Water quality in wetlands along an impervious surface gradient

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Introduction

Valdivia is a quickly growing city and urban development has sky rocketed over the past few decades. To make room for this development, wetlands have been infilled and the areas surrounding the wetlands have been increasingly urbanized. A high prevalence of impervious surfaces has been shown in other studies to alter flow regimes and increase the amount of nutrients in nearby waterways, but no research has been done in Valdivia with regards to these impacts on urban wetlands.

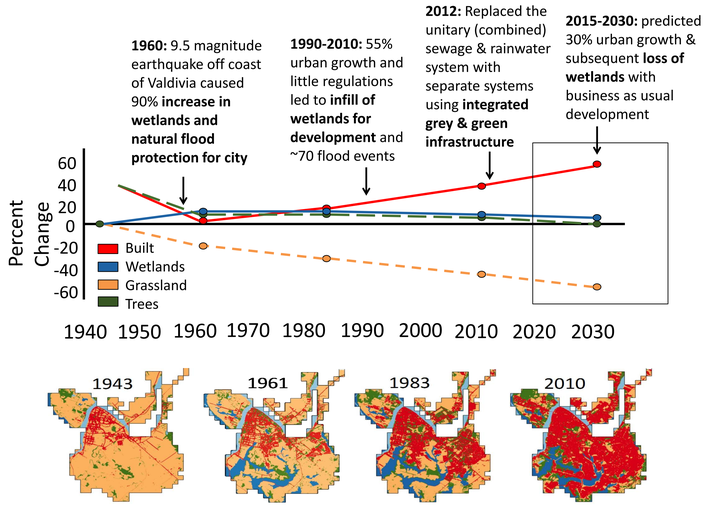


Figure 1: After a significant increase in wetlands following the 1960 9.5 magnitude earthquake, rapid urbanization and lack of development regulations led to the infill and decline of natural wetlands in the city. Historically, wetlands were valued more as cheap land for development and waste disposal than for their ecological value. Recently, however, wetlands have been acknowledged in planning documents as valuable flood protection.

Objective

Our goal was to determine how water quality changed in Valdivia's wetlands based on the amount of surrounding impervious surfaces.

Methods

- We collected and filtered surface water samples from 82 sites in wetlands across the city.
- Analyzed those samples for nitrate (NO_3), phosphate (PO_4), and ammonia (NH_3)
- Separated sites into categories based on the amount of impervious surfaces in a 200m radius surrounding the location.

Results

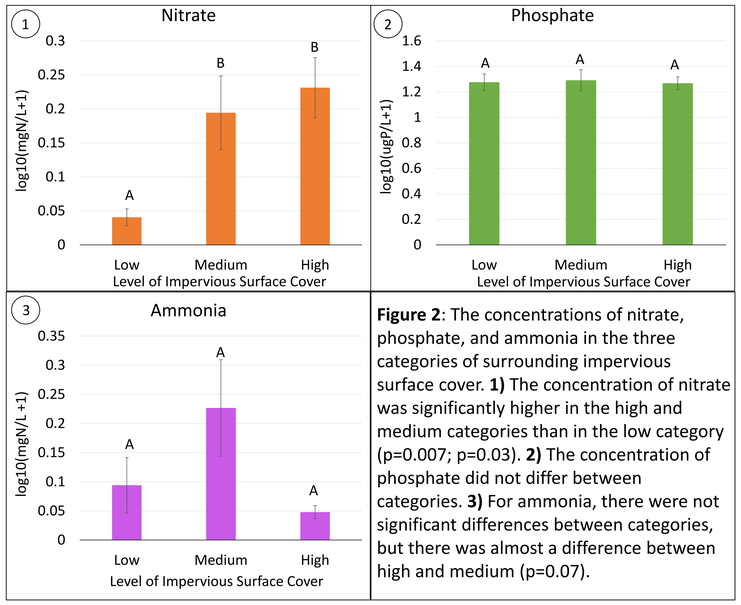
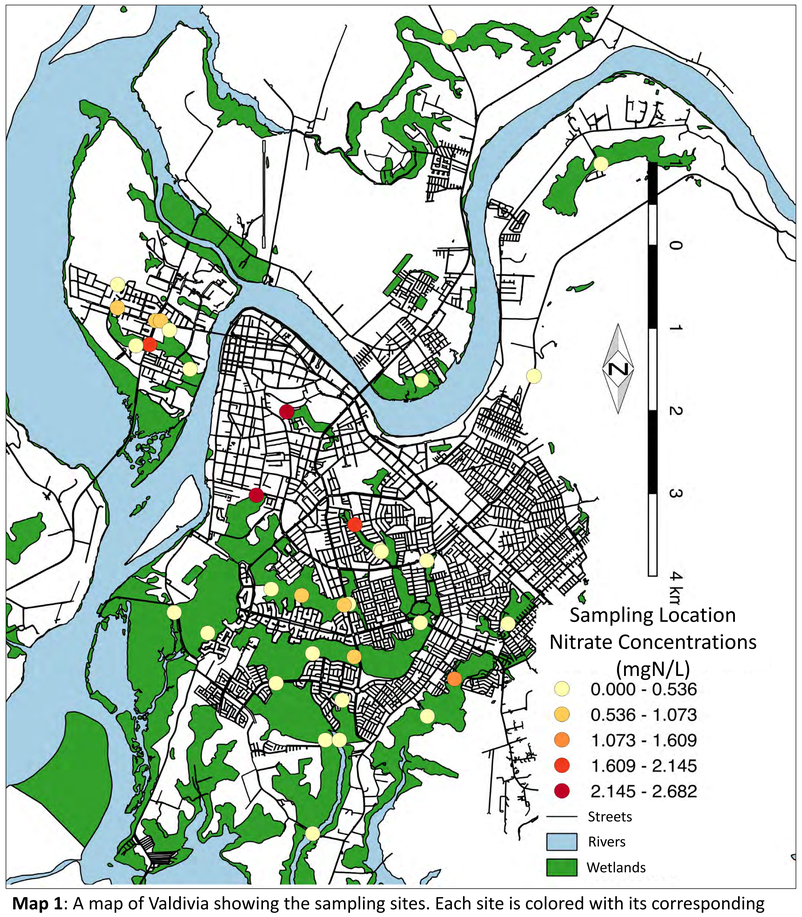


Figure 2: The concentrations of nitrate, phosphate, and ammonia in the three categories of surrounding impervious surface cover. **1)** The concentration of nitrate was significantly higher in the high and medium categories than in the low category (p=0.007; p=0.03). **2)** The concentration of phosphate did not differ between categories. **3)** For ammonia, there were not significant differences between categories, but there was almost a difference between high and medium (p=0.07).



Map 1: A map of Valdivia showing the sampling sites. Each site is colored with its corresponding nitrate concentration. Note that, in general, the sites surrounded by more streets tend to have a higher concentration of nitrate than the sites with fewer nearby streets.

Some photographs from the field. To the right and top left, you can see trash left in the wetlands. This is fairly common to see along the edges of the wetlands, especially in locations with heavy traffic. Though, some fairly remote sites were clearly used as dumping grounds where individuals must have driven their waste to the site in order to dispose of it. In the bottom left, you can see a new housing development encroaching on a, now, partially infilled wetland.

Conclusions and Next Steps

- Our results suggest that the amount of impermeable surfaces surrounding wetlands does impact the quality of water in terms of nitrate, but not in terms of phosphate and ammonia.
- High concentrations of nitrate can lead to undesirable algae blooms and other negative ecosystem impacts.
- Knowing that the concentration of nitrate changes along this impermeable surface gradient is important, but is this is just a preliminary finding.
- As a follow up, we conducted *in situ* experiments to determine how the nutrient retention efficiency changes in wetlands across this gradient. These experiments were done at 9 sites, with 3 sites in each impervious surface category. The experiments will provide valuable information about the water purification ecosystem services that Valdivia's wetlands provide.

Acknowledgments

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