An Assessment of Nitrogen Dynamics in Branford, Connecticut Salt Marshes

Lillian Mitsakos, Dr. Jean-Paul Simjouw, & Dr. Roman Zajac

Department of Biology & Environmental Science, University of New Haven, West Haven, CT

Introduction

Salt marshes are grasslands formed on coastlines that are flooded daily by tidal changes. They provide natural protection from flooding and from eutrophication in coastal waters. The salt marsh naturally filters out such nutrients as nitrogen through microbial denitrification, keeping them from building up along the coast and damaging the coastal system (Deegan 2012).

The excess nutrients that are filtered naturally through salt marshes, such as phosphorus and nitrogen, can be connected to marsh loss throughout New England (Deegan, et al. 2012; Gren 1999). Specifically looking at nitrogen, it can be found in the form of nitrate, nitrite, and ammonia, ammonia and nitrate being the most abundant forms of nitrogen (Valiela and J.M. Teal 1979). Nitrogen can cause plant die-off in low marsh plants, slowly converting the marsh into a mud flat. The more nitrogen that is built up in the sediment, there is also an increase in microbial activity, which in turn increased decomposition of roots, stems, and other vegetation that is holding the sediment together (Deegan, et al. 2012; Nelson, 2012).

The extra nutrient pollution that comes from ammonia and nitrate from residential and industrial areas also will not be filtered, and the excess nutrient will also enter the coastal waters when tide water recedes. (Gren 1999).

If there are amounts of nitrogen in the coastal waters, it is possible that the excess nutrients that are in the coastal waters will be transported back into the marsh during high tide. A higher amount of nitrogen during high tide could cause higher amounts of nitrogen during low tide as well, if the nitrogen is being used by organisms or if the nutrients cannot leave the system due to tidal pools or creeks that form during low tide.

Objectives of this Study:

The objectives of this study were to:

- Assess the difference of nitrogen, specifically nitrate and ammonia, concentration between coastal waters and the different points of the tidal cycle in salt marshes.
- Determine if there is a difference in nitrogen concentrations in tidal pools and creeks at low tide compared to at high tide.

Methods

1. Samples were taken from two adjacent salt marshes in Branford, CT. Pleasant View and Banca Back. Thirty-two samples were collected at various stages of the tidal cycles from these sites.

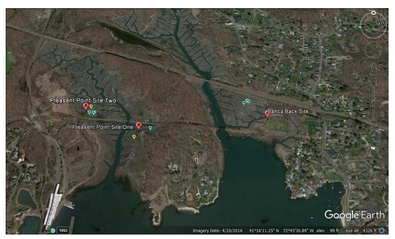
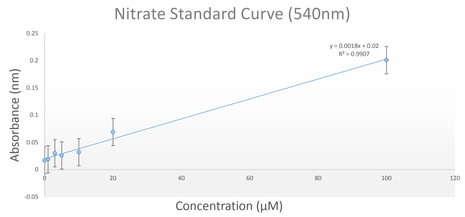


Figure 1: Map of the four different locations where sediment and water samples were taken. Included are the core sites (yellow) and tidal pool (blue) sites are located

2. Water samples were taken from primary and secondary tidal creeks, from the marsh at high tide, and tidal pools at low tide. Core samples were taken in order to sample pore water.
3. All water samples were filtered on site, using a 60 mL Restek syringe with Luer-Lok Intlet and a BD syringe with Luer-Lox filter tip. At least 60 mL of water was filtered to ensure that there was enough laboratory analysis.
4. Sediment samples were centrifuged for fifteen minutes, after which the water was taken from the tube and filtered in the same manners as the water samples were.
5. Samples, including core samples, were transported on ice and stored in a freezer, to prevent contamination and nitrogen from further reacting in the water and sediment samples. During analysis, samples were only taken out for no more than an hour. If needed, the samples were placed in a refrigerator, to keep cool.
6. The samples and standards were analyzed using LaMotte test field kits, and the procedures they provided.
7. Absorbance was measured from the sample in a spectrophotometer, at 540 nm for the nitrate test, and 630 nm for the ammonia test.
8. The absorbance of the samples were used to determine concentration based on a standard curve determined on the day of analysis of each test.

Results



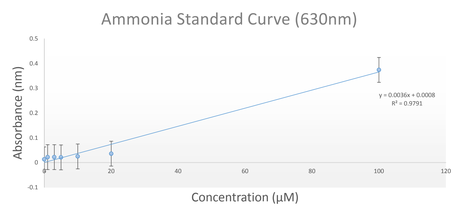


Figure 2&3: The standard curves were determined each time analyses was performed. An R-squared value under .95 was not accepted when the highest concentration was include and an R-squared value under .85 was not accepted when the highest concentration value was not included.

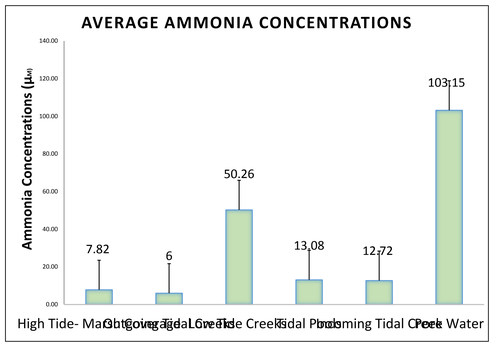


Figure 4: Average ammonia concentration compared based on sample type.

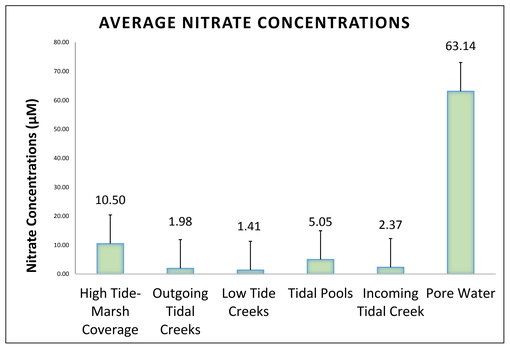


Figure 5: Average nitrate concentration compared based on sample type.

Figure 6: High tide-marsh coverage.

Figure 7: One of two Primary Creeks.

Figure 8: Banca Back salt marsh during low tide.

Discussion

The average concentrations of nitrate and ammonia were similar in all sample sites through this study. Areas where the water built up during tides, such as tidal pools and when the complete marsh was covered at high tide, had a slightly higher nitrate concentration.

The average concentration of nitrate at high tide in samples that were taken from the flooded marsh was higher than other sample groups. This is not sufficient representation, since there were only three samples. Though if this trend continued, it could be a representation of water coming in from the Long Island Sound, since the flooding water that covers the marshes are is mostly supplied from Long Island Sound.

Pore water did have a higher concentration of both nitrate and ammonia, which is possibly from not being filtered through the marsh yet, and is influenced from the residential area that surrounds the sample marshes.

There were not enough samples due to a delay on analyzing the original thirty-two.

Compared to a study done in the Delaware Bay area that determined Nitrogen compound concentration in the form of nitrate in the summer, were in a range between 2µM and 8µM. The values that were from all the samples were falling into that range that was describe in the Delaware study. With the exception of marsh coverage and pore water. (Aurand & Daiber 1973) This could suggest constancy of nitrate values on the United States Atlantic coast. It could also suggest that since the water around the Delaware marshes were described to have high nitrate concentrations in existence already, the concentrations of nitrate in the area study has increased over time, though historical data would be needed to determine that.

Conclusions

There can be no decisive conclusion drawn from this data since it is incomplete. Overall though, there was less nitrate in the marshes than there was ammonia. The data suggests that there was more nitrate entering the system than there was leaving it. There was also more ammonia present in the system at low tide than there was leaving after high tide, more ammonia entered the marshes as the tide rose than when it left as well. This all could suggest that nitrogen is staying in the marshes and building up. More samples throughout more of the tidal cycle and year would need to be taken to see if these trends continue.

References

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Acknowledgements

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