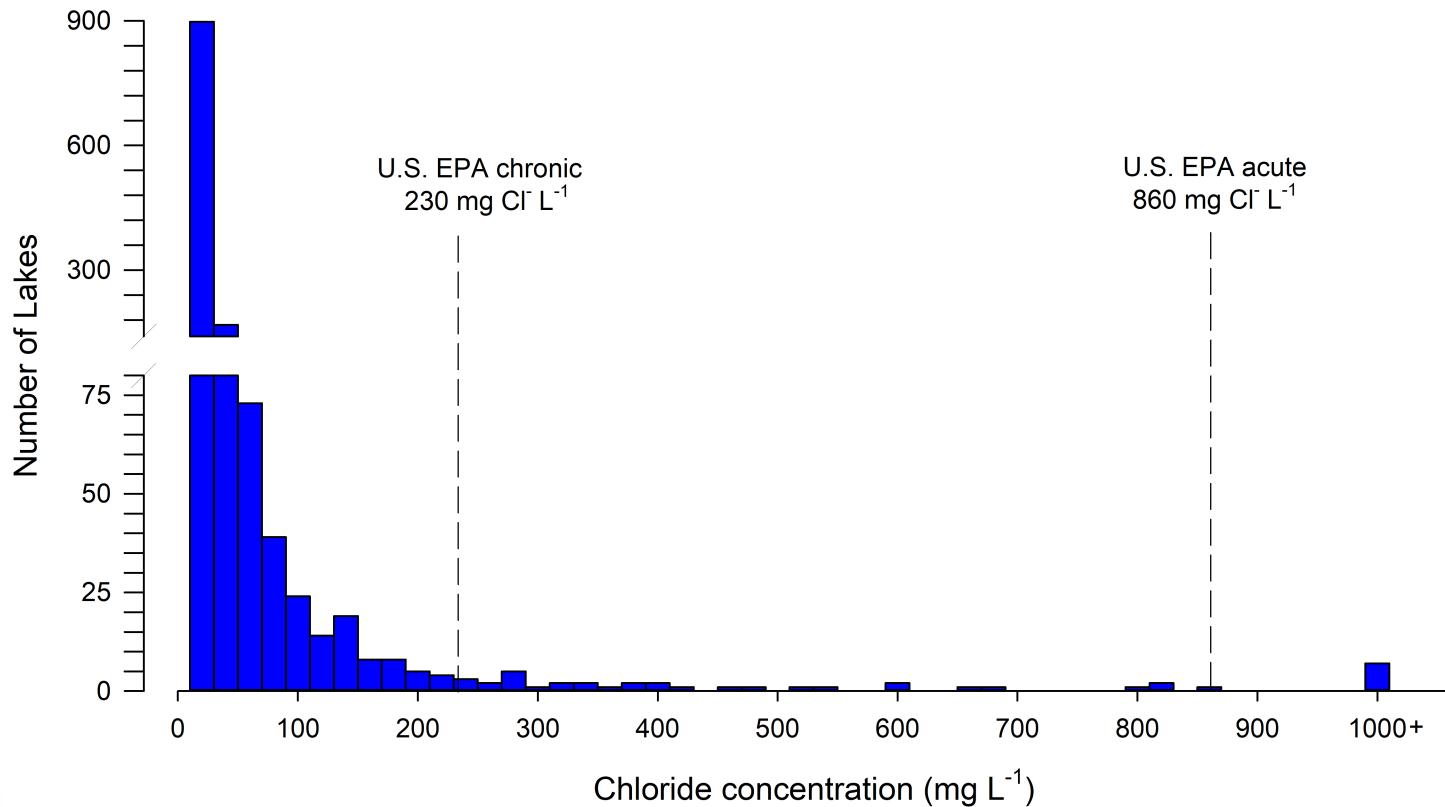
George Partnership

The Business of Reducing the Use of Road Salt

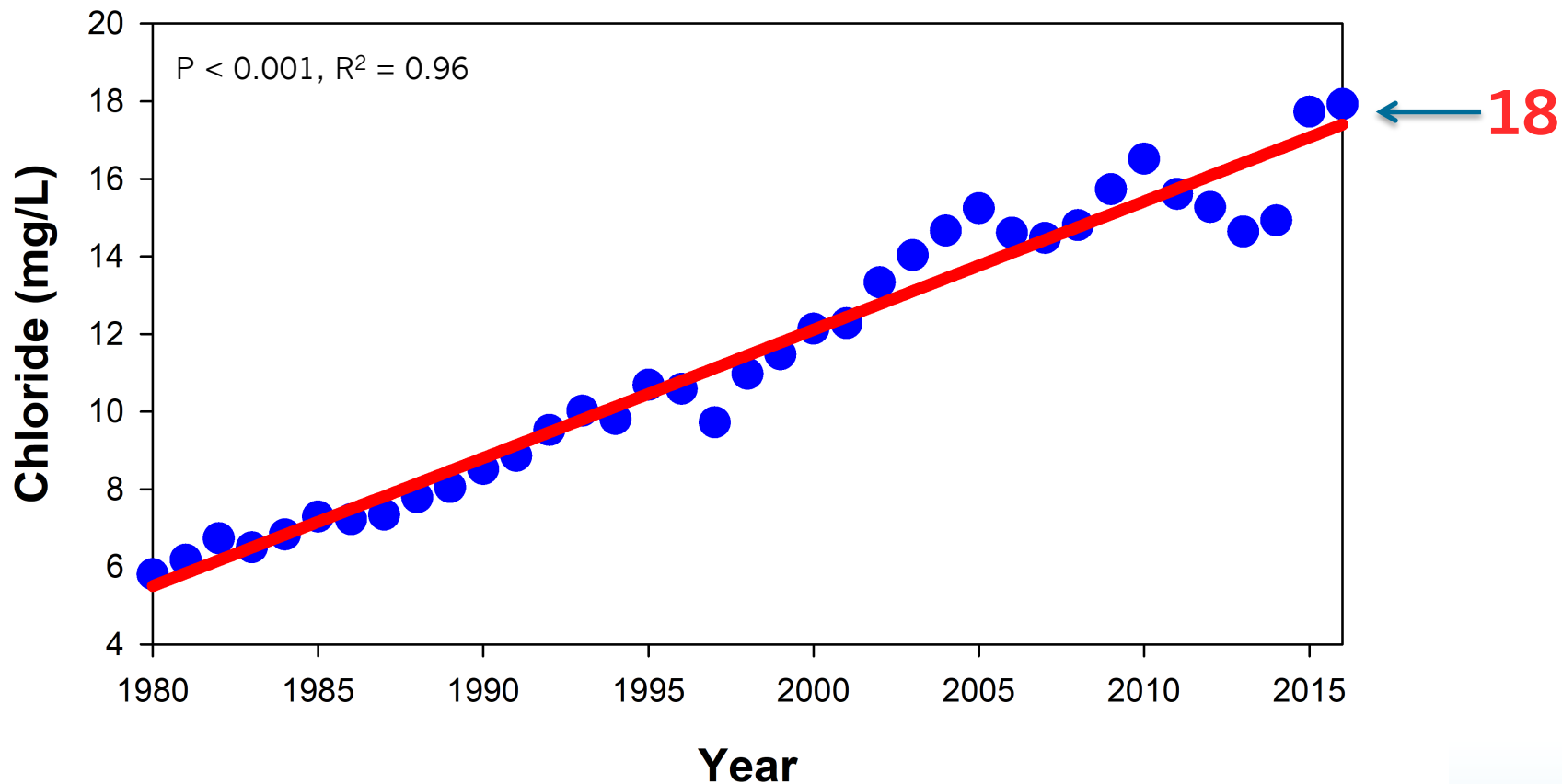
Freshwater salinization: A national phenomenon



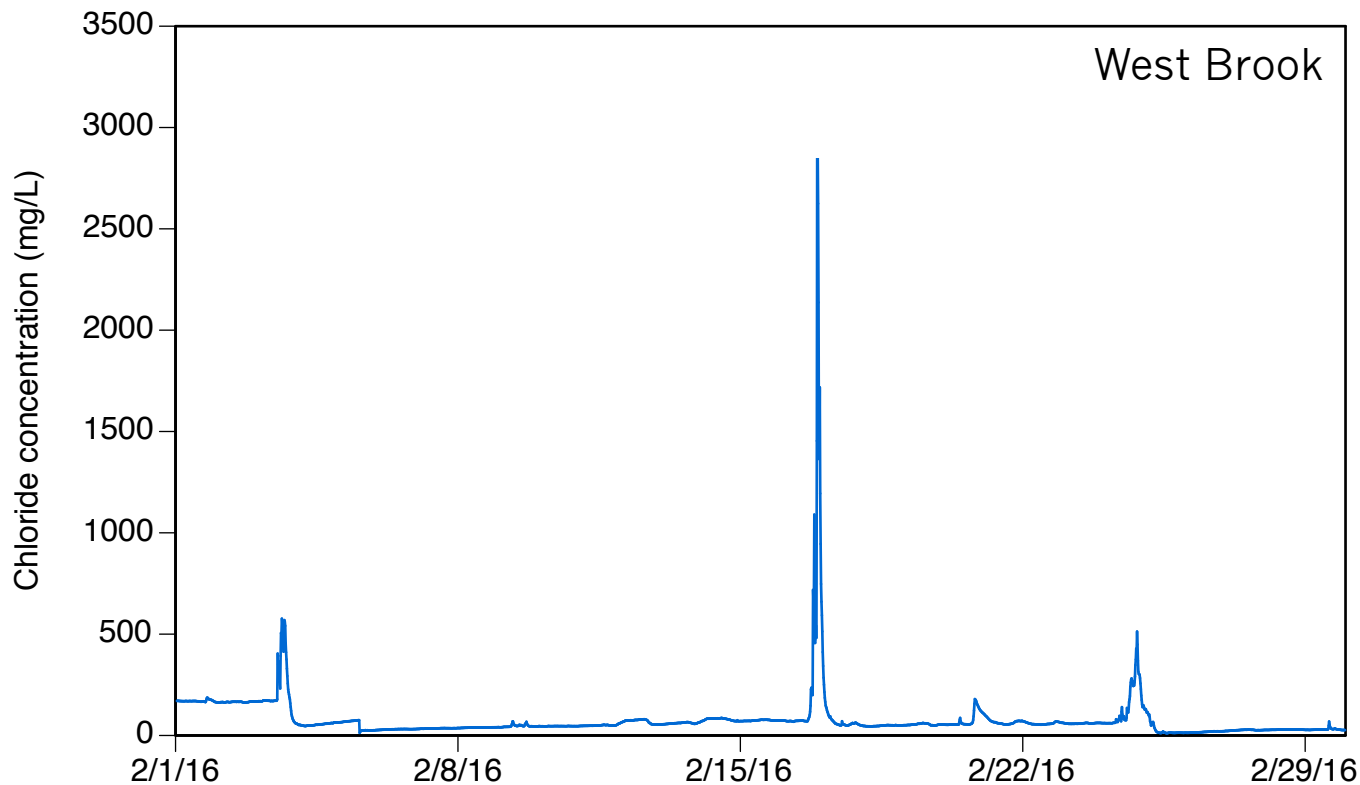
Most lakes have salt concentrations of 0–6 mg Cl⁻/L



The salt concentration in Lake George has been slowly increasing



Our streams can experience 150 times higher salt than our lakes!



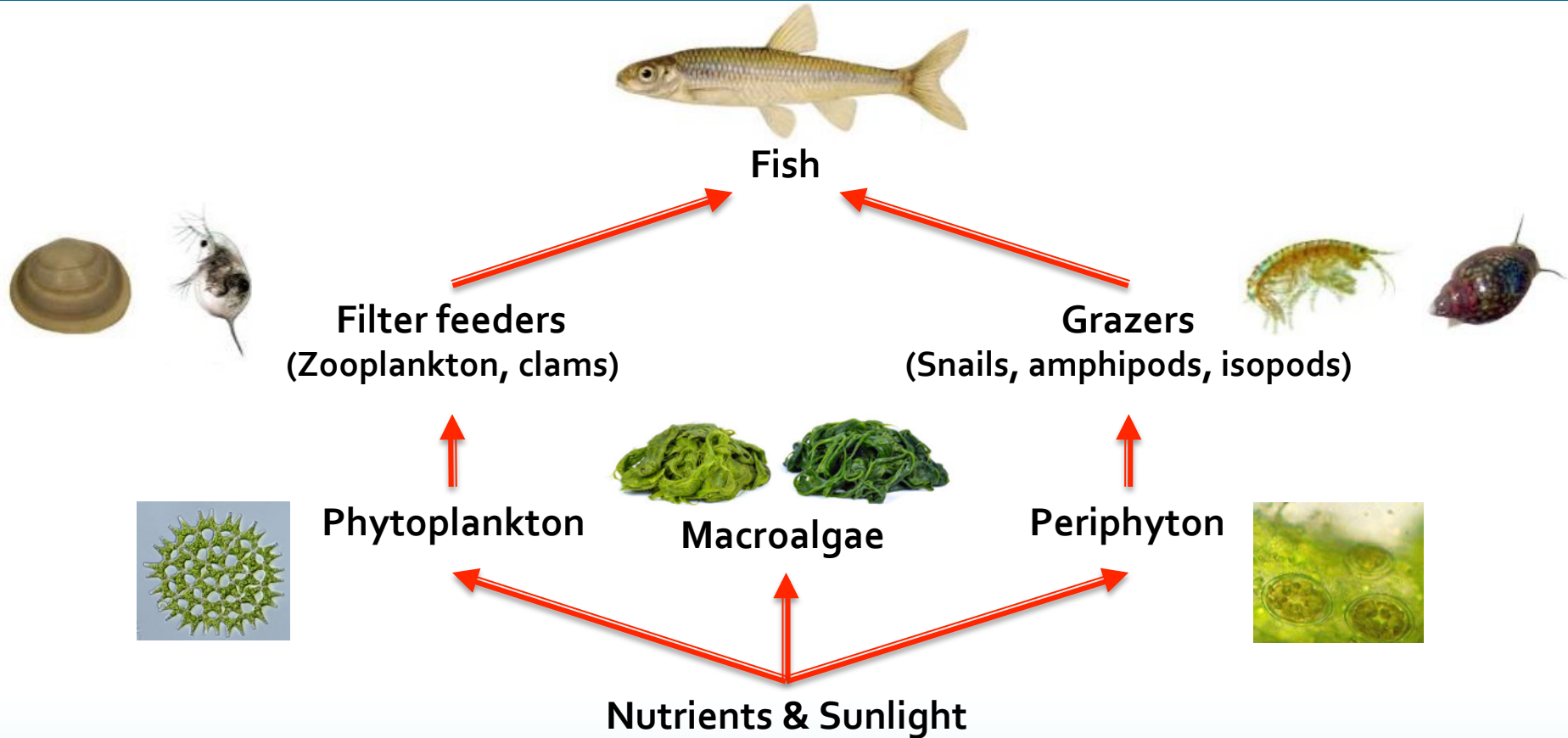
How do increasing salt concentrations affect aquatic organisms?



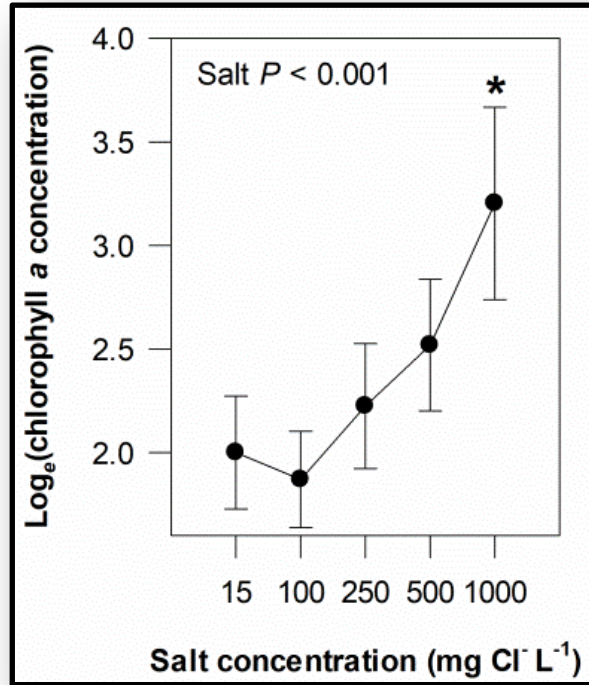
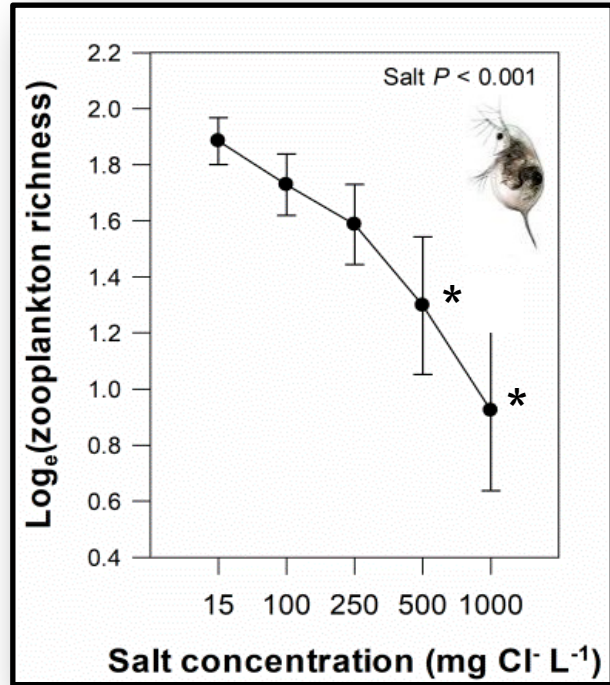
What are the ecological effects of:

- **Common road salt (NaCl)?**
- **Alternative road salts (MgCl_2 , CaCl_2)?**
- **Organic additives?**

Effects of common road salt (NaCl) on food webs

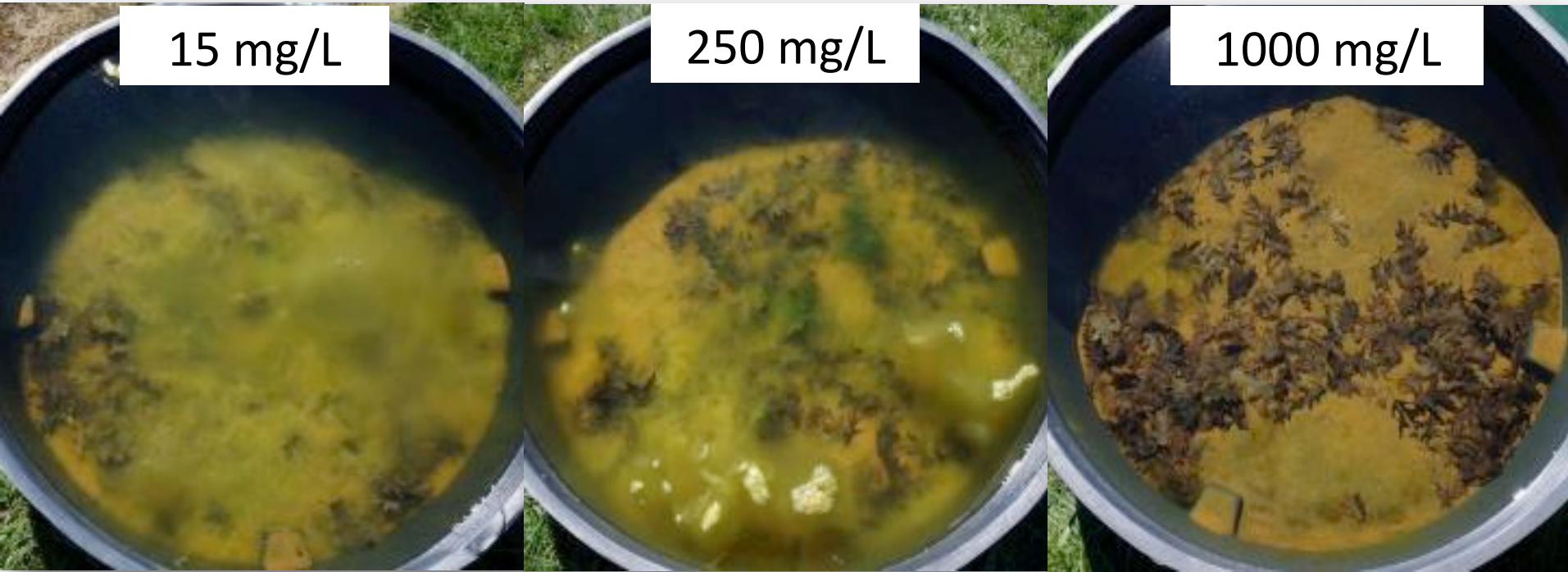


Increased NaCl can kill zooplankton, causing phytoplankton blooms



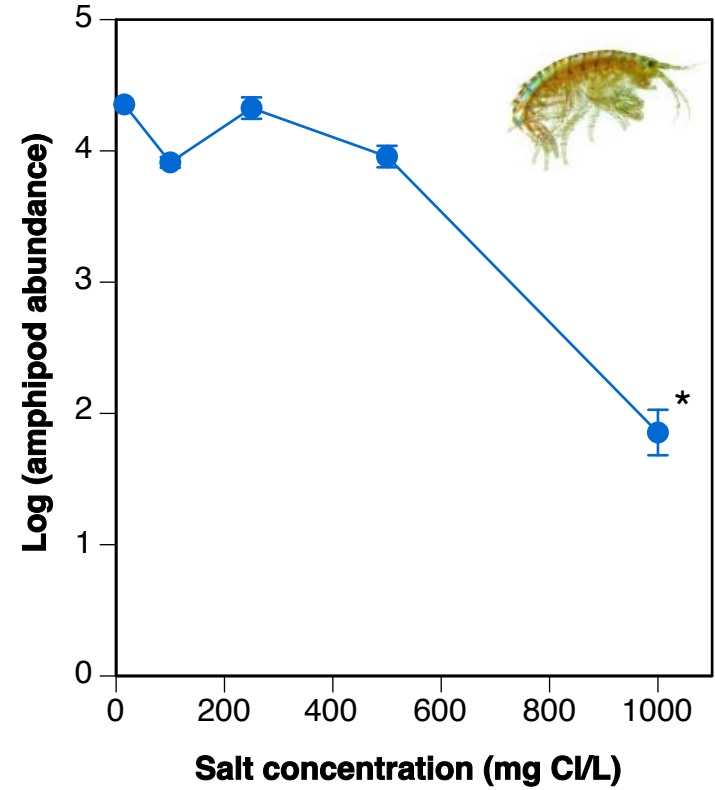
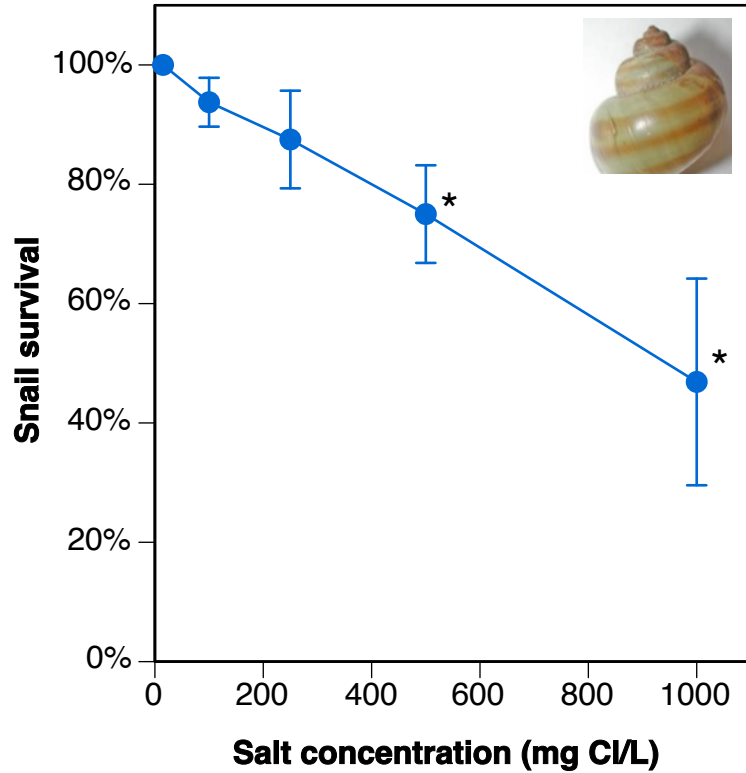
(Hintz et al., 2017)

Increased NaCl can kill filamentous algae



(Hintz et al., 2017)

Increased NaCl can kill banded mystery snails and amphipods



(Hintz et al., 2017)

Effects of common road salt (NaCl)

Some species are unaffected even at high concentrations (1000 mg Cl/L)

Isopods



Periphyton



Fingernail clams



High concentrations of road salt can change an animal's sex!

Exposing wood frog tadpoles to road salt



2 months of salt exposure



10% more males

Some species can evolve an increased tolerance to NaCl



Salt-susceptible
zooplankton

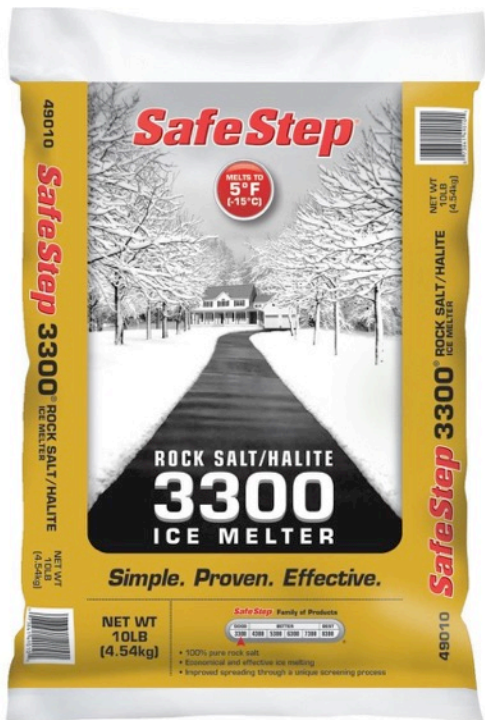
2.5 months of salt exposure



Salt-tolerant
zooplankton

What about alternative road salts (MgCl_2 , CaCl_2)?

NaCl



MgCl_2



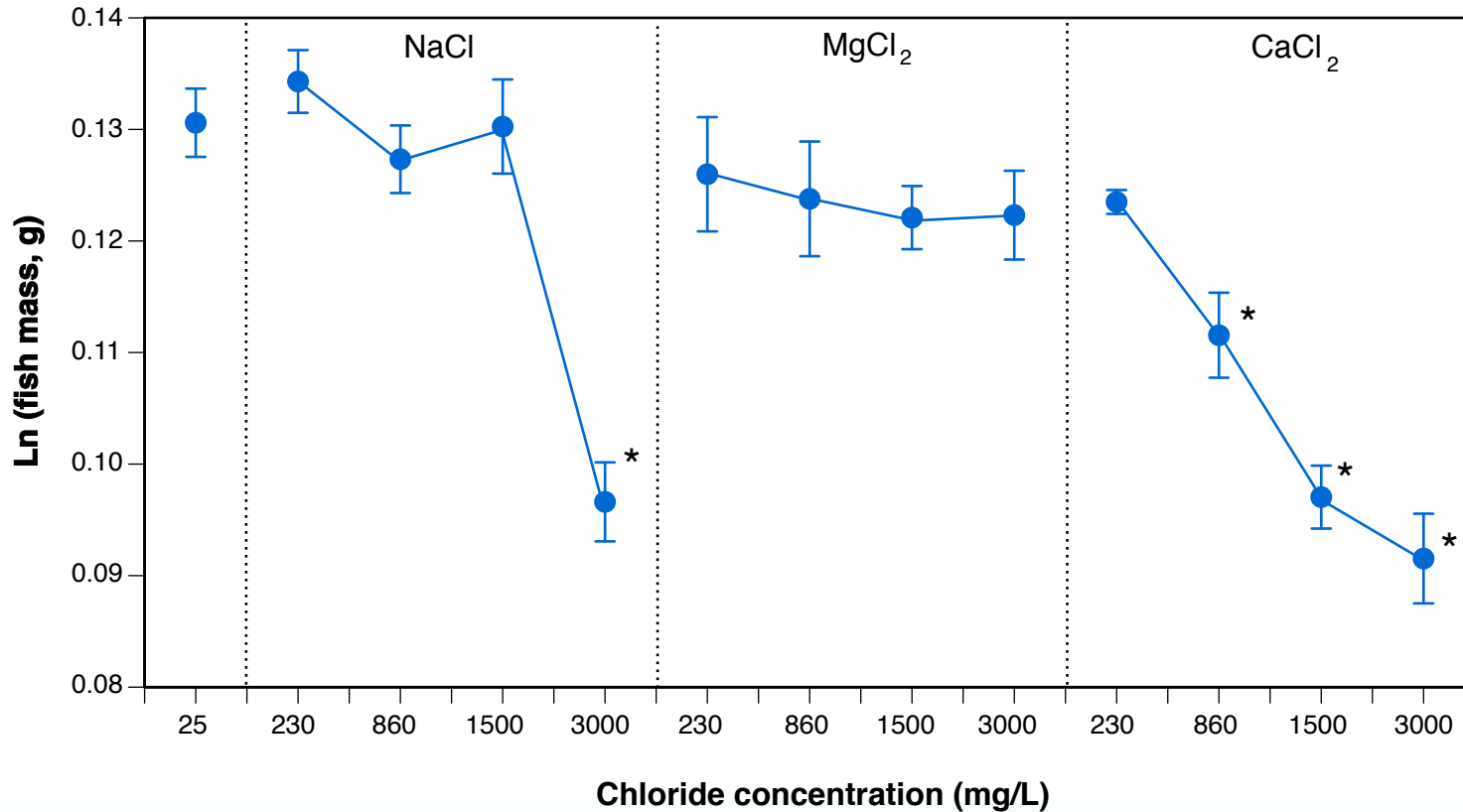
CaCl_2



Applications of different salts in NY

NaCl (Road Salt)	836,020 tons
Treated Road Salt	44,761 tons
Liquid CaCl_2	46,820 gallons
Liquid MgCl_2	176,691 gallons
Salt Brine	856,825 gallons
Abrasives	10,619 tons

Effects of alternative road salts on the growth of rainbow trout



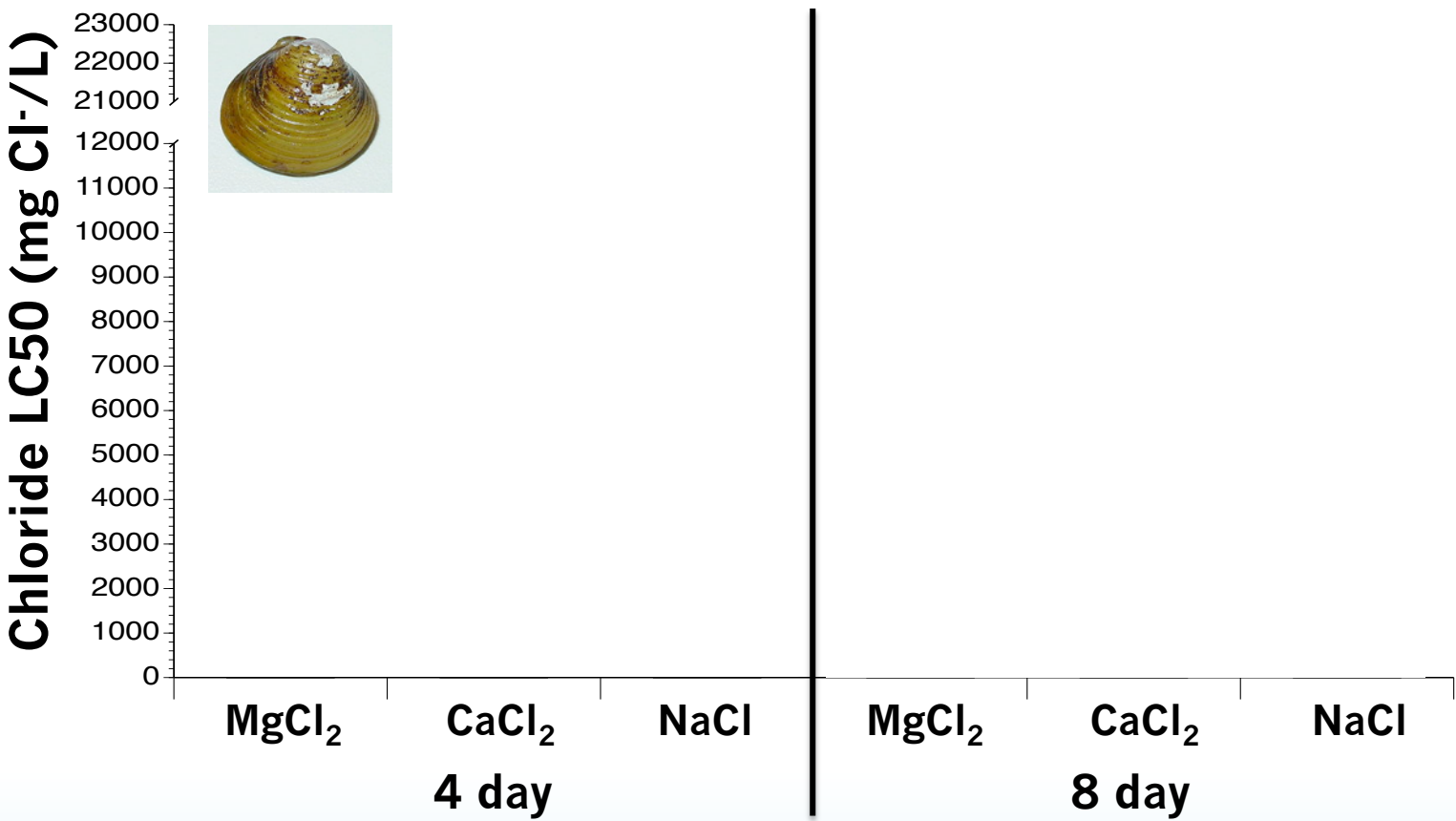
Effects of alternative road salts on the growth of rainbow trout

3,000 mg Cl/L CaCl_2

No salt

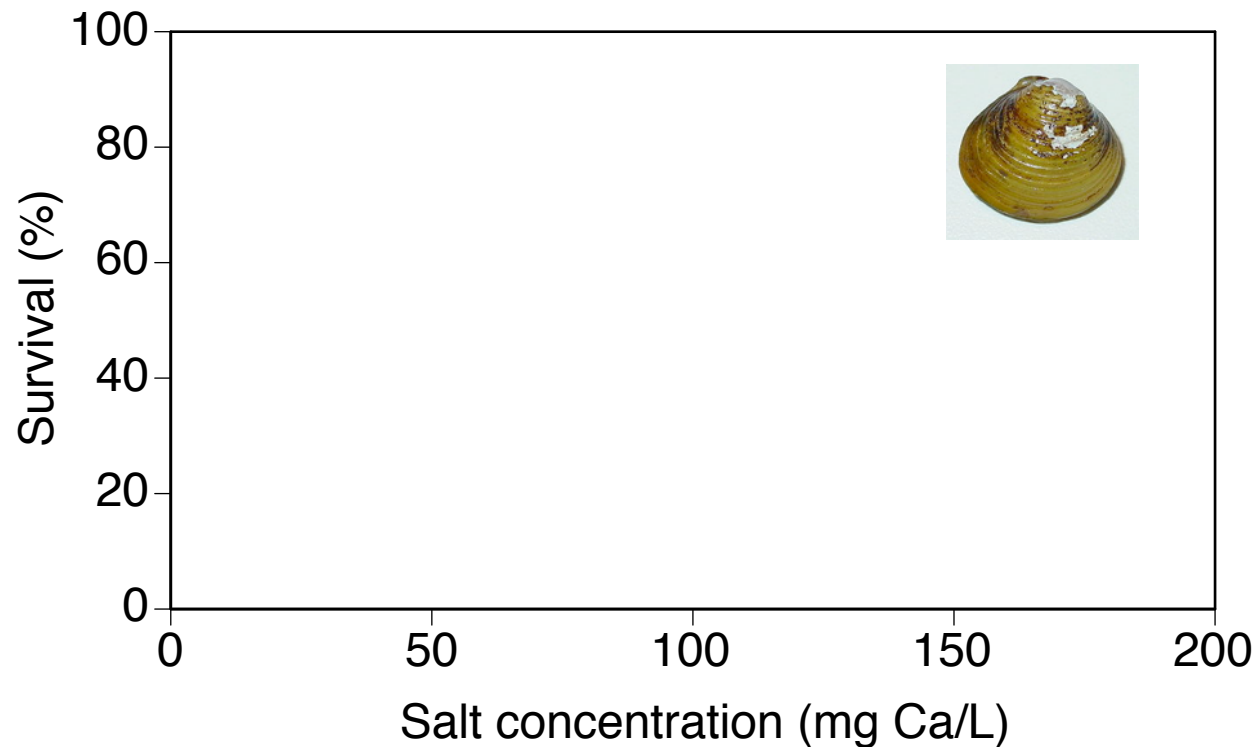


How much of each road salt does it take to kill Asian clams?

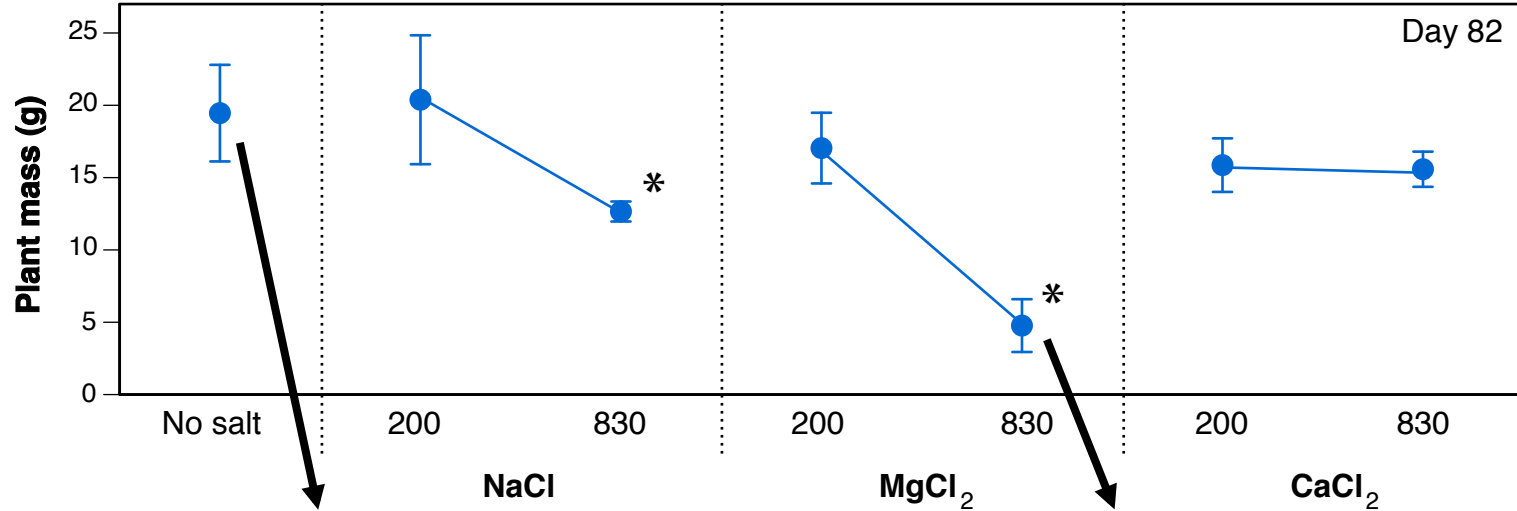


(Coldsnow & Relyea 2018)

Do lower concentrations of CaCl_2 favor calcium-loving Asian clams?



Effects of alternative road salts on plant growth



(Coldsnow et al., in prep.)

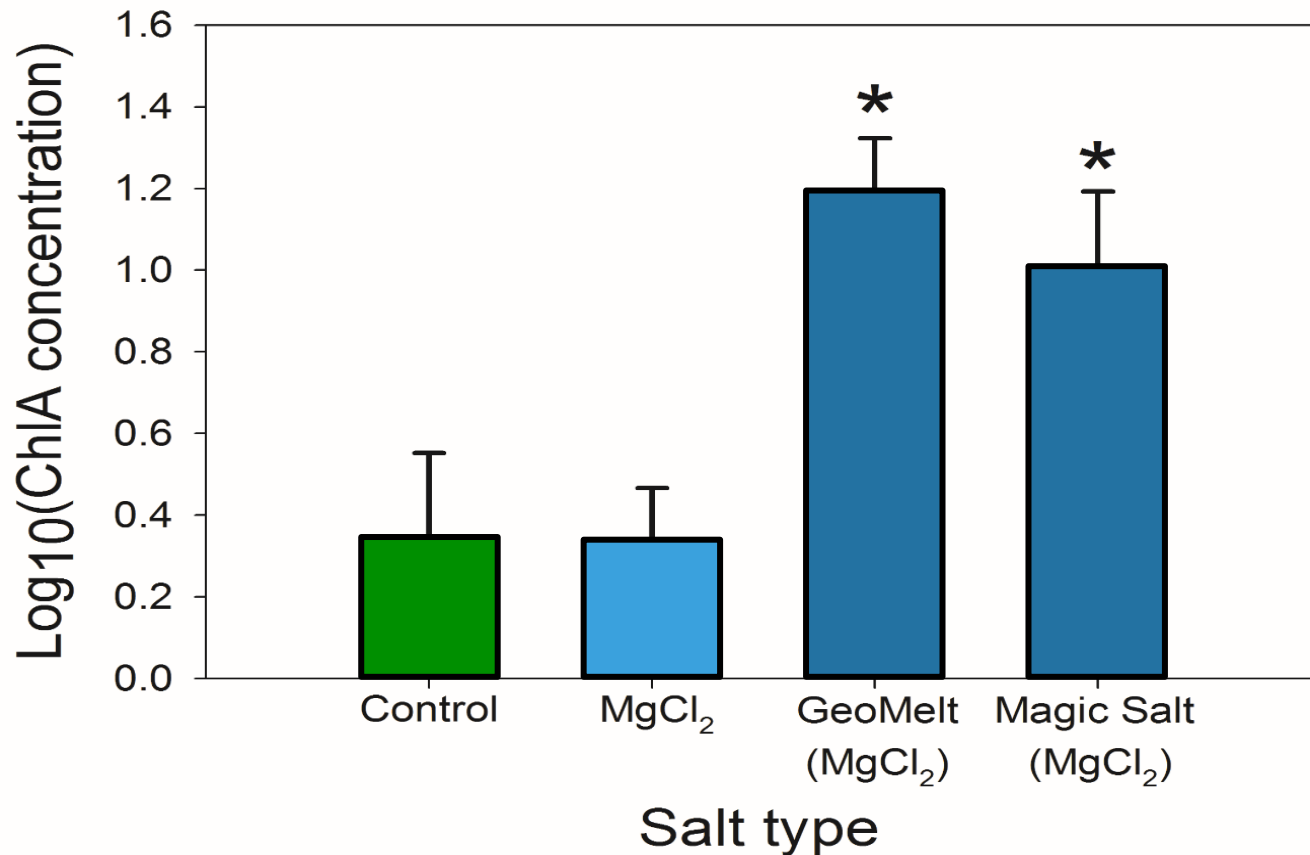
Organic additives allow 30-50% less salt use

Common organic additives include:

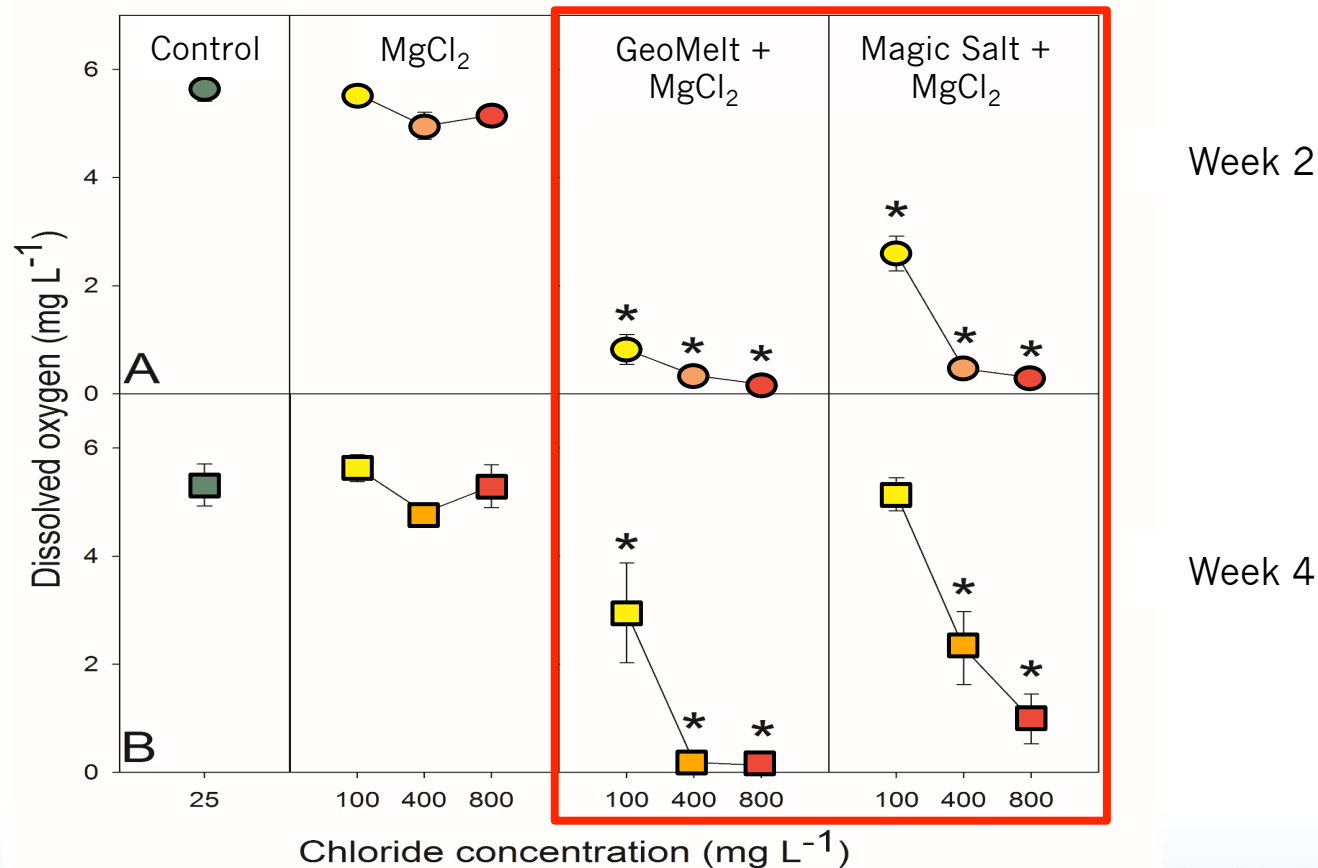
- **Beet juice (e.g., GeoMelt)**
- **Distillation by-products (e.g., Magic Salt)**



Organic additives: How do they affect aquatic ecosystems?



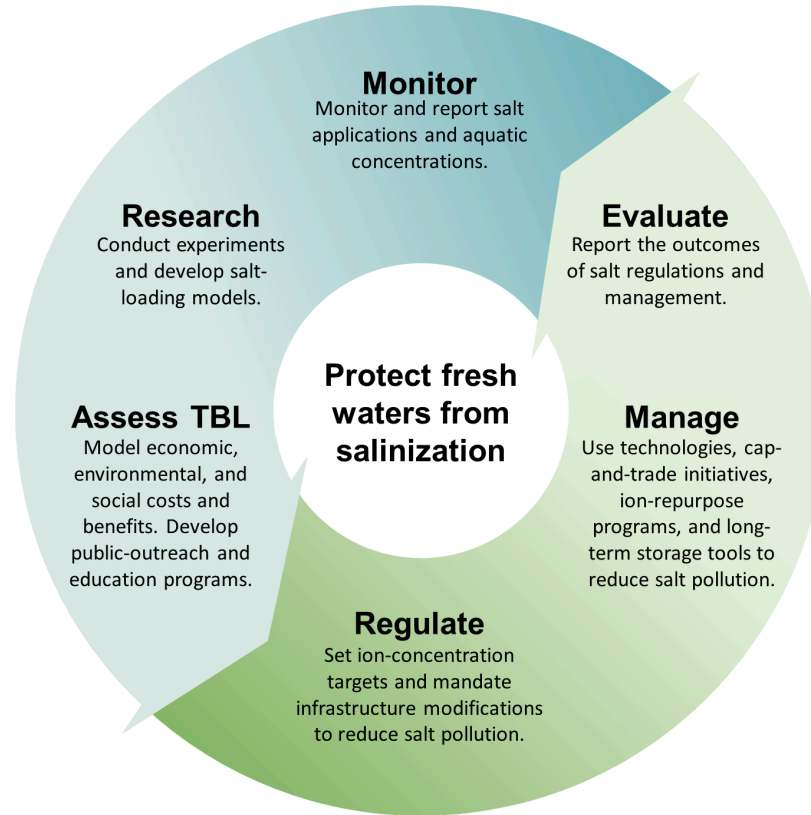
Organic additives: How do they affect aquatic ecosystems?



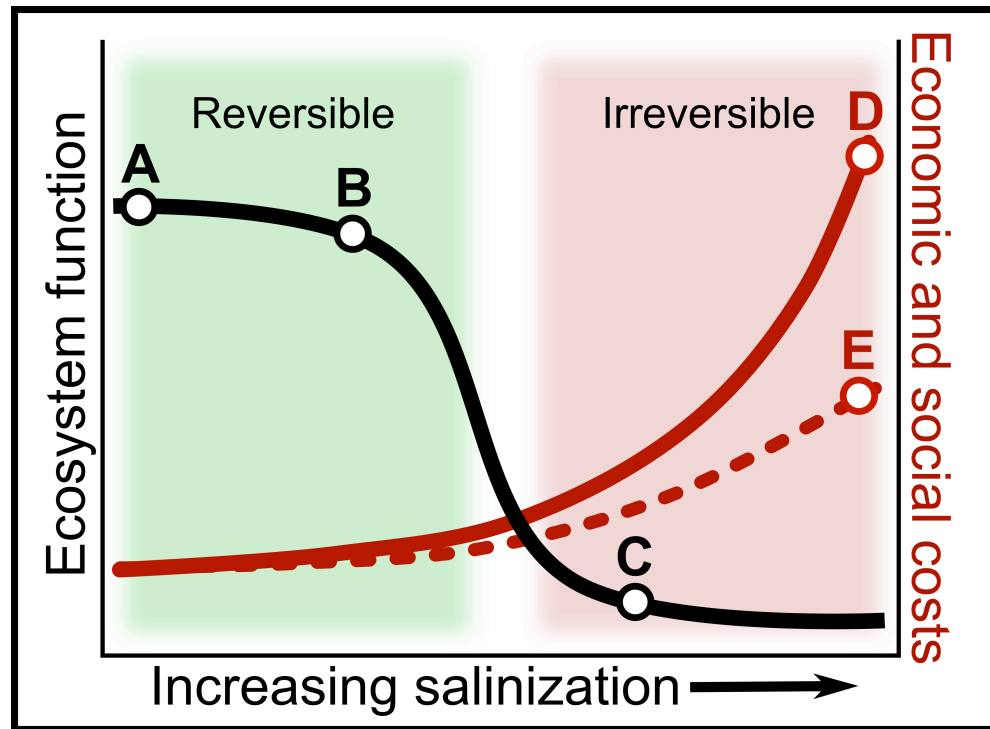
A Review of the Combined Threats of Road Salts and Heavy Metals to Freshwater Systems

MATTHEW S. SCHULER AND RICK A. RELYEA

Protecting fresh water from salinization



The long-term consequences of not protecting freshwater



Conclusions

Common road salt (NaCl) causes widespread harm to aquatic species, but only at fairly high concentrations (>200 mg Cl/L)

Fortunately, Lake George has a chloride concentration of 18 mg Cl/L, and it is increasing slowly (~0.3 mg per year)

Salt alternatives are more effective at melting snow, but their costs are higher and their harm to aquatic species can be higher

Salt additives allow less salt to be used, but they can act as fertilizers as they decompose

The problem is serious, but we have the time and technologies to reduce the salt in Lake George and lakes around the world

Acknowledgements

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4th Annual S.A.V.E. Lake George Partnership

SALT SUMMIT

The Business of Reducing
the Use of Road Salt

Thank You!