Any Port in a Storm: Impacts of Salt Pollution on Pond-Dwelling Amphibian Communities

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Introduction

Urban freshwater systems are limited & lower quality – pollution, isolation. Patterns of disturbance within urban streams have been observed. Urban ponds, however, remain comparatively understudied [1].

Salt is a major urban freshwater pollutant, especially in artificial habitat (*e.g.*, stormwater retention ponds). Increases in salinity have been associated with reductions in habitat quality, biological integrity, and restructuring of biological communities [2].

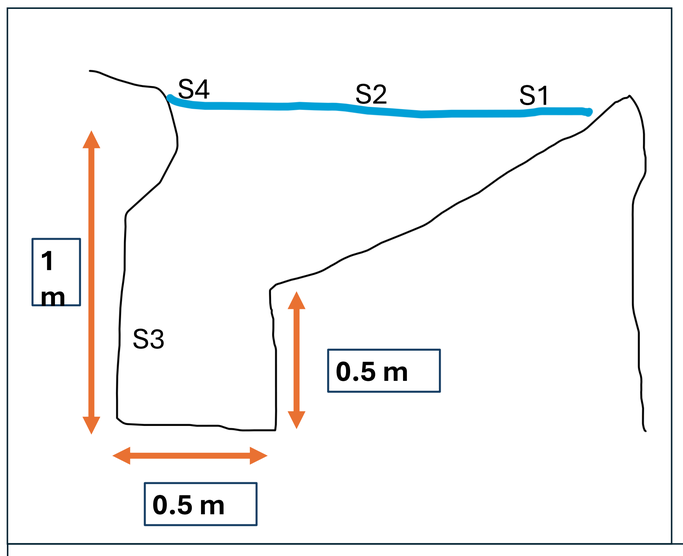
Amphibians have been a popular choice in bioindicator for assessing the impacts of freshwater ecosystem salt pollution. However, their responses can be affected by the complexity of urban disturbance regimes [3].

This project isolates the effects of salt on amphibian habitat choice and breeding success to answer two main questions:
1) Are ponds with elevated salinity habitat for amphibians?
2) Are ponds with elevated salinity **good** habitat for amphibians?

Methods

Long term study in a mesocosm system:
- 10 experimental ponds, adjacent & constructed identically
- 5 control, 5 elevated salinity (1 g/L – in line with CEPA chronic toxicity thresholds)

Surveys every two weeks (breeding season) or four weeks (winter):
- Water Quality
- Amphibian Larvae
- Macroinvertebrates (Hannah Bodmer)
- Adult Dragonflies & Damselflies (Hannah Bodmer)



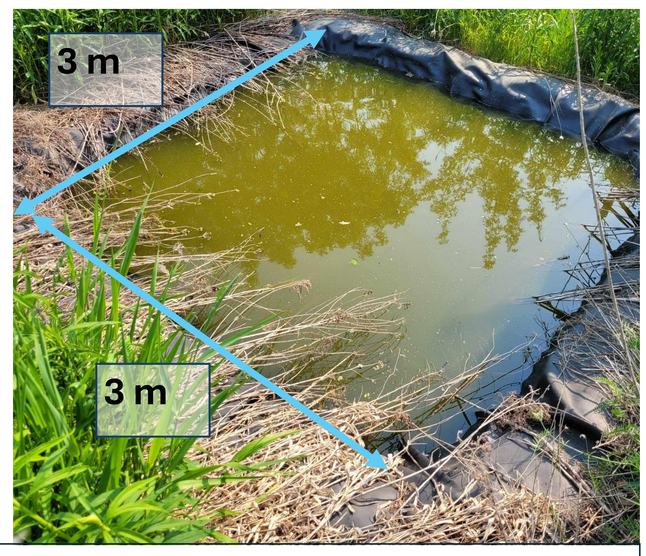


Figure 1: Experimental Pond Structure & Dipnet Survey Design. A) Experimental pond layout. Ponds are designed to provide multiple microhabitats. S1-4 are sweep locations in the different pond microhabitats: S1 –Shallows; S2 - Open water column; S3 – Benthic layer + leaf litter; S4 – Sheltered water column (overhang & submerged vegetation).

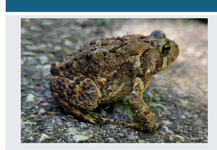
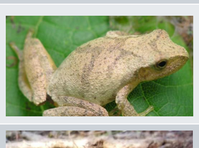
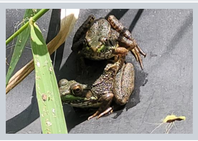
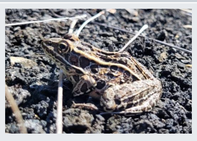
Species	Adult Presence		Larvae Presence (2024)		Larval Population Size	Larval Metamorphosis	Observed Larval Mortality	
	Control	Treatment	Control	Treatment			Control	Treatment
 American Toad	**Y**	**Y**	**Y**	**Y**	No Effect Observed	No Effect Observed	0	**16**
 Grey Tree Frog	**Y**	*N*	**Y**	*N*	No Effect Observed	No Effect Observed	1	0
 Spring Peeper	**Y**	**Y**	**Y**	**Y**	Treatment **< Control (Yr 1)** **Treatment >** Control **(Yr 2)**	No Effect Observed	4	2
 Green Frog	**Y**	**Y**	*N*	**Y**	No Effect Observed	No Effect Observed	0	5
 American Bullfrog	**Y**	**Y**	*N*	*N*				
 Mink Frog	**Y**	**Y**	*N*	*N*				
 Northern Leopard Frog	**Y**	*N*	**Y**	*N*				

Table 1: Habitat Choice & Breeding Success from 2023-2024. All anuran species observed in the local landscape and in the experimental pond network. Landscape community composition assessed using bioacoustics (Research Opportunity Student Undergraduate Projects: Ethan Sun & Helen Wen). Treatment had a significant effect on larval community structure (PERMANOVA: Treatment: $p<0.01$, Treatment*Year: $P<0.05$) & this table identifies changes to habitat choice & larval population dynamics attributed to treatment.

Preliminary Conclusions

1) Ponds with elevated salinity are **still** habitat for adults, but not necessarily for breeding.
2) Ponds with elevated salinity were **worse** habitat: Increased larval mortality, overwintering failure
3) Observed guild changes in invertebrate communities – chironomids to chaoborids.
4) Water quality reductions. Increased incidence of lemna blooms, reduced incidence of algal blooms.

Next Steps: Persistence! Larval body condition, ecological functioning, trophic structuring.

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1: Ferzoco *et al.*, (2023). **Freshwater insect communities in urban environments around the globe: a review of the state of the field. *Frontiers in Ecology & Evolution* 11**
2: Ferzoco & McCauley (2024). **Novel habitats for biodiversity? A systematic review and meta-analysis of freshwater biodiversity in stormwater management ponds. *Science of the Total Environment 942***
3: Guzy *et al.*, (2012). **Urbanization interferes with the use of amphibians as indicators of ecological integrity of wetlands. *Journal of Applied Ecology 49***